THE STONE-MILLIS ARITHMETIC

INTERMEDIATE

BENJ. H. SANBORN & CO.

Home Economics Division

Federal Board for Vocational Education.

THE STONE-MILLIS ARITHMETICS

INTERMEDIATE

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PREFACE

In the preparation of this series of arithmetics the chief aims have been more adequately to adapt the subject matter to the experiences, interests, and immediate needs of children, and to provide means for a mastery of the formal phases of arithmetic through more scientifically organized drills.

The books are based upon the principles that knowledge to be real must be founded upon the actual experiences of the individual learner; that knowledge to be retained must be given opportunity for use, the more immediately the better; and that a necessary condition for true learning is that the process be self-actuated through motive or interest.

Hence, throughout the series an endeavor has been made not only to develop the principles and processes in a most economical and psychological order but to provide an adequate mental imagery as a basis for their rational understanding.

In the selection of problem material the utmost care has been exercised to use only problems that deal with the experiences of children. They deal with their chief occupation — play, with their constructive activities, with phases of the home and the local community life with which they come into direct contact. The problems of adult life, of interest only to adults, who have had a wider experience and in consequence interests foreign to the lives of children, have been painstakingly excluded from the lower grades. Many pages of problems are grouped to tell a story, and they teach lessons valuable in themselves. Many are based upon and portray actual facts, as given in statistics, etc. By using problems touching the actual experiences of childhood we are assured of adequate imagery in the child's mind, upon which his success in the interpretation and solution of problems most depends. Such problems also provide opportunity for the pupil's arithmetical knowledge to function through use, for they give practice in solving the very problems which children actually encounter in their activities in and out of school. Evidently such problems furnish the maximum of motive or interest, the prerequisite for self-actuated study. This feature of the Stone-Millis Arithmetics manifests itself conspicuously throughout the series.

The play instinct has been appealed to throughout the series, especially in the work of the primary grades. In the work of the second and third grades numerous games have been introduced that have been found, by actual use in the classrooms of many schools, to be of deep interest to children. These provide an excellent basis of problems and a means for motivated drills.

Most of the commercial applications of arithmetic are foreign to the experiences of children. In order to provide in the school the experiences that are otherwise lacking, and that are necessary for the mastery of this phase of arithmetic, suggestions have been given at different points of the series showing how the business processes may be dramatized or acted out in make-believe activities in the schoolroom.

Motivated drills, for the mastery of the tables and formal processes of arithmetic, have been systematically and plentifully provided throughout the books, and should prove a strong feature of the series. The game element has been introduced frequently in these drills, especially for the primary grades.

The series consists of three books: the *Primary*, *Intermediate*, and *Advanced*. The *Primary* book contains the work suggested for the second, third, and fourth grades; the *Intermediate*, the work for the fifth and sixth grades; and the *Advanced*, the work for the seventh and eighth grades.

In the preparation of this second edition, the authors have had the assistance of many teachers and educators, who have read the manuscript and proof critically and have offered valued constructive suggestions.

They are especially indebted to Supt. L. P. Bénézet of La Crosse, Wisconsin, and to Supt. Don C. Bliss of Montclair, New Jersey, and to their corps of principals and teachers, to all of whom they wish to acknowledge their deepest gratitude.

JOHN C. STONE,
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JANUARY, 1914.

SUGGESTIONS TO TEACHERS

In using these books, the best results will be obtained by following carefully the order and method of development of topics in the text. There is a most economical and psychological, as well as logical, order of steps in the development of each of the formal processes, and they must be thoroughly developed and rationalized in the mind of every pupil. A thorough understanding of each process necessitates that underlying it there be built up in the mind of the pupil a clear body of imagery. Part of this imagery is developed through objective teaching, and part is mere picturing of the form of the process — keeping numbers in straight columns, etc. The text suggests many ways of providing this imagery through the use of objects, etc. Other objective means of providing adequate mental imagery will suggest themselves to the thinking teacher who fully grasps the principle involved. Do not continue with the concrete aids after their object is once attained, *i.e.* after making clear the meaning of the fact or process. Each formal process should become to the pupil a machine. Automatic control of this machine as such should be the ultimate aim. For this purpose much drill work is necessary. Supplement the drills of the text by cards, charts, games, etc.

In the solution of an applied problem, the essential thing is to see that there is a clear mental picture in each pupil's mind of the situation involved in the problem. The reason that problems are hard, and that pupils fail with them, is because the mental imagery is not provided. It is wise, before sending pupils home to get a lesson, to see that every pupil in the class possesses adequate imagery for the interpretation of each problem in the lesson. This is the most essential thing in successful teaching.

If the problems used are only those that come within the range of the child's actual experiences and activities, the imagery required for their interpretation is apt to be possessed by the pupils. It is when we use problems from the world of adults, dealing with matter with which children have had no experience, that we ask the impossible of the pupils. The problems of this text deal, in so far as it is possible, with the experiences of childhood, yet some children in every class may be lacking in the particular imagery that is necessary for the interpretation of some of the problems. This the teacher must take care to supply.

The problems of the text should be supplemented in every community by the use of local problems drawn from the environment of the pupils. Apply every topic to problems which the pupils meet in their other school work, and in their own everyday lives in the home and in the larger community. The teacher and pupils together should collect the data for these problems. If in a rural school, where agriculture is taught, draw upon that subject for problems — the testing of seeds for planting, etc. Strive to make arithmetic a practical tool in the solution of the pupil's own personal problems.

In the text, problems have not been labeled "oral" or "written," an invariable custom among other books. We prefer, rather, that the pupil be encouraged to solve every problem as far as possible without a pencil, as in real life.

It is believed that such a procedure will tend toward a more spontaneous method of analysis, and hence lead away from the mechanical and deadening forms so often seen in the schoolroom.

Neither have many set forms of solution been given in the text. In most cases the teacher should not demand any particular form, but should encourage a pupil to study each problem and choose the method that seems to him to require the least figuring. Encourage short methods. Do not repress originality or individuality.

The play instinct of children should be utilized in the teaching of arithmetic, by the use of games in the primary grades, and by contests and dramatizations in the higher grades. Various types of games for the primary grades are suggested in the text. They afford motivated drills on the tables and processes. These games will suggest others that the teacher may invent. Some are well adapted for use by a large class in the classroom, some are suited for smaller groups of children, and some are good for two or more children to play at home. In the upper grades children enjoy drills in the form of contests or "number downs," where the class is divided into two opposing teams.

The dramatization of the commercial applications of arithmetic has been tried with remarkable success in many schools. Suggestions as to how this may be carried out are given at several points of the text. The pupils organize and "go through the motions" of a make-believe business, using real business forms and processes. This work makes the commercial processes realistic, appeals to the play instinct, utilizes the social motive, affords immediate applications of the arithmetic work, and applies the principle of learning to do by doing. Most of this activity may be carried on outside the regular school hours, and only the checking up, summaries, and drills need consume the recitation time.

The tables of drills given throughout the text should be used carefully by teachers. Many are printed in script because of a number of evident advantages. Some of these tables, as those on pages 219, 220, and 221 of the Primary book, should be used for a short time each day, for several days in succession. In the use of such tables use a time limit, encouraging the pupils to work rapidly and accurately. Have the pupils score their results each day, as suggested in the text, and keep their scores for several days. They will thus be able to measure and observe their own progress from day to day, and will try to improve their records. Teachers who understand the graphing of statistics might show the pupils how to picture their progress by means of graphs of their daily scores. These drill tables, involving contest and the game element, have been used in this way with unbounded interest on the part of the pupils, and with gratifying results.

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INTERMEDIATE ARITHMETIC

PART ONE: FIFTH YEAR

I. FRACTIONS

1. HALVES AND FOURTHS

1. How do we find $\frac{1}{2}$ of 4? $\frac{1}{2}$ of 6? $\frac{1}{2}$ of 8?

2. If I divide an apple into 2 equal parts, what do I call each part?

3. To find $\frac{1}{2}$ of a number or an object, as a circle or a rectangle, we divide it into two equal parts. Then how many *halves* in a circle? In a rectangle?

In a single thing there are two halves.

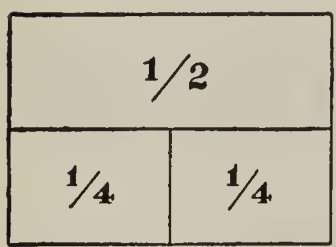
4. How do you find $\frac{1}{4}$ of 12? $\frac{1}{4}$ of 16? $\frac{1}{4}$ of 20?

5. How do you find $\frac{1}{4}$ of an apple? $\frac{1}{4}$ of a circle?

6. How many fourths in an apple? In a circle?

In a single thing there are four fourths.

2. FRACTIONS: COMPARING HALVES AND FOURTHS



1. Look at the rectangle and tell how many fourths in one half of it.

2. How many fourths in one half of a pie?

3. How many halves in a whole apple? How many fourths?

4. Draw a 2-inch square and divide it into 1-inch squares.

5. Shade one of the 1-inch squares.

6. What part of the 2-inch square is the 1-inch square?

7. A 1-inch square is called **a square inch**. How many square inches in $\frac{1}{2}$ of a 2-inch square?

8. Which is larger, $\frac{1}{2}$ of anything or $\frac{1}{4}$ of it?

9. If I have an apple and eat $\frac{1}{2}$ of it, what part remains?

10. If you have an orange and eat $\frac{1}{4}$ of it, how many fourths remain?

11. $\frac{1}{4}$ of a pie taken from $\frac{1}{2}$ of it will leave how much?

12. How many inches in 1 foot? How many inches in $\frac{1}{2}$ of a foot? In $\frac{1}{4}$ ft.? ("$\frac{1}{4}$ ft." is read "$\frac{1}{4}$ of a foot.")

Practical Uses of Halves and Fourths

1. How many pint bottles of milk will it take to fill a quart bottle? Then a pint is what part of a quart?

2. When milk is 10 cents a quart, how much is a pint worth?

3. How many quarts in a gallon? Then a quart is what part of a gallon?

4. When milk is 36 cents a gallon, how much is a quart worth?

1 qt. 1 pt.

5. How many quarts in $\frac{1}{2}$ of a gallon? Then 2 quarts make what part of a gallon?

6. When a gallon of cider costs 20 cents, how much is 2 quarts worth?

7. How many pecks in a bushel? In $\frac{1}{2}$ of a bushel? In $\frac{1}{4}$ of a bushel?

8. A peck measure of nuts will fill what part of a bushel measure?

9. If potatoes are 80 cents a bushel, what is the cost of a peck?

10. How many ounces in one pound? In $\frac{1}{2}$ of a pound?

11. Then 8 oz. make what part of a pound? At 40 cents a pound, how much will 8 oz. of candy cost?

12. At 30 cents a pound, how much is 8 oz. of candy worth?

13. At 24 cents a pound, how much is 8 oz. of nuts worth?

14. How many 4-ounce packages will it take to make a pound? Then 4 ounces make what part of a pound? At 60 cents a pound, how much will 4 ounces of chocolate creams cost?

15. If your mother sends you to the market for a steak and it weighs 1 lb. 8 oz., how much will it cost at 32 cents a pound? (Add the cost of 1 pound to the cost of 8 ounces.)

16. John sold some spring chickens that weighed 2 lb. 4 oz. each. If he received 28 cents a pound, how much did he receive for each chicken? (Add the price of 2 lb. to the price of 4 oz.)

SOLUTION

$$\begin{array}{rl} 28¢ & \\ \underline{2\frac{1}{4}} & \\ 7¢ & = \text{price of 4 oz.} \\ \underline{56¢} & = \text{price of 2 lb.} \\ 63¢ & = \text{price of 2 lb. 4 oz.} \end{array}$$

17. In the solution, how was the 7¢ found? How was the 56¢ found? How was the 63¢ found?

18. Henry's mother sent him to mail a parcel that weighed 2 lb. 4 oz. How much did it cost at 24¢ a pound?

19. How many inches in 1 yard? In $\frac{1}{2}$ yard? In $\frac{1}{4}$ yard?

20. Some girls made badges of pieces of ribbon 9 inches long. What part of a yard was this? How many such pieces in 1 yard?

21. 45 inches are how much more than 1 yard? If Mary needs 45 inches of silk to make a doll's dress, she should ask the clerk for a yard and what part of a yard?

22. How many inches in two yards? How would you express in yards and a fraction of a yard, the length of a ribbon 90 inches long?

23. James needed a strip of carpet 81 inches long for a rug for his canoe. Carpet is sold by the yard. For how much must he ask the dealer?

24. These girls have a sewing club. Alice is making a pillow for her doll. For the ruffle around it she bought 18 inches of ribbon. What part of a yard did she call for at the store? How much did it cost her at 24¢ a yard?

25. Gertrude is making a handkerchief for a Christmas present. She got a yard and a half of lace at the store for it. How much did it cost her at 10 cents a yard?

26. She got also a yard and a quarter of insertion for the handkerchief, at 8 cents a yard. How much did it cost her?

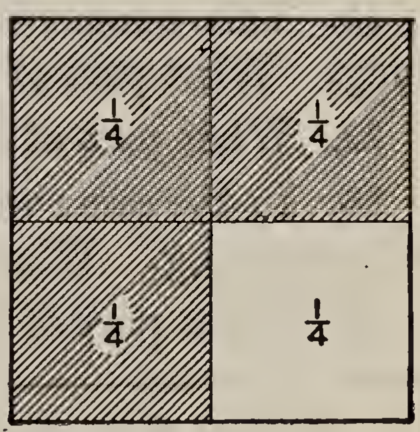
27. Elizabeth is making a tea-apron. She bought 2 yards and 9 inches of lace for it at 12¢ a yard. How many yards did she call for at the store? How much did it cost?

28. Some of the girls are making skate-bags of denim. If $\frac{1}{2}$ of a yard is required for each bag, how many yards does it take for 10 bags? How much does it cost at 22¢ a yard?

29. What part of a yard is 9 inches? If you need 45 inches of tape to bind a book-bag, how much more than a yard is it?

30. In buying tape we usually ask for the length in yards and fractions of a yard. How much tape would you call for to bind the bag in Exercise 29? How much will it cost at 12¢ a yard?

3. WRITING MORE THAN ONE FRACTIONAL UNIT



1. Look at the drawing and tell how many fourths are shaded.

Three fourths is written $\frac{3}{4}$.

2. Three pecks are how many fourths of a bushel?

3. Three quarts are how many fourths of a gallon?

3 quarts = —— gallon.

4. Three quarters are how many fourths of a dollar?

5. To find $\frac{3}{4}$ of 12, we divide by 4 (find one fourth), and multiply the quotient by 3. How much is it?

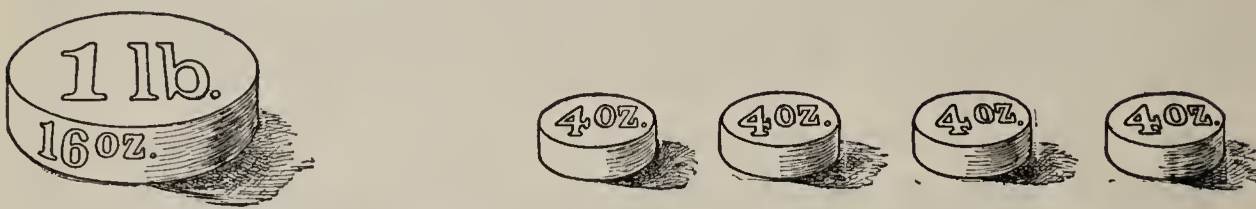
Find $\frac{3}{4}$ of 8. Find $\frac{3}{4}$ of 16. Find $\frac{3}{4}$ of 24.

6. How many halves in a whole thing? Two halves is written $\frac{2}{2}$.

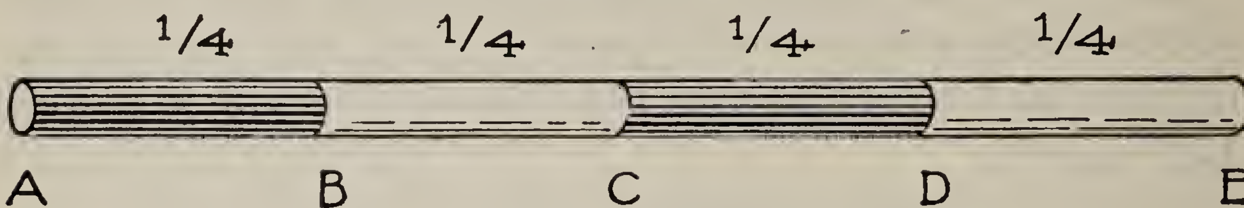
7. How many fourths in a whole? How is four fourths written?

8. How is two fourths written?

9. At 24 ¢ a pound, how much will $\frac{3}{4}$ lb. of steak cost?



10. How many ounces in 1 pound? What part of a pound is 4 ounces? What part of a pound is 8 ounces? 12 ounces?



11. Look at the rod above, and tell what part of it is between *A* and *B*. Between *A* and *C*. Between *A* and *D*.

12. Take a foot rule and mark it off into parts each 3 inches long. What part of a foot is 3 inches?

13. What part of a foot is 6 inches? 9 inches?

14. In the same way divide a yard stick into parts each 9 inches long. What part of a yard is 9 inches?

15. What part of a yard is 18 inches? 27 inches?

> *To find three fourths of anything we first divide it into four equal parts, then take three of the parts.*

16. Find $\frac{3}{4}$ of 128 pounds.

SOLUTION

$$\begin{array}{r} 4\overline{)128 \text{ lb.}} \\ 32 \text{ lb.} \\ \underline{3} \\ 96 \text{ lb.} \end{array}$$

1. How did we find one fourth of 128 pounds?
2. How much is $\frac{1}{4}$ of 128 pounds?
3. When we knew $\frac{1}{4}$ of 128 pounds, how did we find $\frac{3}{4}$ of it?

17. Find $\frac{3}{4}$ of each, 328, 464, 584, 736, and 972.

18. 21 inches are how many more inches than 1 foot? Since 9 inches make $\frac{3}{4}$ of a foot, 21 in. = $1\frac{3}{4}$ ft.

19. If you divide a dozen oranges into four equal groups, how many oranges in each group? One group is what part of a dozen? Three groups are what part of a dozen?

20. 4 is what part of a dozen? 8 is what part of a dozen? 12 is what part of a dozen?

21. Express as dozens, 16 oranges; 18 eggs; 21 apples.

22. Express as pounds, 20 ounces; 24 ounces; 28 ounces.

23. How many hours in 1 day? In $\frac{1}{4}$ of a day? In $\frac{1}{2}$ of a day? In $\frac{3}{4}$ of a day?

24. How many quarts in 1 peck? In $\frac{1}{4}$ of a peck? In $\frac{1}{2}$ of a peck? In $\frac{3}{4}$ of a peck?

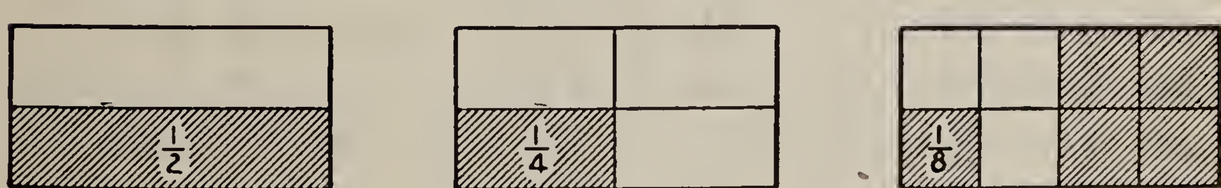
25. If you divide a peck of beans into 4 equal parts, how many quarts in each part?

26. John's father caught 12 fish, and John caught $\frac{3}{4}$ as many. How many did John catch?

27. Robert is 48 inches tall, and his sister is $\frac{3}{4}$ as tall. How many inches tall is she?

28. Our aquarium holds 28 gallons of water. It is $\frac{3}{4}$ full. How many gallons does it contain?

4. FRACTIONS INCLUDING EIGHTHS



1. How do you find $\frac{1}{8}$ of 16? $\frac{1}{8}$ of 24? $\frac{1}{8}$ of 32? $\frac{1}{8}$ of 40?
2. How do you find $\frac{1}{8}$ of a rectangle?
3. How many eighths in a whole?
4. How many eighths are shaded?
5. *Five eighths* is written $\frac{5}{8}$. Write *seven eighths; four eighths; six eighths.*

6. Read: $\frac{3}{8}$, $\frac{4}{8}$, $\frac{2}{8}$, $\frac{7}{8}$.

7. Which figure shows how many? Which one shows what fractional part, or into how many parts the whole has been divided?

8. A quart is what part of a peck? Then 3 qt. are what part of a peck?

9. 1 qt. $= \frac{1}{8}$ pk.; 2 qt. $= \frac{2}{8}$ pk.; 3 qt. = —— pk.; 4 qt. = —— pk.

10. Write as a part of a peck, 5 qt.; 6 qt.; 7 qt.

At sight give the following:

11. $\frac{3}{4}$ of 8; of 12; of 16; of 20; of 24; of 28; of 32; of 36; of 40.

12. Give $\frac{3}{8}$ of each of the following: 16, 24, 32, 40, 48, 56, 64, 72, 80.

13. Give $\frac{5}{8}$ of each number in Exercise 12.

14. Give $\frac{7}{8}$ of each number in Exercise 12.

Find the following:

15. $\frac{3}{4}$ of 48.

16. $\frac{3}{4}$ of 92.

17. $\frac{3}{4}$ of 144.

18. $\frac{3}{4}$ of 284.

19. $\frac{3}{8}$ of 96.

20. $\frac{3}{8}$ of 136.

21. $\frac{3}{8}$ of 752.

22. $\frac{3}{8}$ of 976.

23. $\frac{5}{8}$ of 264.

24. $\frac{5}{8}$ of 368.

25. $\frac{7}{8}$ of 672.

26. $\frac{7}{8}$ of 952.

27. Find $2\frac{5}{8}$ times 392.

SOLUTION

$$\begin{array}{rl}
392 & \\
\underline{2\frac{5}{8}} & \\
\underline{49} & = \frac{1}{8} \text{ of } 392 \\
\underline{5} & \\
245 & = \frac{5}{8} \text{ of } 392 \\
\underline{784} & = 2 \times 392 \\
1029 & = 2\frac{5}{8} \times 392
\end{array}$$

28. $2\frac{5}{8} \times 424 = ?$

29. $2\frac{7}{8} \times 576 = ?$

30. $3\frac{3}{8} \times 672 = ?$

31. $2\frac{3}{4} \times 972 = ?$

32. $4\frac{3}{8} \times 376 = ?$

33. $5\frac{7}{8} \times 928 = ?$

34. $2\frac{5}{8} \times 984 = ?$

35. $3\frac{7}{8} \times 272 = ?$

36. $4\frac{3}{4} \times 356 = ?$

37. $5\frac{3}{4} \times 968 = ?$

38. $3\frac{7}{8} \times 696 = ?$

39. $8\frac{3}{4} \times 144 = ?$

40. $6\frac{3}{8} \times 592 = ?$

41. $5\frac{7}{8} \times 648 = ?$

Practical Uses of Eighths

1. How many hours in $\frac{1}{8}$ of a day? In $\frac{3}{8}$ of a day? In $\frac{5}{8}$ of a day?

2. Of the 24 hours in a day, Roger sleeps $\frac{3}{8}$ of the time, he is in school $\frac{2}{8}$ of the time, and he studies at home $\frac{1}{8}$ of the time. How many hours does he spend in each way?

3. The grocer sells spices in boxes holding $\frac{1}{8}$ of a pound each. How many ounces of spice in a box?

4. Mary bought $\frac{7}{8}$ of a yard of ribbon for her dolls at 16¢ a yard. How much did it cost?

5. A class in sewing made skate-bags of denim. Each bag took $\frac{5}{8}$ of a yard of cloth. How much did the denim for one bag cost at 24¢ a yard? How many yards did it take for 16 bags? Find the total cost.

6. If silk costs $1.20 a yard, find the cost of $\frac{7}{8}$ of a yard.

7. A merchant bought boys' suits for $4.80 apiece, and sold them at a gain of $\frac{3}{8}$ of what they cost him. How much did he gain on each suit? For how much did he sell each suit?

8. If a merchant marks toys for a special sale at $\frac{7}{8}$ of the regular price, what does he get for a dozen marbles the regular price of which is 32 cents?

9. For how much does he sell a gun, of which the regular price is 80 cents?

10. For how much does he sell a doll-carriage, of which the regular price is 96 cents?

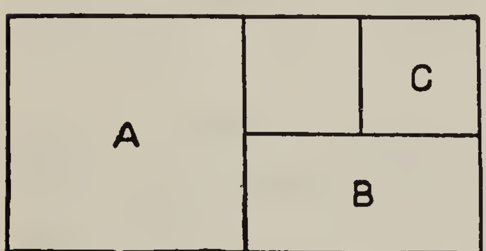
11. How much would you pay him for a pair of skates, of which the regular price is $1.60?

5. COMPARING HALVES, FOURTHS, AND EIGHTHS

NOTE. — In addition to the use of such devices as that shown below, the foot rule, divided into eighths of an inch, will be found an excellent means of making all kinds of comparisons of $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{8}$. Teachers should use it freely to supplement these exercises. If divided into sixteenths of an inch, the comparison may be extended.

1. What is a rectangle? Make a rectangle 3 inches long and 2 inches wide.

2. Into how many equal parts is this rectangle divided to get A? Then A is what part of the rectangle?



3. If the rectangle had been divided into parts like B, how many would there have been? Then what part of the rectangle is B?

4. How many parts like C will make the whole rectangle? What part of the rectangle is C?

5. $\frac{1}{2}+\frac{1}{2}=$ ——; $\frac{1}{4}+\frac{1}{4}+\frac{1}{4}+\frac{1}{4}=$ ——; $\frac{1}{4}+\frac{1}{4}+\frac{1}{2}=$ ——.

6. Look at the figure, and tell what $\frac{1}{4}+\frac{1}{8}+\frac{1}{8}$ equals.

7. $\frac{2}{8}+\frac{1}{2}=\frac{?}{4}$; $\frac{1}{2}+\frac{1}{4}+\frac{2}{8}=$ ——; $1-\frac{1}{8}=$ ——.

8. Compare $\frac{1}{2}$ and $\frac{1}{4}$ thus: $\frac{1}{2}$ is 2 times $\frac{1}{4}$; $\frac{1}{4}$ is $\frac{1}{2}$ of $\frac{1}{2}$.

9. Compare $\frac{1}{4}$ and $\frac{1}{8}$; $\frac{1}{2}$ and $\frac{1}{8}$.

10. Cut an apple into 8 equal parts. What is each part called? How many of these eighths make one fourth of the apple?

11. Compare $\frac{1}{2}$ and $\frac{1}{4}$; $\frac{1}{2}$ and $\frac{1}{8}$; $\frac{1}{4}$ and $\frac{1}{8}$.

12. $\frac{1}{2}+\frac{1}{4}=$ —— fourths; $\frac{1}{2}+\frac{1}{4}+\frac{1}{8}=$ —— eighths.

13. $\frac{1}{2}-\frac{1}{8}=$ —— eighths; $\frac{1}{4}-\frac{1}{8}=$ —— eighths.

14. $1=$ —— halves, or —— fourths, or —— eighths.

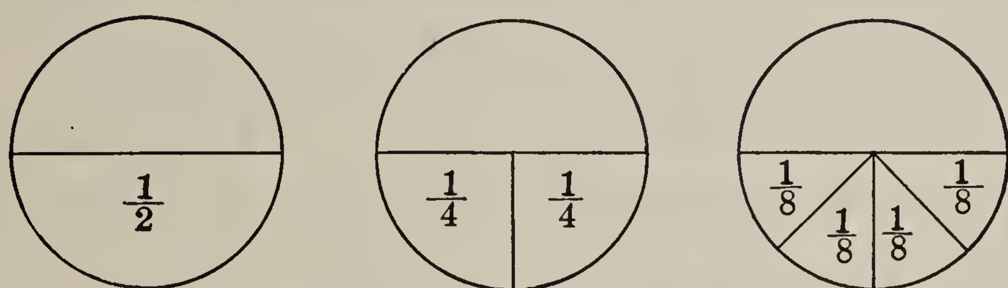
15. $1 - \frac{3}{8} =$ —— eighths; $1 - \frac{1}{4} = \frac{?}{4}$; $1 - \frac{3}{4} =$ ——.

16. When $\frac{1}{2}$ pound of tea costs 20 cents, how much shall I pay for $\frac{1}{4}$ lb.?

17. When $\frac{1}{2}$ dozen oranges cost 30 cents, how much will $\frac{1}{4}$ dozen cost?

18. When $\frac{1}{2}$ pound of pepper costs 40 cents, how much will $\frac{1}{8}$ of a pound cost?

19. When $\frac{1}{4}$ lb. of tea costs 25¢, how much is that per pound?



$$\frac{1}{2} = \frac{2}{4} = \frac{4}{8}$$

20. When $\frac{1}{8}$ bushel of potatoes costs 15¢, how much will $\frac{1}{4}$ of a bushel cost? How much will a bushel cost?

21. 8 pints equal 1 gallon. A pint is what part of a gallon? 2 pints equal what part of a gallon? 4 pints equal what part of a gallon?

22. 4 pecks = 1 bushel. 2 pecks = —— bushel. 3 pecks $= \frac{?}{4}$ bu.

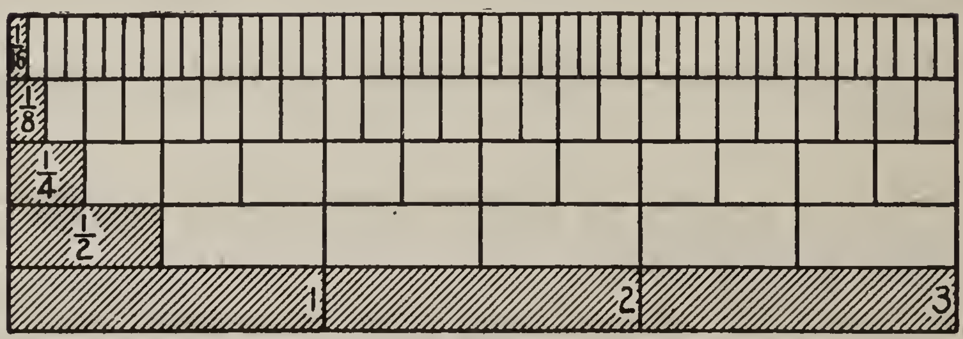
23. 6 = what part of a dozen? 3 = what part of a dozen?

24. How many hours longer is $\frac{1}{2}$ a day than $\frac{1}{8}$ of a day?

25. How many inches longer is $\frac{1}{2}$ a yard than $\frac{1}{4}$ of a yard?

26. $\frac{1}{2}$ a pound is how many ounces heavier than $\frac{1}{8}$ of a pound?

6. EXERCISES IN HALVES, FOURTHS, EIGHTHS, AND SIXTEENTHS



1. Look at the figure and tell how many 4ths in $\frac{1}{2}$.

2. How many 8ths in $\frac{1}{2}$? How many 8ths in $\frac{1}{4}$?

3. How many 16ths in $\frac{1}{2}$? In $\frac{1}{4}$? In $\frac{1}{8}$?

4. Look at the figure and see how to fill the blanks below:

one half = —— fourths
one half = —— eighths
one half = —— sixteenths
one fourth = —— eighths
one fourth = —— sixteenths
one eighth = —— sixteenths

5. $\frac{1}{2} = \frac{?}{4}$; $\frac{1}{2} = \frac{?}{8}$; $\frac{1}{2} = \frac{?}{16}$.

6. $\frac{1}{4} = \frac{?}{8}$; $\frac{1}{4} = \frac{?}{16}$; $\frac{1}{8} = \frac{?}{16}$.

7. How many ounces in a pound? Then an ounce is what part of a pound?

8. Write as parts of a pound: 2 oz.; 3 oz.; 5 oz.; 7 oz.; 9 oz.

9. At 32 cents a pound, find the cost of 1 lb. 2 oz. of butter. Find the cost of 2 lb. 4 oz.

10. Write in ounces: $\frac{5}{16}$ lb.; $\frac{3}{8}$ lb.; $\frac{7}{16}$ lb.; $\frac{3}{4}$ lb.; $\frac{7}{8}$ lb.

11. Write in pounds: 1 oz.; 3 oz.; 5 oz.; 7 oz.; 9 oz.

Practical Problems in Fractions

1. Pepper is sold in boxes containing $\frac{1}{8}$ lb. each. How many boxes does it take to make $\frac{1}{4}$ lb.? To make $\frac{1}{2}$ lb.?

2. A $\frac{1}{8}$-lb. box of caraway seed sells for 10 cents. What will $\frac{1}{4}$ lb. cost? $\frac{1}{2}$ lb.? 1 lb.?

3. One pound of cloves will fill how many boxes, each holding $\frac{1}{2}$ lb.? How many each holding $\frac{1}{4}$ lb.? How many each holding $\frac{1}{8}$ lb.?

4. A quart is what part of a peck? Then if you were a clerk selling a customer $\frac{1}{2}$ peck of potatoes, and measured them out with a quart measure, how many times would you fill the measure?

$$\frac{1}{2}\text{ pk.} = \frac{?}{8}\text{ pk.}$$

5. If you were selling a customer $\frac{1}{4}$ pk. of green beans, and measured them with a quart measure, how many times would you fill the measure?

$$\frac{1}{4}\text{ pk.} = \frac{?}{8}\text{ pk.}$$

6. A $\frac{1}{2}$-pint measuring cup used in cooking holds what part of a gallon? A quart is what part of a gallon? Then if a recipe called for a quart of material, and you measured it out with the $\frac{1}{2}$-pint measure, how many times would you fill the measure?

$$\frac{1}{4}\text{ gal.} = \frac{?}{16}\text{ gal.}$$

7. If a recipe called for $\frac{1}{2}$ gallon of material, and you measured it out with the $\frac{1}{2}$-pint measure ($\frac{1}{16}$ gallon), how many times would you fill the measure?

$$\frac{1}{2}\text{ gal.} = \frac{?}{16}\text{ gal.}$$

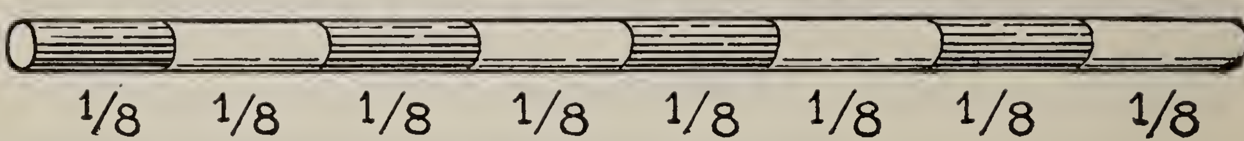
8. Some children have a lemonade stand at which they sell lemonade in glasses of two sizes. One glass holds $\frac{1}{16}$ gallon and the other $\frac{1}{8}$ gallon. How many of the smaller does it take to fill one of the larger?

7. NAMING THE TERMS OF A FRACTION

1. Draw a rectangle. Divide it into fourths. Shade three fourths of it.

2. Write in figures the part shaded. What two numbers are needed to write three fourths?

> *The two numbers needed to express a fraction are called the* **terms** *of the fraction.*



3. Point out $\frac{3}{8}$ of the rod shown in the diagram; $\frac{5}{8}$ of it; $\frac{7}{8}$ of it; $\frac{6}{8}$ of it.

4. In any fraction, which term shows the number of equal parts into which the whole has been divided?

5. Which term of a fraction shows how many of the equal parts make up the fraction?

> *The lower term of a fraction shows into* **how many** *equal parts the whole has been divided. It* **names** *the equal parts, and is called the* **denominator**.
>
> *The upper term shows the* **number** *of equal parts that make up the fraction, and is called the* **numerator**.

6. In a fraction such as $\frac{5}{8}$, we regard $\frac{1}{8}$ as a new **unit**, called the **fractional unit**, and 5 as the **number** of these units. Tell the *fractional unit*, and the *number* of units in $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{16}$, $\frac{9}{16}$.

8. MIXED NUMBERS

1. How many *fourths* in a whole apple? A whole yard? The whole of anything?

2. If you have $\frac{5}{4}$ of a yard of ribbon, how much more than a yard is this?

3. $\frac{5}{4}$ yd. $= 1\frac{1}{4}$ yd. $\frac{7}{4}$ yd. $= 1\frac{3}{4}$ yd. $\frac{9}{8}$ yd. = —— yd.

4. $\frac{9}{4}$ lb. are how much more than 2 lb? $\frac{9}{4}$ lb. $= 2\frac{1}{4}$ lb.

> *A number composed partly of a whole number and partly of a fraction is a* **mixed number.**

5. Name five mixed numbers. Write five mixed numbers.

6. $\frac{11}{4}$ gallons are how much more than 2 gallons?

> *Dividing the numerator of a fraction by the denominator gives the number of whole things, and the remainder is the number of fractional units that are left.*

7. $\frac{15}{4} = 3\frac{3}{4}$, for $15 \div 4 = 3$ with 3 remaining. Change $\frac{17}{4}$ to a mixed number.

8. Change the following to mixed numbers: $\frac{9}{4}$, $\frac{11}{4}$, $\frac{13}{8}$, $\frac{27}{8}$.

9. ADDING AND SUBTRACTING FRACTIONS

1. *Three* fourths and *two* fourths are *how many* fourths?

2. *Read and add:*

$\frac{2}{4} + \frac{3}{4} =$	$\frac{2}{4} + \frac{3}{4} =$	$\frac{5}{8} + \frac{3}{8} =$	$\frac{3}{16} + \frac{5}{16} =$
$\frac{3}{4} + \frac{1}{4} =$	$\frac{1}{8} + \frac{5}{8} =$	$\frac{4}{8} + \frac{2}{8} =$	$\frac{4}{16} + \frac{3}{16} =$
$\frac{1}{8} + \frac{2}{8} =$	$\frac{2}{8} + \frac{3}{8} =$	$\frac{5}{8} + \frac{2}{8} =$	$\frac{5}{16} + \frac{11}{16} =$

3. *Read and subtract:*

$\frac{3}{4} - \frac{1}{4} =$	$\frac{3}{8} - \frac{1}{8} =$	$\frac{9}{16} - \frac{7}{16} =$	$\frac{15}{16} - \frac{3}{16} =$
$\frac{5}{8} - \frac{3}{8} =$	$\frac{7}{8} - \frac{6}{8} =$	$\frac{11}{16} - \frac{5}{16} =$	$\frac{12}{16} - \frac{9}{16} =$

4. How many eighths in $\frac{1}{4}$? Then $\frac{1}{4}+\frac{5}{8}=\frac{?}{8}$.

> *Before adding or subtracting fractions they must be changed to* **like fractions**; *that is, to fractions whose denominators are alike.*

5. By a drawing show that $\frac{3}{4}=\frac{6}{8}$.

6. *Illustrate some of the following by drawing and dividing rectangles:*

$\frac{1}{2}=\frac{2}{4}$	$\frac{2}{4}=\frac{4}{8}$	$\frac{3}{8}=\frac{6}{16}$	$\frac{6}{8}=\frac{12}{16}$
$\frac{1}{4}=\frac{2}{8}$	$\frac{1}{8}=\frac{2}{16}$	$\frac{4}{8}=\frac{8}{16}$	$\frac{7}{8}=\frac{14}{16}$
$\frac{3}{4}=\frac{6}{8}$	$\frac{2}{8}=\frac{4}{16}$	$\frac{5}{8}=\frac{10}{16}$	$\frac{1}{2}=\frac{8}{16}$

7. Observe the fractions in Exercise 6 and tell how the fractions with larger terms might have been made from the fractions with smaller terms without using drawings.

> *When both terms of a fraction are multiplied by the same number, we have a new fraction with larger terms, but the new fraction represents the same value as the fraction with smaller terms.*

8. Without a drawing, change to *sixteenths:*

$\frac{3}{4}$, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{3}{8}$, $\frac{7}{8}$, $\frac{5}{8}$.

9. Lucy has $\frac{1}{2}$ yd. of pink ribbon, $\frac{1}{4}$ yd. of red ribbon, and $\frac{1}{8}$ yd. of blue ribbon. How much has she in all three pieces?

SOLUTION

$\frac{1}{2}$ yd. $=\frac{4}{8}$ yd.
$\frac{1}{4}$ yd. $=\frac{2}{8}$ yd.
$\frac{1}{8}$ yd. $=\frac{1}{8}$ yd.
Sum $=\frac{7}{8}$ yd.

10. Add $\frac{1}{2}$, $\frac{3}{4}$, and $\frac{5}{8}$.

Add the following:

11. $\frac{3}{4}+\frac{1}{8}+\frac{5}{16}$.

12. $\frac{7}{8}+\frac{1}{2}+\frac{11}{16}$.

13. $\frac{3}{8}+\frac{3}{4}+\frac{1}{16}$.

14. $\frac{7}{16}+\frac{3}{4}+\frac{1}{8}$.

15. $\frac{1}{4}+\frac{1}{2}+\frac{11}{16}$.

16. $\frac{3}{8}+\frac{1}{16}+\frac{7}{8}$.

Practical Problems in Addition and Subtraction

1. Mary bought $\frac{3}{4}$ of a yard of ribbon, and used all but $\frac{1}{4}$ of a yard. How much did she use?

2. Gertrude bought $\frac{7}{8}$ of a yard of lace for her dolls' clothes, and used $\frac{5}{8}$ of a yard. How much did she have left?

3. If she had used $\frac{3}{4}$ of a yard, how much would she have had left?

4. If she had used $\frac{1}{2}$ of a yard, how much would she have had left?

5. Alice bought $\frac{1}{2}$ of a yard of one kind of lace and $\frac{3}{4}$ of a yard of another kind. How much did she get in all?

6. If it takes $\frac{1}{8}$ of a skein of wool for the collar, cuffs, and bottom of a doll's sweater, and $\frac{1}{2}$ of a skein to make the main part, what part of a skein does it take for the whole sweater?

7. At 16¢ a skein, how much will the wool cost for 8 sweaters like the one in Problem 6?

8. To weave a holder, a girl used $\frac{1}{2}$ yd. of striped material and $\frac{3}{4}$ yd. of plain. How much did she use in all?

9. Some girls made dolls' hats. In all, they used $\frac{5}{8}$ lb. of plain and $\frac{1}{4}$ lb. of colored raffia. What part of a pound did they use? How many ounces was this? If they made 14 hats from the raffia, how many ounces did each weigh?

10. If the girls mentioned in Problem 9 had 1 lb. of each kind of raffia when they began, how much of each was left?

11. Dorothy made a cooking-apron. She used $\frac{3}{8}$ yd. for sleeves and bib, and $\frac{7}{8}$ yd. for the apron. How much material was needed in all? How much did it cost at 16¢ a yard?

Exercises in Adding and Subtracting Fractions

1. Add $18\frac{1}{2}$, $26\frac{3}{4}$, and $19\frac{3}{8}$.

WORK

$$\begin{array}{rr} 18\frac{1}{2} & \frac{4}{8} \\ 26\frac{3}{4} & \frac{6}{8} \\ 19\frac{3}{8} & \frac{3}{8} \\ \hline 64\frac{5}{8} & \frac{13}{8} \end{array}$$

Changing all of the fractions to eighths and writing them in a column to the right, we find that their sum is $\frac{13}{8}$. But $\frac{8}{8}$ make a whole one of anything. So $\frac{13}{8} = 1\frac{5}{8}$. Write the $\frac{5}{8}$ under the fractions and carry the 1 to ones' column.

Add the following:

2. $16\frac{1}{4}$, $13\frac{1}{2}$, $12\frac{5}{8}$

3. $26\frac{7}{8}$, $16\frac{3}{8}$, $19\frac{1}{2}$

4. $28\frac{3}{4}$, $39\frac{5}{8}$, $16\frac{1}{2}$

5. $16\frac{5}{8}$, $38\frac{1}{16}$, $19\frac{1}{2}$

6. $48\frac{1}{2}$, $56\frac{3}{4}$, $72\frac{1}{8}$

7. $38\frac{1}{16}$, $46\frac{1}{8}$, $92\frac{1}{4}$

8. $72\frac{1}{4}$, $96\frac{3}{8}$, $45\frac{1}{16}$

9. 96, $75\frac{1}{2}$, $84\frac{11}{16}$

10. Subtract $14\frac{3}{8}$ from $26\frac{1}{2}$.

WORK

$$\begin{array}{r} 26\frac{1}{2} \\ 14\frac{3}{8} \\ \hline 12\frac{1}{8} \end{array}$$

Since $\frac{1}{2} = \frac{4}{8}$, we subtracted $\frac{3}{8}$ from $\frac{4}{8}$.

Subtract the following:

11. $46\frac{9}{16}$ − $31\frac{1}{8}$

12. $54\frac{1}{2}$ − $16\frac{1}{4}$

13. $64\frac{1}{2}$ − $26\frac{3}{16}$

14. $84\frac{1}{2}$ − $36\frac{1}{8}$

15. $84\frac{5}{8}$ − $46\frac{1}{2}$

16. $56\frac{5}{8}$ − $26\frac{3}{16}$

17. $80\frac{1}{4}$ − $19\frac{3}{16}$

18. $38\frac{3}{4}$ − $16\frac{3}{8}$

10. PRACTICAL PROBLEMS WITH FRACTIONS

1. If I buy $\frac{1}{2}$ yd. of lace in one piece, $\frac{3}{4}$ yd. in a second, and $\frac{7}{8}$ yd. in a third, how much do I buy all together?

2. I spent $\frac{1}{2}$ of my vacation at the lake, $\frac{1}{8}$ of it on a hunting trip, and the rest at home. How much of the vacation was spent at home?

3. If Raymond lives $\frac{1}{2}$ of a mile from school, and you live $\frac{3}{8}$ of a mile from school, how much farther does he have to go than you?

4. If you lost $\frac{1}{16}$ of your marbles, and gave away $\frac{1}{4}$ of them, what part of them would you have left?

5. Edward is $53\frac{3}{4}$ inches tall. Frederick is $51\frac{5}{8}$ inches tall. How much taller is Edward than Frederick?

6. Charles is now $55\frac{9}{16}$ inches tall. When he was measured a year ago he was $52\frac{3}{8}$ inches tall. How much has he grown in the year?

7. One day a boy delivered three beef roasts. One weighed $6\frac{3}{4}$ lb., another weighed $8\frac{1}{2}$ lb., and the other $7\frac{3}{8}$ lb. How much did all three weigh?

8. Our Thanksgiving turkey weighed $12\frac{5}{8}$ pounds. Our Christmas turkey weighed $14\frac{3}{4}$ pounds. How much more did the larger one weigh?

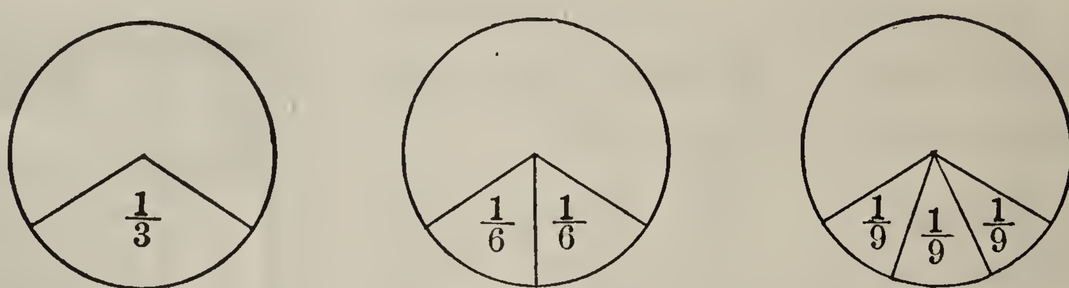
9. If turkeys cost 32¢ per pound, how much more did the Christmas turkey cost than the other?

10. Ralph has a garden $18\frac{1}{2}$ feet long and $12\frac{1}{4}$ feet wide. He wishes to stretch a wire around it. How many feet will it take?

11. Grace needs $\frac{1}{4}$ yd. of ruching for each sleeve of her dress and $\frac{3}{8}$ yd. for the neck. How much does she need in all?

11. THIRDS, SIXTHS, AND NINTHS

NOTE. — The following exercises should be varied and supplemented by use of the yardstick and rectangles.



$\frac{1}{3}$ $\qquad$ $\frac{1}{3} = \frac{2}{6}$ $\qquad$ $\frac{1}{3} = \frac{3}{9}$

1. In the whole of anything there are —— thirds, —— sixths, or —— ninths. $1 = \frac{3}{3} = \frac{6}{6} = \frac{9}{9}$.

2. Compare $\frac{1}{3}$ and $\frac{1}{6}$ thus: $\frac{1}{3} = 2 \times \frac{1}{6}$; $\frac{1}{6}$ is $\frac{1}{2}$ of $\frac{1}{3}$.

3. Compare $\frac{1}{3}$ and $\frac{1}{9}$.

4. If you give away $\frac{1}{3}$ of an apple, how much remains?

5. If an apple is cut into 6 equal parts, what is each part called? $1 - \frac{1}{6} =$ ——. $1 - \frac{5}{6} =$ ——.

6. How many feet in a yard? A foot is what part of a yard?

7. How many inches in $\frac{1}{3}$ yd.? In $\frac{1}{6}$ yd.? In $\frac{1}{9}$ yd.?

8. $\frac{1}{3} + \frac{1}{6} =$ —— sixths; $\frac{2}{3} - \frac{1}{6} =$ ——; $\frac{2}{3} + \frac{1}{9} =$ —— ninths.

Add the following:

9. $\frac{2}{3}$ $\underline{\frac{1}{6}}$	10. $\frac{2}{3}$ $\underline{\frac{5}{9}}$	11. $\frac{2}{9}$ $\underline{\frac{1}{3}}$	12. $\frac{5}{6}$ $\underline{\frac{2}{3}}$
13. $26\frac{1}{3}$ $\underline{18\frac{1}{6}}$	14. $54\frac{2}{9}$ $\underline{63\frac{1}{3}}$	15. $38\frac{2}{3}$ $\underline{64\frac{1}{9}}$	16. $28\frac{5}{9}$ $\underline{16\frac{1}{3}}$

Subtract the following:

17. $\frac{2}{3}$ $\underline{\frac{1}{6}}$	18. $\frac{5}{6}$ $\underline{\frac{2}{3}}$	19. $48\frac{7}{9}$ $\underline{36\frac{2}{3}}$	20. $32\frac{5}{9}$ $\underline{24\frac{1}{3}}$

Practical Problems

1. When you have read $\frac{1}{6}$ of a book, what part of it do you still have to read?

2. William has eaten $\frac{1}{3}$ of a cake, and his sister has eaten $\frac{4}{9}$ of it. Which has eaten the more? How much more?

3. If you sleep $\frac{1}{3}$ of the day and play $\frac{1}{6}$ of it, how much of the day is left for other things?

4. How many is $\frac{1}{3}$ doz. eggs? $\frac{2}{3}$ doz.? $\frac{1}{6}$ doz.? $\frac{5}{6}$ doz.?

5. If you buy $\frac{2}{3}$ dozen bananas at 18¢ a dozen, how much do they cost?

6. If you buy $1\frac{1}{3}$ dozen oranges at 36¢ a dozen, how much do they cost?

7. If you buy $1\frac{5}{6}$ doz. eggs at 36¢ a dozen, how much do you pay?

8. Gertrude bought $1\frac{8}{9}$ yards of braid at 27¢ a yard. Find the cost.

9. How much will $4\frac{2}{9}$ yards of linen cost at 54¢ a yard?

10. Laura bought $\frac{8}{9}$ of a yard of lace, and used $\frac{2}{3}$ of a yard. How much did she have left?

11. A lady roasted meat to sell at a ladies' bazaar. It lost $\frac{4}{9}$ of its weight in cooking. What part of the original weight was the roasted meat?

12. If she bought 18 lb., how much did it weigh after it was roasted?

13. A merchant made a special sale, and marked his goods to sell at $\frac{2}{3}$ of the regular prices. The regular price of gingham was 27¢ a yard. At what price did he sell it?

14. For how much did he sell a ball in the toy department, of which the regular price was 15¢?

15. Give the reduced price when a $12 overcoat has been reduced $\frac{1}{3}$. When an $18 dress has been reduced $\frac{1}{6}$.

12. EXERCISES IN FRACTIONS

1. $\frac{1}{2} = \frac{?}{4} = \frac{?}{6} = \frac{?}{8} = \frac{?}{12} = \frac{?}{16}$.

2. $\frac{1}{3} = \frac{?}{6} = \frac{?}{9} = \frac{?}{12}$.

Add:

3. $\frac{1}{4} + \frac{3}{8} + \frac{1}{2}$.	**6.** $\frac{3}{4} + \frac{7}{8} + \frac{1}{2}$.	**9.** $\frac{4}{5} + \frac{2}{5} + \frac{7}{10}$.
4. $\frac{1}{3} + \frac{5}{6} + \frac{7}{12}$.	**7.** $\frac{5}{8} + \frac{1}{2} + \frac{1}{4}$.	**10.** $\frac{3}{4} + \frac{7}{12} + \frac{1}{4}$.
5. $\frac{11}{12} + \frac{5}{6} + \frac{2}{3}$.	**8.** $\frac{1}{6} + \frac{1}{3} + \frac{11}{12}$.	**11.** $\frac{1}{4} + \frac{7}{8} + \frac{1}{2}$.

12. Elizabeth practices her violin lesson $\frac{1}{2}$ of an hour before school, $\frac{1}{4}$ of an hour during the intermission, and $\frac{1}{3}$ of an hour after school. How much more than an hour does she practice in all?

13. If you cut $\frac{2}{3}$ of a yard of ribbon from a piece $\frac{3}{4}$ of a yard long, what part of a yard remains?

Add:

14. $\frac{1}{4}+\frac{1}{2}+\frac{1}{8}$.
15. $\frac{3}{4}+\frac{1}{2}+\frac{3}{8}$.
16. $\frac{1}{2}+\frac{7}{8}+\frac{3}{4}$.
17. $\frac{3}{8}+\frac{1}{2}+\frac{1}{4}+\frac{5}{8}$.
18. $\frac{1}{2}+\frac{3}{4}+\frac{7}{8}+\frac{5}{8}$.

Subtract:

19. $\frac{3}{4}-\frac{1}{2}$.
20. $\frac{1}{2}-\frac{3}{8}$.
21. $\frac{3}{4}-\frac{5}{8}$.
22. $\frac{7}{8}-\frac{3}{4}$.
23. $\frac{3}{4}-\frac{1}{3}$.

Add:

24. $\frac{1}{6}+\frac{1}{3}$.
25. $\frac{2}{3}+\frac{5}{6}$.
26. $\frac{1}{12}+\frac{2}{3}$.
27. $\frac{3}{4}+\frac{5}{12}$.
28. $\frac{5}{6}+\frac{3}{4}$.

Add:

29. $\frac{1}{2}+\frac{1}{4}+\frac{1}{16}$.
30. $\frac{3}{4}+\frac{5}{16}+\frac{1}{2}$.
31. $\frac{3}{8}+\frac{3}{16}+\frac{1}{4}$.
32. $\frac{5}{8}+\frac{5}{16}+\frac{1}{2}$.
33. $\frac{3}{4}+\frac{3}{8}+\frac{7}{16}$.
34. $\frac{11}{16}+\frac{7}{8}+\frac{1}{2}$.

Practical Problems

1. Mrs. Brown and her daughter went shopping. At the lace remnant counter they bought a piece of lace containing $\frac{7}{8}$ yd., another containing $\frac{3}{4}$ yd., and another containing $1\frac{1}{2}$ yd. How much did they buy in all?

2. They paid 16¢ for one piece, 15¢ for one, and 27¢ for the other. Mrs. Brown gave the clerk a dollar bill. How much change did she receive?

3. Then they went to the ribbon remnant counter. There they got one piece of ribbon containing $1\frac{1}{4}$ yd., one piece containing $\frac{11}{12}$ yd., one containing $\frac{5}{6}$ yd., and one containing $\frac{2}{3}$ yd. How much ribbon did they buy in all?

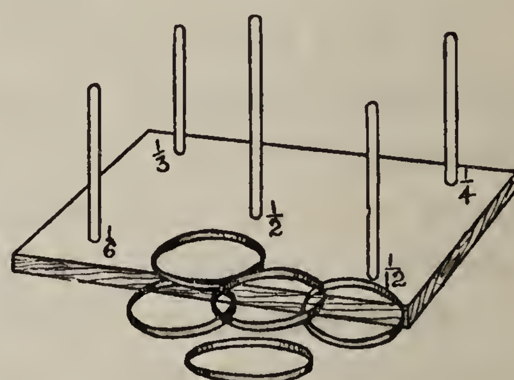
4. From there they went to the silk remnant counter, where they bought one piece containing $1\frac{1}{3}$ yd. But they

wanted $4\frac{1}{2}$ yd. of the one kind, so they got the rest at the regular silk counter. How much did they ask for there?

5. In the grocery department they ordered 6 bars of soap at $3\frac{1}{3}$ cents a bar, 9 cans of corn at $16\frac{2}{3}$ cents a can, $2\frac{1}{2}$ lb. of sweet potatoes at 6 cents a pound, and 8 pounds of sugar at $5\frac{1}{4}$ cents a pound. How much did they spend in the grocery department?

6. When they started to town, Mrs. Brown had $12 in her purse, and when they got home she had $1.85. How much did they spend that day?

7. In this ring-toss game there are five pins and five rings. Each player gets five throws. If the ring falls on the middle pin, it counts $\frac{1}{2}$, and on the other pins $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{6}$, and $\frac{1}{12}$, respectively. The rule is to add all of the counts that the player makes with the five rings. The one getting the highest score wins.



If you throw $\frac{1}{2}$, 0, $\frac{1}{6}$, $\frac{1}{12}$, and 0, what is your score?

8. If you throw $\frac{1}{2}$, $\frac{1}{2}$, $\frac{1}{3}$, 0, and $\frac{1}{6}$, what is your score?

9. If you throw $\frac{1}{12}$, 0, 0, $\frac{1}{6}$, and $\frac{1}{4}$, what is your score?

10. Robert and Harry make scores as follows. Who wins?

Robert, $\frac{1}{6}$, 0, $\frac{1}{2}$, $\frac{1}{3}$, 0.

Harry, $\frac{1}{3}$, $\frac{1}{4}$, 0, $\frac{1}{12}$, $\frac{1}{6}$.

11. Charles makes the largest score possible. How much does he score?

12. Give, without pencil, the scores as your teacher states the counts.

13. Mary made three dresses for her dolls. She used $\frac{1}{2}$ of a yard of gingham for one, $\frac{3}{8}$ of a yard for another, and $\frac{1}{4}$ of a yard for the third. How much did she use in all?

14. George and his father have a truck garden. They have $\frac{3}{4}$ of an acre of sweet corn, $\frac{1}{2}$ of an acre of peas, $\frac{5}{8}$ of an acre of cabbage, and $1\frac{1}{4}$ acres in other vegetables. How large is their garden?

15. A farmer laid $\frac{1}{4}$ of a mile of drain tile one year, $\frac{5}{8}$ of a mile the next, $\frac{1}{8}$ of a mile the next, and $\frac{1}{2}$ of a mile the fourth year. How much did he lay in 4 years?

16. Alice has two pieces of ribbon. One piece contains $1\frac{1}{4}$ yd. and the other $\frac{5}{8}$ yd. If she uses $1\frac{1}{2}$ yd. in trimming a doll dress, how much is left?

13. FRACTIONAL PARTS OF WHOLE NUMBERS

1. What is $\frac{1}{4}$ of 16? Since $\frac{3}{4}$ is three times as much as $\frac{1}{4}$, $\frac{3}{4}$ of $16 = 3 \times$ ——, or ——.

2. Find $\frac{5}{8}$ of 136; of 344; of 192.

Copy and fill blanks:

3. $\frac{3}{4}$ of $12 =$ ——.

4. $\frac{2}{3}$ of $27 =$ ——.

5. $\frac{3}{5}$ of $35 =$ ——.

6. $\frac{4}{5}$ of $30 =$ ——.

7. $\frac{2}{3}$ of $18 =$ ——.

8. $\frac{2}{4}$ of $28 =$ ——.

9. $\frac{3}{5}$ of $40 =$ ——.

10. $\frac{4}{5}$ of $45 =$ ——.

11. $\frac{3}{4}$ of $36 =$ ——.

12. $\frac{2}{3}$ of $21 =$ ——.

13. $\frac{4}{5}$ of $25 =$ ——.

14. $\frac{3}{4}$ of $20 =$ ——.

15. $\frac{2}{3}$ of $12 =$ ——.

16. $\frac{3}{4}$ of $24 =$ ——.

17. $\frac{2}{5}$ of $40 =$ ——.

18. $\frac{5}{6}$ of $48 =$ ——.

19. $2\frac{1}{2} \times \$8$ means $\frac{1}{2}$ of $\$8 + (2 \times \$8)$, or $\$4 + \$16$.

20. $3\frac{3}{4} \times 20$ ft. $= \frac{3}{4}$ of 20 ft. $+ (3 \times 20$ ft.$) =$ ——.

Find:

21. $2\frac{1}{2} \times 10$ ft.
22. $1\frac{1}{3} \times 12$ yards.
23. $3\frac{1}{2} \times \$4$.
24. $2\frac{1}{4} \times 16$ bushels.
25. $1\frac{1}{8} \times 24$ men.
26. $4\frac{1}{2} \times \$10$.
27. $3\frac{1}{6} \times 12$ pounds.
28. $4\frac{1}{3} \times 9$ quarts.
29. $6\frac{1}{2} \times 8$ quarts.
30. $7\frac{1}{2} \times 10$ cents.
31. $6\frac{1}{2} \times 12$¢.
32. $5\frac{1}{3} \times 15$¢.
33. $4\frac{1}{2} \times 10$ quarts.
34. $6\frac{1}{3} \times 6$ feet.
35. $9\frac{1}{4} \times \$8$.
36. $7\frac{1}{5} \times 15$ yd.

14. MULTIPLYING BY MIXED NUMBERS

1. A farmer sold $8\frac{3}{4}$ acres of land at \$196 an acre. How much did he receive for it?

We are to find $8\frac{3}{4} \times \$196$.

WORK

$$\begin{array}{r} \$196 \\ \underline{8\frac{3}{4}} \\ 49 \\ \underline{3} \\ 147 \\ \underline{1568} \\ \$1715 \end{array}$$

EXPLANATION. — $\frac{1}{4}$ of $196 = 49$; $\frac{3}{4}$ of $196 = 3 \times 49 = 147$; $8 \times 196 = 1568$; $1568 + 147 = 1715$. So he receives \$1715.

Or we may multiply by 3 first and then divide by 4, as in the work at the right. The second method is generally the better.

WORK

$$\begin{array}{r} \$196 \\ \underline{8\frac{3}{4}} \\ 4\overline{)588} \\ 147 \\ \underline{1568} \\ \$1715 \end{array}$$

In this way find:

2. $7\frac{2}{5} \times 125$.
3. $9\frac{2}{3} \times 741$.
4. $5\frac{4}{5} \times 945$.
5. $8\frac{3}{4} \times 624$.
6. $6\frac{3}{8} \times 728$.
7. $12\frac{1}{2} \times \$894$.
8. $32\frac{3}{4} \times 532$ ft.
9. $16\frac{2}{3} \times 726$ yd.
10. $42\frac{3}{5} \times 795$.

11. There are $16\frac{1}{2}$ ft. in a rod. How many feet in a mile, or 320 rods?

12. When butter costs 45 cents a pound, how much will $4\frac{3}{4}$ pounds cost?

SOLUTION

$$\begin{array}{r} 45\text{¢} \\ 4\frac{3}{4} \\ \hline 4)\overline{135} \\ \hline 33\frac{3}{4} \\ 180 \\ \hline 213\frac{3}{4}\text{¢} \end{array}$$

Hence \$2.14

EXPLANATION. — In this case the 45 is not divisible by 4 without a remainder. So it is better to multiply first by 3, then divide by 4. The product is $213\frac{3}{4}$¢. Hence the cost would be \$2.14, for $\frac{3}{4}$¢ could not be paid. Usually the amount charged is the nearest cent, a number ending $\frac{1}{2}$¢ or more being called the next whole number.

Find the cost of the following:

13. $6\frac{3}{4}$ lb. of meat at 32 cents a pound.

14. $12\frac{1}{2}$ lb. of butter at 47 cents a pound.

15. $6\frac{3}{4}$ doz. eggs at 38 cents a dozen.

16. $12\frac{3}{4}$ yd. of silk at 95 cents a yard.

Practical Problems

1. Alice needs 5 yards and 9 inches of gingham for a dress. How much will it cost at 18¢ a yard?

2. Two years ago Henry weighed $62\frac{3}{4}$ pounds. Now he weighs $79\frac{15}{16}$ pounds. How much has he gained in two years?

3. A farmer owned $86\frac{3}{4}$ acres of land near a town. He sold $20\frac{1}{8}$ acres for building lots. How much did he have left?

4. A farmer owned a small farm of $18\frac{3}{4}$ acres and sold it at \$325 per acre to a man who wanted to divide it into city lots. How much did he receive for it?

5. A man had a field of corn containing $12\frac{3}{4}$ acres. It produced a crop of 84 bu. to the acre. Find the total yield of the field.

6. Find the cost of a beef roast weighing $9\frac{7}{16}$ lb., if the price is 24 ¢ a pound.

7. Find the cost of a box of prunes, net weight $10\frac{3}{4}$ lb., when the price is 11 ¢ a pound.

8. Find the cost of 45 lb. of Christmas candy at $16\frac{2}{3}$ ¢ a pound.

9. This year the average rainfall per month at a certain place was $3\frac{7}{8}$ inches, and last year $2\frac{3}{4}$ inches. How much more per month was it this year than last year? How much more for the entire year?

10. The Ohio River fell from $38\frac{7}{12}$ ft. to $37\frac{1}{4}$ ft. above low-water mark in an hour. How much was the fall? At this rate how far would the river fall in 24 hours?

11. If the record for the running high jump is $6\frac{3}{4}$ ft., and John can jump $4\frac{5}{8}$ ft., how much higher must he jump in order to equal the record?

12. If the record for throwing the discus is $132\frac{5}{6}$ ft., and Arthur can throw it $87\frac{3}{4}$ ft., how much farther must he throw it in order to equal the record?

13. If the record for pole vaulting is $12\frac{5}{6}$ ft., and Fred can pole vault $8\frac{2}{3}$ ft., how much higher must he go to equal the record?

14. If your average step or pace is $2\frac{5}{12}$ ft., and it takes 264 steps for you to walk a certain distance, how many feet is it?

15. How much will $17\frac{3}{4}$ yards of linen cost at 48¢ a yard?

Find the entire cost of the following:

16. $7\frac{1}{2}$ lb. sugar @ 6¢.
$\frac{3}{4}$ lb. tea @ 60¢.
$2\frac{1}{2}$ lb. coffee @ 48¢.

17. $2\frac{3}{4}$ yd. gingham @ 20¢.
$4\frac{1}{2}$ yd. braid @ 12¢.
$\frac{1}{2}$ doz. buttons @ 30¢.

18. The owner of a house sold it for $4816, and received $\frac{3}{4}$ of the money at the time of the sale. How much more was due?

15. BILLS

1. Check the following bill. That is, see whether it is correct.

New York, Jan. 26, 1911.

Mrs. Chas. Brenner,
513 East 47th St.,

To CLARK & THOMPSON, Dr.

Dealers in Fancy Groceries, 426 East 49th St.

Jan.	10	4 cans tomatoes	@ 12¢	48		
		2 1/2 lb. butter	@ 32¢	80		
		2 lb. coffee	@ 38¢	76	2	04
Jan.	12	3 cans soup	@ 20¢	60		
		2 1/4 lb. cheese	@ 24¢	54	1	14
					3	18
		Rec'd payment,				
		Clark & Thompson.				

2. Look at the bill and give the *dates of the purchases.*

3. Give the name of the *seller* or the *firm.* Of the *buyer.*

4. Has the bill been paid? What shows it?

Rule paper, make out and receipt the following bills, using different names for buyer and seller:

5. Feb. 5, $3\frac{3}{4}$ lb. meat at 16¢; Feb. 6, $8\frac{1}{4}$ lb. lard at 16¢, and $3\frac{1}{2}$ lb. steak at 22¢; Feb. 7, $4\frac{3}{4}$ lb. chicken at 24¢, and $2\frac{1}{4}$ lb. sausage at 12¢.

6. March 10, $3\frac{1}{4}$ lb. butter at 32¢, and $\frac{3}{4}$ lb. tea at 60¢; March 12, 2 heads lettuce at 6¢, $4\frac{1}{2}$ lb. raisins at 14¢, and $3\frac{1}{2}$ doz. eggs at 34¢.

7. Apr. 4, $\frac{3}{4}$ doz. grapefruit at 80¢, $2\frac{1}{2}$ doz. oranges at 40¢, and $1\frac{1}{2}$ doz. bananas at 20¢; Apr. 7, 2 pineapples at 18¢ each, $1\frac{3}{4}$ doz. oranges at 48¢, and $\frac{1}{2}$ doz. grapefruit at 90¢.

8. Dec. 10, $6\frac{3}{4}$ lb. roast beef at 16¢, $2\frac{1}{2}$ lb. sausage at 14¢; Dec. 12, $5\frac{1}{4}$ lb. chicken at 20¢, and $3\frac{1}{2}$ lb. steak at 22¢.

9. May 5, $8\frac{1}{2}$ yd. flannel at 96¢, and $4\frac{3}{4}$ yd. braid at 16¢; May 10, 12 yd. embroidery at $22\frac{1}{2}$¢, and 10 yd. lace at $27\frac{1}{2}$¢.

10. July 16, $1\frac{3}{4}$ doz. green corn at 20¢, 2 cantaloupes at $12\frac{1}{2}$¢, and $\frac{1}{2}$ doz. peaches at 40¢; July 24, 2 melons at 55¢, $1\frac{1}{2}$ doz. bananas at 30¢, and $2\frac{1}{2}$ doz. pears at 30¢.

Problems in the Dry Goods Business

1. What articles are bought and sold by the yard?

2. How many feet make a yard? How many inches?

3. If you want a piece of ribbon 18 inches long, what part of a yard would you call for at the counter?

4. How many inches make $\frac{1}{4}$ of a yard? $\frac{3}{4}$ of a yard?

5. Can you tell how many inches in $\frac{1}{8}$ of a yard?

6. If the ribbon I wish to buy costs 48¢ a yard, how much shall I pay for $1\frac{1}{4}$ yards?

7. Mrs. Edna Jones bought the following articles of Marshall Field & Co. Make and receipt a bill and find the whole cost.

$7\frac{1}{2}$ yd. Scotch gingham	@ 18¢
$2\frac{1}{4}$ yd. cambric	@ 12¢
6 yd. trimming	@ $4\frac{1}{2}$¢
$\frac{3}{4}$ doz. towels	@ $3

8. Edward Henderson bought the following articles of Mandel Bros. Make and receipt a bill of them.

$\frac{1}{2}$ doz. pillowcases 45″ by 33″	@ 25¢ pr.
4 hemstitched sheets 72″ by 88″	@ $1.75 pr.
2 pr. hemstitched sheets 80″ by 99″	@ $3.00 pr.
2 pr. Saxony blankets	@ $5.50 pr.
1 satin bedspread	@ $2.83

9. Mrs. Mills bought of "The Fair" the following articles. What was the amount of her bill?

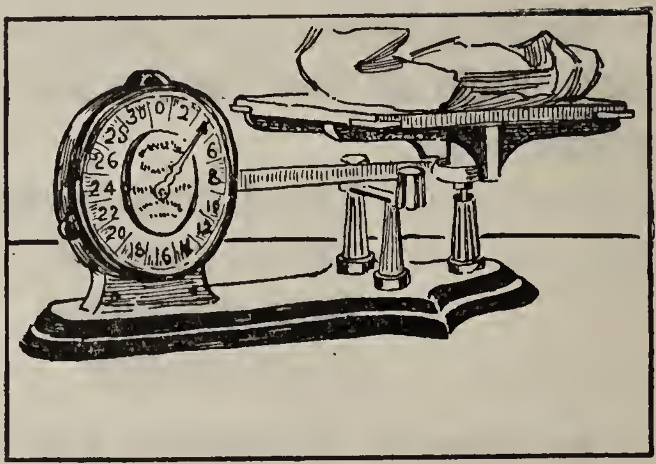
2 linen tablecloths	@ $3.00
18 napkins	@ $2.40 doz.
3 pr. Nottingham lace curtains	@ $1.50
3 window poles and trimmings	@ $0.25

10. How much denim will be needed for 16 skate-bags if $\frac{3}{8}$ of a yard will make one bag? What will be the cost of the material for each bag if the denim is 24¢ a yard, and the tape for each costs 2¢?

11. How many yards of ribbon will be required to tie 48 diplomas, if $\frac{3}{4}$ of a yard is used on each end of each diploma?

12. What will be the cost of $15\frac{3}{4}$ yards of tapestry carpet at 80¢ a yard?

Problems in a Grocer's Business



1. What articles are bought or sold by pounds and ounces?

2. What articles are bought and sold by the bushel? By the peck? By the quart? By the gallon? By the pint?

3. A grocer's counter scales show pounds and ounces. How many ounces make a pound?

4. 1 ounce is what part of a pound?

5. How many ounces in $\frac{1}{8}$ of a pound?

6. What part of a pound in 4 ounces?

7. 8 ounces are what part of a pound?

8. How many ounces in $\frac{3}{4}$ of a pound?

9. 14 ounces are how many eighths of a pound?

10. How much must you pay for $1\frac{1}{4}$ pounds of cheese at 20¢ a pound?

11. How much will the grocer charge you for 1 lb. 4 oz. of porterhouse steak at 32¢ a pound?

12. 5 pounds of spice are wrapped in packages containing 2 ounces each. How many packages are there?

13. Find the cost of the following articles:

$2\frac{3}{4}$ lb. print butter	@ 36¢
12 lb. granulated sugar	@ $5\frac{1}{2}$¢
4 cans peas	@ $12\frac{1}{2}$¢

14. Make and receipt a bill for the articles in Exercise 13.

15. Make a bill and find the cost of the following articles:

$4\frac{1}{2}$ lb. fowl	@ 20¢	per lb.
3 pk. potatoes	@ 80¢	per bu.
9 oranges	@ 40¢	per doz.

16. How much must Mrs. Wright pay for $1\frac{3}{4}$ lb. of tea at 64¢ a pound?

17. How much will $\frac{3}{8}$ of a bushel of apples cost at $1.20 a bushel?

18. If you buy an $8\frac{3}{4}$ lb. roast at 24 cents a pound and a $5\frac{1}{2}$ lb. fowl at 26 cents a pound, giving the clerk a $5 bill, how much change should you receive?

Problems involving Comparison of Fractions

1. $\frac{1}{2}$ bbl. of flour weighs 98 pounds. What does $\frac{1}{4}$ of a barrel weigh? What do $1\frac{1}{2}$ barrels weigh?

2. When $\frac{1}{4}$ ton of hay is worth $5.25, how much must I pay for $\frac{1}{2}$ ton? How much for 1 ton?

3. When $\frac{1}{8}$ of a farm is worth $3200, how much is $\frac{1}{2}$ of it worth? ($\frac{1}{2}$ is how many times as large as $\frac{1}{8}$?)

4. A farmer sold 20 bushels of potatoes. This was $\frac{1}{4}$ of all he raised. How many did he keep?

5. When onions are 35¢ per peck, how much will 6 bushels cost?

6. When a 20-pound cheese is worth $1.90, how much will a 10-lb. cheese cost? Find from your answer the cost of a 30-lb. cheese. The cost of a 90-lb. cheese.

7. A man sold 54 acres, which was $\frac{1}{6}$ of his farm. How many acres remained?

HINT. — How many 6ths remained? Compare $\frac{5}{6}$ with $\frac{1}{6}$.

8. After walking $\frac{1}{2}$ the distance to school, a boy has 145 rods yet to go. How many rods from school does he live?

9. When $\frac{1}{3}$ of a ton of coal costs \$2.75, how much will a ton cost? How much will 15 tons cost?

10. When $\frac{1}{6}$ of a barrel of apples is worth 85¢, how much will 12 barrels of apples be worth?

11. A farmer sold 43 bushels of potatoes. If this was $\frac{1}{8}$ of all he raised, how many did he keep?

Review Problems involving Fractions

1. How many inches in $\frac{3}{4}$ of a foot?

2. What part of a bushel is a peck?

3. John jumps $5\frac{1}{4}$ feet. Edward's jump measures $\frac{1}{2}$ foot less. How far does Edward jump?

4. A child should sleep $\frac{1}{3}$ of his time. If he does this, how many hours in a day will he be awake?

5. A single jar holds $\frac{3}{4}$ of a pint. How much will 12 such jars hold?

6. What will $2\frac{1}{2}$ yards of ribbon cost at 16¢ a yard?

7. A sea captain, sixty years old, has spent $\frac{3}{4}$ of his life on the sea. How many years has he spent on the land?

8. Eliza has \$$\frac{1}{2}$, \$$\frac{1}{4}$, and \$$\frac{1}{10}$. How many cents has she in all?

9. What shall I pay for $\frac{3}{4}$ of a dozen eggs when two dozen are sold for \$0.72?

10. How much will $\frac{1}{4}$ of a pound of 60-cent tea and $\frac{1}{2}$ pound of 40-cent coffee cost?

11. What part of an hour is 40 minutes?

12. How many inches in $\frac{1}{4}$ of a yard?

13. Find $\frac{7}{8}$ of 56.

14. How much will $\frac{5}{8}$ of a pound cost when one pound costs 64¢?

15. Take $\frac{2}{3}$ of 24 from $\frac{5}{6}$ of 30.

16. Gladys has read all but $\frac{1}{8}$ of a book containing 72 pages. How many pages has she still to read?

17. What does a man earn in a week (6 days) at $\$2\frac{1}{2}$ a day?

18. A cow gives $3\frac{1}{2}$ gallons of milk in a day. How much will she give in a week?

19. Add:

$\frac{1}{2}+\frac{1}{4}=$; $\frac{2}{3}+\frac{1}{6}=$; $\frac{3}{4}+\frac{1}{8}=$; $\frac{2}{3}+\frac{1}{12}=$; $\frac{2}{3}+\frac{5}{9}=$.

20. Subtract:

$\frac{7}{12}-\frac{1}{4}=$; $\frac{5}{9}-\frac{1}{3}=$; $\frac{5}{6}-\frac{1}{2}=$; $\frac{11}{12}-\frac{2}{3}=$; $\frac{1}{2}-\frac{3}{8}=$.

21. A man rented a farm and was allowed $\frac{2}{3}$ of the crop for planting and harvesting it. If he raised 1326 bushels of wheat, what was his share?

22. Mr. Lane was to have $\frac{1}{8}$ of all he dug to pay him for digging my crop of potatoes. If his share was 8 bushels, what was mine?

23. Jennie is $\frac{1}{7}$ as old as her mother. If Jennie is 6 years old, how old is her mother?

24. I leave home at half-past seven and travel $6\frac{3}{4}$ hours. At what hour do I reach the end of my journey?

25. A farmer paid $\$3\frac{3}{5}$ for 4 bushels of seed wheat. How much did he pay for a bushel? (Write $\$3\frac{3}{5}$ as $3.60.)

26. Find $\frac{3}{8}$ of 1784 bushels.

II. WHOLE NUMBERS

16. NOTATION AND NUMERATION

1. Name the ten figures used in writing numbers. How do we write numbers larger than 9?

> *The nine* **figures**, 1, 2, 3, 4, 5, 6, 7, 8, 9, *are sometimes called* **digits.** 0 *is called* **zero, cipher,** *or* **naught.**
>
> *The right-hand figure of a whole number is called a* **figure of the first order**; *the next at the left of it, a* **figure of the second order**; *and so on for other orders.*

2. In the number 3056, name the figure in the first order. Name the one in the second order.

3. What does the *zero* in the third order show?

> *Writing numbers according to any system is called* **notation.**
>
> *Reading numbers that have been written according to any system of notation is called* **numeration.**
>
> *Our system of notation is the* **Hindu notation,** *because it was invented by the Hindus.*

4. In 235, what does the 5 stand for? The 3? The 2?
235 = 2 hundreds + 3 —— + ——.

5. What is the value of each figure in the following:

385; 2963: 3063; 17,842?

6. What is the value of each 5 in 555? Compare the value of each with the next one at the left.

7. How many *ones* make 1 *ten?* How many ***tens*** make 1 *hundred?*

8. The **units** in the first place at the right, or lowest **order**, are **ones**; the **units** in the second order are **tens**; the **units** in the third order are **hundreds**; those in the fourth order are **thousands.**

> *Since ten units of any order make one unit of the next higher order, our system of writing numbers is called a* **decimal system.**

Decimal comes from a word meaning *ten.*

9. What does the zero show in each of the following:

302; 1053; 260; 3078?

10. Could we write such numbers as three hundred six if we had no zero?

11. Write in figures twenty-five thousand, two hundred.

12. Write one hundred nine thousand, three hundred three.

13. Write eighty-six thousand, forty-three.

14. Write seven hundred seven thousand, three hundred nine.

15. Write one hundred nine thousand, three.

16. Write the population of these cities in figures:

South Bend, fifty-three thousand, six hundred eighty-four; Davenport, forty-three thousand, twenty-eight.

17. READING AND WRITING MILLIONS

1. Are larger numbers than thousands ever needed? For what?

> *Large numbers are separated into* **groups of three figures each,** *beginning at the right. The first three make* **ones'** *group, the next three* **thousands'** *group, and the next* **millions'** *group.*
>
> *Each group is read as if it stood alone, and then the name of the group is added. Do not use* **and** *in reading whole numbers.*

2. 35,567,370 is read:

35 million, 567 thousand, 370.

NOTE. — The group name is not used in reading *ones.*

3. Read the population of each of the 3 largest cities of the United States in 1910:

New York, 4,766,883; Chicago, 2,185,283; Philadelphia, 1,549,008.

4. The following is the population of each of the six greatest cities of the world. Read them:

London (1908), 7,323,327; New York, 4,766,883; Paris (1906), 2,763,393; Chicago, 2,185,283; Berlin (1908), 2,048,000; Tokio (1908), 2,040,148.

5. The distance from the earth to the sun is 92,900,000 miles. Read this distance.

Write in figures:

6. Five million, three hundred five thousand, five hundred one.

7. Twenty-eight million, fifty-seven thousand, six hundred.

8. Two hundred five million, thirty-six thousand, five hundred seventy.

9. Eighteen million, three hundred fifty-nine.

10. Six million, six thousand, six.

Write in figures the numbers used in the following statements:

11. The mineral production of the United States in 1907 included

Two hundred ninety-five million tons of bituminous and eighty-five million tons of anthracite coal;

One hundred sixty-six million barrels of petroleum;

Forty-five million tons of high-grade and eleven million tons of low-grade iron ore;

Two million, five hundred thousand tons of phosphate rock, and

Eight hundred sixty-nine million tons of copper.

12. The industries of this country that subsist wholly or mainly upon wood pay the wages of more than one million, five hundred thousand men and women.

Our forests now cover five hundred fifty million acres, or about one fourth of the United States.

Since 1870, forest fires have destroyed a yearly average of fifty lives and fifty million dollars' worth of timber.

Not less than fifty million acres of forest is burned over yearly.

13. According to the census of 1910 the population of Massachusetts is three million, three hundred sixty-six thousand, four hundred sixteen.

18. RAPID WORK IN ADDITION

To add rapidly and accurately requires much practice in calling at sight all the possible sums of two one-figure numbers.

All Possible Combinations of Two Figures

Announce the 45 sums in half a minute:

1	1	2	2	4	1	3	3	4	3	1	4	2	4	7
1	3	1	2	1	5	2	3	2	6	7	3	5	6	7
8	9	8	5	6	4	5	5	7	1	5	6	6	8	9
9	9	8	5	1	4	3	4	2	8	6	6	9	6	1
8	7	7	4	9	7	6	7	5	3	2	4	5	7	6
2	3	5	8	3	8	7	9	9	8	9	9	8	4	2

Call the sums of the following in 30 seconds:

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
2	4	8	3	7	5	1	3	4	1	2	4	1	4	2
3	2	1	3	2	3	5	1	3	1	1	1	7	4	2
6	5	7	8	3	6	7	8	3	9	6	7	8	1	9
7	4	7	3	8	5	8	7	1	8	7	3	6	8	5
3	5	9	6	7	2	2	6	6	4	4	8	2	5	7
3	9	8	6	4	3	9	6	8	7	3	4	9	2	1

Combinations of Two-place Numbers with One-place Numbers

To add columns quickly requires ability to recognize the sum of such groups as the following:

Announce the 70 *results in one minute and a half or less:*

21 7	41 3	62 9	72 2	44 6	51 5	63 2	33 3	41 7	64 3
18 9	49 9	68 8	45 5	66 5	74 4	15 3	65 4	27 2	41 8
94 2	83 6	36 8	48 6	29 4	88 2	87 3	67 4	14 8	49 3
57 8	46 7	17 9	95 9	23 8	42 9	54 9	55 8	47 4	66 2
35 7	86 5	38 6	79 3	26 9	99 8	76 5	53 9	89 4	56 7
82 9	58 4	92 8	39 7	93 9	85 6	78 5	98 6	43 9	37 6
34 8	93 9	77 6	84 7	96 5	52 9	97 4	73 8	28 9	75 6

Adding Single Columns

Skill in adding numbers of any size depends upon skill in adding single columns.

Practice until you can add the 45 columns in five minutes.

	a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*l*	*m*	*n*	*o*
	2	8	7	9	7	1	7	8	7	2	5	8	1	2	9
	9	1	9	3	8	2	6	9	4	1	7	7	6	4	3
	8	1	6	6	9	4	3	3	6	1	8	6	3	5	3
	7	4	3	7	3	7	4	5	9	4	9	9	5	6	7
1.	6	6	5	8	6	6	5	6	8	4	7	7	9	8	8
	3	3	9	2	7	9	7	8	6	6	6	3	8	4	3
	1	5	2	1	2	8	1	4	4	8	3	1	1	2	9
	5	7	1	1	4	1	8	2	3	3	4	6	5	1	6
	9	7	6	5	7	3	2	3	5	9	7	1	4	8	2
	1	4	6	3	2	3	8	7	5	9	4	3	4	3	6
	6	3	5	5	4	3	9	7	6	8	4	6	6	8	3
	3	6	3	4	6	9	6	8	7	1	7	8	3	9	4
2.	1	8	8	5	7	8	6	9	8	6	2	7	8	7	9
	2	3	3	6	8	3	3	3	9	3	3	2	7	8	6
	4	1	4	3	9	4	7	8	7	4	6	5	9	4	7
	6	1	2	8	7	7	8	4	4	8	6	9	1	2	8
	8	1	9	1	8	7	8	5	6	8	3	7	8	9	7
	7	7	7	8	5	6	3	7	3	8	6	8	2	5	3
	6	6	6	5	7	8	9	8	9	1	9	1	8	6	6
	4	7	8	4	6	5	6	9	2	9	2	6	7	1	5
3.	4	8	5	7	3	4	7	3	8	6	8	8	2	7	1
	3	4	8	1	9	6	3	6	1	8	2	4	9	8	9
	5	3	9	3	8	9	1	5	7	4	9	1	6	5	8
	1	2	6	9	2	7	4	8	3	7	1	7	4	4	6

Exercise in Copying and Adding

Copy and add. How long did it take to copy the whole page? How long did it take you to add them?

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
3	6	3	3	2	4	6	9	7	3	3	9
6	2	7	5	8	1	5	3	4	8	4	5
2	4	4	5	8	3	9	8	7	9	3	7
7	3	2	6	8	9	7	2	9	2	7	3
8	4	6	3	2	2	8	8	2	4	6	2

13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.
3	4	6	4	6	3	7	3	7	2	8	8
6	2	8	2	4	2	4	6	8	3	9	4
4	1	2	8	8	7	2	8	3	4	2	7
2	1	4	1	2	8	8	5	2	9	7	9
4	7	3	7	3	7	7	4	8	6	3	3
3	7	9	3	1	8	5	9	4	7	1	2

25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.
9	1	8	6	8	8	7	9	1	6	6	5
1	4	6	6	2	4	6	7	6	3	9	6
7	6	4	6	6	9	4	2	7	2	2	7
8	7	3	5	4	6	7	3	8	7	3	8
4	9	2	3	9	3	8	4	5	9	4	4
3	2	8	2	9	1	8	7	4	1	5	3

37.	38.	39.	40.	41.	42.	43.	44.	45.	46.	47.	48
7	9	7	9	3	3	1	5	9	7	9	3
6	7	2	1	9	8	4	7	2	3	1	6
9	3	9	7	7	6	5	6	8	9	8	9
3	6	6	3	1	4	6	3	1	6	7	8
7	8	3	6	9	2	4	9	7	8	3	4
4	1	4	8	9	9	8	7	6	4	2	7

Adding Larger Numbers

Copy all, then see how many you can add in 15 *minutes. Allow* 10 *points for each correct answer. Find your score.*

1.	2.	3.	4.	5.
9346	1396	8372	2693	8347
3721	7854	3967	7386	6427
7864	3796	4291	7432	3196
9721	8728	7683	8496	8731
8349	9346	9428	7834	7469
3142	7821	3192	3486	9332

6.	7.	8.	9.	10.
6543	8364	7557	4576	3861
5196	7436	8643	8894	1638
8576	9184	9381	7396	3496
3497	7395	6379	6938	9436
9846	5864	8437	4224	6349
6371	3291	4692	5983	8729

11.	12.	13.	14.	15.
3964	3164	4896	8673	7364
9436	4314	7381	9134	8532
8147	9638	1738	8346	1968
7418	8396	6984	9834	4637
4817	7381	8247	3476	3647
6431	9844	6381	8647	7463

16.	17.	18.	19.	20.
1346	4891	5466	8396	8536
8439	1948	7396	9136	3699
9438	6336	6481	8346	1875
8963	9381	7638	3842	6138
7611	7684	8399	9684	8435
3241	4619	1933	3176	9681

Practical Problems Involving Addition

1. A man bought a city lot for \$2650. He built a house upon it costing \$9785. The grading of the lot cost \$385. The fixtures and cost of decorating the house amounted to \$978. Find the total cost of the finished property.

2. A farmer hauled to a dealer five loads of wheat weighing as follows: 4628 lb.; 3863 lb.; 4128 lb.; 3989 lb.; 4065 lb. How many pounds in all? Allowing 60 lb. to a bushel, how many bushels?

3. A real-estate dealer bought four houses costing as follows: \$7650; \$8430; \$7850; \$9065. He then spent \$1236 in repairs. Find the total cost of the four.

4. A Board of Education ordered the following arithmetics for the six schools of the city: Hillside School, 285; Mt. Hebron School, 324; Cedar Ave. School, 195; Central School, 580; Maple Ave. School, 460; Fourth Ward School, 395. How many in all? Find the cost at 35¢ each.

5. Mrs. Brown has an allowance of \$85 a month for household expenses. One month she paid out as follows: rent, \$18; groceries, \$32.38; meats, \$16.21; milk, \$5.14; gas, \$3.45; electric light, \$2.14; car fare, \$4.85. How much had she left?

6. A family's average monthly expenses for a year were as follows: rent, \$22; groceries, \$23.85; meat, \$15.98; milk, \$4.86; clothing, \$32.40; incidentals, \$8.45. Find the average monthly expenses. Find the yearly expenses.

7. Three Vermont farmers tapped the following number of maple trees: Mr. Harris, 972 trees; Mr. Cook, 1348 trees; Mr. Warren, 1088 trees. How many trees were tapped by the three? If each tree produced $\frac{3}{4}$ of a gallon of maple sirup, how many gallons did they all produce?

Adding Two Numbers of Two Digits Each

One often wishes to know the sum of two numbers of two digits each without a pencil. To do this well requires much practice.

Give the sums in 40 seconds or less:

	A	B	C	D	E	F	G	H	I	J
1.	65 30	27 30	67 40	36 10	85 80	83 40	12 90	87 60	28 80	13 10
2.	37 70	48 50	95 90	63 10	78 40	47 50	36 30	54 60	92 60	56 50
3.	68 30	47 20	87 90	83 70	69 40	18 40	91 70	24 20	52 10	66 80
4.	96 30	97 30	16 70	28 60	87 30	79 20	85 50	96 80	76 70	87 70
5.	28 90	29 50	55 70	49 40	63 80	56 30	14 20	43 80	78 50	68 60
6.	96 50	39 80	28 70	76 20	99 40	87 60	68 30	72 90	98 90	88 50

Drill Table in Addition

Give these sums in one minute:

	A	B	C	D	E	F	G	H	I	J
1.	81 81	14 64	35 38	22 72	55 59	18 39	16 26	37 89	92 79	31 55
2.	34 45	47 48	81 52	65 67	14 98	63 85	92 88	73 39	51 44	91 66
3.	24 99	83 23	52 64	92 93	85 76	23 21	63 26	96 57	71 77	53 18
4.	67 47	72 15	93 34	25 35	41 79	96 49	46 87	91 68	58 97	66 78
5.	48 28	34 67	14 46	12 86	62 87	79 59	73 97	78 56	29 54	85 79

Give the sums from dictation as well as from sight.

Problems

1. Henry paid 45 ¢ for a knife and 75 ¢ for a book. How much did the two cost?

2. If there are 34 people on one street car and 48 on another, how many are there on both?

3. 45 cars pass a corner between 6 A.M. and 6 P.M., and 27 cars during the rest of the day. How many cars pass the corner in a whole day?

4. 68 trains arrive at a certain station in the morning and 53 in the afternoon. How many in all?

5. A freight train contains 18 box cars and 26 flat cars. How many cars of both kinds in the train?

6. If a freight train contains 19 empty cars and 24 loaded cars, how many cars in the train?

7. One car contains 34 tons of coal and another 37 tons. How many tons in the two cars?

8. It is 85 miles from Chicago to Ottawa, and 14 miles from Ottawa to La Salle. How far is it from Chicago to La Salle?

9. It takes 38 hours to go from St. Louis to Colorado Springs, and 56 hours to go from Colorado Springs to San Francisco. How many hours does it take to go from St. Louis to San Francisco?

10. In furnishing his house, Mr. Martin bought for the parlor five chairs for $28 and a rug for $24. What was the total cost?

11. For the dining room he bought a table for $29 and 6 chairs for $18. How much did all cost?

12. He bought a couch for $17 and a bookcase for $22. Find the cost of both.

13. For the kitchen he bought a range for $16 and a cabinet for $13. Find the cost of both.

14. He bought a bed for $23 and a dresser for $18. How much did both cost?

19. RAPID WORK IN SUBTRACTION

Subtraction depends upon addition. To find the difference, think what number added to the smaller makes the larger.

Subtraction Table

Give the 60 *differences in one minute:*

4 2	5 3	5 4	10 4	5 2	8 3	6 4	6 2	9 3	8 5
4 3	7 2	9 4	6 5	7 5	12 3	8 2	6 3	7 4	11 2
7 6	11 4	11 5	14 6	12 5	8 6	12 4	15 6	14 5	13 4
9 6	8 7	11 7	10 8	10 6	14 7	11 8	11 6	15 8	9 7
9 8	13 6	10 9	14 8	14 9	12 7	13 8	11 9	16 9	13 7
21 2	32 3	54 5	76 7	38 9	25 6	42 4	81 9	65 7	43 6

Drill in Subtraction

Without copying, see how many correct answers you can write down in three minutes. Score 5 for every correct answer, and see what score you make.

1.	2.	3.	4.
96312	38635	96781	86342
14101	16321	75340	15121

5.	6.	7.	8.
87369	75697	67938	86397
15235	13425	45125	15165

9.	10.	11.	12.	13.
875	934	673	634	842
136	128	247	418	627

14.	15.	16.	17.	18.
834	926	816	903	807
172	342	344	241	463

19.	20.	21.	22.	23.
813	931	813	425	926
246	175	467	178	278

Drill in Subtraction

Copy all, then subtract and check. Score 5 points for every correct answer, and see what score you can make in 5 minutes. Practice daily.

1.	2.	3.	4.	5.
3894	8346	7186	8639	3892
1936	3892	3894	7846	1976

6.	7.	8.	9.	10.
9163	8391	6476	5184	6281
7846	1738	1738	1329	4839

11.	12.	13.	14.	15.
3961	6132	8396	9463	3926
1884	4096	1939	8482	1932

16.	17.	18.	19.	20.
4392	3248	8063	9307	9320
1965	1296	2847	8438	7664

21.	22.	23.	24.	25.
1963	3294	9312	8076	7302
1897	2968	4638	1987	4867

Practical Problems Involving Subtraction

1. One year a five-acre field of corn yielded 8546 pounds of corn in the ear. The next year, by using selected seed and better cultivation, the same field yielded 12,870 pounds. Find the increase.

2. In a corn contest John, who won first prize, made an acre yield 5400 pounds. Henry, who won the second prize, made his acre yield 4987 pounds. How much more did John's acre yield than Henry's?

3. Potatoes dug 80 days after planting yielded 9865 pounds an acre, while the same variety dug 95 days after planting yielded 14,000 pounds an acre. What was the increase during the additional period?

4. A farmer delivered to a creamery during June 4962 lb. of milk, and during July 3598 lb. How much less did he deliver in July than in June?

5. A man gathered 1285 bushels of apples from his orchard one year. The next year he sprayed his trees, and they yielded 1520 bushels. What was the increase?

6. If the cost of spraying Irish potatoes to prevent blight is $5.29 an acre, and the increase in value $19.16 an acre, what is the profit from spraying?

7. The population of a town is now 12,735. Ten years ago it was 8898. Find the increase during the ten years.

8. In 1900 the population of the United States was 76,303,387. In 1910 it was 93,346,543. Find the increase.

9. The distance from New York to San Francisco by way of Cape Horn is 13,090 miles. The distance by way of the Panama Canal is only 5278 miles. How much is the trip from New York to San Francisco shortened by building the Panama Canal?

Drill in Subtraction

Give differences as rapidly as possible at sight:

1.	67	59	75	86	94	47	85	53	78	59
	30	40	60	50	71	32	53	23	36	48

2.	1246	3721	4986	5478	3966	2791
	300	600	880	5406	3900	2500

3.	539	287	396	417	824	391	864	249
	408	125	190	95	704	270	453	127

Subtract each one of the following amounts from $1.00:

	A	B	C	D	E	F	G	H
4.	11¢	88¢	44¢	74¢	52¢	70¢	36¢	13¢
5.	35¢	61¢	82¢	14¢	81¢	33¢	22¢	65¢
6.	83¢	30¢	23¢	57¢	89¢	43¢	95¢	29¢
7.	20¢	81¢	73¢	63¢	21¢	94¢	56¢	99¢
8.	92¢	19¢	63¢	45¢	96¢	18¢	50¢	46¢
9.	64¢	75¢	24¢	90¢	34¢	39¢	78¢	38¢

10–15. *Give the differences between any two amounts in the same line in adjacent columns.*

Problems

(*Solve without a pencil.*)

1. Two years ago Robert was 45 inches tall. Now he is 52 inches tall. How much has he grown in the two years?

2. William sold 31 copies of the *News* and 23 copies of the *American* one afternoon. How many more copies of the *News* than of the *American* did he sell?

3. Harry earned 38 cents Friday and 52 cents Saturday. How much more did he earn on Saturday?

4. Tom is 12 years old and his father is 41. How much older than Tom is his father?

5. A class studying soils found that a pan of soil when wet weighed 42 ounces. After it had been heated for a long time over a fire, it weighed only 28 ounces. What weight of water did the soil contain originally?

6. Of 73 ounces of sandy loam, 37 ounces were found to be sand. How many ounces of other soil were there?

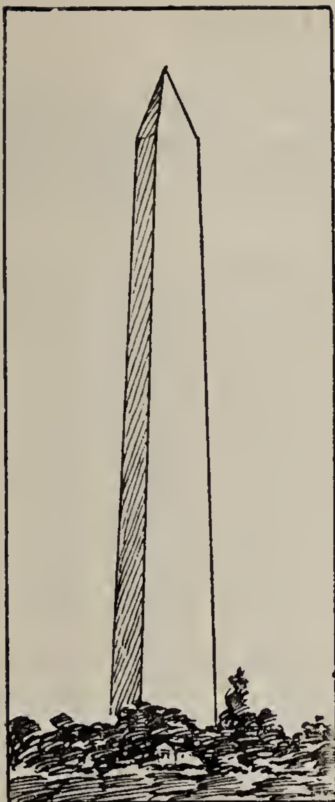
7. If a man earns $94 a month and spends $68, how much does he save?

8. If a farmer raised 43 bu. of potatoes, and wished to keep 16 bu. for his own use, how many bushels could he sell?

9. If he raised 31 bu. of onions, and wished to keep 8 bu. for his own use, how many bushels could he sell?

10. If you bought 2 yd. of ribbon and used 64 in., how many inches would you have left?

11. The table on page 55 gives the heights of some of the world's most famous structures. How much higher is the Eiffel Tower than the Metropolitan Life Building? Than Cologne Cathedral? Than the Great Pyramid? Than the Capitol at Washington?



Washington Monument

Heights of Famous Structures	
Eiffel Tower, Paris	984 ft.
Metropolitan Life Building, N.Y.	700 ft.
Singer Building, N.Y.	612 ft.
Washington Monument	556 ft.
Cologne Cathedral	512 ft.
Strassburg Cathedral	465 ft.
Great Pyramid, Egypt	451 ft.
St. Peter's, Rome	433 ft.
Capitol, Washington	288 ft.
Bunker Hill Monument	221 ft.

12. How much higher is the Singer building, New York City, than the Washington Monument? Than Strassburg Cathedral? Than the Great Pyramid?

13. How much higher is the Great Pyramid of Egypt than St. Peter's, Rome? Than the Capitol at Washington?

14. If you make a purchase amounting to 57 ¢, what change should you get from $ 1.00?

15. If you make a purchase amounting to 34 ¢, what change should you get from $ 1.00?

16. If you make a purchase amounting to 72 ¢, what change should you get from $ 1.00?

Tell at sight the change from a $ 2 bill for a purchase amounting to:

17. $1.45.	**20.** $1.81.	**23.** $1.39.
18. $1.64.	**21.** $1.73.	**24.** $0.85.
19. $1.38.	**22.** $1.47.	**25.** $0.48.

26. Let one pupil act as cashier or clerk for a short time. Let each of the others pretend to make a purchase, naming the amount and pretending to offer a sum, as $ 1.00 or $ 2.00, in payment. Let the cashier make the change.

20. RAPID WORK IN MULTIPLICATION

You have already learned the multiplication table, but it must be reviewed so that you can tell any product instantly.

THE MULTIPLICATION TABLE

$2 \times 1 = 2$	$3 \times 1 = 3$	$4 \times 1 = 4$	$5 \times 1 = 5$
$2 \times 2 = 4$	$3 \times 2 = 6$	$4 \times 2 = 8$	$5 \times 2 = 10$
$2 \times 3 = 6$	$3 \times 3 = 9$	$4 \times 3 = 12$	$5 \times 3 = 15$
$2 \times 4 = 8$	$3 \times 4 = 12$	$4 \times 4 = 16$	$5 \times 4 = 20$
$2 \times 5 = 10$	$3 \times 5 = 15$	$4 \times 5 = 20$	$5 \times 5 = 25$
$2 \times 6 = 12$	$3 \times 6 = 18$	$4 \times 6 = 24$	$5 \times 6 = 30$
$2 \times 7 = 14$	$3 \times 7 = 21$	$4 \times 7 = 28$	$5 \times 7 = 35$
$2 \times 8 = 16$	$3 \times 8 = 24$	$4 \times 8 = 32$	$5 \times 8 = 40$
$2 \times 9 = 18$	$3 \times 9 = 27$	$4 \times 9 = 36$	$5 \times 9 = 45$
$6 \times 1 = 6$	$7 \times 1 = 7$	$8 \times 1 = 8$	$9 \times 1 = 9$
$6 \times 2 = 12$	$7 \times 2 = 14$	$8 \times 2 = 16$	$9 \times 2 = 18$
$6 \times 3 = 18$	$7 \times 3 = 21$	$8 \times 3 = 24$	$9 \times 3 = 27$
$6 \times 4 = 24$	$7 \times 4 = 28$	$8 \times 4 = 32$	$9 \times 4 = 36$
$6 \times 5 = 30$	$7 \times 5 = 35$	$8 \times 5 = 40$	$9 \times 5 = 45$
$6 \times 6 = 36$	$7 \times 6 = 42$	$8 \times 6 = 48$	$9 \times 6 = 54$
$6 \times 7 = 42$	$7 \times 7 = 49$	$8 \times 7 = 56$	$9 \times 7 = 63$
$6 \times 8 = 48$	$7 \times 8 = 56$	$8 \times 8 = 64$	$9 \times 8 = 72$
$6 \times 9 = 54$	$7 \times 9 = 63$	$8 \times 9 = 72$	$9 \times 9 = 81$

Give the 45 *products from the following table in* 30 *seconds:*

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
1.	1 1	1 3	2 1	2 2	4 1	1 5	3 2	3 3	4 2	3 6	1 7	4 3	2 5	4 6	7 7
2.	8 9	9 9	8 8	5 5	6 1	4 4	5 3	5 4	7 2	1 8	5 6	6 6	6 9	8 6	9 1
3.	8 2	7 3	7 5	4 8	9 3	7 8	6 7	7 9	5 9	3 8	2 9	4 9	5 8	7 4	6 2

Drill in Multiplication

See how many you can solve in 20 minutes.
Score 5 for each correct answer. What is your score?

1.	3×693.	**26.**	7×847.	**51.**	6×8897.
2.	2×709.	**27.**	9×7654.	**52.**	9×8983.
3.	7×628.	**28.**	7×9346.	**53.**	$2 \times 93{,}674$.
4.	3×587.	**29.**	5×9988.	**54.**	$5 \times 24{,}685$.
5.	4×936.	**30.**	4×8909.	**55.**	$8 \times 12{,}987$.
6.	6×807.	**31.**	6×9364.	**56.**	$9 \times 47{,}789$.
7.	9×268.	**32.**	9×9836.	**57.**	$2 \times 84{,}579$.
8.	4×754.	**33.**	4×8096.	**58.**	$6 \times 86{,}421$.
9.	7×917.	**34.**	7×8457.	**59.**	$4 \times 89{,}543$.
10.	6×945.	**35.**	5×6677.	**60.**	$8 \times 23{,}975$.
11.	5×708.	**36.**	9×1345.	**61.**	$5 \times 35{,}791$.
12.	8×257.	**37.**	6×8475.	**62.**	$2 \times 79{,}367$.
13.	3×692.	**38.**	5×8967.	**63.**	$6 \times 97{,}531$.
14.	7×386.	**39.**	7×9568.	**64.**	$4 \times 78{,}365$.
15.	6×872.	**40.**	9×8736.	**65.**	$9 \times 63{,}842$.
16.	8×369.	**41.**	6×9586.	**66.**	$3 \times 98{,}731$.
17.	5×649.	**42.**	7×9189.	**67.**	$7 \times 46{,}820$.
18.	4×865.	**43.**	4×7384.	**68.**	$9 \times 98{,}765$.
19.	6×753.	**44.**	9×2965.	**69.**	$3 \times 24{,}679$.
20.	8×197.	**45.**	6×7364.	**70.**	$5 \times 97{,}864$.
21.	7×963.	**46.**	7×8679.	**71.**	$9 \times 91{,}735$.
22.	6×909.	**47.**	5×8345.	**72.**	$8 \times 68{,}895$.
23.	8×750.	**48.**	4×9685.	**73.**	$3 \times 90{,}647$.
24.	9×651.	**49.**	9×7961.	**74.**	$8 \times 97{,}264$.
25.	6×893.	**50.**	7×9036.	**75.**	$7 \times 35{,}971$.

Practical Problems

1. Mary's mother bought 9 yards of cloth for a dress at \$ 2.65 a yard. Find the cost.

2. A man had a 6-acre field of potatoes that yielded 168 bushels per acre. How many bushels in the six acres?

3. In what two ways can you find the answer to Problems 1 and 2? Which way is shorter? When can multiplication be used to save addition?

4. Frank has three rows of grapevines. If they yield 286 pounds to the row, how many pounds will he have?

5. If it is 238 miles to your grandmother's, how much mileage will your father use from his mileage book to pay for going and returning if there are 3 to go? If there are 4 to go?

6. A certain factory makes 1365 pairs of shoes per day. How many pairs is that in a week of 6 days?

7. In one orchard a man gathered 485 bushels of apples. In another he gathered just 3 times as many. How many did he gather in all? Solve without using addition.

8. A contractor built 4 houses for Mr. Brown at \$ 7525 each. Find the cost of all.

9. A man paid \$ 1000 for a plot of land and spent \$ 350 in having it laid out into 6 building lots. If he sells the lots at \$ 325 each, how much will he make?

10. If you walk 1286 yards in going and returning to school each day, how many yards do you walk in this way in a week of 5 days? In a month of 4 weeks?

11. A contractor employs 9 men at \$ 2.25 per day. How much does he pay out for help each day? How much in a week of 6 days?

21. DRILL FOR RAPID WORK IN MULTIPLICATION

Give the products quickly:

	A	B	C	D	E	F	G	H	I	J
1.	37	41	23	36	85	39	94	56	45	96
	2	5	2	3	6	2	9	9	2	2
2.	83	49	57	53	15	82	38	74	97	43
	4	3	7	2	9	5	8	8	3	7
3.	17	66	35	95	42	49	14	64	48	34
	3	4	8	9	8	8	7	7	5	8
4.	52	94	21	73	24	63	98	54	91	37
	8	2	9	5	7	9	6	4	6	9
5.	19	81	65	57	99	27	44	13	26	75
	6	6	6	8	5	7	3	3	9	4
6.	71	12	93	33	16	72	25	62	88	46
	7	9	4	7	3	6	5	2	4	3
7.	86	55	18	87	29	73	92	32	61	59
	9	8	5	6	4	4	4	5	7	5

22. MULTIPLYING BY A NUMBER OF THREE DIGITS

Find the product of 376×485.

WORK

```
   485
   376
  ----
  2910
 3395
1455
------
182360
```

Read the first *partial product*. Where was the first figure placed?

Read the second partial product. Where was the first figure placed?

Read the third partial product. Where was the first figure placed?

What is the sum of the partial products?

Find the products of:

1. 375×893.	4. 643×785.	7. 734×867.
2. 463×786.	5. 836×974.	8. 843×796.
3. 527×389.	6. 349×738.	9. 384×963.

23. MULTIPLIERS CONTAINING ZEROS

1. Find the product of 306×847.

```
    A            B
   847          847
   306          306
  ----         ----
  5082         5082
  000         2541
2541          ------
------        259182
259182
```

Since the zeros in the second partial product of the work marked *A* do not affect the complete product, they are omitted in practice. The work is written as in *B*. Where is the first figure of the second partial product written?

Find the product of:

2. 305×946.	6. 403×763.	10. 207×964.
3. 708×264.	7. 906×542.	11. 309×728.
4. 890×387.	8. 380×675.	12. 730×645.
5. 406×843.	9. 450×783.	13. 901×768.

Find the product of:

NOTE. — Select as multiplier the factor that will give but two partial products when possible.

14. 509 × 648.
15. 704 × 945.
16. 907 × 893.
17. 395 × 607.
18. 809 × 694.
19. 907 × 648.
20. 876 × 394.
21. 507 × 809.
22. 494 × 608.
23. 904 × 889.
24. 879 × 707.
25. 609 × 984.
26. 685 × 982.
27. 809 × 698.
28. 764 × 904.
29. 8701 × 906.
30. 9076 × 807.
31. 7809 × 703.
32. 3009 × 847.
33. 9070 × 369.
34. 8095 × 908.

Problems involving Multiplication

1. If a mechanic receives $3.25 a day, how much will he receive in a month of 26 working days?

2. A man sold 17 cords of wood at $4.25 a cord. How much did he receive for it?

3. If the annual cost per pupil to run the city schools is $38.96, what is the total cost for 1508 pupils?

4. A dealer bought 218 tons of coal at $5.27 per ton, and sold the lot for $1667.70. How much did he gain?

5. A dealer bought 209 barrels of flour at $4.52 per barrel, and sold it for $6.20 per barrel. How much did he gain on the whole purchase?

6. There are 238 teachers in the schools of a city. If the number of pupils to each teacher averages 38, find the total number of pupils.

7. A farmer raised 26 bushels of wheat per acre on 49 acres. How much is it worth at 87¢ per bushel?

8. A farmer sold 96 sheep and 57 lambs. He got \$6.45 each for the sheep and \$3.95 each for the lambs. How much did he get for all?

9. If a boy earns \$3.75 per week selling papers and \$2.50 more selling butter and eggs, how much can he earn in 26 weeks?

10. When 9 pounds of tea are worth \$4.86, how much will 72 pounds cost? Solve in two ways.

24. MEANING OF ABSTRACT AND CONCRETE NUMBERS

1. Of these numbers, which apply to things that can be seen, handled, or measured? 5 books; 3 ft.; \$9; 15; 6 gal.; 23; 10 lb.; 14; 7 trees.

2. Which of these numbers are not connected with things of any kind?

> *Numbers that are applied to things of any kind are called* **concrete** *numbers.*

3. Name five concrete numbers.

> *Numbers used without reference to things of any kind are called* **abstract** *numbers.*

4. Name some abstract numbers.

5. In what respect are 9 ft. and 11 ft. alike? Can you think of any respect in which 5 gal. and 8 hr. are alike?

> **Like numbers** *have units of the same name and kind.*

6. Mention three like numbers; four that are unlike. Why are all abstract numbers like numbers?

7. Using the objects, actually multiply 2 pencils or 2 books by 3. Which of these numbers do you see and handle? Which is abstract? Of what use is the abstract number?

8. $6 \times \$8 = \$48$. How many numbers are used in this example? Which of them are like numbers? Why?

9. Which is more, 5×6 inches or 6×5 inches?

Principles in Multiplication. — 1. *In multiplication the multiplier is always an abstract number.*

2. *The product and the multiplicand must be like numbers.*

3. *If the numbers composing the multiplicand and multiplier are interchanged, the product is not changed.*

25. INTERCHANGING MULTIPLIER AND MULTIPLICAND

A farmer sold 238 sheep at \$7 each. How much did he get for them?

Since the amount received for 1 sheep was \$7, the amount received for 238 was $238 \times \$7$.

What is the *multiplier?* Which number is the *multiplicand?*

When there are 3 figures in the multiplier, how many partial products have we?

When there is but one figure in the multiplier, we get the whole product at once.

$$\begin{array}{r} \$7 \\ \underline{238} \\ 56 \\ 21 \\ \underline{14} \\ \$1666 \end{array}$$

Compare $238 \times \$7$ with $7 \times \$238$. Which is shorter, to find $238 \times \$7$ or $7 \times \$238$? Find each.

$$\begin{array}{r} \$238 \\ \underline{7} \\ \$1666 \end{array}$$

In practice we select the number for multiplier that will make the least work. To do this we have to think of it as an abstract number. From the real multiplicand we know what things the product represents.

Find the cost of:

1. 644 chairs at $3.
2. 197 desks at $5.
3. 623 sofas at $7.
4. 865 tables at $9.
5. 346 beds at $8.

Change:

6. 425 weeks to days.
7. 785 yards to feet.
8. 649 gallons to quarts.
9. 427 days to hours.
10. 416 pounds to ounces.

26. FACTORS AND MULTIPLES

Since the multiplier and multiplicand *make* the product, they are called **factors** of the product.

Exercises

1. What are the products of the following factors:
9 and 8; 15 and 6; 20 and 5; 25 and 3; 16 and 6?
2. If 3 is one factor of 21, what is the other?
3. 12 is a factor of 60. Find the other factor.
4. Find the factors of 22; of 34; of 26; of 35.

Give the factors smaller than 14 *that produce the following:*

5. 28, 32, 33.
6. 35, 36, 39.
7. 42, 45, 48.
8. 49, 52, 54.
9. 65, 66, 72.
10. 77, 78, 81.
11. 84, 88, 91.
12. 96, 99, 104.
13. 108, 110.
14. 117, 121.
15. 130, 132.
16. 143, 156.

Instead of saying that one number will *contain* another number, we say that it is a **multiple** of the number. Thus, 36 is a multiple of 2, or 3, or 4. Give four other numbers of which 36 is a multiple.

Exercises

1. 35 is a multiple of what two numbers?
2. Which of the following are multiples of 2? Of 3?

   4, 5, 9, 12, 15, 18, 16, 24, 27, 32, 54.
3. Beginning with 4, name all the multiples of 2 to 100.
4. Name all multiples of 3 to 99.
5. Name all multiples of 4 to 100.
6. 38 is a multiple of what two factors?
7. Give the multiples of 5 to 200.
8. $3 \times \$8 = \$$——. Name two factors that make $24.

27. DIVISION

Our skill in division depends largely upon our skill in multiplication. One does not know that $\frac{1}{11}$ of 99 is 9 until he first knows that $9 \times 11 = 99$.

Exercises

1. The product is 121 ft.; one factor is 11. Find the other.
2. —— × 9 miles = 108 miles, hence 108 miles ÷ 9 miles = ——; 7 × —— = \$77, hence \$77 ÷ 7 = \$——.

> *In division the* **product** *becomes the* **dividend.**
> *The* **known factor** *becomes the* **divisor.**
> *The other factor, when found, is the* **quotient.**

3. If the *dividend* is 91 days and the *divisor* is 7 days, what is the quotient? If the divisor is 7, what is the quotient?

4. The dividend is 96¢. The divisor is 8. What is the quotient?

5. One factor is 12 feet. The product is 84 feet. What is the other factor?

6. Product = $96; multiplier = 8; multiplicand = what?

7. Product = $150; multiplicand = $25; multiplier = ?

Two Kinds of Division

It was seen in the exercises given above that since 3 × $5 = $15, therefore $15 ÷ $5 = 3, and $15 ÷ 3 = $5. These two kinds of division have different meanings.

> *When both dividend and divisor are concrete, they must be like numbers and the quotient is abstract.*

This kind of division is sometimes called **measuring**, for the quotient shows how many times the dividend *will contain* the divisor. $15 ÷ $5 = 3 is usually read "$15 *contains* $5 *three times*." The sign of division (÷) can only be read "contains" when both dividend and divisor are like numbers.

> *When the dividend is concrete and the divisor abstract, the quotient is like the dividend.*

This kind of division is sometimes called **partition**, for the dividend has been divided into a number of equal parts and the quotient shows the size of each part. Thus: $15 ÷ 3 = $5 shows that $15 has been divided into 3 equal parts, and the $5 shows the size of each part. This is read "$15 *divided by* 3 *equals* $5" or "one third of $15 is $5."

Exercises

1. Give five examples of the "measuring" kind of division.

2. Give five examples of the "partition" kind of division.

Read the following, give the quotient, and tell which kind of division:

3. $24 ÷ 3 = ?
4. 28 ft. ÷ 4 ft. = ?
5. 81 qt. ÷ 9 = ?
6. 72 in. ÷ 8 = ?
7. 56 ft. ÷ 7 = ?
8. $42 ÷ $6 = ?
9. $36 ÷ 4 = ?
10. 63 pt. ÷ 7 pt. = ?
11. 45¢ ÷ 5 = ?
12. $48 ÷ $8 = ?
13. 32 mi. ÷ 4 = ?
14. 21 ft. ÷ 3 ft. = ?
15. 30 mi. ÷ 3 mi. = ?
16. $35 ÷ 5 = ?
17. 40¢ ÷ 5 = ?
18. 54 yd. ÷ 9 = ?
19. 64 gal. ÷ 8 gal. = ?
20. 18 ft. ÷ 3 ft. = ?
21. 50¢ ÷ 5¢ = ?
22. 72 pt. ÷ 8 = ?
23. 49 bu. ÷ 7 = ?
24. 36 pk. ÷ 6 = ?
25. 24 qt. ÷ 3 qt. = ?
26. 54 yd. ÷ 6 = ?

Give quotients at sight:

1.	2.	3.	4.	5.
5)875	4)976	4)784	5)965	4)724
6.	**7.**	**8.**	**9.**	**10.**
6)942	6)876	5)925	4)984	5)805
11.	**12.**	**13.**	**14.**	**15.**
7)574	7)665	8)984	8)928	7)875
16.	**17.**	**18.**	**19.**	**20.**
9)837	9)756	8)752	7)644	6)852

Drill in Short Division

Score each correct answer 5 and see what score you can make in 10 minutes:

1. $876 \div 2$.	11. $936 \div 4$.	21. $1071 \div 7$.
2. $948 \div 2$.	12. $992 \div 4$.	22. $1274 \div 7$.
3. $756 \div 2$.	13. $815 \div 5$.	23. $1344 \div 7$.
4. $934 \div 2$.	14. $705 \div 5$.	24. $1064 \div 8$.
5. $756 \div 3$.	15. $835 \div 5$.	25. $1536 \div 8$.
6. $825 \div 3$.	16. $582 \div 6$.	26. $1384 \div 8$.
7. $891 \div 3$.	17. $978 \div 6$.	27. $1728 \div 9$.
8. $765 \div 3$.	18. $798 \div 6$.	28. $1539 \div 9$.
9. $764 \div 4$.	19. $876 \div 6$.	29. $1647 \div 9$.
10. $628 \div 4$.	20. $924 \div 7$.	30. $1368 \div 9$.

Drill in Long Division

See how many you can divide in 15 minutes:

1. $782 \div 23$.	6. $7626 \div 82$.	11. $7448 \div 98$.
2. $2115 \div 45$.	7. $4371 \div 93$.	12. $2975 \div 85$.
3. $3886 \div 58$.	8. $6003 \div 69$.	13. $8241 \div 67$.
4. $4914 \div 63$.	9. $3712 \div 64$.	14. $12{,}282 \div 89$.
5. $6225 \div 83$.	10. $3060 \div 85$.	15. $23{,}275 \div 95$.

See how many you can divide in 15 minutes:

16. $38{,}778 \div 46$.	21. $49{,}914 \div 59$.	26. $12{,}596 \div 47$.
17. $27{,}702 \div 38$.	22. $14{,}994 \div 49$.	27. $62{,}371 \div 97$.
18. $34{,}278 \div 87$.	23. $27{,}649 \div 43$.	28. $80{,}808 \div 84$.
19. $72{,}072 \div 77$.	24. $31{,}265 \div 37$.	29. $62{,}884 \div 79$.
20. $76{,}911 \div 93$.	25. $38{,}070 \div 45$.	30. $84{,}099 \div 97$.

Minimum Weights of Produce

The following are minimum weights of certain articles of produce according to the laws of the United States:

	Per Bushel		Per Bushel
Wheat	60 lb.	Sweet Potatoes	55 lb.
Corn, in the ear	70 lb.	Onions	57 lb.
Corn, shelled	56 lb.	Turnips	55 lb.
Rye	56 lb.	Clover Seed	60 lb.
Buckwheat	48 lb.	Flaxseed	56 lb.
Barley	48 lb.	Timothy Seed	45 lb.
Oats	32 lb.	Blue Grass Seed	44 lb.
White Beans	60 lb.	Corn Meal	48 lb.
White Potatoes	60 lb.	Ground Peas	24 lb.

NOTE. — Do not use a fraction of a bushel, but give the answer to the nearest bushel.

1. The capacity of a certain car is 65,000 pounds. With how many bushels of shelled corn may it be loaded?

2. How many bushels of sweet potatoes can be loaded in a car whose capacity is 38,000 pounds?

3. A farmer sold 38,500 pounds of corn in the ear. How much did he get for it at 54¢ a bushel?

4. A farmer had 40 acres of oats and the same of wheat. He had 51,200 pounds of oats and sold them at 48¢ a bushel. He had 48,000 pounds of wheat which he sold at 87¢ a bushel. From which field did he receive more? How much?

5. One year a field produced 56,800 pounds of wheat. The next year with better preparation of the soil and greater care in selecting seed the same field produced 62,500 pounds. How much was the increase worth at 85¢ a bushel?

6. From an acre a gardener dug 15,000 pounds of white potatoes. At this rate, how many bushels will 40 acres produce?

Drills in Division

See how many you can divide in 20 minutes:

1. 259,182 ÷ 847.
2. 288,530 ÷ 946.
3. 186,912 ÷ 264.
4. 342,258 ÷ 843.
5. 307,489 ÷ 763.
6. 491,052 ÷ 542.
7. 199,548 ÷ 964.
8. 224,952 ÷ 728.
9. 691,968 ÷ 768.
10. 329,832 ÷ 648.
11. 665,280 ÷ 945.
12. 809,951 ÷ 893.
13. 239,765 ÷ 395.
14. 561,446 ÷ 694.
15. 587,736 ÷ 648.
16. 300,352 ÷ 494.
17. 803,656 ÷ 889.
18. 621,453 ÷ 879.
19. 599,256 ÷ 984.
20. 564,682 ÷ 698.

Find quotients:

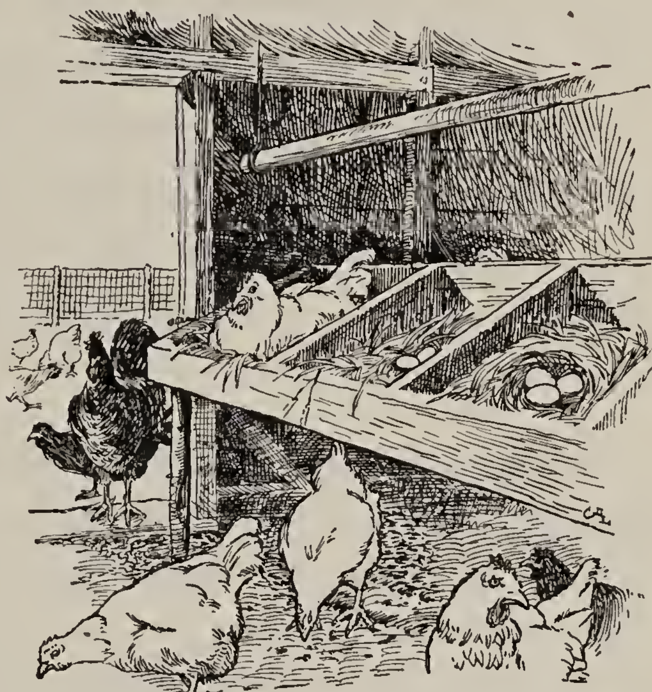
21. $7560 ÷ 15.
22. 8472 ft. ÷ 12.
23. 1080 in. ÷ 15.
24. 6432 ft. ÷ 96.
25. 6400 yd. ÷ 84 yd.
26. 5600 mi. ÷ 34.
27. 8476 ÷ 68.
28. One factor of $475,000 is $250. Find the other.
29. The product of two numbers is 100,000. One factor is 125. Find the other.
30. One factor is 197. The dividend is $90,817. What is the other factor?

Divide and check by multiplication:

31. 3468 by 75.
32. 7923 by 64.
33. 8495 by 85.
34. 3048 by 54.
35. 5703 by 72.
36. 17,863 ÷ 121.
37. 19,831 ÷ 131.
38. 57,632 ÷ 143.
39. 28,931 ÷ 151.
40. 73,201 ÷ 173.
41. 864,371 by 426.
42. 698,428 by 573.
43. 386,471 by 648.
44. 694,328 by 901.
45. 846,792 by 837.
46. 478,329 ÷ 926.
47. 384,731 ÷ 692.
48. 483,009 ÷ 741.
49. 624,642 ÷ 888.
50. 911,783 ÷ 951.
51. 684,732 ÷ 895.

Poultry Raising

Poultry raising is now an important industry. Many farmers derive a considerable part of their income from the sale of poultry and eggs, and some people make their living entirely by poultry raising.



1. If you collect 48 eggs Monday, 46 Tuesday, 49 Wednesday, 54 Thursday, 54 Friday, 47 Saturday, and 50 Sunday, how many dozen do you collect during the whole week?

2. At 28 cents a dozen, how much are they worth?

3. If the dealer who buys them ships them to a large city market and receives 34 cents a dozen, what is his profit on the entire lot?

4. Eggs usually are shipped in cases, each of which holds 30 dozen. How many eggs does each case hold? How many eggs in 18 cases?

5. The number of cases of eggs shipped to Chicago in a recent year was as follows: Jan., 40,843; Feb., 72,697; March, 223,134; April, 690,288; May, 678,349; June, 454,358; July, 333,978; Aug., 257,528; Sept., 157,762; Oct., 112,571; Nov., 63,407; Dec., 60,681. How many dozen eggs were received in Chicago during the year?

6. The average price paid for these eggs was 23 cents a dozen. Find the value of all the eggs received.

7. If you set 15 dozen eggs, worth 24 cents a dozen, and only 120 chickens hatch, what is the cost of each chicken?

28. MEASURES OF TIME

60 seconds (sec.)	**= 1 minute (min.)**
60 minutes	**= 1 hour (hr.)**
24 hours	**= 1 day (da.)**
7 days	**= 1 week (wk.)**
12 months (mo.)	**= 1 year (yr.)**
100 years	**= 1 century**

It takes the earth nearly $365\frac{1}{4}$ days to revolve around the sun. In the calendar 365 days make a **common year.** Hence, in order to correct the error made in considering 365 days a year, an extra day is added to all years divisible by 4, except the century years, which must be divisible by 400. These years containing an extra day are **leap years.**

The extra day is added to the month of February, which has but 28 days in a common year. Four of the months have 30 days each. They are April, June, September, and November. The remaining seven have 31 days each.

> "*Thirty days have September,*
> *April, June, and November.*
> *All the rest have thirty-one,*
> *Save February, which alone*
> *Has twenty-eight, and one day more*
> *We add to it one year in four.*"

1. Tell which of the following years will be leap years: 1912; 1922; 1940; 1956; 2000; 2100; 2300; 2400.

2. Write the leap years from 1800 to 1900.

3. Name the leap years from 1900 to 2000.

Exercises in Measures of Time

1. How many seconds in 15 minutes? In 1 hour?

2. How many minutes in 8 hours? In 1 day?

3. How many hours in 1 week? In the month of July?

4. How many days in 6 wk.?

5. Your vacation lasts 12 weeks, or how many days?

6. If you are 11 years old, how many months old are you?

7. George's brother is $2\frac{1}{2}$ years old. How many months old is he?

8. A month is what part of a year?

9. Give as a fraction of a year each of the following: 2 mo.; 3 mo.; 4 mo.; 5 mo.; 6 mo.; 7 mo.; 8 mo.; 9 mo.; 10 mo.; 11 mo.

10. When rent is $600 per year, how much is that for 6 months? For 3 months? For 9 months? For 2 months?

11. If you are in school 9 months of the year, what part of the year is that? What part of the year are you out of school?

12. If you are in school 10 months of the year, what part of the year are you out of school?

29. AVOIRDUPOIS MEASURES OF WEIGHTS

The weights used in weighing all common articles, as groceries, grain, and meat, are called **Avoirdupois weights.** There are two other systems of weights. One is used to weigh gold, silver, and other valuable metals and gems. It is called **Troy weight.** The other system is used by druggists in filling prescriptions. It is called **Apothecaries' weight.**

It is not necessary to learn the last two named tables, for commonly all reference is to *Avoirdupois weight.*

16 ounces (oz.) = 1 pound (lb.)
2000 pounds = 1 ton (T.)

Sometimes the "**hundredweight**" (cwt.), meaning 100 lb., is used as a unit. In weighing some ores at the mine, 2240 lb. is called a ton. To distinguish one from the other, 2240 lb. is called a **long ton**, and 2000 lb. a **short ton.**

Problems in Weight

1. How many ounces in 12 pounds? In 20 pounds?

2. How many pounds in 8 tons? In 35 tons?

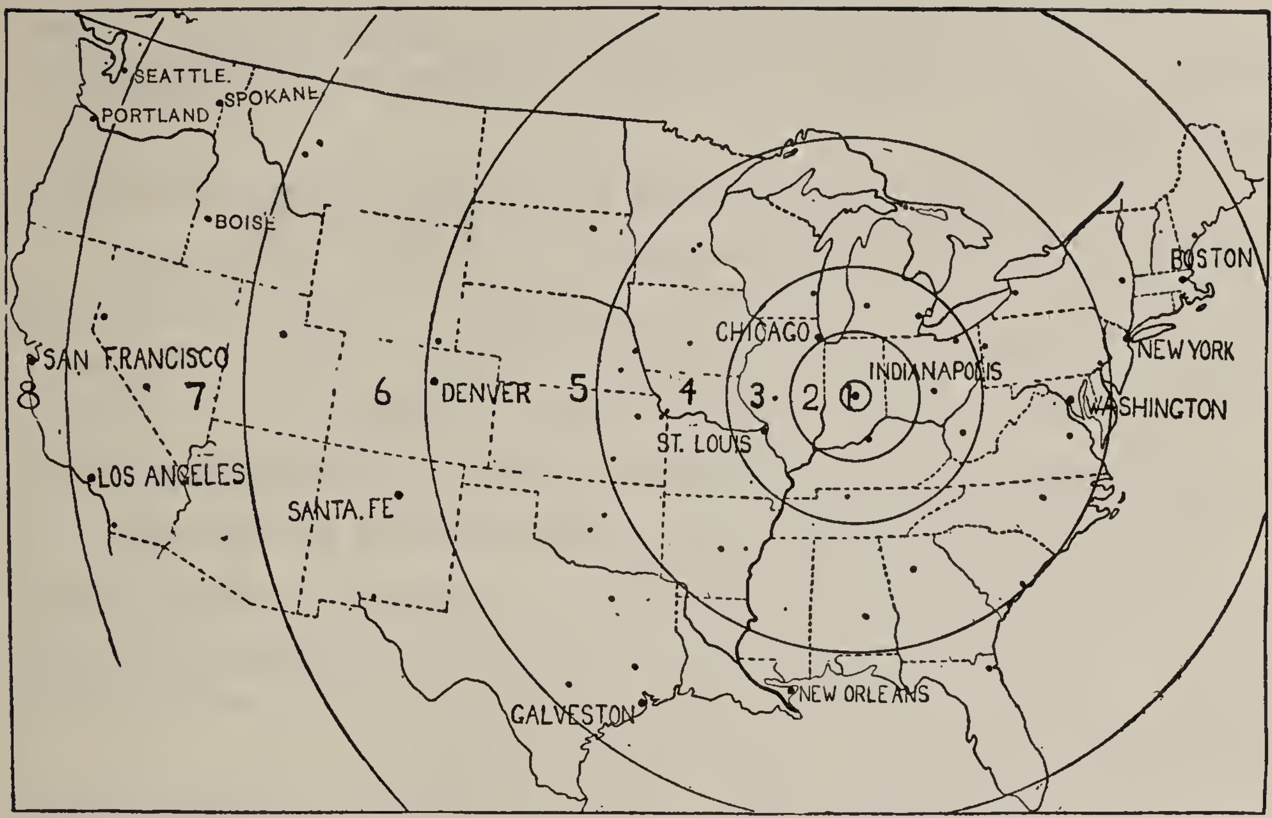
3. How many tons may be put in a car whose capacity is 48,000 pounds? In one whose capacity is 72,000 pounds?

4. Four men together bought a car load of coal for $5.20 a ton, delivered. The car load weighed 40,000 lb. How many tons did each man get? How much did it cost each? How much did each man save if the dealers would have charged $6.75 a ton to deliver it?

5. From 15 acres a farmer sold 62,500 pounds of timothy hay. How much did he get for it at $16 a ton? How much was this for the hay produced on 1 acre?

6. A man bought 8 tons of coal. The first load contained 4350 pounds, the second 4750 pounds, the third 3900 pounds. How many pounds must the fourth load contain?

7. During the months of January, February, March, and April, a family used 200 pounds of coal a day. How much did it cost at $6.75 a ton?



When a package weighing not more than 4 oz. is sent by parcel post, the rate of postage is 1¢ for each ounce. For a heavier package the rate is by the pound, a fraction of a pound being considered a pound, and the cost depends upon the distance that it is sent. For this purpose the country is divided into eight areas called zones. The mailing point is at the center of the first zone, which is practically a circle with a radius of 50 miles; the second zone is a belt lying beyond the first zone; the third zone is a belt lying beyond the second zone; etc. The rate of postage on a parcel for local delivery is 5¢ for the first pound and 1¢ for each additional *two* pounds.

RATES OF POSTAGE

Zones	First Pound	Each Additional Pound
First and Second	5¢	1¢
Third	6¢	2¢
Fourth	7¢	4¢
Fifth	8¢	6¢
Sixth	9¢	8¢
Seventh	11¢	10¢
Eighth	12¢	12¢

1. Chicago is in the third zone from Indianapolis. What does it cost to send an 8-pound package from Indianapolis to Chicago?

2. What does it cost to send a 6-pound package from your post office to a friend living in the fifth zone from you?

3. If you mail a 9-pound package at Indianapolis to a friend in Boston (see the map), in what zone is Boston? What is the postage? How much for $7\frac{1}{2}$ lb.?

4. If you mail a 10-pound package at Indianapolis to a person in San Francisco, Cal., what will the postage be?

5. For packages mailed from any point in the United States to the Philippine Islands the rate is that for the eighth zone. Find the postage on a 9-pound package sent to the Philippine Islands. On a $6\frac{1}{2}$ lb. package.

6. For a package sent from Boston to a United States naval vessel stationed in the waters off Mexico the rate is that for the eighth zone. Find the postage on a 7-pound package.

7. By computing the rates for different zones and different weights, fill out the complete table below.

Weight	Local Rate	1st Zone Rate	2d Zone Rate	3d Zone Rate	4th Zone Rate	5th Zone Rate	6th Zone Rate	7th Zone Rate	8th Zone Rate
1 lb.									
2 lb.									
3 lb.									
4 lb.									
5 lb.									
8 lb.									
10 lb.									
12 lb.									
15 lb.									
18 lb.									
20 lb.									

Making and Receipting Bills

1. Check the following bill. That is, see if it is correct:

NEWARK, N. J., *May 10, 1910.*

HAHNE & CO.

SOLD TO *Miss Louise Bacon*

14 yards English Serge	@ *$1.25*	*$17*	*50*		
$1\frac{1}{4}$ yards Velvet	@ *4.00*	*5*	*00*		
2 yards Silesia	@ *.15*		*30*		
				$22	*80*

PAID
Hahne & Co.

Make and receipt bills for the following, using any names you wish:

2. Find cost of the following bill of material for basketry:

9 lb. plain raffia @ $0.20 per lb.
5 lb. colored raffia @ .50 per lb.
3 lb. ash splints @ 1.25 per lb.
3 lb. No. 1 reed @ .95 per lb.
5 lb. No. 2 reed @ .75 per lb.

3. The following supplies were ordered for a sewing class. What was the amount of the bill?

3 boxes thread @ $0.48 per box.
20 yd. cambric @ .15 per yd.
18 yd. toweling @ $.12\frac{1}{2}$ per yd.
7 yd. damask for scarfs @ .39 per yd.

Make out bills for the following and find the amount of each:

4. On June 1, 1913, Mr. Henry James bought of Smith & Sons, Detroit, Mich., 3 plows at \$16 each, 2 wagons at \$65 each, 4 cultivators at \$22 each.

5. On August 4, 1913, Miss Agnes Moore bought of L. S. Plant & Co. of Newark, N.J., 10 yards of silk at \$1.15, 8 yards of serge at 75¢, 12 yards of muslin at 12¢, 6 spools of thread at 5¢, and 3 doz. buttons at 48¢.

6. On July 10, 1913, Mrs. L. H. Williams bought of Madison Bros., Springfield, Mass., 3 lb. rice at 8¢, 6 lb. lard at 14¢, 5 lb. prunes at 12¢, 6 cans of peaches at 22¢, and $1\frac{1}{2}$ lb. cheese at 18¢.

Suppose yourself the proprietor of a grocery store. Make out some blanks which you can use. Suppose that some of your schoolmates have bought the following goods, and make out the bills.

7. 5 lb. butter at 38¢.
6 lb. sugar at $6\frac{1}{2}$¢.
4 lb. prunes at $12\frac{1}{2}$¢.
6 lb. oatmeal at 6¢.
$2\frac{1}{2}$ lb. coffee at 38¢.

8. $3\frac{1}{2}$ lb. butter at 42¢.
$2\frac{1}{2}$ doz. eggs at 38¢.
3 cans corn at 14¢.
2 cans peas at 18¢.
$1\frac{1}{2}$ lb. coffee at 36¢.

9. $3\frac{1}{2}$ lb. rice at 8¢.
6 lb. lard at 14¢.
$1\frac{1}{2}$ lb. cheese at 24¢.
10 lb. sugar at $6\frac{1}{2}$¢.
6 lb. meal at 5¢.
$2\frac{1}{2}$ lb. raisins at 16¢.

10. 4 cans soup at 20¢.
3 cans peaches at 24¢.
$2\frac{1}{2}$ lb. butter at 40¢.
3 lb. oatmeal at 7¢.
6 lb. lard at $12\frac{1}{2}$¢.
$1\frac{1}{2}$ lb. coffee at 32¢.

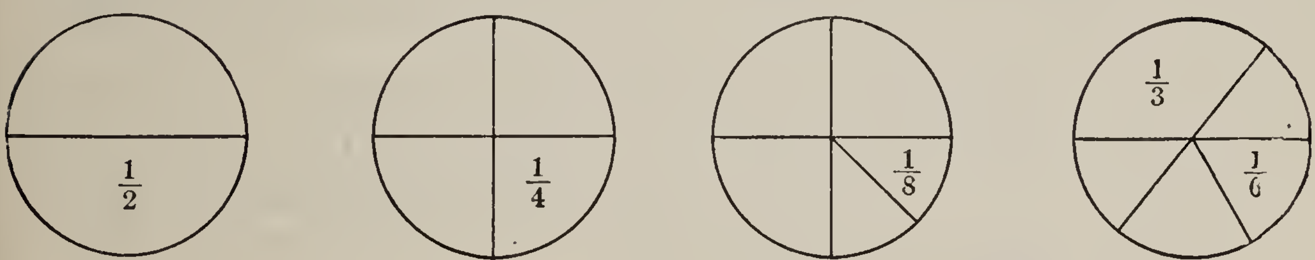
11. Let each pupil in the class make out a bill to each of the others, representing that he is in some business and that the others have bought a bill of goods. Each pupil must *check* the bill he receives; that is, go over all the work to see if it is correct.

III. FRACTIONS

30. REVIEW IN FRACTIONS

1. To get *one half* of a circle we divide it into —— parts.

2. To get *one fourth* of a circle we divide it into —— parts.



3. Compare $\frac{1}{2}$ of a circle and $\frac{1}{4}$ of it. $\frac{1}{2}$ of $\frac{1}{2}$ of a circle $=$ ——; $\frac{1}{4}+\frac{1}{4}=$ ——.

4. If each fourth be divided into 2 equal parts, the whole circle will be divided into how many equal parts?

5. What is each part called? Then how many 8ths of a circle in $\frac{1}{4}$ of it? $\frac{1}{4} \div 2 = \frac{?}{8}$.

SUGGESTION. — "Divided by 2" means divided into 2 equal parts.

6. 4 times $\frac{1}{8}$ of a circle $= \frac{?}{8}$, or $\frac{?}{4}$ of it; $6 \times \frac{1}{8}$ of a circle $= \frac{?}{8}$, or $\frac{?}{4}$ of it.

7. $\frac{1}{4} \div \frac{1}{8} =$ ——; $\frac{1}{2} \div \frac{1}{8} =$ ——.

8. 1 circle $- \frac{3}{8}$ of it $= \frac{?}{8}$ of it.

9. How many $\$\frac{1}{4}$ in a dollar? In $\$\frac{1}{2}$?

10. $\$\frac{1}{4} + \$\frac{1}{2} = \$\frac{?}{4}$. $\$1 - \$\frac{1}{4} = \$\frac{?}{4}$.

11. If you divide a circle into three equal parts, what is each part called? If you divide each of the 3 equal parts into 2 equal parts, what is each part called? Write two thirds.

12. $\frac{1}{3} = \frac{?}{6}$; $\frac{1}{3} + \frac{1}{6} = \frac{?}{6}$, or $\frac{1}{?}$.

13. $\frac{1}{3}$ yd. = —— in.; $\frac{2}{3}$ yd. = —— in.

14. $\frac{1}{8}$ bu. = —— qt.; $\frac{3}{8}$ bu. = —— qt.; $\frac{3}{4}$ bu. = —— qt.

15. $\frac{1}{2}$ hr. = —— min.; $\frac{1}{4}$ hr. = —— min.; $\frac{3}{4}$ hr. = —— min.

Review of Fractional Lengths

1. How many inches in a foot?
2. What part of a foot is here represented?
3. How many $\frac{1}{2}$ in. spaces in 1 in.? In 2 in.? In 3 in.?
4. How many $\frac{1}{4}$ in. spaces in $\frac{1}{2}$ in.? In 1 in.? In 3 in.?
5. How many $\frac{1}{8}$ in. spaces in $\frac{1}{4}$ in.? In $\frac{1}{2}$ in.? In 2 in.?
6. How many times is $\frac{1}{8}$ in. contained in $\frac{3}{4}$ in.? In $2\frac{1}{2}$ in.?
7. 6 times $\frac{1}{8}$ in. = $\frac{?}{4}$ in.; 8 times $\frac{1}{4}$ in. = —— in.
8. $1\frac{1}{2}$ in. + $1\frac{1}{2}$ in. = —— in.; $2\frac{1}{2}$ in. + $1\frac{1}{4}$ in. = —— in.
9. $\frac{1}{4}$ in. + $\frac{3}{8}$ in. = $\frac{?}{8}$ in., $\frac{1}{4}$ in. + $\frac{1}{8}$ in. + $\frac{1}{2}$ in. = —— in.
10. $1\frac{1}{4}$ in. + $\frac{3}{4}$ in. = —— in.; $\frac{3}{4}$ in. + $\frac{1}{8}$ in. + $\frac{1}{8}$ in. = $\frac{?}{8}$ in.

Add:

11.	12.	13.	14.	15.
$1\frac{1}{2}$ in.	$1\frac{1}{4}$ in.	$\frac{3}{4}$ in.	$1\frac{1}{4}$ in.	$1\frac{5}{8}$ in.
$2\frac{1}{4}$ in.	$1\frac{3}{8}$ in.	$1\frac{1}{4}$ in.	$2\frac{1}{8}$ in.	$2\frac{3}{8}$ in.
$3\frac{1}{2}$ in.	$2\frac{1}{4}$ in.	$2\frac{7}{8}$ in.	$1\frac{7}{8}$ in.	4 in.

16. $1\frac{3}{4}$ in. $-$ $1\frac{1}{2}$ in. = ——.

17. $\frac{5}{8}$ in. $-$ $\frac{1}{4}$ in. = ——.

18. $\frac{1}{4}$ in. $-$ $\frac{1}{8}$ in. = ——.

19. $\frac{3}{4}$ in. $-$ $\frac{5}{8}$ in. = ——.

20. $\frac{6}{8}$ in. $-$ $\frac{1}{2}$ in. = ——.

21. 2 in. $-$ $1\frac{1}{4}$ in. = ——.

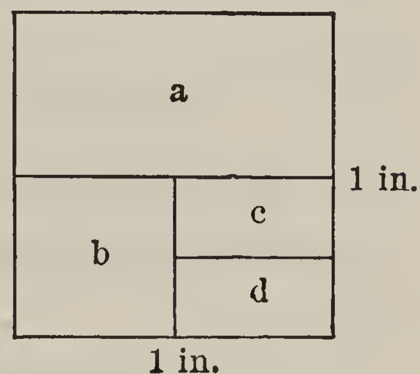
22. 3 in. $-$ $2\frac{1}{8}$ in. = ——.

23. $3\frac{1}{4}$ in. $-$ $2\frac{1}{2}$ in. = ——.

24. Draw a rectangle $2\frac{1}{2}$ inches long and $1\frac{1}{2}$ inches wide. What is the distance around it?

The distance around a closed figure, that is, the sum of the lines bounding a surface, is called the **perimeter**.

Review in Comparison of Fractions



1. *a* is what part of a square inch?

2. *b* is what part? *c* is what part?

3. Compare $\frac{1}{2}$ sq. in. and $\frac{1}{4}$ sq. in.; $\frac{1}{4}$ sq. in. and $\frac{1}{8}$ sq. in.

4. If this square represents a piece of valuable metal worth \$24, what is *a* worth? What is *b* worth? What is *c* worth?

5. $\frac{1}{8}$ sq. in. + $\frac{1}{8}$ sq. in. + $\frac{1}{4}$ sq. in. = $\frac{1}{2}$ sq. in.; $4 \times \frac{1}{8}$ sq. in. = ——.

6. $\frac{1}{2}$ sq. in + $\frac{1}{4}$ sq. in. = ——; $\frac{1}{4}$ sq. in. $\div$ $\frac{1}{8}$ sq. in. = —— times.

7. $\frac{1}{2} \div 2$ = ——; $\frac{1}{4} \div 2$ = ——; $\frac{1}{2} \div 4$ = ——.

8. $\frac{3}{4} - \frac{1}{8}$ = ——; $\frac{1}{2} - \frac{3}{8}$ = ——; $\frac{1}{4} - \frac{1}{8}$ = ——; $1 - \frac{5}{8}$ = ——.

9. When I divide a square into 6 equal parts, what is each part called?

10. What are five of those parts called?

11. If I divide \$30 into 6 equal parts, what part of \$30 is each part?

12. Five of those parts are what part of \$30?

13. Find $\frac{5}{6}$ of \$42; $\frac{7}{8}$ of \$40; $\frac{2}{3}$ of 12 feet; $\frac{5}{6}$ of 12 inches.

14. 1 oz. is what part of a pound? 4 oz. is what part of a pound? 8 oz. is what part of a pound?

15. If a pound costs 28¢, how much will 4 oz. cost?

16. At 28¢ a pound how much will 1 lb. 8 oz. cost?

17. At 12¢ a pound how much will 1 lb. 8 oz. cost? How much will 4 oz. cost? 1 lb. 12 oz. will cost how much?

18. At 24¢ a yard how much will 1 yd. 18 in. cost? How much will 9 in. cost? 1 yd. 27 in.?

19. At 40¢ a bushel how much will 1 bu. 3 pk. cost?

Review in Finding Parts of Numbers

1. $\frac{1}{3}$ of 36 inches is how many inches?

2. $\frac{2}{3}$ of 36 inches means what? $\frac{2}{3}$ of 36 inches $= 2 \times$ ——, or——.

3. $\frac{1}{4}$ of 24 lb. = ——; $\frac{3}{4}$ of 24 lb. $= 3 \times$ ——lb., or—— pounds.

Find in like manner:

4. $\frac{3}{4}$ of \$40.	13. $\frac{2}{9}$ of 45 tons.	22. $\frac{6}{7}$ of 56.
5. $\frac{5}{6}$ of 30 ft.	14. $\frac{6}{7}$ of 42 qt.	23. $\frac{5}{12}$ of 108.
6. $\frac{3}{7}$ of 28 mi.	15. $\frac{9}{10}$ of \$70.	24. $\frac{7}{12}$ of 144.
7. $\frac{2}{5}$ of 45 lb.	16. $\frac{7}{9}$ of \$72.	25. $\frac{4}{11}$ of 121.
8. $\frac{3}{8}$ of 24 oz.	17. $\frac{2}{3}$ of \$33.	26. $\frac{3}{4}$ of 400.
9. $\frac{4}{9}$ of 27 doz.	18. $\frac{5}{7}$ of 63 hr.	27. $\frac{5}{6}$ of 600.
10. $\frac{5}{7}$ of \$35.	19. $\frac{6}{11}$ of \$66.	28. $\frac{5}{9}$ of 270.
11. $\frac{5}{8}$ of 48 yd.	20. $\frac{7}{12}$ of 84 hr.	29. $\frac{6}{7}$ of 350.
12. $\frac{7}{9}$ of 63 gal.	21. $\frac{8}{11}$ of \$44.	30. $\frac{4}{11}$ of 1100.

31. 5 is $\frac{1}{4}$ of what number?

32. 8 is $\frac{1}{5}$ of what number?

33. 8 is what part of 24? Of 32? Of 40?

34. 20 min. is what part of an hour? 10 min. is what part?

35. 12 oz. is what part of a pound?

36. How many pounds in a ton? 1000 lb. is what part of a ton? 500 lb. is what part? 1500 lb. is what part?

37. If butter is selling at 24 ¢ a pound, how much will $\frac{1}{4}$ of a pound cost? How much will $2\frac{1}{4}$ lb. cost?

38. At 40 ¢ a pound how much will 12 oz. of tea cost?

39. A boy sells $\frac{3}{4}$ of his papers and has 5 left. How many had he at first?

40. If $\frac{1}{2}$ doz. oranges cost 20 ¢, how much will 5 doz. cost?

41. If 4 qt. of nuts cost 40 ¢, how much will $\frac{1}{4}$ bu. cost?

Review of Addition of Fractions

1. Divide a strip of paper 1 foot long into pieces 1 inch long. How many pieces have you? What part of a foot is each?

2. What is meant by $\frac{3}{12}$ of a foot? What are the terms of this fraction?

3. What does the 12 show? What does the 3 show?

> *The lower term of a fraction shows* (1) *into* **how many equal parts** *the whole has been divided, and hence* (2) **names the fractional units.** *It is called the* **Denominator.**
>
> *The upper term shows the* **number of fractional units** *in the fraction. It is called the* **Numerator.**

4. In the fraction $\frac{5}{8}$ of a gallon, tell what each term shows.

5. In what respect are 3 feet and 9 feet alike?

6. In what respect are $\frac{7}{12}$ of a foot and $\frac{5}{12}$ of a foot alike?

> *Numbers whose units have the same name are* **Like Numbers.**

7. Add 1 inch, 2 inches, and 4 inches.

8. Add $\frac{1}{12}$ ft., $\frac{2}{12}$ ft., and $\frac{4}{12}$ ft.

9. $\frac{1}{3} + \frac{1}{4} = \frac{4}{12} + \frac{3}{12} = \frac{?}{12}$. $\frac{4}{12}$ and $\frac{3}{12}$ are *like* fractions. Why?

10. $\frac{1}{3} + \frac{1}{6} = \frac{1}{?}$; $\frac{1}{12} + \frac{1}{12} + \frac{1}{3} =$ ——; $\frac{2}{3} + \frac{1}{6} =$ ——.

Add the following:

11. $\frac{1}{2} + \frac{1}{3}$.

12. $\frac{1}{12} + \frac{5}{6}$.

13. $\frac{1}{12} + \frac{1}{6} + \frac{1}{3}$.

14. $\frac{1}{12} + \frac{1}{6} + \frac{2}{3}$.

15. $\frac{1}{3} + \frac{5}{12}$.

16. $\frac{1}{6} + \frac{2}{3}$.

17. 6 in. + 9 in. = —— in., or 1 foot and —— inches.

18. $\frac{6}{12} + \frac{9}{12} = \frac{15}{12}$, or $1\frac{3}{12}$; $\frac{7}{12} + \frac{10}{12} = \frac{?}{12}$, or $1\frac{?}{12}$.

19. Before unlike numbers can be added, how must they be changed?

31. REDUCTION OF FRACTIONS

1. Which is most valuable, 1 half-dollar, 2 quarter-dollars, 5 dimes, or 10 nickels?

2. Compare the size of the units in these numbers.

3. Express 3 quarts in smaller units.

4. Represent 2 bushels in smaller units.

5. Change $\frac{2}{4}$ to a larger unit.

6. A gallon is how many quarts? How many pints?

7. Which of the following numbers contains the largest number of units? The largest units? How do the numbers compare in value?

9 in. $\frac{3}{4}$ ft. $\frac{1}{4}$ yd.

8. Change the form of the following numbers without changing their value:

12 pt. 2 bu. 16 oz. $\frac{8}{12}$ $\frac{1}{3}$.

From these exercises we learn that the same value may be expressed in units of different size. As we lessen the size of the units, we increase their number, and as we lessen the number of the units, we increase their size.

> *Changing the form of a number without changing its value is* **Reduction.**

9. Draw rectangles to show that $\frac{4}{8} = \frac{2}{4} = \frac{1}{2}$.

As in Example 9, *show the following:*

10. $\frac{3}{6} = \frac{1}{2}$.

11. $\frac{3}{9} = \frac{1}{3}$.

12. $\frac{4}{12} = \frac{1}{3}$.

13. $\frac{6}{12} = \frac{3}{6} = \frac{1}{2}$.

14. $\frac{8}{16} = \frac{4}{8} = \frac{1}{2}$.

15. $\frac{4}{12} = \frac{2}{6} = \frac{1}{3}$.

16. $\frac{12}{16} = \frac{6}{8} = \frac{3}{4}$.

17. $\frac{1}{4} = \frac{2}{8} = \frac{4}{16}$.

18. $\frac{2}{3} = \frac{4}{6} = \frac{8}{12}$.

In the examples given we have illustrations of the following principles:

> I. *Both terms of a fraction may be divided by the same number without changing the value of the fraction.*
>
> II. *Both terms of a fraction may be multiplied by the same number without changing the value of the fraction.*

Change to smallest terms:

19. $\frac{2}{12}$; $\frac{10}{12}$; $\frac{3}{12}$; $\frac{9}{12}$; $\frac{4}{12}$; $\frac{8}{12}$.

20. $\frac{3}{18}$; $\frac{15}{18}$; $\frac{6}{18}$; $\frac{12}{18}$; $\frac{9}{18}$; $\frac{16}{18}$.

21. $\frac{6}{24}$; $\frac{18}{24}$; $\frac{4}{24}$; $\frac{20}{24}$; $\frac{8}{24}$; $\frac{16}{24}$.

22. $\frac{4}{20}$; $\frac{8}{20}$; $\frac{12}{20}$; $\frac{16}{20}$; $\frac{5}{20}$; $\frac{25}{30}$.

23. $\frac{6}{30}$; $\frac{12}{30}$; $\frac{18}{30}$; $\frac{24}{30}$.

24. $\frac{6}{36}$; $\frac{30}{36}$; $\frac{4}{36}$; $\frac{8}{36}$.

25. $\frac{28}{36}$; $\frac{32}{36}$; $\frac{4}{48}$; $\frac{20}{48}$.

26. $\frac{6}{60}$; $\frac{18}{60}$; $\frac{42}{60}$; $\frac{54}{60}$.

27. Which is the larger, $\frac{1}{2}$ or $\frac{1}{4}$? $\frac{1}{3}$ or $\frac{1}{6}$? $\frac{1}{4}$ or $\frac{1}{8}$?

> *When a fraction is changed to its smallest terms, its units are made the largest possible.*

28. Give the different numbers of 12ths that can be changed to larger units.

29. Can 3ds, 5ths, 7ths, 11ths, or 13ths be changed to larger units?

30. What is the largest unit to which $\frac{75}{100}$ can be changed?

Change to largest units:

31. $\frac{8}{12}$; $\frac{9}{12}$; $\frac{10}{12}$; $\frac{12}{16}$; $\frac{14}{16}$; $\frac{6}{16}$; $\frac{15}{18}$; $\frac{30}{50}$; $\frac{50}{75}$.

32. $\frac{14}{32}$; $\frac{20}{32}$; $\frac{30}{36}$; $\frac{18}{42}$; $\frac{36}{42}$; $\frac{33}{44}$; $\frac{20}{45}$; $\frac{24}{60}$; $\frac{24}{64}$.

Exercises in Reduction of Fractions

Change the following fractions as indicated:

1. $\frac{9}{12}$ to fourths.
Dividing both terms by 3, $\frac{9}{12} = \frac{3}{4}$.

2. $\frac{8}{12}$ to thirds.

3. $\frac{4}{16}$ to fourths.

4. $\frac{8}{16}$ to halves.

5. $\frac{12}{16}$ to fourths.

6. $\frac{6}{8}$ to fourths.

7. $\frac{10}{16}$ to eighths.

8. $\frac{10}{12}$ to sixths.

9. $\frac{10}{15}$ to thirds.

10. $\frac{14}{16}$ to eighths.

11. $\frac{8}{10}$ to fifths.

12. $\frac{6}{9}$ to thirds.

13. $\frac{18}{20}$ to tenths.

14. $\frac{15}{20}$ to fourths.

15. $\frac{12}{20}$ to fifths.

16. $\frac{10}{20}$ to halves.

17. $\frac{1}{3}$ to ninths.

Multiplying both terms by 3, $\frac{1}{3} = \frac{3}{9}$.

18. $\frac{2}{5}$ to tenths.

19. $\frac{3}{8}$ to sixteenths.

20. $\frac{2}{3}$ to twelfths.

21. $\frac{3}{4}$ to twelfths.

22. $\frac{7}{8}$ to sixteenths.

23. $\frac{2}{3}$ to ninths.

24. $\frac{2}{3}$ to fifteenths.

25. $\frac{3}{4}$ to eighths.

26. $\frac{3}{4}$ to sixteenths.

27. $\frac{5}{6}$ to twelfths.

28. $\frac{5}{6}$ to eighteenths.

29. $\frac{4}{5}$ to fifteenths.

30. $\frac{4}{5}$ to twentieths.

31. $\frac{5}{8}$ to twenty-fourths.

32. $\frac{6}{7}$ to fourteenths.

33. How do you change a fraction with large terms to an equal fraction with smaller terms?

34. How may you make the terms of a fraction larger without changing its value?

35. When is a fraction in its smallest terms?

> *A fraction is in its smallest terms when no factor will divide them both.*

32. ADDING AND SUBTRACTING FRACTIONS

1. Add 3 feet, 2 yards, 24 inches.

2. To what *common unit* did you change the numbers?

3. Add 3 qt., 1 gal., 3 pt. To what *unit* did you change them?

4. From 75 minutes subtract 1 hour. What change in form did you make; that is, to what common unit did you change the two numbers?

5. Add $\frac{1}{2}$ and $\frac{1}{4}$. To what common unit did you change the fractions?

> *Before integers or fractions can be added or subtracted, they must have* **Like Units.**

6. Add $\frac{1}{2}$ and $\frac{1}{8}$. Can $\frac{1}{2}$ be changed to 8ths?

7. Add $\frac{1}{3}$ and $\frac{1}{4}$. Can $\frac{1}{3}$ be changed to 4ths? To what like unit can both be changed? $\frac{1}{3}+\frac{1}{4}=\frac{4}{12}+\frac{3}{12}=\frac{?}{12}$.

Exercises

Change these fractions to like units, and find their sum and their difference:

1. $\frac{1}{5}, \frac{1}{10}$.	4. $\frac{5}{6}, \frac{3}{10}$.	7. $\frac{1}{12}, \frac{4}{9}$.	10. $\frac{4}{9}, \frac{1}{6}$.
2. $\frac{1}{2}, \frac{1}{3}$.	5. $\frac{2}{3}, \frac{1}{2}$.	8. $\frac{2}{9}, \frac{4}{5}$.	11. $\frac{8}{9}, \frac{7}{8}$.
3. $\frac{2}{9}, \frac{1}{6}$.	6. $\frac{5}{6}, \frac{1}{4}$.	9. $\frac{3}{8}, \frac{5}{6}$.	12. $\frac{3}{10}, \frac{3}{5}$.

13. Add $1\frac{1}{2}$, $2\frac{1}{4}$, 3. $1\frac{1}{2}+2\frac{1}{4}+3=1\frac{2}{4}+2\frac{1}{4}+3=6\frac{3}{4}$.

Add the following mixed numbers:

14.	15.	16.	17.	18.
$3\frac{1}{3}$	$3\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{2}$	$2\frac{1}{8}$
$2\frac{1}{6}$	$1\frac{2}{3}$	$7\frac{3}{4}$	$7\frac{3}{8}$	$3\frac{3}{4}$
$4\frac{1}{2}$	$4\frac{1}{6}$	$6\frac{1}{2}$	$6\frac{1}{4}$	$6\frac{7}{8}$

19. How many oranges in a box containing $\frac{2}{3}$ doz., $\frac{5}{6}$ doz., and $\frac{11}{12}$ doz.?

33. IMPROPER FRACTIONS AND MIXED NUMBERS

1. What is your idea of $\frac{5}{4}$ of an apple?

2. Why can we not *properly* speak of $\frac{5}{4}$ of one apple?

> *A* **proper** *fraction is always less than one.*

3. In adding fractions have you ever found a result that contained more fractional units than a whole one contains?

4. Add $\frac{3}{4}$ ft. + $\frac{2}{4}$ ft. Is $\frac{5}{4}$ ft. greater or less than 1 ft.? How many 4ths greater?

5. In $1\frac{1}{4}$ ft. how many different units are represented?

> *A fraction equal to or greater than a whole one is an* **improper** *fraction.*
> *A number made up of a whole number and a fraction is a* **mixed number.**

A whole number is often called an *integer.*

Exercises

1. Which of these are fractions and which integers?
   3 feet; $\frac{2}{3}$ inch; $42; $\frac{5}{6}$ rd.; $\frac{22}{3}$ yd.; \$$\frac{6}{4}$; $\frac{9}{8}$ qt.
2. What does $\frac{4}{4}$ of a dollar equal? $\frac{12}{12}$ of a foot?
3. Is \$$\frac{5}{4}$ more or less than $1? How much?
4. Is $\frac{13}{12}$ ft. more than 1 foot? How much?
5. Tell which of these are improper fractions:
   $\frac{2}{3}$ yd.; $\frac{9}{8}$ gal.; $\frac{23}{12}$; $\frac{6}{7}$; $\frac{5}{4}$; $\frac{7}{8}$.

6. What is the value of $\$\frac{7}{4}$? Of $\frac{15}{12}$ ft.? Of $\frac{10}{4}$ gal.?

7. Change the following to mixed numbers:

$\$\frac{3}{2}$; $\$\frac{5}{4}$; $\frac{7}{2}$ qt.; $\frac{8}{3}$ yd.; $\frac{7}{4}$ bu.; $\frac{19}{16}$ lb.; $\frac{11}{2}$ qt.

8. How many 4ths in $2\frac{1}{4}$? In $1\frac{3}{4}$? In $3\frac{3}{4}$?

9. Change $\frac{138}{5}$ to a mixed number.

WORK

5 fifths)138 fifths
$27\frac{3}{5}$

Therefore $\frac{138}{5} = 27\frac{3}{5}$.

EXPLANATION. — 5 fifths = 1; in 138 fifths there are as many 1's as there are 5's in 138, or $27\frac{3}{5}$.

Dividing the numerator of an improper fraction by its denominator gives the number of whole things, and the remainder is the number of fractional units that are left.

Change to mixed numbers:

10. $\frac{63}{8}$.	15. $\frac{123}{14}$.	20. $\frac{83}{11}$.	25. $\frac{71}{12}$.
11. $\frac{43}{9}$.	16. $\frac{631}{10}$.	21. $\frac{48}{17}$.	26. $\frac{86}{13}$.
12. $\frac{43}{6}$.	17. $\frac{281}{8}$.	22. $\frac{65}{14}$.	27. $\frac{75}{16}$.
13. $\frac{107}{12}$.	18. $\frac{47}{16}$.	23. $\frac{98}{11}$.	28. $\frac{97}{16}$.
14. $\frac{347}{13}$.	19. $\frac{55}{14}$.	24. $\frac{64}{15}$.	29. $\frac{53}{14}$.

30. Which is more, $\frac{234}{16}$ ft. or $14\frac{9}{16}$ ft.?

Add and change the sum to a mixed number:

31.	32.	33.	34.	35.
$\frac{1}{2}$	$\frac{2}{3}$	$\frac{13}{16}$	$\frac{2}{3}$	$\frac{3}{5}$
$\frac{3}{4}$	$\frac{5}{6}$	$\frac{7}{8}$	$\frac{7}{9}$	$\frac{7}{10}$
$\frac{7}{8}$	$\frac{7}{12}$	$\frac{1}{4}$	$\frac{13}{18}$	$\frac{13}{20}$
$\frac{3}{8}$	$\frac{11}{12}$	$\frac{5}{8}$	$\frac{5}{6}$	$\frac{3}{4}$

Adding and Subtracting Fractions and Mixed Numbers

We have seen that fractions must be *like fractions* before they can be added or subtracted. We have learned to change fractions to other forms having the same value, and to change improper fractions to whole or mixed numbers. Therefore we are now ready to add or subtract any fractions or mixed numbers.

1. Add $16\frac{3}{4}$, $28\frac{2}{3}$, $17\frac{5}{6}$.

WORK

$$\begin{array}{ll} 16\frac{3}{4} & \frac{9}{12} \\ 28\frac{2}{3} & \frac{8}{12} \\ 17\frac{5}{6} & \frac{10}{12} \\ \hline 63\frac{1}{4} & \frac{27}{12} = 2\frac{3}{12} = 2\frac{1}{4} \end{array}$$

The steps were as follows:

1. By inspection we saw that 12 is the smallest number that can be divided by 4, 3, and 6, the given denominators. Hence twelfths is the largest unit to which all the fractions can be changed, or 12 is the **least common denominator (L. C. D.)**.

2. We next changed all the fractions to 12ths.

3. We next added the numerators and found 27 twelfths.

4. Then we changed $\frac{27}{12}$ to a mixed number. $\frac{27}{12} = 2\frac{3}{12}$.

5 The next step was to change $\frac{3}{12}$ to smallest terms. $\frac{3}{12} = \frac{1}{4}$.

6. In this way we found that the sum of the fractions was $2\frac{1}{4}$, and wrote $\frac{1}{4}$, the fraction, under the fractions and carried 2, the whole number, to the first column of whole numbers.

Add and describe each step in the process:

2.	**3.**	**4.**	**5.**	**6.**
$48\frac{2}{3}$	$57\frac{5}{8}$	$63\frac{2}{3}$	$84\frac{1}{2}$	$103\frac{3}{8}$
$17\frac{5}{6}$	$63\frac{3}{4}$	$41\frac{3}{4}$	$96\frac{3}{4}$	$81\frac{1}{2}$
$19\frac{3}{4}$	$24\frac{15}{16}$	$17\frac{5}{6}$	$90\frac{7}{8}$	$930\frac{5}{16}$
$48\frac{11}{12}$	$32\frac{7}{8}$	$18\frac{7}{12}$	$46\frac{1}{2}$	$42\frac{3}{4}$

7.	**8.**	**9.**	**10.**	**11.**
$46\frac{1}{4}$	$93\frac{1}{2}$	$86\frac{1}{3}$	$36\frac{1}{2}$	$19\frac{1}{2}$
$58\frac{1}{4}$	$86\frac{7}{16}$	$94\frac{2}{3}$	$28\frac{3}{4}$	$46\frac{5}{8}$
$96\frac{7}{8}$	$54\frac{7}{8}$	$51\frac{5}{6}$	$42\frac{2}{5}$	$13\frac{5}{6}$
$14\frac{13}{16}$	$96\frac{3}{4}$	$83\frac{5}{12}$	$16\frac{9}{10}$	$28\frac{11}{12}$

12. From $86\frac{5}{6}$ subtract $19\frac{3}{4}$.

WORK

$$\begin{array}{ll} 86\frac{5}{6} & \frac{10}{12} \\ \underline{19\frac{3}{4}} & \underline{\frac{9}{12}} \\ 67\frac{1}{12} & \end{array}$$

STEPS: 1. By inspection, we saw that both fractions could be changed to 12ths, for 12 will contain both 6 and 4.

2. Next, both fractions were changed to 12ths.

3. The difference of the numerators was 1, so the difference of the fractions was $\frac{1}{12}$ which was written under the fractions.

4. Then the difference between the whole numbers was found.

Subtract:

13.	14.	15.	16.	17.
$186\frac{2}{3}$	$46\frac{3}{4}$	$308\frac{5}{8}$	$87\frac{5}{6}$	$93\frac{1}{2}$
$94\frac{1}{4}$	$17\frac{1}{6}$	$96\frac{5}{16}$	$28\frac{1}{4}$	$43\frac{3}{8}$

18.	19.	20.	21.	22.
$48\frac{2}{3}$	$93\frac{4}{5}$	$86\frac{1}{4}$	$54\frac{7}{8}$	$67\frac{4}{5}$
$16\frac{1}{5}$	$86\frac{1}{3}$	$17\frac{1}{6}$	$15\frac{3}{4}$	$48\frac{2}{3}$

23. From $38\frac{1}{4}$ take $12\frac{2}{3}$.

WORK

$$\begin{array}{ll} 38\frac{1}{4} & \frac{3}{12} \\ \underline{12\frac{2}{3}} & \underline{\frac{8}{12}} \\ 25\frac{7}{12} & \end{array}$$

1. The new step in this problem resulted from the fact that $\frac{8}{12}$ cannot be taken from $\frac{3}{12}$. So 1 was taken from the 8 *ones*. $\frac{8}{12}$ from $1\frac{3}{12}$, or $\frac{15}{12}$, leaves $\frac{7}{12}$.

2. Then the next subtraction was 2 from 7, for 1 has already been taken from 8.

Subtract:

24.	25.	26.	27.	28.
$29\frac{1}{3}$	$57\frac{1}{3}$	$29\frac{1}{2}$	$38\frac{1}{5}$	$43\frac{1}{8}$
$16\frac{1}{2}$	$21\frac{3}{4}$	$16\frac{7}{8}$	$16\frac{2}{3}$	$16\frac{3}{4}$

29.	30.	31.	32.	33.
$54\frac{1}{6}$	$87\frac{1}{3}$	$81\frac{1}{6}$	$41\frac{1}{4}$	$54\frac{1}{8}$
$19\frac{3}{4}$	$19\frac{1}{2}$	$17\frac{2}{3}$	$16\frac{7}{16}$	$17\frac{3}{4}$

Drill Exercises in Addition

See how many you can add in 10 minutes. Score each correct answer 5. What is your score?

1.	2.	3.	4.	5.	6.	7.
$\frac{1}{2}$	$\frac{1}{2}$	$\frac{2}{3}$	$\frac{1}{3}$	$\frac{1}{6}$	$\frac{7}{12}$	$\frac{3}{4}$
$\frac{1}{4}$	$\frac{2}{3}$	$\frac{5}{6}$	$\frac{1}{6}$	$\frac{2}{3}$	$\frac{2}{3}$	$\frac{1}{2}$
$\frac{1}{3}$	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{11}{12}$	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{11}{12}$

8.	9.	10.	11.	12.	13.	14.
$\frac{1}{2}$	$\frac{1}{4}$	$\frac{2}{3}$	$\frac{5}{8}$	$\frac{1}{2}$	$\frac{5}{16}$	$\frac{5}{8}$
$\frac{3}{4}$	$\frac{1}{2}$	$\frac{5}{6}$	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{1}{4}$	$\frac{3}{4}$
$\frac{7}{8}$	$\frac{5}{8}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{7}{8}$	$\frac{7}{8}$	$\frac{7}{16}$

15.	16.	17.	18.	19.	20.	21.
$\frac{1}{2}$	$\frac{2}{3}$	$\frac{3}{5}$	$\frac{7}{8}$	$\frac{2}{3}$	$\frac{1}{6}$	$\frac{3}{4}$
$\frac{4}{5}$	$\frac{4}{5}$	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{5}{6}$	$\frac{7}{9}$	$\frac{2}{5}$
$\frac{9}{10}$	$\frac{7}{15}$	$\frac{9}{10}$	$\frac{15}{16}$	$\frac{8}{9}$	$\frac{1}{6}$	$\frac{7}{10}$

In how many minutes can you add all of the following?

22.	23.	24.	25.	26.
$26\frac{1}{2}$	$17\frac{2}{3}$	$48\frac{5}{6}$	$38\frac{2}{3}$	$82\frac{3}{4}$
$38\frac{1}{4}$	$28\frac{5}{6}$	$23\frac{1}{3}$	$48\frac{1}{4}$	$96\frac{5}{8}$
$19\frac{1}{8}$	$14\frac{1}{2}$	$19\frac{3}{4}$	$93\frac{1}{6}$	$74\frac{1}{2}$
$17\frac{3}{4}$	$17\frac{3}{4}$	$46\frac{1}{2}$	$46\frac{1}{2}$	$16\frac{11}{16}$

27.	28.	29	30.	31.
$16\frac{4}{5}$	$49\frac{1}{2}$	$53\frac{1}{2}$	$86\frac{8}{9}$	$81\frac{3}{4}$
$49\frac{3}{4}$	$86\frac{3}{5}$	$98\frac{2}{3}$	$54\frac{1}{2}$	$45\frac{1}{2}$
$83\frac{3}{10}$	$89\frac{1}{4}$	$49\frac{7}{9}$	$42\frac{2}{3}$	$73\frac{9}{10}$

Drills in Subtraction

See how many you can subtract in 5 minutes:

1.	2.	3.	4.	5.	6.	7.	8.
$\frac{2}{3}$	$\frac{3}{4}$	$\frac{4}{5}$	$\frac{7}{9}$	$\frac{5}{6}$	$\frac{5}{8}$	$\frac{3}{8}$	$\frac{5}{6}$
$\frac{1}{2}$	$\frac{2}{3}$	$\frac{2}{3}$	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{1}{16}$	$\frac{1}{2}$

9. $\frac{4}{5} - \frac{3}{4}$.
10. $\frac{3}{5} - \frac{1}{3}$.
11. $\frac{8}{9} - \frac{1}{2}$.
12. $\frac{3}{7} - \frac{1}{14}$.
13. $\frac{7}{8} - \frac{3}{4}$.
14. $\frac{1}{2} - \frac{1}{3}$.
15. $\frac{1}{2} - \frac{2}{7}$.
16. $\frac{3}{4} - \frac{1}{3}$.
17. $\frac{7}{8} - \frac{2}{3}$.
18. $\frac{5}{8} - \frac{1}{12}$.
19. $\frac{9}{16} - \frac{1}{4}$.
20. $\frac{11}{12} - \frac{2}{3}$.
21. $\frac{3}{5} - \frac{2}{15}$.
22. $\frac{4}{5} - \frac{1}{4}$.
23. $\frac{11}{12} - \frac{5}{8}$.
24. $\frac{7}{8} - \frac{5}{12}$.
25. $\frac{5}{6} - \frac{3}{8}$.
26. $\frac{2}{3} - \frac{1}{8}$.
27. $\frac{3}{4} - \frac{5}{12}$.
28. $\frac{5}{8} - \frac{5}{12}$.

In what time can you subtract all of the following?

29.	30.	31.	32.	33.
$107\frac{3}{4}$	$206\frac{1}{4}$	$412\frac{2}{3}$	$316\frac{1}{4}$	$528\frac{1}{3}$
$98\frac{1}{5}$	$138\frac{3}{5}$	$156\frac{1}{4}$	$147\frac{2}{3}$	$136\frac{3}{8}$

34.	35.	36.	37.	38.
$201\frac{1}{8}$	$790\frac{3}{4}$	$340\frac{1}{2}$	$461\frac{3}{8}$	$509\frac{2}{3}$
$136\frac{2}{3}$	$186\frac{1}{3}$	$156\frac{3}{4}$	$185\frac{5}{6}$	$180\frac{5}{7}$

39. $16\frac{2}{3} - 9\frac{1}{5}$.
40. $18\frac{1}{6} - 5\frac{2}{5}$.
41. $19\frac{1}{8} - 7\frac{5}{6}$.
42. $21\frac{2}{3} - 9\frac{7}{8}$.
43. $30\frac{1}{4} - 7\frac{5}{6}$.
44. $41\frac{1}{8} - 17\frac{5}{6}$.
45. $24\frac{1}{7} - 9\frac{2}{3}$.
46. $18\frac{1}{3} - 9\frac{7}{8}$.

Problems in Addition and Subtraction of Fractions

1. A certain rug is made of $\frac{1}{4}$ flax, $\frac{1}{3}$ hemp, and the rest jute. What part is jute?

2. A lady bought $9\frac{3}{4}$ yards of silk for a dress and had $2\frac{1}{8}$ yards left. How much did she use?

3. I filled my coal bin $\frac{2}{3}$ full in the fall. In the spring it was yet $\frac{1}{6}$ full. What part of a binful had I used?

4. How much in three remnants of ribbon if one piece contains $3\frac{1}{4}$ yards, another $2\frac{1}{2}$ yards, and the third $6\frac{3}{4}$ yards?

5. After spending $\frac{1}{4}$ of his money for a suit and $\frac{1}{6}$ of it for an overcoat, a boy had what part left?

6. Lucile had $2\frac{5}{6}$ yards of braid. She used $1\frac{1}{3}$ yards. How much had she left?

7. A milliner trimmed three hats one day. She used $2\frac{3}{4}$ yd. of silk velvet for one, $3\frac{1}{4}$ yd. for another, and $4\frac{1}{4}$ yd. for the third. How much did the velvet cost her at $2.40 a yard?

8. From a remnant of lace $1\frac{1}{8}$ yd. long, 18 inches were cut. What part of a yard remained?

9. If you live $1\frac{1}{4}$ miles from school and James lives $\frac{7}{8}$ of a mile nearer, how far does he live from the school?

10. John is $4\frac{3}{4}$ ft. tall and Henry is 3 in. taller. How tall is Henry?

11. In June Harry weighed $87\frac{3}{4}$ pounds. In October he weighed $93\frac{1}{2}$ pounds. How much had he gained?

12. If $3\frac{1}{3}$ in. should be cut from each end of a yard stick, how much would remain?

Give results without a pencil:

1. $\frac{1}{2}+\frac{3}{4}$.	9. $\frac{1}{2}+\frac{1}{3}+\frac{1}{4}$.	17. $\frac{3}{4}-\frac{1}{2}$.	25. $\frac{7}{8}-\frac{5}{16}$.
2. $\frac{3}{4}+\frac{2}{3}$.	10. $\frac{1}{2}+\frac{2}{3}+\frac{3}{4}$.	18. $\frac{7}{8}-\frac{3}{4}$.	26. $\frac{15}{16}-\frac{3}{8}$.
3. $\frac{2}{3}+\frac{3}{5}$.	11. $\frac{1}{5}+\frac{1}{2}+\frac{7}{10}$.	19. $\frac{5}{6}-\frac{1}{3}$.	27. $\frac{13}{14}-\frac{3}{7}$.
4. $\frac{1}{2}+\frac{2}{3}$.	12. $\frac{5}{6}+\frac{3}{4}+\frac{2}{3}$.	20. $\frac{9}{10}-\frac{3}{5}$.	28. $\frac{6}{7}-\frac{5}{14}$.
5. $\frac{3}{5}+\frac{1}{2}$.	13. $\frac{7}{8}+\frac{1}{4}+\frac{1}{2}$.	21. $\frac{7}{8}-\frac{3}{16}$.	29. $\frac{3}{8}-\frac{1}{4}$.
6. $\frac{1}{2}+\frac{5}{6}$.	14. $\frac{9}{10}+\frac{4}{5}+\frac{1}{2}$.	22. $\frac{3}{4}-\frac{5}{12}$.	30. $\frac{2}{3}-\frac{1}{4}$.
7. $\frac{2}{3}+\frac{4}{5}$.	15. $\frac{5}{6}+\frac{7}{12}+\frac{3}{4}$.	23. $\frac{2}{3}-\frac{5}{9}$.	31. $\frac{5}{6}-\frac{1}{2}$.
8. $\frac{1}{4}+\frac{5}{6}$.	16. $\frac{3}{8}+\frac{3}{4}+\frac{1}{2}$.	24. $\frac{4}{5}-\frac{3}{10}$.	32. $\frac{7}{8}-\frac{3}{16}$.

Drill Table

Using any two adjacent fractions in either columns or rows, give their sums, then their differences.

	A.	*B.*	*C.*	*D.*	*E.*	*F.*	*G.*	*H.*	*I.*	*J.*
1.	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{5}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{7}{9}$	$\frac{2}{3}$	$\frac{5}{6}$	$\frac{1}{2}$
2.	$\frac{2}{3}$	$\frac{1}{6}$	$\frac{3}{4}$	$\frac{3}{8}$	$\frac{1}{4}$	$\frac{5}{6}$	$\frac{2}{3}$	$\frac{8}{9}$	$\frac{1}{2}$	$\frac{3}{5}$
3.	$\frac{3}{4}$	$\frac{2}{3}$	$\frac{7}{8}$	$\frac{3}{4}$	$\frac{2}{3}$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{2}{3}$	$\frac{4}{5}$	$\frac{7}{10}$

Exercises with Mixed Numbers

1. $2\frac{1}{2}+3\frac{1}{4}+7\frac{3}{8}$.

2. $5\frac{3}{4}+6\frac{7}{8}+5\frac{1}{2}$.

3. $7\frac{2}{3}+6\frac{5}{9}+8\frac{1}{3}$.

4. $6\frac{1}{2}+7\frac{3}{8}+9\frac{5}{16}$.

5. $6\frac{3}{4}+5\frac{5}{6}+8\frac{1}{3}$.

6. $7\frac{1}{2}+6\frac{3}{5}+\frac{9}{10}$.

7. $8\frac{3}{4}+7\frac{2}{3}+1\frac{5}{6}$.

8. $7\frac{2}{3}-5\frac{1}{6}$.

9. $8\frac{3}{4}-6\frac{1}{2}$.

10. $9\frac{7}{8}-8\frac{3}{4}$.

11. $7\frac{5}{6}-3\frac{5}{12}$.

12. $18\frac{1}{2}-12\frac{1}{6}$.

13. $17\frac{5}{6}-8\frac{1}{4}$.

14. $15\frac{8}{9}-6\frac{2}{3}$.

15. $6\frac{1}{2}-3\frac{1}{4}$.

16. $3\frac{5}{8}-1\frac{1}{4}$.

17. $6\frac{7}{8}-3\frac{3}{4}$.

18. $3\frac{2}{3}-1\frac{1}{6}$.

19. $7\frac{3}{4}-5\frac{1}{3}$.

20. $3\frac{5}{6}-1\frac{3}{4}$.

21. $5\frac{3}{4}-3\frac{1}{2}$.

22. Subtract $3\frac{7}{8}$ from 7.

SOLUTION

$$\begin{aligned} 7 &= 6\tfrac{8}{8} \\ 3\tfrac{7}{8} &= 3\tfrac{7}{8} \\ \hline & \quad 3\tfrac{1}{8} \end{aligned}$$

EXPLANATION. — Since there is no fraction from which to take $\frac{7}{8}$, we take 1 *one* from the 7 *ones*. $1=\frac{8}{8}$; hence $7=6\frac{8}{8}$.

23. $9-6\frac{3}{8}$.

24. $8-3\frac{5}{6}$.

25. $9-7\frac{5}{6}$.

26. $10-7\frac{3}{4}$.

27. $12-6\frac{3}{4}$.

28. $15-6\frac{5}{6}$.

29. $16-12\frac{3}{4}$.

30. $12-9\frac{7}{16}$.

31. $8-3\frac{11}{16}$.

32. From a box of butter weighing 7 lb., $3\frac{1}{2}$ lb. were sold at one time and $2\frac{3}{4}$ lb. at another. How much remained?

34. MULTIPLICATION OF A FRACTION BY AN INTEGER

1. 5×7 in. = —— in.
2. 5×7 yd. = —— yd.
3. 6×3 ft. = —— ft.
4. 5×7 eighths = —— eighths.
5. 5×7 twelfths = —— twelfths.
6. 6×3 fifths = —— fifths.
7. Write Exercises 4, 5, and 6 in fractional form.

Thus, $5 \times \frac{7}{8} = \frac{35}{8}$, etc.

> *A fraction is multiplied by an integer by multiplying the numerator, which shows* **how many things,** *and placing the product over the denominator, which shows* **what the things are.**

Exercises and Problems

Find the products of the following:

1. $5 \times \frac{2}{3}$.	5. $5 \times \frac{4}{7}$.	9. $4 \times \frac{3}{7}$.	13. $9 \times \frac{7}{10}$.
2. $6 \times \frac{3}{5}$.	6. $8 \times \frac{3}{5}$.	10. $7 \times \frac{7}{8}$.	14. $6 \times \frac{4}{5}$.
3. $4 \times \frac{2}{5}$.	7. $2 \times \frac{4}{9}$.	11. $3 \times \frac{3}{11}$.	15. $8 \times \frac{7}{9}$.
4. $4 \times \frac{5}{6}$.	8. $6 \times \frac{5}{11}$.	12. $5 \times \frac{5}{8}$.	16. $10 \times \frac{6}{7}$.

17. How much will 6 lb. of crackers cost at $6\frac{1}{2}$ cents a pound?

SOLUTION.

$$\begin{aligned} 6 \times 6¢ &= 36¢ \\ 6 \times \tfrac{1}{2}¢ &= \underline{\ \ 3¢} \\ 6 \times 6\tfrac{1}{2}¢ &= 39¢ \end{aligned}$$

Find the cost of the following:

18. 8 lb. of meat at $16\frac{1}{4}$ cents a pound.
19. 12 yd. of ribbon at $8\frac{1}{2}$ cents a yard.
20. 6 qt. of berries at $8\frac{1}{2}$ cents a quart.

21. 13 qt. of milk at $6\frac{1}{2}$ cents a quart.

22. 8 lb. of lard at $16\frac{1}{2}$ cents a pound.

23. 8 lb. butter at $30\frac{1}{2}$ cents a pound.

24. Find the cost of 9 cans of tomatoes at $16\frac{2}{3}$¢.

25. At $\$1\frac{3}{4}$ each, how much will 12 books cost?

26. Find the cost of 36 yd. of carpet at $\$1\frac{1}{4}$.

27. If 5 dozen oranges cost $\$1\frac{3}{4}$, how much will 20 dozen cost? Suggestion. — 20 is how many times 5?

28. If 6 bushels of apples cost $\$2\frac{1}{2}$, how much will 18 bushels cost at the same rate? Suggestion. —— $\times\ \$2\frac{1}{2} =$ ——.

35. MULTIPLYING AN INTEGER BY A FRACTION

1. How do you find $\frac{2}{3}$ of an apple?

2. Find $\frac{2}{3}$ of 24.

3. Multiplying by a fraction has not the same meaning as multiplying by an integer. To multiply a number by $\frac{2}{3}$ means to find $\frac{2}{3}$ of the number. Which term of the fraction is used as a divisor? Which term of the fraction is used as a multiplier?

4. Just as $3 \times 4 = 4 \times 3$, so $24 \times \frac{2}{3} = \frac{2}{3} \times 24$. Find $24 \times \frac{2}{3}$ by the method of § 34 and $\frac{2}{3} \times 24$ by the method of this section, and thus see that both results are the same.

5. Look at the statement in § 34 and make one statement for both sections. Begin thus, "The product of a fraction and an integer is found by ——."

Note. — Unless the integer is a multiple of the denominator, it is best to perform the multiplication first.

Find the cost of the following articles:

6. $\frac{3}{4}$ lb. candy @ 10¢.
7. $\frac{2}{3}$ yd. ribbon @ 16¢.
8. $\frac{5}{6}$ doz. oranges @ 25¢.
9. $\frac{2}{9}$ yd. lace @ 30¢.
10. $\frac{7}{8}$ lb. butter @ 20¢.
11. $\frac{11}{12}$ yd. ribbon @ 30¢.
12. $2\frac{1}{2}$ lb. crackers @ 10¢.
13. $3\frac{1}{3}$ yd. cotton @ 10¢.
14. $4\frac{1}{8}$ lb. meat @ 15¢.
15. $5\frac{1}{2}$ lb. coffee @ 25¢.

36. THE MEANING OF MULTIPLICATION BY A FRACTION

1. If you did not know the product of 4 × \$7, in what other way could 4 × \$7 be found? What then does it mean to multiply by an integer?

2. Is it proper to say $\frac{2}{3}$ times \$6? That is, can you take \$6 $\frac{2}{3}$ times and add as in Exercise 1?

> *When the multiplier is a fraction, the multiplication sign* (×) *should be read "of."*

For convenience in writing, multiplication by a fraction is usually written with the sign of multiplication instead of the word "of," but the sign must be *read* "of." Thus, $\frac{2}{3}$ × \$6 is read $\frac{2}{3}$ of \$6.

Read and find the product of the following:

3. $\frac{5}{8} \times 6$.
4. $\frac{3}{7} \times 9$.
5. $\frac{3}{11} \times 8$.
6. $\frac{2}{9} \times 12$.
7. $\frac{3}{4} \times 16$.
8. $\frac{2}{9} \times 21$.
9. $\frac{7}{8} \times 24$.
10. $\frac{5}{9} \times 16$.

11. When a journey of 64 miles is $\frac{3}{4}$ completed, how many miles remain to be traveled?

12. What time is it when $\frac{2}{3}$ of the day of 24 hours has passed?

37. MULTIPLYING BY A MIXED NUMBER

1. How much are $2\frac{3}{4}$ lb. of butter worth at 32¢ a pound?

Evidently, 2 lb. are worth 2×32¢, or 64¢.
And $\frac{3}{4}$ lb. is worth $\frac{3}{4}$ of 32¢, or 24¢.
Hence $2\frac{3}{4}$ lb. are worth 64¢ + 24¢, or 88¢.

2. Find the product of $25\frac{3}{4} \times 28$.

WORK

$$\begin{array}{rl} 28 & \\ \underline{25\frac{3}{4}} & \\ 4\overline{)84} & \\ 21 & = \frac{3}{4} \times 28 \\ 140 & = 5 \times 28 \\ \underline{560} & = 20 \times 28 \\ 721 & = 25\frac{3}{4} \times 28 \end{array}$$

Find the product of the following:

3. $16\frac{2}{3} \times 24$.
4. $8\frac{1}{3} \times 375$.
5. $12\frac{1}{2} \times 360$.
6. $22\frac{5}{6} \times 42$.
7. $14\frac{7}{8} \times 96$.
8. $17\frac{5}{6} \times 48$.
9. $42\frac{2}{3} \times 84$.
10. $17\frac{4}{9} \times 36$.
11. $18\frac{5}{6} \times 96$.
12. $48\frac{2}{3} \times 51$.

13. Find the cost of 8 yards of gingham at $16\frac{2}{3}$¢ a yard.

$$8 \times 16\tfrac{2}{3}¢ = 8 \times 16¢ + 8 \times \tfrac{2}{3}¢ = 128¢ + 5\tfrac{1}{3}¢ = \$1.33\tfrac{1}{3}.$$

NOTE. — The usual practice of traders is to charge to the nearest cent. Hence in this transaction the purchaser would pay $1.33 for the gingham. Had the fraction been $\frac{1}{2}$¢ or more, the purchaser would have paid $1.34 instead of $1.33.

Make and receipt bills for the following:

14.

$16\frac{3}{4}$ yd. of silk at 85¢.
12 yd. of lining at $16\frac{2}{3}$¢.
$18\frac{1}{2}$ yd. of braid at 12¢.

15.

14 yd. of braid at $8\frac{1}{3}$¢.
$8\frac{3}{4}$ yd. of ribbon at 10¢.
$16\frac{1}{2}$ yd. muslin at 8¢.

16.

$7\frac{1}{2}$ doz. eggs at 32¢.
$5\frac{3}{4}$ lb. roast at 24¢.
$3\frac{1}{2}$ lb. lard at 18¢.

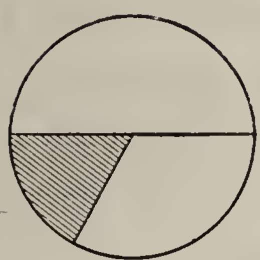
17.

$5\frac{1}{2}$ bu. apples at $1.20.
$10\frac{1}{4}$ bu. potatoes at 80¢.
$2\frac{1}{4}$ bu. turnips at 60¢.

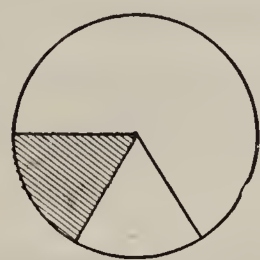
38. MULTIPLYING A FRACTION BY A FRACTION

We have seen that to multiply an integer by a fraction is to find a part of the integer. Likewise, to multiply a fraction by a fraction is to find a part of the fraction.

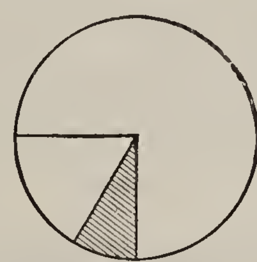
Exercises



$\frac{1}{3}$ of $\frac{1}{2} = \frac{1}{6}$



$\frac{1}{2}$ of $\frac{1}{3} = \frac{1}{6}$



$\frac{1}{3}$ of $\frac{1}{4} = \frac{1}{12}$

$\frac{1}{2}$ of $\frac{1}{6} = \frac{1}{12}$

1. Divide $\frac{1}{2}$ a circle by 3; that is, find $\frac{1}{3}$ of $\frac{1}{2}$ a circle.

Remember that to divide by 3 may mean to separate whatever is divided — a number, a whole thing, or a part of a thing — into 3 equal parts.

2. Observe in the circles what it is to divide $\frac{1}{3}$ by 2; $\frac{1}{4}$ by 3; $\frac{1}{6}$ by 2.

3. Draw rectangles to show $\frac{1}{2}$ of $\frac{1}{4} = \frac{1}{8}$. Show $\frac{1}{4}$ of $\frac{1}{2}$.

As in Exercise 3, *show:*

4. $\frac{1}{3}$ of $\frac{1}{4}$.	**7.** $\frac{1}{5}$ of $\frac{1}{2}$.	**10.** $\frac{1}{4}$ of $\frac{1}{4}$.
5. $\frac{1}{4}$ of $\frac{1}{3}$.	**8.** $\frac{1}{2}$ of $\frac{1}{6}$.	**11.** $\frac{1}{2}$ of $\frac{1}{8}$.
6. $\frac{1}{2}$ of $\frac{1}{5}$.	**9.** $\frac{1}{6}$ of $\frac{1}{2}$.	**12.** $\frac{1}{8}$ of $\frac{1}{2}$.

13. What does it mean to find $\frac{3}{4}$ of 8? $\frac{2}{5}$ of 10?

14. What is it to find $\frac{2}{3}$ of $\frac{4}{5}$ of a thing?

15. Find $\frac{2}{3}$ of $\frac{4}{5}$.

SUGGESTION. — $\frac{4}{5}$ divided into 3 equal parts; that is, $\frac{1}{3}$ of $\frac{4}{5}$ is $\frac{4}{15}$, for 5ths divided into 3 equal parts are 15ths. Now since $\frac{2}{3}$ of anything is 2 times $\frac{1}{3}$ of it, we are to take $2 \times \frac{4}{15}$, which are $\frac{8}{15}$.

Find:

16. $\frac{2}{3}$ of $\frac{1}{4}$.
17. $\frac{2}{3}$ of $\frac{3}{4}$.
18. $\frac{2}{3}$ of $\frac{5}{6}$.
19. $\frac{3}{4}$ of $\frac{2}{3}$.
20. $\frac{3}{4}$ of $\frac{1}{2}$.
21. $\frac{3}{4}$ of $\frac{1}{4}$.
22. $\frac{2}{3}$ of $\frac{3}{5}$.
23. $\frac{3}{5}$ of $\frac{2}{3}$.
24. $\frac{2}{3}$ of $\frac{4}{5}$.

Observe that:

> *The product of two or more fractions is a fraction whose numerator is the product of the numerators, and whose denominator is the product of the denominators of the fractions.*

Multiplication Shortened by Cancellation

If all factors common to both terms of the product are cancelled before multiplying, work is saved.

Thus, $8 \times \frac{3}{4} = \frac{\overset{2}{\cancel{8}} \times 3}{\cancel{4}} = 6.$ $\quad \frac{2}{3} \times 18 = \frac{2 \times \overset{6}{\cancel{18}}}{\cancel{3}} = 12.$

$$\frac{4}{5} \times \frac{15}{16} = \frac{\cancel{4} \times \overset{3}{\cancel{15}}}{\cancel{5} \times \underset{4}{\cancel{16}}} = \frac{3}{4}. \qquad \frac{8}{9} \times \frac{15}{32} = \frac{\cancel{8} \times \overset{5}{\cancel{15}}}{\underset{3}{\cancel{9}} \times \underset{4}{\cancel{32}}} = \frac{5}{12}.$$

Using cancellation as far as possible, find:

1. $15 \times \frac{2}{3}$.
2. $18 \times \frac{3}{4}$.
3. $35 \times \frac{4}{15}$.
4. $64 \times \frac{3}{16}$.
5. $56 \times \frac{5}{16}$.
6. $32 \times \frac{7}{16}$.
7. $42 \times \frac{7}{12}$.
8. $63 \times \frac{5}{18}$.
9. $26 \times \frac{7}{8}$.
10. $\frac{3}{8} \times 24$.
11. $\frac{5}{6} \times 18$.
12. $\frac{7}{8} \times 32$.
13. $\frac{5}{6} \times 16$.
14. $\frac{5}{9} \times 24$.
15. $\frac{3}{8} \times 42$.
16. $\frac{5}{7} \times 21$.
17. $\frac{5}{9} \times 21$.
18. $\frac{5}{12} \times 30$.
19. $\frac{5}{8} \times 90$.
20. $\frac{3}{4} \times \frac{8}{9}$.
21. $\frac{2}{3} \times \frac{15}{16}$.
22. $\frac{7}{8} \times \frac{10}{21}$.
23. $\frac{5}{6} \times \frac{14}{15}$.
24. $\frac{3}{8} \times \frac{4}{9}$.
25. $\frac{3}{8} \times \frac{8}{9}$.
26. $\frac{5}{8} \times \frac{7}{10}$.
27. $\frac{3}{16} \times \frac{8}{15}$.

28. $\frac{7}{16} \times \frac{4}{21}$.
29. $\frac{3}{5} \times \frac{4}{9}$.
30. $\frac{3}{8} \times \frac{16}{21}$.
31. $\frac{9}{16} \times \frac{4}{9}$.
32. $\frac{3}{7} \times \frac{14}{15}$.
33. $\frac{2}{9} \times \frac{21}{22}$.
34. $\frac{3}{5} \times \frac{20}{21}$.
35. $\frac{11}{16} \times \frac{4}{11}$.
36. $\frac{15}{16} \times \frac{2}{3}$.
37. $\frac{3}{5} \times \frac{5}{12}$.
38. $\frac{3}{4} \times \frac{24}{25}$.
39. $\frac{5}{9} \times 21$.
40. $\frac{7}{8} \times 36$.
41. $\frac{5}{7} \times 28$.
42. $\frac{3}{8} \times 42$.
43. $56 \times \frac{3}{14}$.
44. $64 \times \frac{7}{16}$.
45. $90 \times \frac{5}{18}$.
46. $84 \times \frac{5}{8}$.
47. $96 \times \frac{5}{36}$.
48. $108 \times \frac{5}{24}$.
49. $\frac{15}{16} \times \frac{44}{45}$.
50. $\frac{17}{18} \times \frac{27}{50}$.
51. $\frac{5}{18} \times \frac{45}{4}$.
52. $\frac{20}{21} \times \frac{35}{36}$.
53. $\frac{18}{25} \times \frac{35}{27}$.
54. $\frac{16}{11} \times \frac{33}{48}$.
55. $\frac{5}{9} \times \frac{81}{50}$.
56. $\frac{3}{7} \times \frac{56}{63}$.
57. $\frac{5}{9} \times \frac{27}{35}$.

39. MULTIPLYING A MIXED NUMBER BY A FRACTION OR BY ANOTHER MIXED NUMBER

We have seen that an improper fraction may be changed to a whole or mixed number. Likewise, by reversing the work, a whole or mixed number may be changed to an improper fraction.

$$\frac{13}{4} = 3\frac{1}{4}, \text{ so } 3\frac{1}{4} = \frac{13}{4}.$$

SOLUTION. — $1 = \frac{4}{4}$, and hence $3 = 3 \times \frac{4}{4} = \frac{12}{4}$. So $3\frac{1}{4} = \frac{12}{4} + \frac{1}{4} = \frac{13}{4}$.

In practice we multiply 3 by 4, add 1, and place the result over 4.

Exercises

1. Change $2\frac{3}{4}$ to an improper fraction.

Change to improper fractions and multiply:

2. $2\frac{2}{3} \times 1\frac{1}{4}$.
3. $2\frac{1}{4} \times 5\frac{1}{3}$.
4. $3\frac{7}{8} \times 5\frac{1}{2}$.
5. $1\frac{5}{6} \times 3\frac{1}{3}$.
6. $3\frac{1}{4} \times 2\frac{1}{2}$.
7. $7\frac{1}{8} \times 6\frac{1}{4}$.
8. $2\frac{1}{5} \times 3\frac{2}{3}$.
9. $1\frac{5}{6} \times 5\frac{1}{3}$.
10. $2\frac{1}{6} \times 5\frac{1}{2}$.
11. $1\frac{2}{3} \times 5\frac{3}{4}$.
12. $2\frac{1}{4} \times 5\frac{1}{3}$.
13. $6\frac{1}{2} \times 1\frac{7}{8}$.

Practical Problems in Multiplication

1. When sugar is $6\frac{1}{2}$¢ per pound, how much will $7\frac{1}{2}$ lb. cost?

2. There are $4\frac{3}{7}$ wk. in January. At the rate of $2\frac{1}{2}$ lb. of butter per week, how much will a family use during January?

3. For a week a farmer averaged plowing $2\frac{3}{4}$ acres per day. At this rate, how much can he plow in $11\frac{1}{2}$ days?

4. A man had a field of $12\frac{3}{4}$ acres. If the average yield of oats in the field was $42\frac{1}{2}$ bu. per acre, how much did the whole field yield?

5. A man uses 1 bu. 3 pk. of seed wheat per acre. How much will he need for a field of $14\frac{3}{4}$ acres?

6. When lard is $12\frac{1}{2}$¢ per pound, how much must your mother pay for $7\frac{1}{2}$ lb.?

7. A gallon of water weighs $8\frac{5}{16}$ lb. Find the weight of a barrel ($31\frac{1}{2}$ gal.) of water, including the barrel which weighs $50\frac{1}{2}$ lb.

8. A train averaged $46\frac{3}{4}$ mi. per hour for $26\frac{1}{2}$ hours. How far did it travel?

9. Find the cost of $68\frac{1}{4}$ lb. of wire at $6\frac{1}{4}$¢ per pound.

10. A butcher bought $350\frac{1}{2}$ lb. of lard at $9\frac{3}{8}$¢ per pound, and sold it at $12\frac{1}{2}$¢ per pound. Find the profit.

11. For $2\frac{3}{4}$ years Henry's average growth was $2\frac{1}{8}$ inches per year. How many inches did he grow during the $2\frac{3}{4}$ years?

12. For $3\frac{1}{4}$ years a boy's average increase in weight was $8\frac{3}{4}$ lb. per year. Find the total increase.

13. At the rate of $4\frac{3}{4}$ mi. per hour, how far could you row in $2\frac{1}{4}$ hours?

14. One year the yield of corn in a field was $26\frac{3}{4}$ bu. If better cultivation and proper fertilizing will give a yield $2\frac{1}{2}$ times as great, what will the yield then be?

Home Problems

Find the prices at your local meat market of the following:

Spring chicken	Sirloin steak
Roasting chicken	Porterhouse steak
Fowl	Round steak
Pork chops	Rib roast
Pork roast, loin	Lamb chops
Bacon	Loin of lamb
Ham	Leg of lamb

1. Find the cost of a spring chicken weighing $1\frac{3}{4}$ lb.; 2 lb.; $2\frac{1}{4}$ lb.; $2\frac{1}{2}$ lb.; 3 lb.

2. Find the cost of a roasting chicken weighing $3\frac{1}{2}$ lb.; $4\frac{1}{4}$ lb.; 5 lb.; $5\frac{3}{4}$ lb.

3. Find the cost of a porterhouse steak weighing $1\frac{1}{4}$ lb.; $1\frac{3}{4}$ lb.; 2 lb.; $2\frac{1}{2}$ lb.

4. Find the cost of a sirloin steak weighing $1\frac{3}{4}$ lb.; $2\frac{1}{4}$ lb.; $2\frac{3}{4}$ lb.; $3\frac{1}{4}$ lb.

5. Find the cost of $4\frac{1}{2}$ lb. of round steak; of $3\frac{1}{4}$ lb.; of $1\frac{1}{2}$ lb.

6. Find the cost of a pork roast weighing $2\frac{3}{4}$ lb.; $3\frac{1}{4}$ lb.; $4\frac{3}{4}$ lb.; $5\frac{1}{2}$ lb.

7. Suppose that a family of six ordered the following for dinners for one week, and find the cost:

Monday, a $3\frac{1}{2}$ lb. sirloin steak; Tuesday, a $5\frac{1}{4}$ lb. leg of lamb; Wednesday, $2\frac{1}{2}$ lb. of pork chops; Thursday, a $6\frac{1}{4}$ lb. rib roast; Friday, a $3\frac{1}{4}$ lb. fish at 22 ¢; Saturday, a 4 lb. loin of lamb roast; and Sunday, a $5\frac{3}{4}$ lb. roasting chicken.

Problems of a Grocery

Apples	pk.	$0.40	Oranges	doz.	$0.40
Butter	lb.	0.36	Peaches	$\frac{1}{2}$ pk.	0.30
Cabbage	lb.	0.04	Pickles	qt.	0.20
Cauliflower	hd.	0.20	Potatoes	pk.	0.36
Celery (3 bunches)		0.10	Rice	lb.	0.08
Coffee	lb.	0.38	Sugar	lb.	0.06
Eggs	doz.	0.32	Tomatoes	lb.	0.06
Flour	$24\frac{1}{2}$ lb.	0.70	Corn	doz.	0.15

Write out sales checks and receipts for the following:

1. $\frac{1}{2}$ pk. apples; $2\frac{1}{2}$ lb. butter; 2 hd. cauliflower; 1 pk. peaches.

2. $3\frac{1}{2}$ lb. head cabbage; 6 bunches celery; $1\frac{1}{2}$ doz. oranges; 1 pt. pickles; $1\frac{1}{2}$ doz. corn.

3. 1 sack flour; $1\frac{1}{2}$ doz. eggs; $1\frac{1}{2}$ lb. coffee; $5\frac{1}{2}$ lb. tomatoes; $2\frac{1}{2}$ doz. corn.

4. $\frac{1}{2}$ bu. peaches; $\frac{1}{2}$ pk. potatoes; $7\frac{1}{2}$ lb. sugar; $3\frac{1}{2}$ lb. rice.

5. $1\frac{3}{4}$ lb. butter; $\frac{1}{2}$ pk. apples; 2 hd. cauliflower; $1\frac{1}{2}$ doz. eggs.

6. 10 lb. tomatoes; $1\frac{1}{2}$ pk. potatoes; $1\frac{1}{2}$ pk. peaches; 9 oranges; $3\frac{1}{4}$ doz. corn.

7. $2\frac{1}{2}$ lb. coffee; 18 eggs; 3 pt. pickles; 1 lb. 8 oz. coffee.

8. $6\frac{1}{4}$ lb. head cabbage; 2 lb. 4 oz. rice; $\frac{3}{4}$ pk. potatoes.

9. $3\frac{1}{2}$ lb. butter; $2\frac{1}{2}$ doz. eggs; 5 lb. tomatoes; $5\frac{1}{2}$ lb. sugar.

10. 1 pk. peaches; $\frac{1}{2}$ pk. potatoes; 3 pt. pickles.

Problems on Market Reports

Fruits

Pears. — Best, \$1.25 per bu.

Apples. — Best, \$2.25; fair grades, \$1.50 per bbl.

Peaches. — Good, \$2 per bu.; fancy, \$2.50 per bu.

Grapes. — Concords, 25¢ per 10-lb. basket; Niagara, 25¢ per 10-lb. basket.

Cranberries. — \$6.75 per bbl.

Lemons. — California, \$4.50 per box.

Farm and Garden

Potatoes. — Michigan, 55¢ per bu.

Sweet Potatoes. — Jersey, \$1.40; Virginia, 85¢ per bu.

Cheese. — Full cream, Michigan, $10\frac{1}{2}$¢ per lb.

Eggs. — Regular receipts, 19¢; candled, $22\frac{1}{2}$¢ per doz.

Butter. — State creamery, 22¢; extra dairy, 17¢ per lb.

Vegetables. — New carrots, 45¢ per bu.; celery, 25¢ per doz.

From the market report shown above, find the cost of the following:

1. 365 bu. potatoes.

2. 12 cases, 30 doz. each, eggs, candled.

3. 378 10-lb. baskets Concord grapes.

4. 216 boxes California lemons.

5. 17 barrels cranberries. **7.** 48 bbl. best apples.

6. 34 bu. peaches, fancy. **8.** 53 bbl. apples, fair grade.

9. 17 barrels, $2\frac{1}{2}$ bu. each, sweet potatoes, Virginia.

10. How much more would the same quantity of Jersey sweet potatoes cost?

11. 97 lb. extra dairy butter. **12.** 54 bushels best pears.

13. 312 baskets of Niagara grapes.

14. 38 cases, 30 doz. each, eggs, regular receipts.

15. 19 full cream cheese, 14 lb. each.

16. 17 bu. new carrots and 36 doz. celery.

Problems of the Home

1. It takes Charles $2\frac{3}{4}$ hours to mow the lawn. At 12¢ per hour how much does he earn?

2. If he mows the lawn 8 times during the summer, how long does he spend at it in all? How much does he earn?

3. If John works for Mr. Smith $\frac{3}{4}$ hr. before school and $1\frac{1}{2}$ hr. after school, how many hours does he work during each school week (5 days)?

4. If he works $6\frac{1}{2}$ hours on Saturday, how many hours does he work for Mr. Smith during the week? At 12¢ per hour how much does he earn?

5. Mary's mother bought two spring chickens weighing $2\frac{1}{4}$ lb. each. How much did they cost at 22¢ a pound?

6. Lucile bought $4\frac{1}{4}$ yd. of linen at 45¢ a yard for a dress, and other material costing 85¢. Find the total cost.

7. If the dress (Problem 6) would have cost $ 6.50 when bought "ready-made," how much did Lucile save?

8. The material for two dresses (Problem 6) would have cost how much less than one "ready-made" dress?

9. If a dress requires $6\frac{3}{4}$ yards of 28-inch material costing 36¢ a yard, or $4\frac{1}{2}$ yards of 36-inch material costing 48¢ a yard, which will be cheaper and how much?

10. A family uses $2\frac{3}{4}$ lb. of butter a week. Find the cost at 32¢ a pound.

11. Robert's father uses $1\frac{3}{4}$ bu. of seed wheat for each acre. How much will he need for a 24-acre field?

12. Two families are going on a picnic. Find the total cost of the food if they take $9\frac{1}{2}$ lb. broiling chickens at 25¢ a pound; $1\frac{1}{2}$ doz. ears of green corn at 30¢ a dozen; 2 qt. potatoes at 6¢; 1 watermelon at 55¢; $1\frac{1}{2}$ loaves of bread at 10¢; $\frac{3}{4}$ lb. butter at 36¢; and $\frac{1}{2}$ lb. coffee at 42¢.

Problems of the Farm

1. A farmer put 12 bushels of potatoes in his cellar. If 4 bushels rotted, what part of them rotted?

2. A farmer contracted to give $\frac{2}{3}$ of the crop to a renter, who did all the work. In all, the farm produced 1632 bushels of corn. How many bushels should each receive?

3. If a renter is to get $\frac{5}{8}$ of a crop of potatoes for his work, how many bushels will the owner of the farm get from a crop of 248 bushels?

4. If $1\frac{1}{2}$ bushels of peas are needed to plant an acre, how much will the seed cost at $3.75 a bushel for a 10-acre field?

5. By improved methods of cultivation a farmer increased his yield of corn from 40 bushels per acre to 60 bushels. The increase was what fractional part of the former yield?

6. A farmer raised but 72 bushels of potatoes per acre. His neighbor, by spraying to cure blight, raised $2\frac{1}{2}$ times as many bushels per acre. How many bushels did the neighbor raise? Find the value of the increase at 60 cents a bushel.

7. Before draining a piece of land a farmer got $1\frac{1}{2}$ tons of marsh hay per acre, worth $4 per ton. After draining it he got 60 bushels of corn per acre, worth $42\frac{1}{2}$ cents per bushel. Find the increase upon a farm of 40 acres.

8. Mr. Smith raised 80 bushels of potatoes per acre upon a 10-acre field. By greater care in the selection of seed and by better cultivation he could have raised $1\frac{3}{4}$ times as many bushels. How many bushels could he have raised? At 50 cents a bushel, to how much would the increase have amounted?

9. One year a farmer received $5860, as the total income from his crops. If rotation of crops will increase this by $\frac{2}{5}$, how much will he then receive?

Problems of the Fish Market

Boneless herring per lb. .	20¢	Smoked sturgeon per lb. .	64¢
Salt whitefish per lb. . .	16¢	Smoked salmon per lb. .	40¢
Royal fat mackerel per lb.	25¢	Smoked whitefish per lb. .	20¢
Salt salmon per lb. . .	15¢	Smoked halibut per lb. .	32¢
Herring, 2 for	15¢	Whole codfish per lb. . .	$12\frac{1}{2}$¢

Above are the prices at which fish sold in a market one day. *Find the cost of:*

1. 2 lb. whole codfish.
2. 3 lb. 2 oz. salt whitefish.
3. 1 lb. 4 oz. smoked salmon.
4. 2 lb. 8 oz. boneless herring.
5. 12 oz. smoked sturgeon.
6. $3\frac{1}{4}$ lb. salt salmon.
7. $1\frac{1}{4}$ lb. smoked whitefish.
8. 2 lb. 10 oz. mackerel.
9. $\frac{1}{2}$ doz. herring.
10. 2 lb. 12 oz. smoked halibut.

Drill in Multiplication

See how quickly you can multiply:

1. $\frac{2}{3} \times \frac{6}{7}$.
2. $\frac{5}{9} \times \frac{21}{25}$.
3. $\frac{12}{16} \times \frac{4}{6}$.
4. $\frac{5}{12} \times \frac{8}{15}$.
5. $\frac{3}{4} \times \frac{14}{15}$.
6. $\frac{8}{9} \times \frac{6}{10}$.
7. $\frac{21}{25} \times \frac{10}{21}$.
8. $\frac{24}{35} \times \frac{21}{27}$.
9. $\frac{48}{25} \times \frac{15}{24}$.
10. $\frac{9}{16} \times \frac{20}{21}$.
11. $\frac{18}{25} \times \frac{5}{9}$.
12. $\frac{11}{12} \times \frac{14}{15}$.
13. $6 \times \frac{2}{3}$.
14. $8 \times \frac{3}{4}$.
15. $12 \times \frac{5}{6}$.
16. $24 \times \frac{2}{3}$.
17. $20 \times \frac{3}{4}$.
18. $48 \times \frac{3}{8}$.
19. $36 \times \frac{5}{6}$.
20. $7 \times \frac{1}{2}$.
21. $16 \times \frac{2}{3}$.
22. $8 \times \frac{2}{5}$.
23. $27 \times \frac{3}{4}$.
24. $15 \times \frac{7}{8}$.
25. $\frac{2}{3} \times 12$.
26. $\frac{5}{9} \times 27$.
27. $\frac{3}{5} \times 15$.
28. $\frac{7}{12} \times 36$.
29. $\frac{3}{8} \times 40$.
30. $\frac{7}{9} \times 36$.
31. $\frac{3}{10} \times 20$.
32. $\frac{7}{8} \times 48$.
33. $\frac{2}{7} \times 28$.
34. $\frac{3}{4} \times 15$.
35. $\frac{5}{8} \times 28$.
36. $\frac{7}{12} \times 20$.
37. $2\frac{1}{3} \times 1\frac{1}{2}$.
38. $6\frac{1}{2} \times 2\frac{3}{4}$.
39. $1\frac{1}{4} \times 8\frac{1}{3}$.
40. $6\frac{1}{3} \times 4\frac{1}{6}$.
41. $12\frac{1}{2} \times 18$.
42. $33\frac{1}{3} \times 24$.
43. $37\frac{1}{2} \times 56$.
44. $\frac{1}{2} \times 9\frac{1}{4}$.
45. $\frac{2}{3} \times 4\frac{1}{8}$.
46. $\frac{3}{8} \times 6\frac{1}{2}$.
47. $9\frac{3}{8} \times \frac{1}{4}$.
48. $4\frac{1}{6} \times 3\frac{3}{4}$.

40. DIVISION OF FRACTIONS

To divide 7 pk. by 2 qt. is to find how many times 7 pk. will contain 2 qt. 7 pk. ÷ 2 qt. = 56 qt. ÷ 2 qt. = 28.

It is evident that we cannot find the result by dividing 7 by 2, but that both dividend and divisor must be changed to *like units.* Then the result is found by dividing 56 by 2. The same principle is true, both with whole numbers and fractions :

> *When two numbers both represent the same kind of unit, one is divided by the other by dividing the number of units in one by the number of units in the other.*

Thus,

$$\$8 \div \$2 = 8 \div 2 = 4.$$
$$8 \text{ ft.} \div 2 \text{ ft.} = 8 \div 2 = 4.$$
$$\tfrac{8}{9} \div \tfrac{2}{9} = 8 \div 2 = 4.$$
$$\tfrac{10}{12} \div \tfrac{5}{12} = 10 \div 5 = 2.$$

At sight give the quotients:

1. $\frac{6}{7} \div \frac{2}{7}$.	**6.** $\frac{8}{9} \div \frac{4}{9}$.	**11.** $\frac{21}{7} \div \frac{3}{7}$.	**16.** $\frac{28}{5} \div \frac{4}{5}$.
2. $\frac{10}{12} \div \frac{5}{12}$.	**7.** $\frac{12}{5} \div \frac{3}{5}$.	**12.** $\frac{18}{5} \div \frac{3}{5}$.	**17.** $\frac{16}{15} \div \frac{2}{15}$.
3. $\frac{9}{11} \div \frac{3}{11}$.	**8.** $\frac{16}{7} \div \frac{2}{7}$.	**13.** $\frac{24}{3} \div \frac{2}{3}$.	**18.** $\frac{18}{22} \div \frac{6}{22}$.
4. $\frac{14}{16} \div \frac{7}{16}$.	**9.** $\frac{24}{16} \div \frac{3}{16}$.	**14.** $\frac{18}{11} \div \frac{9}{11}$.	**19.** $\frac{12}{17} \div \frac{4}{17}$.
5. $\frac{18}{8} \div \frac{3}{8}$.	**10.** $\frac{15}{12} \div \frac{5}{12}$.	**15.** $\frac{36}{8} \div \frac{3}{8}$.	**20.** $\frac{8}{17} \div \frac{4}{17}$.

41. DIVISION OF AN INTEGER BY A FRACTION

1. Divide 5 by $\frac{3}{4}$. Here 5 represents *ones* and 3 represents fourths. Since $1 = \frac{4}{4}$, then $5 = 5 \times \frac{4}{4} = \frac{20}{4}$; $\frac{20}{4} \div \frac{3}{4} = 20 \div 3 = 6\frac{2}{3}$.

Observe *that the integer was multiplied by the denominator of the fraction and the product divided by the numerator.*

> *To divide an integer by a fraction, multiply the integer by the divisor inverted; that is, with its terms interchanged.*

WORK

2. Divide 16 by $\frac{4}{5}$.

$$\overset{4}{\cancel{16}} \times \frac{5}{\cancel{4}} = 20.$$

3. $15 \div \frac{3}{4}$.	**6.** $16 \div \frac{4}{7}$.	**9.** $32 \div \frac{4}{5}$.	**12.** $42 \div \frac{7}{8}$.
4. $18 \div \frac{3}{8}$.	**7.** $20 \div \frac{5}{6}$.	**10.** $24 \div \frac{3}{8}$.	**13.** $35 \div \frac{5}{9}$.
5. $12 \div \frac{3}{4}$.	**8.** $28 \div \frac{4}{9}$.	**11.** $45 \div \frac{5}{6}$.	**14.** $40 \div \frac{5}{7}$.

15. Divide 3 by $\frac{4}{7}$. SOLUTION. — $3 \div \frac{4}{7} = 3 \times \frac{7}{4} = \frac{21}{4} = 5\frac{1}{4}$.

Find the quotient of:

16. $3 \div \frac{5}{8}$.	**21.** $7 \div \frac{2}{3}$.	**26.** $5 \div \frac{3}{16}$.	**31.** $18 \div \frac{6}{7}$.
17. $6 \div \frac{7}{8}$.	**22.** $9 \div \frac{4}{5}$.	**27.** $14 \div \frac{4}{5}$.	**32.** $15 \div \frac{9}{11}$.
18. $8 \div \frac{6}{7}$.	**23.** $5 \div \frac{3}{8}$.	**28.** $24 \div \frac{16}{11}$.	**33.** $14 \div \frac{2}{3}$.
19. $4 \div \frac{3}{5}$.	**24.** $9 \div \frac{6}{7}$.	**29.** $32 \div \frac{24}{7}$.	**34.** $10 \div \frac{4}{7}$.
20. $6 \div \frac{4}{5}$.	**25.** $8 \div \frac{6}{11}$.	**30.** $30 \div \frac{12}{13}$.	**35.** $11 \div \frac{3}{5}$.

Practical Problems in Division

1. Into how many pieces $\frac{3}{4}$ of a yard long can 24 yards of ribbon be cut?

2. If carpet is $\frac{3}{4}$ of a yard wide, how many strips are needed for a room 6 yards wide?

3. Some girls made fudge for a fair. They put $\frac{3}{8}$ of a pound in each 15¢ box. How many boxes did they need for 9 pounds of fudge?

4. How many cards $3\frac{1}{2}'' \times 5\frac{1}{3}''$ can be cut from a card $14'' \times 16''$?

5. From 10 yd. of ribbon, badges $\frac{1}{4}$ yd. long were cut. How many did it make?

42. THE DIVISION OF A FRACTION BY A FRACTION

1. Divide $\frac{2}{3}$ by $\frac{3}{4}$.

$$\frac{2}{3} \div \frac{3}{4} = \frac{2 \times 4}{3 \times 4} \div \frac{3 \times 3}{4 \times 3} = (2 \times 4) \div (3 \times 3) = 8 \div 9 = \frac{8}{9}.$$

Explanation. — To get like fractions we changed both fractions to 12ths. To do this both terms of the first fraction were multiplied by 4, the denominator of the second, and both terms of the second fraction by 3, the denominator of the first. We then divided the first numerator by the second, or $8 \div 9$. Since 8 is smaller than 9, the quotient is expressed by writing 8 over 9 as a fraction, $\frac{8}{9}$.

2. Divide $\frac{3}{4}$ by $\frac{2}{5}$.

I. What is the common unit or denominator?

II. By what must both terms of the first fraction be multiplied?

III. By what must both terms of the second be multiplied?

IV. What is the first numerator? The second? The quotient?

Observe that the product of the first numerator by the second denominator is divided by the product of the second numerator by the first denominator. The result is the same as that obtained by multiplying the dividend by the divisor inverted or with its terms interchanged. Hence:

> *To divide one fraction by another, we may invert the divisor and multiply.*

3. Divide $\frac{5}{6}$ by $\frac{2}{3}$.

WORK

$$\frac{5}{6} \div \frac{2}{3} = \frac{5}{\underset{2}{\cancel{6}}} \times \frac{\cancel{3}}{2} = \frac{5}{4} = 1\tfrac{1}{4}.$$

4. $\frac{3}{8} \div \frac{6}{7}$.
5. $\frac{5}{8} \div \frac{7}{16}$.
6. $\frac{3}{7} \div \frac{4}{5}$.
7. $\frac{5}{6} \div \frac{7}{8}$.
8. $\frac{3}{8} \div \frac{6}{5}$.
9. $\frac{11}{12} \div \frac{5}{6}$.
10. $\frac{3}{5} \div \frac{9}{10}$.
11. $\frac{2}{7} \div \frac{9}{14}$.
12. $\frac{5}{16} \div \frac{3}{4}$.

A Fraction divided by a Whole Number

1. Divide $\frac{2}{3}$ by 3. You already know that to divide a number by 3 is to find $\frac{1}{3}$ of it. Hence $\frac{2}{3} \div 3 = \frac{1}{3}$ of $\frac{2}{3} = \frac{2}{9}$.

Since $\frac{1}{3}$ may be considered 3 inverted, if we express 3 in fractional form as $\frac{3}{1}$, then:

> *To divide a fraction by a whole number, write the whole number in the form of a fraction, using one for the denominator, and proceed as in dividing a fraction by a fraction.*

2. $\frac{3}{4} \div 5$.	**5.** $\frac{7}{8} \div 10$.	**8.** $\frac{7}{8} \div 16$.	**11.** $\frac{8}{15} \div 24$.
3. $\frac{2}{3} \div 7$.	**6.** $\frac{5}{6} \div 15$.	**9.** $\frac{5}{9} \div 18$.	**12.** $\frac{7}{9} \div 21$.
4. $\frac{8}{9} \div 6$.	**7.** $\frac{3}{8} \div 24$.	**10.** $\frac{4}{5} \div 12$.	**13.** $\frac{16}{5} \div 24$.

14. If a boy can mow $\frac{2}{3}$ of a lawn in 4 hours, what part of it can he mow in 1 hour?

15. If a rapid-firing gun can fire 8 shots in $\frac{4}{5}$ of a minute, what part of a minute is that per shot?

43. DIVIDING ANY NUMBER BY ANY OTHER NUMBER

Since any number may be written in the form of a fraction, all numbers may be divided by the method used in the preceding sections. That is,

> *To divide one number by another, express both in the form of fractions and multiply the dividend by the divisor inverted.*

Drill Exercises

1. $\frac{2}{3} \div \frac{5}{6}$.
2. $\frac{3}{4} \div \frac{5}{8}$.
3. $\frac{2}{3} \div \frac{2}{9}$.
4. $\frac{3}{4} \div \frac{3}{16}$.
5. $\frac{7}{8} \div \frac{3}{16}$.
6. $\frac{3}{4} \div \frac{1}{2}$.
7. $\frac{7}{8} \div \frac{3}{4}$.
8. $\frac{5}{6} \div \frac{1}{3}$.
9. $\frac{7}{8} \div \frac{1}{4}$.
10. $\frac{11}{12} \div \frac{2}{3}$.
11. $\frac{7}{12} \div \frac{3}{4}$.
12. $\frac{15}{16} \div \frac{3}{8}$.
13. $\frac{11}{14} \div \frac{3}{7}$.
14. $\frac{2}{3} \div \frac{3}{4}$.
15. $\frac{2}{3} \div \frac{4}{5}$.
16. $\frac{3}{4} \div \frac{2}{3}$.
17. $\frac{2}{3} \div \frac{1}{9}$.
18. $\frac{3}{4} \div \frac{1}{16}$.
19. $\frac{5}{6} \div \frac{7}{12}$.
20. $\frac{7}{8} \div \frac{5}{12}$.
21. $2\frac{1}{2} \div \frac{1}{2}$.
22. $3\frac{1}{3} \div \frac{1}{6}$.
23. $5\frac{1}{4} \div \frac{1}{8}$.
24. $6\frac{3}{4} \div \frac{5}{8}$.
25. $\frac{3}{8} \div \frac{5}{6}$.
26. $\frac{3}{8} \div \frac{3}{4}$.
27. $\frac{3}{4} \div \frac{3}{8}$.
28. $\frac{5}{12} \div \frac{3}{4}$.
29. $\frac{7}{12} \div \frac{2}{3}$.
30. $\frac{5}{8} \div \frac{11}{12}$.
31. $2\frac{1}{3} \div \frac{3}{4}$.
32. $5\frac{1}{4} \div \frac{2}{3}$.
33. $3\frac{1}{3} \div \frac{3}{4}$.
34. $7\frac{5}{8} \div \frac{3}{4}$.
35. $8\frac{5}{6} \div \frac{3}{8}$.
36. $\frac{3}{4} \div 2\frac{1}{2}$.
37. $\frac{4}{5} \div 2\frac{1}{3}$.
38. $\frac{3}{8} \div 2\frac{1}{2}$.
39. $\frac{3}{16} \div 3\frac{1}{3}$.
40. $12\frac{1}{2} \div 6\frac{1}{4}$.
41. $2\frac{2}{3} \div 1\frac{1}{2}$.
42. $5\frac{1}{4} \div 2\frac{1}{2}$.
43. $6\frac{2}{3} \div 1\frac{1}{2}$.
44. $7\frac{3}{4} \div 5\frac{2}{3}$.
45. $1\frac{2}{5} \div 2$.
46. $2\frac{3}{4} \div 7\frac{1}{2}$.
47. $6\frac{3}{8} \div 2\frac{1}{4}$.
48. $3\frac{2}{3} \div 1\frac{1}{4}$.
49. $12\frac{1}{2} \div 2\frac{2}{3}$.
50. $24\frac{1}{2} \div 3\frac{1}{4}$.
51. $17\frac{1}{2} \div 6\frac{1}{4}$.
52. $16\frac{2}{3} \div 5$.
53. $26 \div 3\frac{1}{2}$.
54. $42 \div 6\frac{2}{3}$.
55. $16 \div 3\frac{3}{4}$.
56. $26 \div 8\frac{1}{3}$.
57. $42 \div 3\frac{1}{2}$.
58. $3\frac{1}{2} \div 6\frac{2}{3}$.
59. $2\frac{1}{4} \div 8\frac{1}{3}$.
60. $1\frac{2}{3} \div 2\frac{1}{4}$.
61. $\frac{3}{4} \div 1\frac{7}{8}$.
62. $2\frac{1}{12} \div 3\frac{5}{6}$.
63. $\frac{7}{12} \div \frac{2}{3}$.
64. $8 \div 9\frac{1}{2}$.
65. $9\frac{1}{2} \div 8$.
66. $6\frac{3}{4} \div 2\frac{5}{8}$.

Practical Problems in Division

1. How many ribbons, each $1\frac{1}{4}$ yd. long, can be made from a piece $12\frac{1}{2}$ yd. long?

Solution. — $12\frac{1}{2}$ yd. $\div$ $1\frac{1}{4}$ yd. $= \frac{25}{2} \div \frac{5}{4} = \frac{\overset{5}{\cancel{25}}}{\cancel{2}} \times \frac{\overset{2}{\cancel{4}}}{\cancel{5}} = 10.$

Note. — When both numbers are concrete, the quotient is abstract, and only the abstract fractions are used in the division.

2. How many badges, each $\frac{1}{2}$ ft. long, can be made from a piece of ribbon $6\frac{1}{2}$ ft. long?

3. How many pieces of ribbon, each $\frac{2}{3}$ yd. long, can be cut from a piece $5\frac{1}{3}$ yd. long?

4. Sydney grew $4\frac{1}{4}$ inches in $2\frac{1}{2}$ yr. What was the average growth per year?

5. Just $3\frac{1}{2}$ years ago Ralph weighed $48\frac{1}{2}$ pounds. Now he weighs $71\frac{1}{4}$. Find the average growth per year.

6. A girl read 60 pages of her story book in $3\frac{1}{2}$ hours. What was the average number of pages read per hour?

7. Upon a test plot of $5\frac{3}{4}$ acres a man raised 325 bushels of wheat. What was the average yield per acre?

8. From a large jar holding $15\frac{3}{4}$ quarts of grape juice a woman filled $1\frac{1}{2}$ dozen bottles of equal size. How much did each bottle hold?

9. George has a garden plot $12\frac{1}{2}$ feet wide and $15\frac{3}{4}$ feet long. By a line through the center each way he wishes to divide it into four equal rectangular plots. What will be the length and width of each?

10. If a line $8\frac{3}{4}$ feet long is divided into four equal pieces, what is the length of each piece?

11. Wall paper is $1\frac{1}{2}$ ft. wide. How many strips are needed for a wall 18 ft. long?

12. Brussels carpet is $\frac{3}{4}$ yd. wide. How many strips are needed for a room 15 feet wide?

13. A strip of paper $18\frac{1}{2}$ inches long and 4 inches wide is to be cut into cards $2\frac{5}{16}$ inches long and 2 inches wide for tickets. How many will it make?

14. If it takes $3\frac{1}{2}$ yd. for an apron, how many can be cut from $10\frac{1}{2}$ yd. of material? From $38\frac{1}{2}$ yd.?

15. If $2\frac{1}{4}$ yd. of toweling is used for a roller towel, how many can be made from a bolt of toweling containing $56\frac{1}{4}$ yd.?

16. How many widths for ruffling can be cut from $2\frac{7}{8}$ yd., if each piece is $4\frac{1}{2}$ inches wide?

17. If $1\frac{1}{8}$ yd. of cambric is needed for a child's waist, how many can be cut from a piece containing $12\frac{1}{2}$ yd.?

18. A bolt of cheesecloth containing $46\frac{1}{2}$ yd. is to be cut into dusters, each $\frac{3}{4}$ yd. long. How many will it make? At 8¢ per yard, how much will each duster cost?

19. If it takes $\frac{3}{4}$ yd. of denim for a laundry bag, how many can be made from a piece $11\frac{1}{4}$ yd. long?

20. In a school the girls made aprons, each requiring $2\frac{5}{8}$ yd., from a piece of goods containing 42 yd. How many did they make?

21. If it takes $3\frac{1}{2}$ yd. of cloth for a skirt, how many skirts can be cut from a piece of cloth containing 46 yd.?

22. A man has a crop of 400 bushels of potatoes which he wishes to ship in $2\frac{1}{2}$ bushel barrels. How many barrels will he need?

23. If posts are set $8\frac{1}{2}$ feet apart, how many will be needed for a grape arbor $110\frac{1}{2}$ feet long? (Draw a diagram and show that you will need one more post than the quotient you get from division.)

44. THE RATIO OF TWO NUMBERS

The **ratio** of two numbers is the quotient of the first divided by the second.

The ratio of 6 to 3 is 2, for $6 \div 3 = 2$.

The ratio of 3 to 6 is $\frac{1}{2}$, for $3 \div 6 = \frac{3}{6} = \frac{1}{2}$.

By the use of fractions the ratio of any two numbers can be expressed.

The ratio of $2\frac{1}{2}$ to $5\frac{1}{4} = 2\frac{1}{2} \div 5\frac{1}{4} = \frac{5}{\cancel{2}} \times \frac{\overset{2}{\cancel{4}}}{21} = \frac{10}{21}$.

By being able to see the ratio of what is wanted to what is given in a problem, time may often be saved in the solution.

Problems

1. If 8 barrels of apples cost \$27.20, how much will 6 barrels cost at the same rate?

SOLUTION. — Since 6 is $\frac{3}{4}$ of 8, 6 bbl. will cost $\frac{3}{4}$ as much as 8 bbl.

$\frac{3}{4} \times \$\overset{6.80}{\cancel{27.20}} = \$20.40$.

2. If 12 acres produce 576 bushels of wheat, how much will 8 acres produce at the same rate?

Show why $\frac{2}{3} \times 576$ bu. is the answer required.

3. Mr. Brown has a herd of 18 cows and gets an average of 375 pounds of milk daily. How much will he get from 12 of the cows, if they give the same average?

4. If it takes 18 days to plow a field containing 63 acres, how long will it take to plow one containing only 28 acres?

5. If 10 lb. of butter will last a family $2\frac{1}{2}$ wk., how many pounds will they need for $7\frac{1}{2}$ wk.?

6. A boy received \$8.40 for 24 squabs. How much would he get for 18 at the same rate?

Drill Exercises in Ratio

Give the ratios:

1. 8 to 2; 2 to 8.
2. 12 to 4; 4 to 12.
3. 10 to 5; 5 to 10.
4. 16 to 4; 4 to 16.
5. 18 to 6; 6 to 18.
6. 20 to 4; 4 to 20.
7. 14 to 7; 7 to 14.
8. 24 to 6; 6 to 24.
9. 32 to 8; 8 to 32.
10. 28 to 7; 7 to 28.
11. 3 to 5; 5 to 3.
12. 4 to 9; 9 to 4.
13. 5 to 11; 11 to 5.
14. 6 to 15; 15 to 6.
15. 5 to 12; 12 to 5.
16. 8 to 20; 20 to 8.
17. 6 to 25; 25 to 6.
18. 7 to 12; 12 to 7.
19. 8 to 13; 13 to 8.
20. 9 to 15; 15 to 9.
21. What is the ratio of $\frac{1}{2}$ lb. to $\frac{1}{4}$ lb.?

SOLUTION. — Since $\frac{1}{2} \div \frac{1}{4} = 2$, the ratio is 2.

22. What is the ratio of $\frac{1}{4}$ lb. to $\frac{1}{2}$ lb.?

Give the ratios:

23. $\frac{1}{3}$ to $\frac{1}{6}$; $\frac{1}{6}$ to $\frac{1}{3}$.
24. $\frac{1}{2}$ to $\frac{1}{8}$; $\frac{1}{8}$ to $\frac{1}{2}$.
25. $\frac{1}{4}$ to $\frac{1}{12}$; $\frac{1}{12}$ to $\frac{1}{4}$.
26. $\frac{1}{3}$ to $\frac{1}{9}$; $\frac{1}{9}$ to $\frac{1}{3}$.
27. $\frac{1}{4}$ to $\frac{1}{16}$; $\frac{1}{16}$ to $\frac{1}{4}$.
28. $\frac{1}{6}$ to $\frac{1}{12}$; $\frac{1}{12}$ to $\frac{1}{6}$.
29. $\frac{3}{8}$ to $\frac{5}{4}$; $\frac{5}{4}$ to $\frac{3}{8}$.
30. $\frac{3}{8}$ to $\frac{7}{16}$; $\frac{7}{16}$ to $\frac{3}{8}$.
31. $\frac{4}{5}$ to $\frac{3}{10}$; $\frac{3}{10}$ to $\frac{4}{5}$.
32. $\frac{3}{4}$ to $\frac{11}{16}$; $\frac{11}{16}$ to $\frac{3}{4}$.
33. $\frac{5}{9}$ to $\frac{2}{3}$; $\frac{2}{3}$ to $\frac{5}{9}$.
34. $\frac{5}{8}$ to $\frac{3}{16}$; $\frac{3}{16}$ to $\frac{5}{8}$.

Practical Use of Simple Ratios

1. If a $5\frac{1}{2}$-lb. roast costs \$1.21, how much will an **11-lb.** roast cost at the same rate?

SUGGESTION. — Since 11 lb. is just twice as much as $5\frac{1}{2}$ lb., the cost will be twice as much.

2. At 40 cents a pound, how much will 4 ounces of spices cost? (Compare 4 and 16.)

3. When $\frac{1}{2}$ yd. of ribbon costs 18 cents, how much should $\frac{1}{4}$ yd. cost? (Compare $\frac{1}{4}$ and $\frac{1}{2}$.)

4. When $\frac{1}{2}$ pound of tea is worth 40¢, how much shall I pay for $\frac{1}{4}$ pound?

5. When $\frac{1}{4}$ bushel of potatoes is worth 20¢, how much shall I pay for $\frac{1}{2}$ bushel? (Compare $\frac{1}{2}$ and $\frac{1}{4}$.)

6. When $\frac{1}{2}$ acre yields 10 bushels of wheat, what should $\frac{1}{4}$ acre yield?

7. When $\frac{1}{4}$ barrel of flour weighs 49 pounds, what will $\frac{1}{2}$ barrel weigh?

8. When 5 things cost $8, how much will 10 of the same kind cost? How much will 15 cost?

9. When I can buy 6 large marbles for 25¢, how much shall I have to pay for 12? For 24?

10. A farmer had 18 calves. He sold 6 for $90. At this rate, what sum should he receive for the other 12?

11. 3 collars for 25¢ makes 6 cost how much? 9 will cost how much? What is the price per dozen?

12. 32¢ per peck is how much per bushel? How much per quart?

13. I have 5 acres of beans in one field and 15 in another. If I gather 98 bushels from the small field, how many bushels shall I expect from the larger?

14. If I get 285 bushels from the 15-acre field, how many shall I expect to get from the 5-acre field?

15. When 4 cords of wood cost $23.40, what sum shall I have to pay for 24 cords?

16. When $\frac{1}{4}$ ton of coal is worth \$1.75, how much must I pay for $\frac{1}{2}$ ton? How much for 1 ton?

17. When $\frac{3}{8}$ of a farm is worth \$3200, how much is $\frac{3}{4}$ of it worth? ($\frac{3}{4}$ is how many times as large as $\frac{3}{8}$?)

18. A farmer sold 60 bushels of potatoes. This was $\frac{3}{4}$ of all he raised. How many did he keep?

19. When peaches are 75¢ per peck, what will 6 bushels cost?

20. When a 30-lb. cheese is worth \$3.60, how much will a 10-lb. cheese cost? Find from your answer the cost of a 20-lb. cheese. The cost of a 50-lb. cheese.

IV. MENSURATION

45. LINEAR OR LENGTH MEASURE

1. How wide is your book? How long is it? What *unit of measure* did you use in answering these questions?

2. How long is your schoolroom? How wide is it? What unit of measure did you use in answering these questions?

3. What unit of measure do you use in asking for cloth, braid, or ribbon at a dry goods store?

4. How many inches in a foot? Feet in a yard?

5. Take a strong cord and measure off $16\frac{1}{2}$ ft. on it. This makes another kind of unit used in measuring larger distances, as the length of a field. It is called a **rod**.

6. Estimate a rod on the floor, then measure it. Was your estimate correct?

7. How many steps do you take in walking one rod? (Try it and count them.)

8. Step off 2 rods; 4 rods; 10 rods.

9. If you are asked the distance between two cities or the length of a state, you use a longer unit called **miles**. Do you know some place 1 mile away? 320 rods make one mile. How many of your steps make one mile? Step off one mile when you take a long walk.

Remember the following table of length measure:

12 inches (in. or ″)	**= 1 foot (ft. or ′)**
3 feet	**= 1 yard (yd.)**
16½ feet or 5½ yards	**= 1 rod (rd.)**
320 rods	**= 1 mile (mi.)**

Exercises in Length Measure

1. How many inches in a yard? In 12 yards?

2. How many feet in a mile?

3. How many yards in a mile?

4. How many rods in a mile?

5. Estimate the length of your blackboard in feet. Then measure it and see how nearly accurate your judgment is.

6. Estimate, then measure the length of your schoolroom in feet.

7. Estimate and then measure the length of your schoolroom in rods.

8. Estimate and then measure the length of your school grounds in rods.

9. Estimate, then measure the length of the block upon which your school building stands, in yards; in rods.

10. Estimate 10 rods out of doors, then measure it. How nearly did you estimate?

Note. — Have pupils estimate both short and long distances as suggested above, to develop accuracy in judgment of distance.

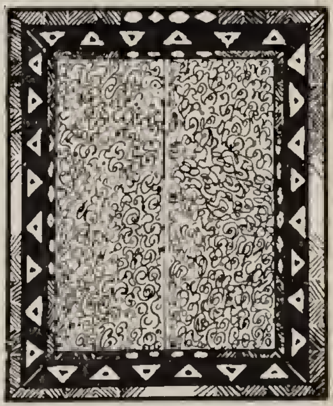
11. The doctor directs a convalescent to walk $\frac{1}{4}$ of a mile on the porch every day. The porch is 40 feet in length. How many times must the man walk across the porch to fulfill the doctor's directions?

12. If the promenade deck of an ocean liner allows passengers to walk 160′, how much more than $\frac{1}{2}$ of a mile did Mr. Jones walk on Wednesday, if he crossed the deck 18 times?

13. The best walker on board crossed the 160-foot deck 40 times. Is that farther than from your house to school? Is it more or less than a mile? How much?

14. An aviator reached an altitude of 6000 feet in his flying machine. Was that more or less than a mile, and how much?

15. Mrs. Johnson bought 4 yards of Brussels carpet, which was 27 inches wide. She had it cut into two pieces of equal length, which were then placed side by side and stitched together to make a rug. To all four sides of this was added a border 12 inches wide, as in the picture. Find the length and width of the completed rug in inches. In feet.



16. The corners of the border were mitered, as in the picture. How many feet of border were used? How many yards? (Find sum of the four sides of the rug.)

17. The carpet cost \$1.50 a yard and the border 65¢ a yard. Find the cost of all material for the rug. Allowing \$2 for making, find the entire cost of the rug.

18. The distance around a square field is $746\frac{1}{2}$ feet. How long is one side?

19. If the average length of a person's step is 30 inches, how many steps will he take in going $\frac{1}{2}$ of a mile?

20. If a man takes 6 steps to the rod, how many is that to the mile?

21. A field is $42\frac{3}{4}$ rd. wide and $45\frac{1}{2}$ rd. long. How many rods of fence will be needed to go around it?

22. Since there are $5\frac{1}{2}$ yd. in 1 rod, how many yards in Ralph's kite string if it is 20 rods long? How many feet?

23. How many feet does an athlete run in making the 40-yard dash? The 220-yard dash?

24. At a field-day contest John Windsor won the running high jump, jumping 54 inches. How many feet was that?

25. In measuring off the distance for the 220-yard dash, some boys used a string 1 rod long. How many times did they apply it?

26. How many times would they have to apply the string to measure off the distance for the 880-yard run?

27. The 1-mile run is how many times as long as the 220-yard dash?

28. The 880-yard run is what part of a mile?

29. A farmer, in draining a field, dug a ditch and laid tiles in it end to end. The ditch was 40 rd. long, and each tile 16 inches long. How many tiles did it take? (Change the 40 rd. to inches.)

30. How many such tiles would it take for a ditch 96 rd. long?

31. How many rods of drainage would 1000 such tiles make? (How many inches in 1 rd.?)

46. THE MEASURE OF SURFACES

1. Draw a square inch upon cardboard. How many such squares will cover a surface 3 inches wide and 4 inches long?

2. Upon the blackboard draw a square foot.

3. Cut a square foot from a piece of paper. How many such squares will cover a surface on the floor 3 feet wide and 5 feet long?

4. Draw a square yard upon the blackboard.

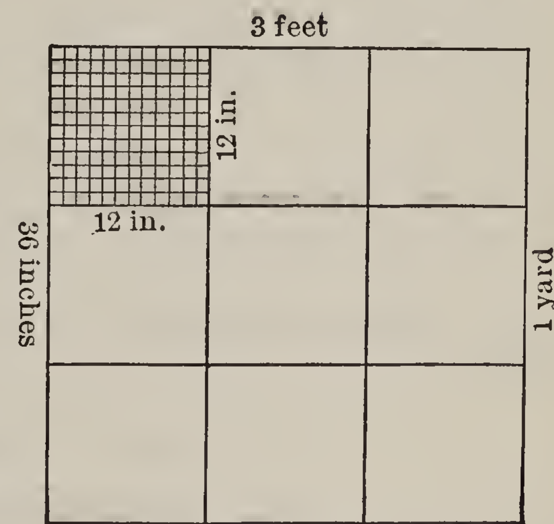
5. How many square yards of paper will cover a surface of the wall 2 yards wide and 4 yards long?

> *In measuring surfaces, as walls, floors, fields, etc., the unit is a square of some size and we call the measure square measure.*

6. Draw a square foot upon the blackboard. Divide it into square inches. How many?

7. Draw a square yard upon the blackboard. Divide it into square feet. How many?

8. On the floor of your schoolroom or upon the playground draw a square rod. 160 such squares make 1 **acre**, a unit used in measuring land.



Scale $\frac{1}{24}$. One square yard

9. How long is a square rod in feet?

10. How long is the perimeter of a square rod?

Remember the following table of square measure:

144 square inches (sq. in.)	=	**1 square foot (sq. ft.)**
9 square feet (sq. ft.)	=	**1 square yard (sq. yd.)**
$30\frac{1}{4}$ square yards (sq. yd.)	=	**1 square rod (sq. rd.)**
160 square rods (sq. rd.)	=	**1 acre (A.)**

Problems in Square and Linear Measure

1. Draw a rectangle 3 inches wide and 4 inches long.

2. Divide it into rectangles 1 inch wide and 4 inches long.

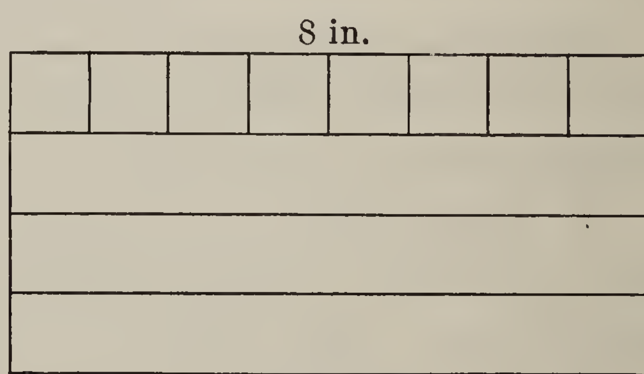
3. How many square inches in one of these rectangles?

4. How many square inches in the whole rectangle?

Draw on a "scale of $\frac{1}{4}$," that is, represent an inch by $\frac{1}{4}$ of an inch, and find the area of rectangles with these dimensions:

5. 8 inches long and 4 inches wide.

Suggestion. — This may be divided into 4 strips 8 inches long and 1 inch wide, each containing —— sq. in. The area then is equal to 4 × 8 sq. in., or 32 sq. in. In what other way could you have divided it?



Scale $\frac{1}{4}$

6. 12 in. long and 5 in. wide.

7. 9 in. long and 7 in. wide.

8. 16 in. long and 12 in. wide.

9. 10 in. long and 7 in. wide.

10. 12 in. long and 8 in. wide.

11. 18 in. long and 4 in. wide.

12. How many square feet are there in the floor of a room 16 feet long and 12 feet wide?

13. How many square inches are there in a yard of ribbon 3 inches wide?

14. How many square yards of carpet will be needed for a room 18 feet long and 15 feet wide?

15. How many square feet are there in the top of a table $7\frac{1}{2}$ feet long and 4 feet wide?

16. A man concreted the sidewalk in front of his house at a cost of $0.75 per square yard. The walk is 9 feet wide and 42 feet long. What did it cost him?

17. How many square feet in the floor of your schoolroom? At 15¢ a square foot, how much would a new floor cost?

18. How many square feet in the ceiling? At 25¢ per square foot, how much will a metal ceiling cost?

19. How many square feet of wire netting are needed for the four sides of a chicken coop 4 feet wide and 8 feet long, if it is 2 feet high?

20. Carrie cut strips 9 in. by 18 in. from a strip of muslin 18 in. wide and $2\frac{1}{2}$ yd. long. How many did she cut?

21. Find the number of acres in a field 40 rods square, and also in one 32 rods by 50 rods. Which requires more fencing and how much?

22. How many tiles 1 inch square are needed for a bathroom floor 8 feet by 10 feet?

23. At $12\frac{1}{2}$¢ per square foot, how much will a concrete walk $40''$ wide and $65'$ long cost?

Exercises in the Cutting of Cards and Paper

1. A sheet of cardboard is $22''$ by $28''$. How many cards measuring $4''$ by $3\frac{1}{2}''$ may be cut from it with the least possible waste? How many square inches of the sheet will be wasted?

SOLUTION. — Draw a diagram of a rectangle $22''$ by $28''$. Lay off the $28''$ into $4''$ parts. Then there could be 7 strips $4'' \times 22''$. Now lay off the $22''$ into parts $3\frac{1}{2}''$ long. There can be 6 of them and $1''$ waste. Hence, there can be 7×6 or 42 cards and a waste of a strip $1''$ by $28''$, or 28 sq. in.

A SECOND SOLUTION. — Draw a diagram and lay off the $28''$ into $3\frac{1}{2}''$ strips. There will be 8 of them and no waste. Lay off a $4''$ piece on each strip. There will be 5 of them and $2''$ waste. There can be 8×5 or 40 cards and a waste of a strip $2'' \times 28''$, or 56 sq. in. Hence the first way is the better, for it gives 42 cards.

2. How many cards $5''$ by $7''$ may be cut from a sheet of the same size? How many square inches of the sheet will be wasted?

3. How many cards $3''$ by $9''$ may be cut from a sheet of the same size? How much is wasted?

4. If a sheet of blotting paper measures $19''$ by $24''$, how many individual blotters measuring $3\frac{1}{2}''$ by $8''$ may be cut from it? How many square inches of the surface of the blotter are wasted? (Draw a diagram.)

5. From a sheet of the same size, how many blotters $3''$ by $8''$ may be cut without any waste? (Diagram.)

6. Demy paper measures $15\frac{1}{2}''$ by $18\frac{1}{2}''$. How many sheets of letter paper measuring $7\frac{3}{4}''$ by $9\frac{1}{4}''$ can be cut from a single demy sheet? (Diagram.)

7. From a sheet of cardboard 22 inches by 28 inches, how many cards $3\frac{2}{3}$ inches by 4 inches can be cut so that there is no waste?

8. Can cards $5\frac{1}{2}$ inches by 7 inches be cut from a sheet 22 inches by 28 inches without waste? How many?

9. From a sheet of blotting paper 18 inches by 24 inches, how many small blotters $4\frac{1}{2}$ inches by 8 inches can be cut?

10. From the same sheet how many blotters $2\frac{1}{4}$ inches by 4 inches can be cut?

11. How much is wasted by cutting from the same sheet blotters $4\frac{1}{2}$ inches by $5\frac{3}{4}$ inches?

12. Demy paper measures $15\frac{1}{2}$ inches by $18\frac{1}{2}$ inches. Cutting crosswise and then lengthwise, we make 4 equal sheets. What are the dimensions of each sheet?

13. A sheet of medium paper 18 inches by 22 inches is cut into 12 equal sheets by cutting twice lengthwise and three times crosswise. What is the size of each small sheet?

14. A printer has an order for 60,000 circulars, each $6\frac{1}{2}''$ by $4\frac{1}{4}''$. How many sheets of folio paper $17''$ by $22''$ will he need?

SOLUTION. — $17 \div 4\frac{1}{4} = 4$; $22 \div 6\frac{1}{2} = 3$ and $\frac{1}{2}$ remaining. Hence it is seen by drawing a diagram that there can be 12 circulars from each sheet and the waste on each sheet will be a strip $\frac{1}{2}''$ by $17''$, or $8\frac{1}{2}$ sq. in.

$17 \div 6\frac{1}{2} = 2$ and 4 remaining. $22 \div 4\frac{1}{4} = 5$ and $\frac{3}{4}$ remaining. So in this case but 10 circulars can be cut and the waste is much greater.

$60{,}000 \div 12 = 5000$. Hence 5000 sheets of folio paper are needed.

15. If 50,000 circulars $7''$ by $3\frac{1}{4}''$ are to be made from flat cap paper $14''$ by $17''$, how many sheets will be needed? How much of each sheet will be wasted?

16. A walk 150 feet long and 6 feet wide is to be laid with tiles 8 inches square. How many tiles in a row? How many rows will it take? Then how many tiles will be needed?

17. A hearth 8 feet long and 1 ft. 8 inches wide is to be laid with brick 8 inches by 4 inches. Laying the length of the brick with the length of the hearth, how many bricks in a row? How many rows? How many bricks?

47. THE MEASURE OF VOLUMES

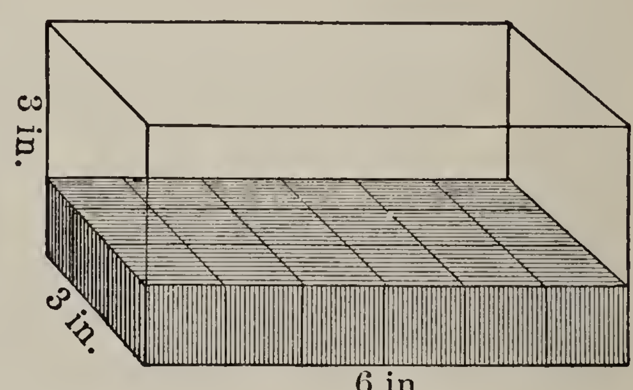
1. How many one-inch cubes will fill a box 2 inches wide, 4 inches long, and 3 inches deep?

2. Make a framework for a cubic foot and cover with paper. How many of these will fill a box 3 feet wide, 3 feet long, and 2 feet deep?

3. Make a framework and cover a cubic yard. How many will fill a room 3 yards wide, 3 yards long, and 4 yards high?

4. How many cubic inches in the bottom layer of this rectangular solid? How many such layers?

Then there are 3×18 cubic inches in the whole solid, and we say the **volume** is 54 *cubic inches*.



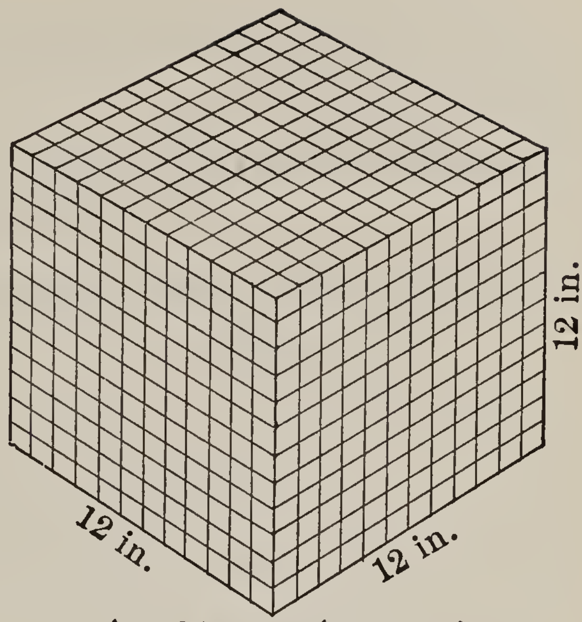
Scale $\frac{1}{4}$

> *In finding the volume of a rectangular solid, first find the number of cubes in one layer, then the number of layers, and then the total number of cubes.*

5. How many cubic inches in one layer of a 12-inch cube? How many layers? Then how many cubic inches in a **cubic foot**?

6. 2 cu. ft. = —— cu. in.

7. Suppose you should separate a cubic foot into halves, how many cubic inches in each half? In $\frac{1}{4}$ of a cubic foot how many cubic inches?



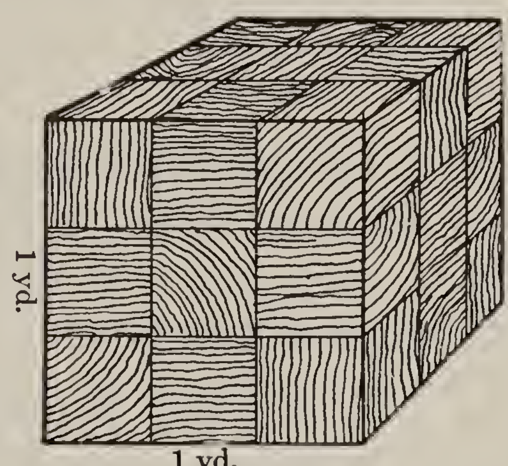
A cubic foot (Scale $\frac{1}{12}$)

8. If you should divide a foot cube into 8 equal cubes, how many cubic inches would each one of them contain?

9. How many cubical blocks, each a foot long, would be needed for a pile 8 ft. long, 7 ft. wide, and 3 ft. high?

10. How many cubic feet will fill a box 1 yard long, 1 yard wide, and 1 yard deep? Then how many cubic feet in a cubic yard?

11. How many cubic feet in 2 cubic yards? How many in 8 cubic yards?



Scale $\frac{1}{36}$

> *In measuring the volumes or capacities of rooms, boxes, bins, etc., the unit is a cube of some size, and we call the measure cubic measure.*

12. Give the volume of a coal bin 10 feet long, 10 feet wide, and 6 feet deep.

13. Give the volume of a room 5 yards wide, 6 yards long, and 3 yards high.

Remember the following table of cubic measure:

1728 cubic inches (cu. in.)	=	1 cubic foot (cu. ft.)
27 cubic feet	=	1 cubic yard (cu. yd.)

Problems in Cubic Measure

1. What is the volume of a rectangular solid $4'' \times 5'' \times 6''$?

2. Does a piece of timber $8'' \times 10'' \times 14''$ contain more or less than a cubic foot? How much?

3. How many cubic inches in a brick $2'' \times 4'' \times 8''$? How many such bricks in a cubic foot?

4. A schoolroom 12 ft. high, 25 ft. wide, and 30 ft. long contains 40 pupils. This is how many cubic feet to each pupil?

5. I am making 3 window boxes, each 1 ft. wide, 1 ft. deep, and 8 ft. long. I asked the gardener to bring me a load (1 cubic yard) of earth to fill them. Is this enough? How much will be left?

6. For 2 small boxes $8'' \times 6'' \times 4'$ I had 3 cubic feet of earth brought. How much was left?

7. How many cakes of soap 2 in. wide and 3 in. long can you lay on the bottom of a box 1 ft. square? If the box is 9 in. deep, and each cake $1\frac{1}{2}$ in. thick, how many cakes will the box hold?

8. How many cubic feet of bricks in a pile 8 ft. long, 4 ft. high, and 3 ft. wide? How many bricks in the pile if 27 bricks contain 1 cu. ft.?

48. Shortening Work by Cancellation

In many problems involving two or more steps in multiplication or division, work may be saved by first indicating all of the steps and then using *cancellation.*

1. How many cubic yards of earth are removed in digging a cellar 18 ft. wide, 24 ft. long, and 5 ft. deep?

WORK

$$\frac{\overset{2}{\cancel{18}} \times \overset{8}{\cancel{24}} \times 5}{\substack{\cancel{27} \\ \cancel{3}}}\text{ cu. yd.} = 80\text{ cu. yd.}$$

Explanation. — The volume is $18 \times 24 \times 5$ cu. ft. To reduce this to cubic yards we must divide by 27. We indicate the division. Then we divide 18 and 27 by their common factor, 9. Then we divide 24 by the 3. Then we find the product of the 2, 8, and 5 that remain.

2. Find by cancellation the number of cubic yards in an excavation 36 ft. by 40 ft. and 6 ft. deep.

3. Allowing $\frac{3}{4}$ of a bushel to a cubic foot, how many bushels of potatoes in a bin 4 ft. wide, 8 ft. long, and 3 ft. deep?

Suggestion. — $\frac{\cancel{4} \times 8 \times 3 \times 3}{\cancel{4}}$ bu. = ?

4. Allowing $\frac{2}{5}$ of a bushel to a cubic foot, find the number of bushels of corn in a crib 10 ft. wide and 36 ft. long when filled to a depth of 8 ft.

5. A farmer has a mow 48 ft. long and 36 ft. wide filled with hay to a depth of 16 ft. Allowing a ton as the weight of 512 cu. ft., find how many tons of hay he has.

6. How many sheets of paper each $3''$ by $6''$ can be cut from a sheet $24''$ by $30''$?

Suggestion. — $\frac{24 \times 30}{3 \times 6}$ = no. of sheets. When can this method be used?

7. How many sheets of paper each $4''$ by $7''$ can be cut from a sheet $28''$ by $36''$?

8. How many cakes of ice $2'$ by $3'$ can be packed in a layer in an ice house $12'$ wide and $16'$ long?

9. How many cakes of soap $3''$ by $4''$ by $1\frac{1}{2}''$ can be packed in a box $20''$ wide, $24''$ long, and $9''$ deep?

10. How many cans of cocoa $2''$ by $3''$ by $4''$ can be packed in a box $12''$ deep, $15''$ wide, and $20''$ long?

11. If 6 acres of corn yield 498 bu., what should 8 acres yield?

SUGGESTION. — $\frac{8 \times 498 \text{ bu.}}{6} = ?$

12. In 4 days George gathered 14 gallons of berries. He sold them for 30¢ a gallon. Find by cancellation how much he made a day.

13. If 9 horses each eat 4 quarts of oats a day, how long will a supply of 228 quarts last?

14. If 28 bushels of wheat make 6 barrels of flour, how many bushels will it take to make 15 barrels?

15. How many bushels of wheat worth 95 cents a bushel must be grown on an acre, to equal in value a crop of 65 bushels of corn worth 57 cents a bushel?

16. If a railroad train runs 270 miles in 6 hours, how far will it go in 8 hours at the same speed?

17. Allowing $57\frac{1}{2}$ lb. to a cubic foot, if the iceman brings you a piece of ice 12 in. by 12 in. by 10 in., how many pounds do you get?

SUGGESTION. — Weight $= \frac{12 \times 12 \times 10 \times 57\frac{1}{2}}{1728}$ lb.

Find the values of the following by cancellation:

18. $\frac{1728}{12 \times 8}$.

19. $\frac{5280}{6 \times 8}$.

20. $\frac{1365}{5 \times 21}$.

21. $\frac{12 \times 784}{16}$.

22. $\frac{9 \times 256}{12}$.

23. $\frac{60 \times 21}{7 \times 9}$.

24. $\frac{12 \times 15 \times 16}{8 \times 5 \times 9}$.

25. $\frac{18 \times 25 \times 49}{21 \times 10 \times 15}$.

26. $\frac{48 \times 54 \times 14}{27 \times 21 \times 16}$.

49. Review: Whole Numbers

1. Use the addition drills on pages 40, 41, 42, 43, 44, 46, and 47. See if you can score as high now as when you last used them.

2. Use the subtraction drills on pages 49, 50, 51, and 53. Compare your score now with your former score.

3. Use the multiplication drills on pages 56, 57, and 59 in the same way.

4. Use the division drill, page 68.

Add, grouping numbers that make 10:

5.	6.	7.	8.	9.
7684	5678	8079	7203	$62.45
3223	3431	3561	5679	28.35
1486	7561	2437	3231	76.73
8817	9087	7142	4485	18.68
1416	5543	6581	6724	44.37

Subtract, then check by addition:

10.	11.	12.	13.	14.
7280	9086	8000	$46.30	$70.85
5726	3597	2573	28.45	35.90

Choose for multipliers the factors giving the least work:

15. 726×308.
16. 485×460.
17. 908×736.
18. 670×490.
19. 906×740.
20. 478×305.
21. 777×640.
22. 816×309.
23. 692×586.

Divide, then check by multiplication:

24. $854{,}321 \div 796$.
25. $396{,}372 \div 493$.
26. $294{,}763 \div 306$.
27. $70{,}893 \div 532$.
28. $25{,}232 \div 304$.
29. $73{,}320 \div 156$.
30. $38{,}146 \div 729$.
31. $19{,}680 \div 581$.
32. $70{,}007 \div 490$.

50. Review: Fractions

1. Draw rectangles and divide them to show that $\frac{3}{6}=\frac{1}{2}$; $\frac{4}{8}=\frac{1}{2}$; $\frac{4}{6}=\frac{2}{3}$; $\frac{9}{12}=\frac{3}{4}$.

2. Reduce to their lowest terms: $\frac{5}{10}$, $\frac{8}{12}$, $\frac{14}{21}$, $\frac{64}{100}$, $\frac{50}{75}$.

3. Reduce to mixed numbers: $\frac{7}{2}$, $\frac{25}{6}$, $\frac{17}{7}$, $\frac{45}{8}$, $\frac{125}{6}$.

4. Write as improper fractions: $1\frac{2}{3}$, $8\frac{1}{3}$, $2\frac{1}{4}$, $12\frac{1}{2}$, $33\frac{1}{3}$.

5. Write as 16ths: $\frac{1}{2}$, $\frac{3}{4}$, $\frac{5}{8}$, $\frac{4}{32}$, $\frac{20}{64}$.

Find the sums:

6. $\frac{1}{2}+\frac{1}{4}+\frac{1}{8}$.	**10.** $\frac{5}{12}+\frac{2}{3}+\frac{3}{4}$.	**14.** $12\frac{1}{4}+48\frac{1}{3}$.
7. $\frac{3}{4}+\frac{2}{3}+\frac{1}{2}$.	**11.** $\frac{7}{8}+\frac{5}{16}+\frac{1}{4}$.	**15.** $56\frac{3}{4}+16\frac{2}{3}$.
8. $\frac{5}{6}+\frac{1}{8}+\frac{3}{4}$.	**12.** $\frac{5}{16}+\frac{3}{8}+\frac{5}{12}$.	**16.** $24\frac{5}{8}+38\frac{7}{12}$.
9. $\frac{5}{6}+\frac{3}{8}+\frac{7}{12}$.	**13.** $\frac{11}{12}+\frac{1}{6}+\frac{3}{8}$.	**17.** $60\frac{5}{6}+17\frac{3}{8}$.

Find the differences:

18. $\frac{3}{4}-\frac{1}{8}$.	**21.** $\frac{3}{8}-\frac{1}{12}$.	**24.** $12\frac{1}{2}-8\frac{1}{4}$.	**27.** $66\frac{2}{3}-18\frac{3}{4}$.
19. $\frac{7}{12}-\frac{3}{8}$.	**22.** $\frac{7}{9}-\frac{1}{6}$.	**25.** $16\frac{2}{3}-7\frac{1}{6}$.	**28.** $42-16\frac{5}{9}$.
20. $\frac{15}{16}-\frac{3}{4}$.	**23.** $\frac{3}{4}-\frac{5}{9}$.	**26.** $48\frac{1}{4}-12\frac{1}{2}$.	**29.** $81-57\frac{3}{8}$.

30. Draw rectangles to show that $\frac{1}{2}$ of $\frac{1}{3}=\frac{1}{6}$; $\frac{1}{4}$ of $\frac{1}{3}=\frac{1}{12}$; $\frac{3}{4}$ of $\frac{2}{3}=\frac{6}{12}=\frac{1}{2}$.

Using cancellation, find the products:

31. $\frac{5}{9}\times\frac{6}{25}$.	**34.** $\frac{7}{8}\times\frac{12}{21}\times\frac{4}{9}$.	**37.** $12\frac{1}{2}\times 16$.	**40.** $33\frac{1}{3}\times 2\frac{1}{4}$.
32. $\frac{3}{8}\times\frac{7}{9}$.	**35.** $\frac{21}{16}\times\frac{48}{96}\times\frac{18}{35}$.	**38.** $3\frac{1}{3}\times 8\frac{1}{2}$.	**41.** $7\frac{5}{12}\times 1\frac{4}{5}$.
33. $\frac{5}{6}\times\frac{12}{25}$.	**36.** $\frac{9}{32}\times\frac{45}{63}\times\frac{28}{81}$.	**39.** $6\frac{1}{4}\times 6\frac{2}{3}$.	**42.** $16\frac{2}{3}\times 1\frac{1}{2}$.

Find the quotients:

43. $\frac{7}{8}\div\frac{5}{6}$.	**46.** $\frac{12}{25}\div\frac{8}{15}$.	**49.** $\frac{9}{16}\div\frac{3}{32}$.	**52.** $\frac{5}{9}\div 10$.
44. $\frac{5}{9}\div\frac{15}{16}$.	**47.** $\frac{6}{35}\div\frac{3}{7}$.	**50.** $10\div\frac{5}{6}$.	**53.** $12\frac{1}{2}\div\frac{5}{6}$.
45. $\frac{3}{16}\div\frac{7}{12}$.	**48.** $\frac{5}{32}\div\frac{7}{16}$.	**51.** $24\div\frac{3}{8}$.	**54.** $3\frac{1}{3}\div 2\frac{1}{2}$.

PART TWO: SIXTH YEAR

V. FRACTIONS

51. MEANING AND USES OF FRACTIONS

1. Divide a rectangle into fourths. Shade $\frac{3}{4}$ of it.

2. In the fraction $\frac{3}{4}$ of the rectangle, which figure shows into how many equal parts the rectangle is divided? What is it called? Which figure shows how many times one of these parts is multiplied or taken to make $\frac{3}{4}$ of the whole rectangle? What is it called?

3. Give the *numerator* and the *denominator* in each of the following fractions, and tell in each case what they mean: $\frac{7}{8}$ of a rectangle; $\frac{9}{16}$ of a pound; $\frac{5}{12}$ of a foot; $\frac{3}{6}$ of a cake.

4. Find $\frac{2}{3}$ of 6 lb.; of 18 ft.; of 24 hr.; of 27; of 36.

5. In finding $\frac{5}{8}$ of any number, as 32 in., what does the denominator show? What does the numerator show?

> *A fraction is used to express one or more equal parts of a thing or of a number of things. Each of the equal parts is called a* **fractional unit**. *The* **denominator** *shows into how many equal parts the whole is divided, and the* **numerator** *shows how many times one of these parts is multiplied or taken.*

6. Name the *fractional unit* in each of the following, and also tell *how many* units there are: $\frac{3}{4}$ in.; $\frac{5}{8}$ gal.; $\frac{7}{8}$ bu.

7. Which is larger, $\frac{1}{4}$ ft. or $\frac{1}{6}$ ft.? $\frac{1}{3}$ yd. or $\frac{1}{4}$ yd.?

8. Does a large denominator denote a large or small fractional unit?

9. Which is larger, $\frac{5}{8}$ in. or $\frac{7}{8}$ in.? $\frac{11}{16}$ lb. or $\frac{13}{16}$ lb.?

10. Does a large numerator indicate a large or a small fraction?

11. Find $\frac{2}{3}$ of 24; $\frac{3}{8}$ of 32; $\frac{5}{9}$ of 54; $\frac{7}{12}$ of 48; $\frac{9}{16}$ of 64.

12. Express the quotient of 7 divided by 12. Of 9 divided by 16. Of 11 divided by 24.

> *A fraction is used to express the quotient of two numbers. The dividend is the numerator, and the divisor is the denominator.*

13. Express by fractions the quotients of the following: $5 \div 12$; $13 \div 16$; $15 \div 24$; $7 \div 36$; $25 \div 48$; $30 \div 64$.

14. What division does $\frac{7}{18}$ express?

15. Divide 1367 by 16.

$$
\begin{array}{r}
85\frac{7}{16} \\
16\overline{)1367} \\
\underline{128} \\
87 \\
\underline{80} \\
7
\end{array}
$$

EXPLANATION. — In dividing we get a quotient of 85 and remainder 7. Since the 7 is part of the dividend that has not been divided by 16, we express the quotient of 7 divided by 16, which is $\frac{7}{16}$, and write it after 85. So the entire quotient is $85\frac{7}{16}$.

16. Divide and express the remainders by fractions: $871 \div 9$; $1645 \div 12$; $683 \div 24$; $2080 \div 25$; $5769 \div 48$.

17. Draw a rectangle 3 in. long and divide it into 3 equal parts. Shade 2 parts. 2 in. is what part of 3 in.?

18. 3 ft. is what part of 4 ft.? Of 10 ft.? Of 12 ft.?

> *A fraction is used to express the relation of two things or numbers. It tells what part one thing or number is of another.*

By use of fractions express the relation of:

19. 2 ft. to 3 ft.

20. \$3 to \$4.

21. 3 in. to 8 in.

22. 9 oz. to 1 lb.

23. 3 pk. to 1 bu.

24. 4 da. to 1 wk.

25. 16 da. to 1 mo. (30 da.).

26. 7 mo. to 1 yr.

52. IMPROPER FRACTIONS AND MIXED NUMBERS

1. How many fourths are there in any whole thing?

2. Is $\frac{5}{4}$ more than 1? How much?

3. What name is given to a fraction that is equal to or more than 1?

4. Tell which of the following are proper and which are improper fractions: $\frac{3}{8}$; $\frac{7}{6}$; $\frac{12}{12}$; $\frac{13}{9}$; $\frac{2}{15}$; $\frac{6}{4}$; $\frac{8}{8}$; $\frac{3}{10}$; $\frac{9}{6}$; $\frac{18}{16}$.

5. What name is given to a number composed of a whole number and a fraction, as $12\frac{3}{4}$?

6. Change $\frac{249}{16}$ to a mixed number.

$$\begin{array}{r|l} & 15\frac{9}{16} \\ \hline 16 & 249 \\ & \underline{16} \\ & 89 \\ & \underline{80} \\ & 9 \end{array}$$

EXPLANATION. — Since the fraction may be considered as expressing a quotient, we divide the numerator by the denominator. The remainder 9 divided by 16 gives the fraction $\frac{9}{16}$. Hence $\frac{249}{16} = 15\frac{9}{16}$.

> *To change an improper fraction to a mixed number, divide the numerator by the denominator. The whole number in the quotient, and the fraction formed by writing the remainder over the divisor, form the mixed number.*

Change to mixed numbers:

7. $\frac{27}{4}$. **9.** $\frac{316}{12}$. **11.** $\frac{824}{48}$. **13.** $\frac{565}{36}$. **15.** $\frac{1728}{32}$.

8. $\frac{125}{16}$. **10.** $\frac{729}{20}$. **12.** $\frac{100}{16}$. **14.** $\frac{361}{15}$. **16.** $\frac{5280}{27}$.

53. REDUCTION OF FRACTIONS: COMMON DENOMINATOR

We have seen that the *number* of units that make up any object may be changed if at the same time their *size* is changed to correspond. Thus we may speak of a gallon as 4 qt., or as 8 pt.; of a yard as 3 ft., or as 36 in. In the same way 15 ft. and 5 yd. represent the same length.

Exercises

1. Give other examples of equal values expressed in units of different sizes.

2. Compare $\frac{1}{4}$ and $\frac{3}{12}$, and tell why the value of $\frac{3}{12}$ is no greater than $\frac{1}{4}$.

3. How does an *increase* in the size of the denominator affect the size of the unit?

4. How does an *increase* in the numerator affect the value of a fraction?

5. How does a *decrease* in the denominator affect the size of the unit?

6. How does a *decrease* in the numerator affect the value of a fraction?

7. If each term of $\frac{8}{18}$ be made $\frac{1}{2}$ as large, how is the value affected? Why is this?

8. Make each term of $\frac{2}{3}$ three times as large. Explain how the change affects the *size* and the *number* of the units.

> *Both terms of a fraction may be multiplied or divided by the same number without changing the value of the fraction.*

9. By the use of this principle, change to 40ths:

$\frac{8}{8}$; $\frac{7}{10}$; $\frac{5}{4}$; $\frac{9}{5}$; $\frac{40}{80}$; $\frac{24}{160}$; $\frac{40}{200}$; $\frac{3}{20}$; $\frac{180}{240}$; $\frac{48}{240}$; $\frac{96}{480}$.

10. Change to 12ths: $\frac{1}{2}$; $\frac{1}{3}$; $\frac{2}{3}$; $\frac{1}{4}$; $\frac{3}{4}$; $\frac{1}{6}$; $\frac{5}{6}$.

11. Change to like units: $\frac{3}{2}$; $\frac{3}{4}$; $\frac{3}{8}$; $\frac{5}{8}$; $\frac{1}{4}$.

12. Change to like units: $\frac{2}{3}$; $\frac{1}{6}$; $\frac{2}{9}$; $\frac{5}{6}$; $\frac{5}{18}$.

13. Change to like units: $\frac{3}{5}$; $\frac{7}{10}$; $\frac{4}{15}$; $\frac{2}{3}$; $\frac{5}{6}$.

> *When fractions are changed to like units they have a* **common denominator.** *The* **smallest** *common denominator to which given fractions can be changed is called their* **least** *common denominator.*

14. What is the least number that can be divided by both 2 and 3? By both 4 and 5?

15. What is the least number that can be divided by both 4 and 6? By both 9 and 12?

16. What is the least number that can be divided by 6, 8, and 9?

> *The least common denominator of two or more fractions is the least number that can be divided by each of the denominators.*

NOTE. — For a method of finding the least common denominator of fractions with large denominators, see Section 61. For the fractions with small denominators such as are found in everyday practical problems, the method of inspection is sufficient.

Change to fractions with least common denominators:

17. $\frac{1}{2}$; $\frac{1}{3}$; $\frac{1}{4}$.

18. $\frac{1}{4}$; $\frac{1}{6}$; $\frac{1}{8}$.

19. $\frac{1}{10}$; $\frac{1}{5}$; $\frac{1}{4}$.

20. $\frac{2}{3}$; $\frac{3}{4}$; $\frac{1}{6}$.

21. $\frac{3}{4}$; $\frac{5}{8}$; $\frac{5}{6}$.

22. $\frac{7}{12}$; $\frac{5}{18}$; $\frac{4}{9}$.

23. $\frac{3}{16}$; $\frac{2}{3}$; $\frac{5}{8}$.

24. $\frac{7}{32}$; $\frac{5}{6}$; $\frac{3}{8}$.

25. $\frac{1}{9}$; $\frac{8}{27}$; $\frac{5}{6}$.

26. $\frac{7}{12}$; $\frac{11}{18}$; $\frac{3}{4}$.

27. $\frac{7}{8}$; $\frac{5}{6}$; $\frac{4}{9}$.

28. $\frac{1}{3}$; $\frac{3}{8}$; $\frac{2}{5}$.

54. ADDITION AND SUBTRACTION OF FRACTIONS

1. What change must be made in the numbers before you can add 2 ft. and 18 in.? 5 lb. and 48 oz.?

2. What change must be made in the numbers before you can subtract 9 in. from 2 ft.? 3 qt. from 2 gal.?

3. What change must be made in fractions with different fractional units (different denominators) before they may be added or subtracted?

Add the following:

4. $\frac{3}{4}, \frac{5}{6}, \frac{7}{12}$.
5. $\frac{4}{5}, \frac{2}{3}, \frac{8}{15}$.
6. $\frac{2}{3}, \frac{5}{6}, \frac{11}{18}$.
7. $\frac{3}{4}, \frac{7}{8}, \frac{9}{16}$.
8. $\frac{5}{9}, \frac{1}{3}, \frac{1}{6}$.
9. $\frac{2}{3}, \frac{5}{6}, \frac{7}{9}$.
10. $\frac{2}{3}, \frac{3}{4}, \frac{1}{6}$.
11. $\frac{1}{2}, \frac{5}{6}, \frac{2}{3}$.
12. $\frac{3}{8}, \frac{1}{2}, \frac{1}{3}$.
13. $\frac{1}{2}, \frac{3}{5}, \frac{8}{10}$.
14. $\frac{2}{3}, \frac{7}{8}, \frac{3}{4}$.
15. $\frac{1}{2}, \frac{1}{5}, \frac{2}{15}$.
16. $\frac{5}{9}, \frac{1}{6}, \frac{1}{2}$.
17. $\frac{7}{8}, \frac{1}{3}, \frac{5}{12}$.
18. $\frac{1}{2}, \frac{1}{6}, \frac{5}{18}$.
19. $\frac{9}{16}, \frac{5}{8}, \frac{3}{4}$.
20. $\frac{1}{3}, \frac{3}{16}, \frac{3}{4}$.
21. $\frac{5}{12}, \frac{2}{3}, \frac{7}{24}$.
22. $13\frac{1}{3}, 16\frac{5}{6}$.
23. $7\frac{3}{8}, 4\frac{9}{16}$.
24. $3\frac{2}{3}, 4\frac{3}{5}$.
25. $6\frac{7}{8}, 3\frac{1}{3}$.
26. $7\frac{2}{3}, 6\frac{3}{4}$.
27. $9\frac{3}{5}, 10\frac{2}{3}$.
28. $16\frac{1}{5}, 3\frac{2}{3}$.
29. $4\frac{3}{4}, 6\frac{1}{3}$.
30. $3\frac{4}{5}, 7\frac{1}{2}$.
31. $9\frac{1}{2}, 3\frac{5}{7}$.
32. $6\frac{3}{4}, 7\frac{5}{6}$.
33. $7\frac{1}{2}, 9\frac{2}{3}$.

Subtract:

34. $\frac{2}{3} - \frac{1}{2}$.
35. $\frac{3}{4} - \frac{1}{3}$.
36. $\frac{7}{8} - \frac{1}{6}$.
37. $\frac{5}{9} - \frac{1}{2}$.
38. $\frac{5}{8} - \frac{1}{6}$.
39. $\frac{9}{16} - \frac{3}{8}$.
40. $\frac{11}{12} - \frac{5}{9}$.
41. $\frac{8}{9} - \frac{5}{6}$.
42. $\frac{11}{16} - \frac{1}{3}$.
43. $\frac{7}{8} - \frac{2}{3}$.
44. $\frac{5}{9} - \frac{1}{4}$.
45. $\frac{5}{8} - \frac{3}{16}$.
46. $\frac{8}{9} - \frac{1}{2}$.
47. $\frac{15}{16} - \frac{3}{8}$.
48. $\frac{7}{12} - \frac{3}{8}$.
49. $\frac{9}{16} - \frac{5}{12}$.
50. $3\frac{1}{2} - 1\frac{3}{4}$.
51. $7\frac{1}{4} - 3\frac{2}{3}$.
52. $3\frac{1}{3} - 1\frac{1}{2}$.
53. $6\frac{3}{8} - 4\frac{1}{6}$.
54. $9\frac{1}{2} - 3\frac{5}{6}$.
55. $8\frac{1}{3} - 5\frac{1}{4}$.
56. $4\frac{7}{12} - 1\frac{3}{8}$.
57. $9\frac{1}{4} - 4\frac{1}{5}$.

Give without a pencil the sums and differences of:

58. $\frac{3}{4}$ and $\frac{1}{2}$.	**61.** $\frac{7}{8}$ and $\frac{2}{3}$.	**64.** $\frac{1}{2}$ and $\frac{5}{12}$.	**67.** $\frac{2}{3}$ and $\frac{2}{5}$.
59. $\frac{3}{4}$ and $\frac{5}{8}$.	**62.** $\frac{5}{9}$ and $\frac{1}{2}$.	**65.** $\frac{11}{12}$ and $\frac{5}{8}$.	**68.** $\frac{7}{12}$ and $\frac{3}{8}$.
60. $\frac{1}{2}$ and $\frac{3}{8}$.	**63.** $\frac{3}{4}$ and $\frac{1}{6}$.	**66.** $\frac{9}{16}$ and $\frac{1}{3}$.	**69.** $\frac{5}{9}$ and $\frac{5}{12}$.

Practical Problems in Addition and Subtraction

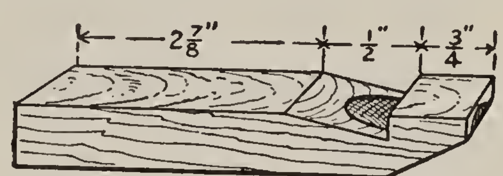
1. I mailed three packages. One weighed $\frac{3}{4}$ lb., one $\frac{7}{8}$ lb., and one $\frac{11}{16}$ lb. What was their total weight?

2. If I buy $\frac{3}{4}$ yd. of lace in one piece, $\frac{5}{12}$ yd. in a second piece, and $\frac{8}{9}$ yd. in a third at a remnant counter, how much do I get in all three pieces?

3. I buy $8\frac{2}{3}$ yd. of goods for one dress and $10\frac{3}{4}$ yd. for another. How many yards do I get for both dresses?

4. If you drive $14\frac{1}{4}$ miles in the forenoon, and $12\frac{7}{8}$ miles in the afternoon, how far do you drive during the whole day?

5. The figure gives the dimensions of a whistle made from a piece of wood. If $\frac{3}{16}''$ must be allowed for waste in making, how long should the piece of wood be from which it is constructed?



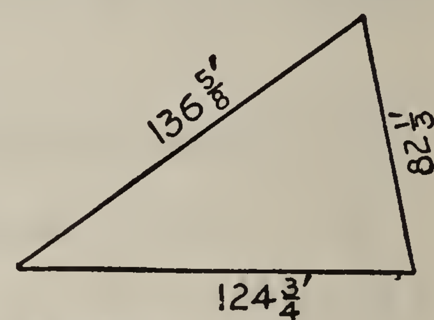
6. A milliner bought two pieces of hat lining. One piece contained $52\frac{1}{3}$ yd., and the other $44\frac{3}{4}$ yd. How many yards in both pieces? Of this she sold $10\frac{3}{4}$ yd., $7\frac{1}{3}$ yd., and $12\frac{5}{12}$ yd. How much did she sell in all?

7. From a bolt of cloth a clerk sold $\frac{2}{5}$ of it at one time and $\frac{1}{4}$ of it at another. How much of it did he sell in all?

8. A farmer built $\frac{3}{4}$ mile of board fence, and $1\frac{1}{8}$ miles of wire fence in one season. How much did he build in all?

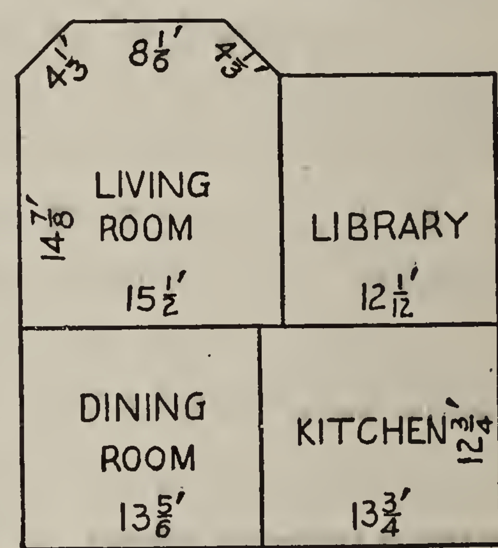
9. A train leaving Chicago at 1.25 P.M. reaches Davenport in $5\frac{2}{3}$ hr. At what time of day does it reach Davenport?

10. A crash towel is to be $27\frac{1}{2}$ in. long when finished. If it takes $\frac{5}{8}$ in. at each end for a hem, how long must the piece of crash be cut in making it?



11. How many feet around this triangle?

12. An iron-holder is to be $5\frac{1}{2}$ in. square when finished. Allowing $\frac{3}{8}$ in. on each side for turning in of material, what must be the length and the width of the pattern?



13. This is the plan of the first floor of a house. Find the number of feet of picture molding required for the living room.

14. Find the amount of picture molding required for the library.

15. Find the number of feet of plate rack for the dining room, allowing $8\frac{1}{3}$ ft. for openings.

16. Find the number of feet of baseboard for the kitchen, allowing $7\frac{1}{2}$ ft. for openings.

17. From an iron bar $9\frac{7}{16}$ inches long, a piece $3\frac{3}{4}$ inches long is cut. How much remains?

18. From a piece of cloth containing $14\frac{2}{3}$ yd., one piece containing $6\frac{3}{8}$ yd. and another containing $4\frac{3}{4}$ yd. are cut. How much is left?

19. A towel is to be made from a piece of toweling $28\frac{3}{4}$ in. long. If $\frac{5}{16}$ in. is used at each end for a hem, how long will the finished towel be?

55. MIXED NUMBERS CHANGED TO FRACTIONS

1. If you draw a line 3 inches long, and mark it off into spaces each $\frac{1}{4}$ inch long, how many $\frac{1}{4}$-inch spaces in 1 inch? In 3 inches?

2. How many $\frac{1}{2}$-inch spaces in 8 inches? In 20 inches?

3. How many eighths of a pound in 5 lb.? In 12 lb.?

4. How many sixths in 2? In 10? In 12?

5. How many fourths in 5? How many fifths in 5?

6. Change each of the following to fourths:
3, 4, 5, 8, 10, 12, 16, 20, 36, 50.

> *A whole number may be expressed as a fraction with any denominator.*

7. Express 6 as a fraction with each of the following as denominator: 2, 4, 5, 6, 10, 12, 20, 32, 48, 100.

8. Express $16\frac{2}{3}$ as an improper fraction.

WORK

$$16\frac{2}{3} = \frac{48}{3} + \frac{2}{3} = \frac{50}{3}.$$

EXPLANATION. — First, changing 16 to thirds gives $\frac{48}{3}$. Adding $\frac{48}{3}$ and $\frac{2}{3}$ gives $\frac{50}{3}$.

Change each of the following to an improper fraction:

9. $3\frac{1}{2}$.	**14.** $9\frac{2}{5}$.	**19.** $16\frac{2}{3}$.	**24.** $18\frac{3}{8}$.	**29.** $40\frac{7}{12}$.
10. $2\frac{3}{4}$.	**15.** $6\frac{1}{4}$.	**20.** $33\frac{1}{3}$.	**25.** $20\frac{3}{4}$.	**30.** $64\frac{1}{8}$.
11. $8\frac{1}{3}$.	**16.** $8\frac{4}{5}$.	**21.** $66\frac{2}{3}$.	**26.** $84\frac{5}{6}$.	**31.** $92\frac{5}{16}$.
12. $5\frac{4}{9}$.	**17.** $1\frac{11}{12}$.	**22.** $37\frac{1}{2}$.	**27.** $33\frac{7}{8}$.	**32.** $28\frac{3}{25}$.
13. $6\frac{7}{8}$.	**18.** $7\frac{7}{12}$.	**23.** $48\frac{5}{6}$.	**28.** $27\frac{5}{9}$.	**33.** $19\frac{3}{32}$.

Change quickly without pencil to improper fractions:

34. $1\frac{1}{2}$; $2\frac{1}{3}$; $8\frac{1}{2}$; $12\frac{1}{2}$; $3\frac{1}{4}$; $5\frac{1}{8}$; $9\frac{1}{4}$; $16\frac{1}{6}$; $14\frac{1}{8}$.

35. $4\frac{2}{3}$; $2\frac{5}{6}$; $3\frac{7}{8}$; $6\frac{4}{9}$; $1\frac{11}{16}$; $8\frac{3}{8}$; $7\frac{2}{9}$; $5\frac{9}{16}$; $6\frac{5}{8}$.

36. $3\frac{7}{16}$; $5\frac{7}{12}$; $16\frac{2}{3}$; $24\frac{1}{2}$; $8\frac{3}{5}$; $2\frac{5}{9}$; $18\frac{2}{3}$; $32\frac{1}{4}$; $25\frac{3}{4}$.

56. MULTIPLICATION OF FRACTIONS

1. Compare $\frac{4}{5}$ and $\frac{1}{5}$; $\frac{4}{5}$ and $\frac{2}{5}$; $\frac{12}{21}$ and $\frac{4}{21}$; $\frac{16}{17}$ and $\frac{4}{17}$.

2. Compare $\frac{1}{5}$ and $\frac{1}{20}$; $\frac{1}{6}$ and $\frac{1}{18}$; $\frac{1}{7}$ and $\frac{1}{21}$; $\frac{1}{4}$ and $\frac{1}{12}$.

> *Multiplying the numerator of a fraction increases the* **number** *of equal parts, and hence multiplies the fraction.*
>
> *Dividing the denominator increases the* **size** *of the equal parts, and hence multiplies the fraction.*

Tell which method you use in the following:

3. $4 \times \frac{3}{5}$.	**6.** $7 \times \frac{8}{14}$.	**9.** $9 \times \frac{2}{7}$.	**12.** $15 \times \frac{7}{30}$.
4. $5 \times \frac{3}{10}$.	**7.** $6 \times \frac{7}{12}$.	**10.** $8 \times \frac{3}{16}$.	**13.** $17 \times \frac{19}{34}$.
5. $6 \times \frac{2}{7}$.	**8.** $5 \times \frac{3}{8}$.	**11.** $9 \times \frac{15}{18}$.	**14.** $13 \times \frac{15}{26}$.

15. How do you find $\frac{3}{4}$ of a circle? Of a rectangle?

16. Compare $\frac{3}{4}$ and $\frac{3}{16}$. When you divide 4ths into four equal parts, what fractional unit do you get?

17. When you divide 5ths into 4 equal parts, what do you call the parts?

18. Find $\frac{3}{4}$ of $\frac{5}{7}$.

WORK

$$\frac{3}{4} \text{ of } \frac{5}{7} = \frac{3 \times 5}{4 \times 7} = \frac{15}{28}$$

EXPLANATION. — Since to find $\frac{3}{4}$ of a number is to divide it into 4 equal parts and then take 3 of them, we divide $\frac{5}{7}$ into 4 equal parts and have $\frac{5}{28}$; then taking 3 of these we have $\frac{15}{28}$.

19. $\frac{3}{5}$ of $\frac{6}{7}$ = ——.	**22.** $\frac{2}{5}$ of $\frac{7}{8}$ = ——.	**25.** $\frac{2}{5}$ of $\frac{4}{7}$ = ——.
20. $\frac{6}{7}$ of $\frac{9}{11}$ = ——.	**23.** $\frac{2}{9}$ of $\frac{5}{7}$ = ——.	**26.** $\frac{8}{9}$ of $\frac{10}{11}$ = ——.
21. $\frac{3}{8}$ of $\frac{7}{10}$ = ——.	**24.** $\frac{3}{7}$ of $\frac{8}{9}$ = ——.	**27.** $\frac{2}{7}$ of $\frac{11}{12}$ = ——.

Finding a part of a number is called "multiplying by a fraction," and the sign of multiplication ($\times$) is used for "of," and must be read "of"; thus $\frac{3}{8} \times \frac{5}{6}$ is read $\frac{3}{8}$ of $\frac{5}{6}$.

Cancellation in Multiplication

1. Find $\frac{5}{9}$ of $\frac{7}{10}$, and reduce the product to lowest terms. By what number do you divide 35 and 90?

2. Find $\frac{6}{7}$ of $\frac{14}{15}$.

WORK

$$\frac{\overset{2}{\cancel{6}}}{\underset{1}{\cancel{7}}}\times\frac{\overset{2}{\cancel{14}}}{\underset{5}{\cancel{15}}}=\frac{4}{5}$$

Explanation. — Multiplying numerators for the numerator of the product, and denominators for the denominator of the product, would give $\frac{84}{105}$. Dividing both terms of this by 3 and by 7 would give $\frac{4}{5}$. A shorter way is to divide the 6 and 15 by 3 and the 7 and 14 by 7 first. This leaves at once 2×2, or 4, for the numerator, and 1×5, or 5, for the denominator of the product. The numbers divided are *cancelled out* when used, as indicated.

> *In multiplication of fractions, if any numerator and any denominator are divisible by the same number, they may be divided by this number before performing the multiplication. This is called* **cancellation**.

Find by cancellation:

3. $\frac{2}{7} \times \frac{21}{36}$.

4. $\frac{8}{9} \times \frac{33}{40}$.

5. $\frac{10}{12} \times \frac{36}{38}$.

6. $\frac{2}{9} \times \frac{18}{22}$.

7. $\frac{4}{11} \times \frac{33}{48}$.

8. $\frac{2}{9} \times \frac{15}{42}$.

9. $\frac{7}{13} \times \frac{39}{49}$.

10. $\frac{2}{15} \times \frac{35}{52}$.

11. $\frac{18}{19} \times \frac{76}{90}$.

12. $\frac{14}{15} \times \frac{45}{56}$.

13. $\frac{4}{17} \times \frac{85}{96}$.

14. $\frac{33}{42} \times \frac{63}{99}$.

15. $\frac{4}{15} \times \frac{60}{63}$.

16. $\frac{8}{17} \times \frac{85}{96}$.

17. $\frac{2}{5} \times \frac{35}{36}$.

18. $\frac{18}{19} \times \frac{38}{90}$.

19. $\frac{7}{8} \times \frac{6}{35}$.

20. $\frac{24}{25} \times \frac{45}{48}$.

21. $\frac{16}{25} \times \frac{15}{32}$.

22. $\frac{36}{56} \times \frac{28}{42}$.

23. $\frac{32}{45} \times \frac{54}{56}$.

24. $\frac{22}{25} \times \frac{35}{66}$.

25. $\frac{9}{17} \times \frac{25}{27}$.

26. $\frac{31}{32} \times \frac{56}{61}$.

27. Find $2\frac{2}{3} \times 3\frac{3}{4}$.

$$2\tfrac{2}{3} \times 3\tfrac{3}{4} = \frac{\overset{2}{\cancel{8}}}{\underset{1}{\cancel{3}}}\times\frac{\overset{5}{\cancel{15}}}{\underset{1}{\cancel{4}}} = 10.$$

Explanation. — First change the mixed numbers to fractions. Then multiply the fractions, using cancellation.

Find the products :

28. $3\frac{1}{3} \times 2\frac{1}{4}$. **30.** $8\frac{1}{3} \times 4\frac{3}{4}$. **32.** $6\frac{3}{8} \times 1\frac{3}{5}$. **34.** $2\frac{5}{12} \times 1\frac{4}{5}$.

29. $6\frac{1}{4} \times 3\frac{1}{5}$. **31.** $7\frac{1}{5} \times 2\frac{7}{12}$. **33.** $1\frac{7}{9} \times 3\frac{7}{8}$. **35.** $12\frac{1}{2} \times 1\frac{3}{5}$.

57. PRACTICAL USES OF CANCELLATION

In solving problems it often is best to indicate the work, then use *cancellation*, as in the multiplication of fractions.

1. If 6 bu. of potatoes cost \$4.50, how much will 20 bu. cost at the same rate ?

SOLUTION *

$$\frac{\overset{10}{\cancel{20}}}{\underset{\underset{1}{\cancel{3}}}{\cancel{6}}} \times \$\overset{1.50}{\cancel{4.50}} = \$15.$$

EXPLANATION. — Since 20 bu. will cost $\frac{20}{6}$ of what 6 bu. cost, then we multiply \$4.50 by $\frac{20}{6}$. First we cancel 2 from 20 and 6, then cancel 3 from 3 and \$4.50.

2. If 8 bu. of apples cost \$10.80, how much will 6 bu. cost at the same rate ?

SUGGESTION. — $\frac{6}{8} \times \$10.80 = ?$

3. If grape fruit is selling at the rate of 6 for 40¢, how much will 9 cost ?

4. When 21 bu. of seed wheat is needed for a 12-acre field, how much is needed for 32 acres at the same rate ?

5. One spring Ralph got 513 eggs from a flock of 18 hens. At the same rate, how many should he expect from a flock of 10 hens ?

* Pupils should be trained to express the relation of any two numbers, and to use this form of solution. In case they seem unable to do so, indicate the solution thus, $20 \times \frac{\$4.50}{6}$, reasoning that \$4.50 ÷ 6 gives the cost of 1 bu. and that 20 times the cost of 1 bu. is required.

6. Last year I used 14 tons of coal and my coal bill was \$90. If I use but 12 tons this year, what will the bill be at the same rate?

7. If a 6-lb. roast costs \$1.68, how much will a 9-lb. roast cost at the same rate?

8. When a 10-lb. ham costs \$2.25, how much will a 16-lb. ham cost at the same rate?

9. When the meat and grocery bill for a family of 6 is \$39 per month, how much should it be for a family of 4 at the same rate?

10. The plates for a banquet of 18 people cost \$22.50. How much would the cost have been for 24 people?

11. A man can plow a 15-acre field in 6 days. How large a field can he plow in 14 days?

12. John had a cyclometer put on his bicycle. He found that he had ridden 244 miles during the first 12 days. At this rate how many miles will he ride in 56 days?

13. A farmer exchanged 24 fine sheep valued at \$14 each for cows valued at \$48 each. How many cows should he get?

SOLUTION

$$\frac{\cancel{24} \times \overset{7}{\cancel{14}}}{\underset{\cancel{2}}{\cancel{48}}} = 7.$$

Hence, 7 cows.

EXPLANATION. — $24 \times \$14$ = value of all the sheep. Therefore there can be as many cows as $24 \times \$14$ will contain \$48. The quotient is abstract, so do not write the dollar sign in the solution.

14. Ralph exchanged 6 hens valued at \$1.50 each for pigeons valued at 45 cents each. How many should he receive in exchange?

15. William exchanged 27 pigeons valued at 40 cents each for hens valued at 90 cents each. How many should he receive?

Problems of the Farm

1. If it takes $12\frac{1}{2}$ bu. of corn, worth 42 cents a bushel, and \$2 worth of other feed to raise a pig until it is six months old, how much has it cost the farmer?

2. If the pig mentioned above weighs 196 pounds when six months old, how much is it worth at $4\frac{3}{4}$ cents a pound? How much has the farmer made above the cost of feed?

3. If a "scrub" pig and a well-bred pig each requires the same amount of feed, but the first weighs 124 lb. and the second 212 lb. when six months old, how much more is the second worth at $5\frac{3}{4}$ cents a pound?

4. A farmer found that a "scrub" cow eats 3 tons of hay worth \$8 per ton, $\frac{1}{2}$ ton ground feed worth \$18 per ton, and pasture worth \$6 each year. Find the total cost of keeping such a cow.

5. If the cow mentioned in Problem 4 gives 16 lb. of milk each day worth $1\frac{3}{4}$¢ a pound, for 300 days in a year, and raises a calf worth \$4, how much profit has the farmer made for his care of her?

6. If the same feed and care would have raised a Jersey giving 28 lb. of milk daily worth $2\frac{1}{4}$ cents per pound, for 300 days, and a calf worth \$7, what would the profit have been?

7. How much greater would the profit on the Jersey have been?

8. A farmer finds that the average annual cost to raise a 4-year old horse is as follows: $2\frac{1}{2}$ tons of hay worth \$8 per ton; 40 bushels of oats worth 38 cents a bushel; and \$5 worth of pasture. How much has the horse cost when four years old? If the horse is a coach horse worth \$200 at 4 years of age, how much has the farmer made?

9. If the horse is a "scrub" worth but \$95, how much has the farmer lost?

10. If $4\frac{1}{4}$ tons of hay worth \$8 a ton, 50 bushels of oats worth 35 cents a bushel, and pasture worth \$13.50 will keep a flock of 14 sheep for a year, what is the average cost per head?

11. If each sheep will shear $8\frac{3}{4}$ pounds of wool worth $22\frac{1}{2}$ cents a pound, and raise a lamb worth \$4.25, what is the net profit from each? What is the profit from the whole flock?

12. A farmer in Vermont found that a field of potatoes sprayed with Bordeaux mixture produced $\frac{5}{8}$ more bushels than another field not sprayed. If the unsprayed field produced 116 bushels per acre, how many bushels did the sprayed field produce?

13. At 55¢ per bushel, by how much was the value of each acre increased?

14. Bordeaux mixture is made by using 5 pounds of unslaked lime worth about 1 cent a pound and 3 pounds of copper sulphate worth 10 cents a pound with 25 gallons of water. How much will 200 gallons needed for one acre cost?

58. DIVISION OF FRACTIONS

1. How many times is \$2 contained in \$8? $\frac{2}{3}$ in $\frac{8}{3}$?

2. How many $\frac{1}{2}$-peck baskets will contain $3\frac{1}{2}$ pecks of peas?

3. How many badges each $\frac{2}{9}$ of a yard long can be cut from $3\frac{1}{3}$ yards of ribbon?

4. If peaches are packed in baskets holding $\frac{3}{8}$ of a bushel each, how many baskets will be needed for $7\frac{1}{2}$ bushels?

5. $5\frac{5}{8}$ yd. of cloth are divided into pieces each containing $1\frac{7}{8}$ yd. How many pieces?

6. If an acre produced $\frac{3}{5}$ of a bale of cotton, how many acres in a field that produced 6 bales?

7. At $\$\frac{1}{3}$ per pound, how much coffee can be bought for $2? For $3? For $5?

8. If a horse eats $\frac{3}{8}$ bu. of oats a day, how long will 6 bu. last?

9. Divide 2 ft. by 8 in. What change did you make before dividing?

10. Give the quotient of $8 ÷ $2; of 8 ft. ÷ 2 ft.? of $\frac{8}{9} \div \frac{2}{9}$.

11. When two fractions have common denominators, how may the division be performed?

12. Divide $\frac{7}{8}$ by $\frac{3}{4}$ by first changing to common denominators.

Find the value of the following:

13. $\frac{3}{8} \div \frac{3}{4}$.	**17.** $1\frac{3}{7} \div \frac{2}{7}$.	**21.** $\frac{2}{3} \div \frac{1}{9}$.
14. $\frac{3}{8} \div \frac{1}{2}$.	**18.** $1\frac{3}{8} \div \frac{3}{4}$.	**22.** $\frac{2}{3} \div \frac{5}{6}$.
15. $\frac{9}{10} \div \frac{3}{5}$.	**19.** $1\frac{5}{6} \div \frac{1}{2}$.	**23.** $\frac{2}{3} \div \frac{4}{9}$.
16. $\frac{2}{7} \div \frac{3}{14}$.	**20.** $\frac{9}{10} \div \frac{4}{5}$.	**24.** $\frac{1}{10} \div \frac{4}{5}$.

25. Describe another method you have used in dividing one fraction by another.

In dividing the following use both methods and tell which one you like better.

26. $\frac{11}{12} \div \frac{3}{4}$.	**30.** $\frac{7}{8} \div \frac{5}{12}$.	**34.** $\frac{7}{12} \div \frac{4}{5}$.	**38.** $\frac{3}{8} \div \frac{2}{3}$.
27. $\frac{4}{5} \div \frac{4}{7}$.	**31.** $\frac{27}{32} \div \frac{5}{16}$.	**35.** $\frac{25}{27} \div \frac{5}{18}$.	**39.** $\frac{11}{34} \div \frac{3}{17}$.
28. $\frac{3}{16} \div \frac{5}{24}$.	**32.** $\frac{7}{8} \div \frac{3}{5}$.	**36.** $\frac{5}{44} \div \frac{2}{11}$.	**40.** $1\frac{2}{5} \div \frac{5}{14}$.
29. $\frac{7}{48} \div \frac{3}{16}$.	**33.** $\frac{11}{12} \div \frac{6}{7}$.	**37.** $\frac{3}{8} \div \frac{9}{10}$.	**41.** $6\frac{1}{4} \div 2\frac{1}{2}$.

42. How many badges $4\frac{1}{6}$ in. long can be made from 5 yards of ribbon?

43. If your father uses $\frac{3}{5}$ of a ton of coal per week, how long will 12 tons last?

44. Mr. Smith has contracted to cut 28 cords of wood. How long will it take him if he can cut $1\frac{3}{4}$ cords a day?

Practical Problems in Division

1. For making a garment $\frac{5}{6}$ yd. of cloth is required. How many garments can be made from 15 yd. of the cloth?

2. How many strips of carpet $\frac{3}{4}$ of a yard wide does it take to cover a floor 6 yd. wide?

3. How many pieces of cord each $\frac{5}{6}$ yd. long can be cut from a piece of cord 25 yd. long?

4. In a waist factory it takes $1\frac{1}{3}$ yd. of lace to trim a certain kind of waist. How many waists can be trimmed with a bolt of lace containing 12 yd.?

5. In a shirt factory it takes $3\frac{1}{8}$ yd. of percale to make a shirt. How many shirts can be made from a bolt containing 30 yd.?

6. A lady bought a remnant containing $7\frac{7}{8}$ yd. of madras to make her husband some shirts. If it took $3\frac{7}{8}$ yd. for each shirt, how many could she make from this piece?

7. She bought a remnant containing $5\frac{3}{8}$ yd. of gingham to make her little daughter some aprons. If it took $2\frac{3}{8}$ yd. for each apron, how many could she make from the remnant?

8. A rectangle containing $\frac{15}{16}$ sq. ft. is $\frac{3}{4}$ ft. wide. How long is it?

9. A rectangle containing $\frac{11}{12}$ sq. yd. is $\frac{5}{6}$ yd. wide. How long is it?

10. A rectangle containing $5\frac{7}{8}$ sq. ft. is $1\frac{3}{4}$ ft. wide. How long is it?

11. If $\frac{5}{8}$ yd. of lace will make one jabot, how many such jabots can be made from $4\frac{3}{8}$ yd. of lace?

12. If $\frac{3}{8}$ yd. of lace will trim one neckband, how many neckbands can be trimmed from $3\frac{3}{4}$ yd. of lace?

13. There are $12\frac{5}{6}$ yd. of braid used on one sailor suit. How many such suits can be trimmed from $51\frac{1}{3}$ yd. of braid?

14. If a farmer gets $9\frac{5}{8}$ tons of hay from a field containing $5\frac{1}{2}$ acres, what is the average yield per acre?

15. If George raised $46\frac{1}{2}$ bu. of corn from a piece of ground containing $\frac{3}{4}$ A., what was the yield per acre?

16. In $5\frac{1}{2}$ months James gained $8\frac{1}{4}$ lb. in weight. What was the average gain per month?

17. Donald rode $19\frac{1}{2}$ miles in $3\frac{1}{2}$ hours. Find the average distance that he rode per hour.

18. A farmer used $28\frac{7}{8}$ bu. of seed wheat upon a field containing $16\frac{1}{2}$ acres. What was the average amount used per acre?

19. How many tucks each $\frac{1}{4}$ in. wide must be put in a piece of goods to shorten it $6\frac{1}{2}$ in.?

20. How many sleeves can be cut out of $4\frac{1}{2}$ yd. of goods, if each sleeve takes $\frac{3}{8}$ yd.?

Making Grape Juice

The following recipe is used in making grape juice:

$1\frac{1}{2}$	cups grapes
1	cup water
$\frac{1}{2}$	cup sugar

1. If we have 3 cups of grapes, that is how many times $1\frac{1}{2}$ cups? Then for 3 cups of grapes we must use how many cups of water?

2. For 3 cups of grapes we must use how many cups of sugar?

3. If we have 2 cups of grapes, how much water must be added? How much sugar?

4. If we have five cups of grapes, how much water must be added? How much sugar?

5. If we have $8\frac{1}{2}$ cups of grapes, how much water must be added? How much sugar?

6. If we have $4\frac{2}{3}$ cups of grapes, how much water must be added? How much sugar?

59. RATIO

The **ratio** of one number to another is the quotient of the first divided by the second.

Exercises in Ratio

1. If 15 doz. eggs are worth $3.15, what are 45 doz. worth?

Suggestion. — Compare 45 and 15. Can you solve the problem without a pencil?

2. What is the ratio of 56 to 14? If 14 tons of coal cost $119, how many times as much will 56 tons cost? How much will 56 tons cost?

3. What is the ratio of 27 to 9? When 9 yards of cloth cost $11.25, how much will 27 yards cost? Can you solve this without a pencil?

4. What is the ratio of 3 to 12? If 12 barrels of sugar cost $237, how much will three barrels cost?

5. What is the ratio of 85 to 17? If 17 bu. of potatoes are worth $14.45, how much are 85 bu. worth? Can you solve this without a pencil?

6. What is the ratio of 64 to 16? If a bicyclist rides 16 miles in $1\frac{1}{4}$ hr., how long at this rate will it take him to ride 64 miles?

7. What is the ratio of 36 to 12? If 12 cars will carry 285 tons, how many tons will 36 cars carry?

8. What is the ratio of 78 to 13? If I receive $45.50 for 13 days' work, how much should I receive for 78 days?

9. If 3 hats cost a dealer $6.75, find the rate per dozen.

10. If an article weighing 18 lb. costs $1.52, how much will one weighing 90 lb. cost at the same rate?

11. What is the ratio of 3 pk. to 1 bu.? How much will 3 pk. of apples cost at $2 a bushel?

12. What is the ratio of 6 oz. to 1 lb.? How much will 6 oz. of spices cost at 40 ¢ a pound?

13. How much will 8 oranges cost at 45 ¢ a dozen?

14. What is the ratio of $\frac{1}{8}$ to $\frac{1}{4}$? If $\frac{1}{4}$ A. of land is worth $32, how much is $\frac{1}{8}$ A. worth?

15. What is the ratio of $\frac{3}{4}$ to $\frac{3}{16}$? If $\frac{3}{16}$ of a farm sells for $1200, how much will $\frac{3}{4}$ of the farm sell for at the same rate?

16. What is the ratio of $\frac{3}{8}$ to $\frac{2}{3}$? (*Hint.* Change to 24ths.) If $\frac{2}{3}$ of the distance to a certain place is 48 miles, what is $\frac{3}{8}$ the distance to that place?

17. What is the ratio of 8 to 6? If 6 cords of wood are worth $15.75, how much are 8 cords worth? (Since 8 is $1\frac{1}{3}$ times 6, 8 cords will cost $1\frac{1}{3}$ times $15.75, or $15.75 + $\frac{1}{3}$ of $15.75. Now can you solve without a pencil?)

18. What is the ratio of 12 to 9? If 9 cars can carry 186 tons of coal, how many can 12 cars carry? (Solve quickly by writing $\frac{1}{3}$ of 186 under 186 and adding.)

19. What is the ratio of 20 to 18? If 18 bushels of apples cost $10.80, how much will 20 bushels cost?

20. If $\frac{3}{16}$ of a farm is worth $360, find the value of $\frac{5}{8}$ of it.

21. What is the ratio of $2\frac{1}{2}$ to 5? At 5 dozen pencils for $2.40, how much will $2\frac{1}{2}$ dozen cost?

Give the ratios of the following quantities:

22. 2 bbl. and 18 bbl.

23. 42 gal. and 7 gal.

24. \$8 and \$64.

25. 1 ft. and 1 yd.

26. 1 bu. and 16 qt.

27. 21 da. and 30 da.

28. 1 lb. and 4 oz.

29. 6 in. and 2 yd.

30. $\frac{3}{4}$ ton and $3\frac{3}{4}$ tons.

31. $2\frac{1}{2}$ yd. and $7\frac{1}{2}$ yd.

32. Make problems including the above quantities and solve them, or propose them to your classmates for solution.

Give the ratios of the following numbers:

33. $\frac{9}{10}$ and $\frac{3}{5}$.

34. $\frac{1}{3}$ and 3.

35. $\frac{2}{5}$ and $\frac{3}{4}$.

36. $\frac{5}{7}$ and $\frac{12}{21}$.

37. $2\frac{1}{2}$ and $1\frac{1}{4}$.

38. $1\frac{1}{8}$ and $4\frac{1}{2}$.

39. $2\frac{3}{8}$ and $\frac{19}{4}$.

40. $\frac{3}{7}$ and $\frac{9}{14}$.

41. 5 and $\frac{1}{3}$.

42. 2 and $\frac{1}{4}$.

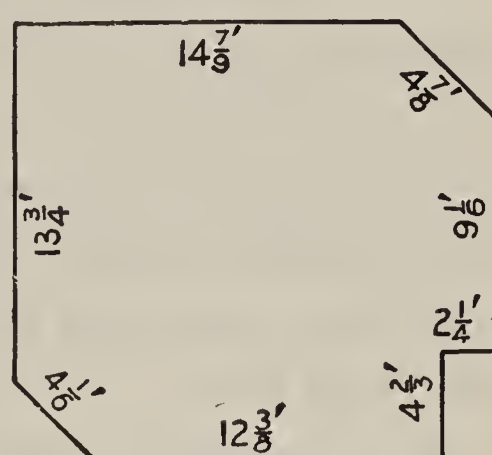
43. 3 and $\frac{1}{5}$.

44. 5 and $\frac{1}{2}$.

45. When $1\frac{1}{8}$ yards of velvet costs \$1.75, how much will $4\frac{1}{2}$ yards cost?

Miscellaneous Problems in Fractions

1. This is the plan of a room. How many feet of border are required in papering the room? How many yards?



2. In this room there is a door $3\frac{5}{8}$ ft. wide, one window $3\frac{3}{4}$ ft. wide, one window $4\frac{5}{12}$ ft. wide, and a mantel $5\frac{1}{6}$ ft. wide. What is the sum of all these widths?

3. By subtracting the sum of the widths of the door and the mantel from the total distance around the room, we get the length of the baseboard in the room. How many feet of baseboard are required in finishing the room?

4. A dealer bought 4 carloads of coal at the mine, weighing as follows: $31\frac{5}{8}$ tons, $27\frac{3}{5}$ tons, $29\frac{7}{10}$ tons, and $30\frac{3}{4}$ tons. How many tons in all?

5. On Tuesday night the Mississippi River at Vicksburg stood at $12\frac{3}{8}$ ft. above low-water mark. During Wednesday it rose $1\frac{5}{9}$ ft., on Thursday $2\frac{7}{12}$ ft., on Friday $1\frac{8}{9}$ ft., and on Saturday $\frac{3}{4}$ ft. How high was it above low-water mark on Saturday night?

6. On Sunday the Mississippi fell $\frac{2}{9}$ ft., on Monday $1\frac{3}{4}$ ft., and on Tuesday $2\frac{5}{6}$ ft. How high was it Tuesday night?

7. How much higher was the river the second Tuesday night than it was the first Tuesday night?

8. From Chicago to Geneva, by the Chicago and Northwestern Railroad, is $35\frac{1}{2}$ miles, and from Geneva to De Kalb is $22\frac{4}{5}$ miles. How far is it from Chicago to De Kalb?

9. If a man can plow $1\frac{7}{8}$ acres in one day, how long will it take him to plow a field containing $22\frac{1}{2}$ acres? A field containing $18\frac{3}{4}$ acres?

10. A man owning $\frac{3}{4}$ of a business sold $\frac{2}{5}$ of his share. What fraction of the whole business did he sell? What part did he have left?

11. A piece of ribbon $6\frac{1}{2}$ ft. long may be divided into how many badges each $\frac{1}{2}$ ft. long?

12. If a horse eats $1\frac{1}{2}$ pecks of oats a day, how long will $22\frac{1}{2}$ pecks last?

13. In making a suit of clothes, a tailor uses $2\frac{5}{8}$ yd. of cloth for the coat, $\frac{8}{9}$ yd. for the vest, and $2\frac{1}{4}$ yd. for the trousers. How many yards does he use in the whole suit? If he cuts the cloth from a piece containing $9\frac{1}{6}$ yd., how much will then be left?

60. FACTORING

NOTE. — Sections 60 and 61 are given as a preparation for Section 62. Since the practical problems met by the average person do not involve fractions with larger terms than those with which we have been working, these three sections may be omitted unless special conditions require fractions with large terms.

1. What are the numbers whose product is 6? 10? 15?

2. What is the product of 2, 3, and 5? Then what are the three numbers whose product is 30?

3. What are the three numbers whose product is 8? 12?

4. What are the numbers other than 1 and 5 whose product is 5? What are the numbers other than 1 and 17 whose product is 17?

> *Those numbers whose product equals a given number are called the* **factors** *of that number. A number which has no factors other than* 1 *and the number itself is called a* **prime number.**

5. Find the prime factors of 660.

WORK

$$\begin{array}{r} 2\,\underline{)660} \\ 2\,\underline{)330} \\ 5\,\underline{)165} \\ 3\,\underline{)\ 33} \\ 11 \end{array}$$

EXPLANATION. — Since the product of the factors must equal 660, each factor must be a divisor of 660. By trial we see that 2 will divide 660, and the quotient is 330. Then we see that 2 will divide 330, and the quotient is 165. Then 5 will divide 165, with the quotient 33. Then 3 will divide 33, with the quotient 11. So the factors are 2, 2, 5, 3, 11. All of these factors are prime numbers.

Find the prime factors of:

6. 34.	**10.** 74.	**14.** 42.	**18.** 100.	**22.** 156.	**26.** 450.
7. 65.	**11.** 51.	**15.** 70.	**19.** 144.	**23.** 126.	**27.** 364.
8. 46.	**12.** 85.	**16.** 24.	**20.** 128.	**24.** 140.	**28.** 1216.
9. 95.	**13.** 94.	**17.** 72.	**21.** 105.	**25.** 324.	**29.** 1728.

61. LEAST COMMON MULTIPLE

1. Name some numbers that can be divided by 3.

2. Name some numbers that will contain both 2 and 3. What is the least number that will contain both 2 and 3?

> *Any number that can be divided by a given number is a* **multiple** *of that number. The least number that can be divided by each of two or more numbers is their* **least common multiple.**

3. Show that 36, 60, 72, and 120 are *multiples* of 12.

Give at sight the least common multiple of:

4. 3 and 4.	**7.** 8 and 12.	**10.** 2, 3, 5.	**13.** 8, 6, 5.
5. 5 and 6.	**8.** 7 and 9.	**11.** 3, 4, 6.	**14.** 3, 4, 8.
6. 6 and 8.	**9.** 9 and 12.	**12.** 2, 4, 8.	**15.** 12, 8, 9.

16. Find the least common multiple of 30 and 42.

WORK

$$30 = 2 \times 3 \times 5$$
$$42 = 2 \times 3 \times 7$$
$$2 \times 3 \times 5 \times 7 = 210, \text{ the L. C. M.}$$
or
$$30 \times 7 = 210, \text{ the L. C. M.}$$

EXPLANATION. — A multiple of 30 must contain all the prime factors of 30, and a multiple of 42 must contain all the prime factors of 42. So we first factor 30 and 42. Now, a number whose factors are 2, 3, 5, and 7 will contain $2 \times 3 \times 5$, or 30, and also $2 \times 3 \times 7$, or 42. So $2 \times 3 \times 5 \times 7$, or 210, is the least common multiple (L.C.M.). In practice we say 30×7, or 42×5, since 7 is not found in 30, or 5 in 42.

17. Find the L. C. M. of 60, 72, and 108.

WORK

$$60 = 2 \times 2 \times 3 \times 5$$
$$72 = 2 \times 2 \times 2 \times 3 \times 3$$
$$108 = 2 \times 2 \times 3 \times 3 \times 3$$
$$108 \times 2 \times 5 = 1080, \text{ L. C. M.}$$

QUESTIONS. — What prime factor of 60 needed in the L.C.M. is not found in 108?

What prime factor of 72 is found more times in 72 than in 108?

18. What is the L. C. M. of 45, 90, 100, and 200?

SUGGESTION. — Since 90 will contain 45 and 200 will contain 100, we need only to find the L. C. M. of 90 and 200.

Find the least common multiple of:

19. 60 and 84.
20. 48 and 120.
21. 25 and 45.
22. 64 and 72.
23. 56 and 70.
24. 42 and 48.
25. 15, 21, 45.
26. 16, 32, 48.
27. 18, 27, 54.
28. 16, 18, 72.
29. 14, 42, 35.
30. 12, 18, 48.

62. ADDING AND SUBTRACTING FRACTIONS WITH LARGE TERMS

1. Add $\frac{25}{66}$ and $\frac{31}{78}$.

WORK

$$66 = 2 \times 3 \times 11$$
$$78 = 2 \times 3 \times 13$$
$$\text{L. C. M.} = 2 \times 3 \times 11 \times 13, \text{ or } 858$$
$$\frac{25}{66} = \frac{13 \times 25}{13 \times 66} = \frac{325}{858}$$
$$\frac{31}{78} = \frac{11 \times 31}{11 \times 78} = \frac{341}{858}$$
$$\text{Sum} = \frac{666}{858} = \frac{111}{143}$$

EXPLANATION. — The least common denominator is the least common multiple of the denominators. Factoring the denominators, we find their L. C. M. to be 858. Multiplying both terms of $\frac{25}{66}$ by 13, the factor of the L. C. M. not contained in 66, and both terms of $\frac{31}{78}$ by 11, we have $\frac{325}{858}$ and $\frac{341}{858}$. The sum $= \frac{666}{858}$. Dividing both terms by 6, $\frac{666}{858} = \frac{111}{143}$.

Find the sum of:

2. $\frac{7}{15} + \frac{4}{21}$.
3. $\frac{31}{33} + \frac{17}{18}$.
4. $\frac{7}{24} + \frac{11}{21}$.
5. $\frac{29}{48} + \frac{29}{32}$.
6. $\frac{17}{84} + \frac{19}{60}$.
7. $\frac{49}{160} + \frac{53}{128}$.
8. $\frac{65}{144} + \frac{61}{132}$.
9. $\frac{56}{81} + \frac{35}{126}$.
10. $\frac{19}{68} + \frac{37}{102}$.
11. $\frac{53}{60} + \frac{19}{72}$.
12. $\frac{89}{90} + \frac{17}{40}$.
13. $\frac{65}{72} + \frac{11}{120}$.

Find the difference:

14. $\frac{65}{72} - \frac{11}{128}$.
15. $\frac{17}{36} - \frac{7}{60}$.
16. $\frac{7}{8} - \frac{11}{156}$.
17. $\frac{9}{16} - \frac{17}{56}$.
18. $\frac{23}{24} - \frac{101}{300}$.
19. $\frac{16}{81} - \frac{1}{126}$.
20. $\frac{17}{33} - \frac{6}{77}$.
21. $\frac{40}{81} - \frac{17}{90}$.
22. $\frac{43}{84} - \frac{17}{96}$.

DECIMAL FRACTIONS

63. THE DECIMAL PARTS OF A DOLLAR

1. Compare the values of \$1, 1 dime, 1 cent.

2. $\frac{3}{10}$ of a dime = —— cents; $\frac{4}{10}$ of a dollar = —— dimes.

3. $\frac{3}{100}$ of a dollar = —— cents; $\frac{25}{100}$ of a dollar = —— cents.

4. Compare the value of $\$\frac{1}{2}$, 50 cents, and \$0.50.

5. Compare the value of $\$2\frac{1}{4}$, $\$2\frac{25}{100}$, and \$2.25.

6. What is the common way of writing a number of dollars and cents? Write 1 dollar and 25 cents.

7. Write 2 dollars and 40 cents. 40 cents = —— dimes.

8. In \$2.45, which figure represents dollars? Which one dimes, or tenths of a dollar? Which one cents, or tenths of a dime?

9. 45 cents is what part of a dollar? Read \$2.45 as dollars and hundredths of a dollar.

10. Read \$1.75 as dollars, dimes, and cents, and as dollars and hundredths of a dollar.

> *The point between dollars and cents is called the* **decimal point** *and separates the dollars from the parts of a dollar.*

11. The first figure at the right of the decimal point represents dimes or —— of a dollar. The second figure at the right represents cents or —— of a dollar.

12. Read as dimes and cents, and then as tenths and hundredths of a dollar: \$0.45; \$0.86; \$0.54.

NOTE. — The decimal point is very important. To make it more conspicuous it is well to fill the ones' place with a zero.

64. THE DECIMAL NOTATION

1. What does each 2 represent in 22?

2. How do they compare in value?

3. In $44, what does each 4 represent? Compare their values.

4. In $3.33, tell what each represents as dollars, dimes, and cents. As dollars, tenths of a dollar, hundredths of a dollar.

5. As you move a figure one place to the right, how do you affect the value which it represents?

6. What then should be the value of the number written in the first place at the right of *ones?* The second place at the right? The third place at the right?

We use a **decimal point** (·) *to locate ones. The first place at the right is* **tenths**, *the second* **hundredths**, *the third*, **thousandths**, *the fourth*, **ten thousandths**, *etc.*

Thus, 3.46 is read, "three, and forty-six hundredths." 6.375 is read, "six, and three hundred seventy-five thousandths."

Numbers written at the **left** *of the decimal point are* **integers**. *They denote so many* **whole** *things.*

Numbers written at the **right** *of the decimal point are* **fractions**. *They denote* **equal parts** *of whole things.*

Because these equal parts are **tenths, hundredths, thousandths**, *etc., we call them* **decimal fractions**, *or, more briefly,* **decimals**.

In reading numbers, "and" is used only between the whole number and the fraction, where the decimal point comes.

Read:

7. 6.7.	**12.** 0.63.	**17.** 3.46.	**22.** 9.095.
8. 9.42.	**13.** 1.09.	**18.** 6.04.	**23.** 11.116.
9. 8.53.	**14.** 10.1.	**19.** 7.41.	**24.** 3.435.
10. 9.07.	**15.** 9.09.	**20.** 7.04.	**25.** 0.056.
11. 0.8.	**16.** 9.95.	**21.** 0.95.	**26.** 0.097.

Write:

27. Three, and four tenths. **29.** Eleven hundredths.

28. Forty-five hundredths. **30.** Nine, and six hundredths.

31. Six, and three hundred six thousandths.

32. Seven, and seventy-seven thousandths.

Write the following, using denominators:

33. 0.5; 0.17; 0.08; 0.25; 0.125; 0.008.

34. 0.36; 0.03; 0.003; 0.9; 0.90; 0.09.

Write as decimals:

35. $\frac{3}{10}$.	**38.** $\frac{7}{10}$.	**41.** $6\frac{24}{100}$.	**44.** $4\frac{545}{1000}$.
36. $\frac{17}{100}$.	**39.** $3\frac{4}{10}$.	**42.** $7\frac{13}{100}$.	**45.** $7\frac{603}{1000}$.
37. $\frac{45}{100}$.	**40.** $5\frac{8}{10}$.	**43.** $9\frac{16}{100}$.	**46.** $8\frac{708}{1000}$.

65. ADDITION OF DECIMALS

1. Add 3.8, 7.5, and 6.45.

WORK

```
 3.8
 7.5
 6.45
-----
17.75
```

REMARK. — Since only like things can be combined into one sum, we place the decimal points under each other so that the *ones* will come in one column, the *tenths* in another, etc.

Add:

2.	3.	4.	5.	6.
0.75	3.42	5.46	1.83	2.86
1.6	7.886	7.531	2.907	1.945
7.23	0.96	8.205	0.76	0.72
2.5	7.445	0.063	1.093	0.806

7.	8.	9.	10.	11.
23.65	69.04	80.46	8.724	145.84
45.3	40.81	2.73	15.379	902.68
8.74	3.59	16.39	40.903	47.25
49.67	67.2	9.81	28.185	408.91

12.	13.	14.	15.	16.
0.786	85.06	96.84	34.965	38.9
34.98	7.8	9.365	7.304	26.85
50.742	6.945	8.04	0.968	7.683
6.08	18.56	19.65	3.8	18.4
7.065	9.352	83.486	19.6	9.64
83.46	7.65	7.48	8.48	7.28
7.19	85.9	9.8	9.752	12.654

Write in columns and add:

17. $38.65 + 26.8 + 17.65 + 8.652 + 9.847 + 10.8 + 64.54.$

18. $396.4 + 84.7 + 68.95 + 83.96 + 7.365 + 84.637 + 19.3.$

19. $84.65 + 32.9 + 8.365 + 17.95 + 86.05 + 756.3 + 87.58.$

20. $38.65 + 296.3 + 84.96 + 75.38 + 396.8 + 400.75 + 83.96.$

21. $9.65 + 0.384 + 16.75 + 86.38 + 1.75 + 0.847 + 3.9 + 8.46.$

22. $8.96 + 86.38 + 5.863 + 17.94 + 73.8 + 8.56 + 83.46 + 20.$

23. $16.8 + 36.85 + 96.38 + 9.84 + 17.65 + 84.375 + 6.84 + 18.$

24. $38.4 + 83.19 + 64 + 3.85 + 0.95 + 3.875 + 14.86 + 85.$

25. $376.8 + 97.38 + 3.875 + 398 + 28.96 + 0.84 + 16.5 + 8.$

66. SUBTRACTION OF DECIMALS

Subtract:

1.	2.	3.	4.	5.
3.46	5.73	6.82	9.81	8.03
1.28	2.9	1.93	3.67	1.8

6. Subtract 3.28 from 5.6.

WORK

5.60
3.28
2.32

REMARK. — Since there are no hundredths in the minuend, we may fill its place with a zero and proceed as in any subtraction.

7. 3.46 from 7.8.
8. 9.13 from 15.7.
9. 6.93 from 9.3.
10. 4.09 from 6.7.
11. 8.16 from 9.
12. 16.453 from 23.84.
13. 14.375 from 29.63.
14. 15.641 from 38.46.
15. 29.365 from 42.6.
16. 41.296 from 50.
17. 42.61 from 63.2
18. 8.296 from 9.05
19. 329.1 from 864.
20. 47.77 from 100.

21.	22.	23.	24.	25.
38.96	48.9	34.89	84.2	38.2
7.875	9.65	9.835	16.875	19.684

26.	27.	28.	29.	30.
16	24	38	42	82
9.765	8.385	19.734	38.965	79.364

31. 8 – 3.675.
32. 10 – 7.842.
33. 3 – 2.486.
34. 2 – 1.896.
35. 17 – 9.846.
36. 8 – 7.985.
37. 8.6 – 7.965.
38. 7.3 – 6.842.
39. 6.2 -- 5.486.
40. 7.1 – 6.384.
41. 9.3 – 8.962.
42. 7.5 – 6.875.
43. 3.2 – 1.8321.
44. 6.1 – 5.7306.
45. 8.2 – 5.9036.
46. 7.8 – 6.9308.
47. 6.1 – 5.3045.
48. 5.8 – 3.9065.

Practical Problems in Addition and Subtraction

1. At one of its stations the Weather Bureau reported the rainfall for a week as follows: Sunday, 1.4 in.; Monday, 1.1 in.; Tuesday, 0.2 in.; Wednesday, 0.3 in.; Thursday, 0.7 in.; Friday, 0.5 in.; Saturday, 0.6 in. Find the total rainfall for the week.

2. The rainfall in inches for 12 months at a certain place was as follows: 2.26, 2.48, 3.67, 3.19, 2.45, 1.37, 1.65, 2.39, 4.72, 3.31, 2.14, 3.63. What was the total rainfall for the year?

3. The rainfall in inches at Chicago for the 12 months beginning with November, 1908, was as follows: 2.67, 1.18, 1.96, 3.84, 1.63, 7.73, 2.18, 5.09, 1.77, 6.20, 3.60, 1.20. Find the total rainfall for the year.

4. From Chicago to Wheaton is 24.9 mi.; from Wheaton to Geneva is 10.6 mi.; from Geneva to Clinton, Ia., is 102.6 mi.; and from Clinton to Cedar Rapids is 81.3 mi. How far is it from Chicago to Cedar Rapids?

5. A dairyman kept a record of the amount of milk that one of his cows gave in 4 weeks. The amount the first week was 73.6 lb., the second week 78.7 lb., the third week 84.3 lb., and the fourth week 68.8 lb. How much did she give in the 4 weeks?

6. How much coal in 6 carloads weighing as follows: 28.74 tons, 29.38 tons, 31.16 tons, 29.75 tons, 30.27 tons, and 28.13 tons?

7. Wet soil that weighed 4.37 lb. was baked in an oven until perfectly dry, and then weighed again. When dry it weighed only 3.69 lb. How much water did it contain originally?

8. A river rose to a point 9.67 ft. above low-water mark after a rain. It then fell to a point 7.85 ft. above low-water mark in one day. How far did it fall in the day?

9. If a river fell 2.05 ft. one day, 1.9 ft. the next day, and 2.16 ft. the next day, how far did it fall in the three days?

10. The ice on a pond was 6.75 in. thick one night and 7.35 in. thick the next morning. How much did it freeze during the night?

11. In 1 lb. of peanuts there is 0.245 lb. of refuse (shell and lining) and 0.069 lb. of water. The rest is nutritive matter. Find the amount of nutritive matter.

12. In 1 lb. of hickory nuts there is 0.622 lb. of refuse and 0.014 lb. of water. The rest is nutritive matter. Find the amount of nutritive matter.

13. In 100 lb. of milk there are 5.7 lb. of sugar, 4.32 lb. of fat, 3.34 lb. of protein, and 0.74 lb. of ash. The rest is water. Find the amount of water.

14. Last year John could run the 100-yard dash in 14.2 seconds. This year he can run it in 12.5 seconds. How much has he lowered his record in one year?

15. The 220-yard run was made last year by Charles in 27.8 seconds. Robert made it in 29.5 seconds. By how many seconds did Charles win?

16. In making an experiment of spraying Irish potatoes, soil that had yielded an average of 208.5 bu. to the acre was made to yield 245.25 bu. to the acre. What was the gain?

17. It was found that in fattening pigs, to produce a pound of increase in weight when the pigs were pastured on peanuts it took 1.77 lb. of grain. When they were pastured on cowpeas it took 3.07 lb. of grain. How many more pounds of grain did it take when pasturing on cowpeas?

67. A DECIMAL MULTIPLIED BY AN INTEGER

1. Give the products of the following numbers:

$7	7 ft.	7 miles	7 tenths	0.7	7 hundredths.
3	3	3	3	3	3

2. Multiply 3.56 by 8.

WORK

$$\begin{array}{r} 3.56 \\ 8 \\ \hline 28.48 \end{array}$$

REMARK. — 8 × 6 hundredths are 48 hundredths, or four tenths and 8 hundredths; the 8 is placed in hundredths' place and the 4 carried to the tenths' place.

Observe that when a decimal is multiplied by a whole number, the decimal point in the product comes under the decimal point of the multiplicand.

Multiply:

3.	4.	5.	6.	7.	8.
3.86	5.48	6.93	14.8	16.9	48.9
9	7	8	9	7	6

9.	10.	11.	12.	13.	14.
2.78	63.5	0.375	9.68	86.3	0.963
43	64	47	65	52	85

68. EFFECT OF ANNEXING ZEROS AT THE RIGHT OF THE DECIMAL POINT

1. Compare $0.5 and $0.50.
2. Compare 0.12 ft. and 0.120 ft.
3. Compare $3. and $3.00.
4. Compare 2.5 with 2.500.

5. Does annexing zeros to a number change the value if the decimal point remains unchanged?

> *The value of a figure depends upon the order which it occupies. If the decimal point is not moved, the order is not changed, and annexing zeros does not change the value.*

69. EFFECT OF MOVING THE DECIMAL POINT

1. Compare \$0.01 and \$1.00. \$1.00 is —— times \$0.01.
2. Compare \$0.05 and \$5.00; \$2.35 and \$235.
3. What is 100 times \$4.30? What is $\frac{1}{100}$ of \$450?
4. What effect on the value of \$4.30 has the changing of the place of the decimal point, so that the number is \$430?
5. What is 10 times 2 ft.? How is 0.2 ft. affected by moving the point so that the number becomes 2 ft.?

NOTE. — We do not really write the decimal point when a number is an integer, but we consider it to be at the right of *ones;* thus 2 ft. might be written 2. ft.

6. Compare 0.2 and 2; 0.3 and 3; 0.02 and 2; 0.05 and 5.
7. Compare 0.002 and 2; 0.006 and 6; 0.125 and 125.

> *Moving the decimal point one place to the right multiplies by* 10; *moving it two places to the right multiplies by* 100; *moving it three places multiplies by* 1000.

Multiply the following by 1000:

8. 0.365; 0.045; 0.08; 1.06.
9. 5.345; 7.08; 8.08; 9.2.

Multiply by moving the decimal point:

10. 10 × 3.4.	**15.** 10 × 2.65.	**20.** 100 × 2.5.
11. 10 × 0.2.	**16.** 100 × 3.783.	**21.** 1000 × 0.065.
12. 100 × 1.25.	**17.** 100 × 0.1675.	**22.** 1000 × 0.17.
13. 100 × 3.04.	**18.** 1000 × 0.243.	**23.** 100 × 19.3.
14. 100 × 0.16.	**19.** 100 × 0.5.	**24.** 1000 × 0.67.

25. Compare $50.00 and $5.00. What change in the place of the decimal point will give $\frac{1}{10}$ of $50?

26. What is $\frac{1}{100}$ of 800? What change is made in the place of the decimal point?

27. Moving the decimal point one place to the left in $700 gives what? What part of $700 is $70?

28. Moving the decimal point two places to the left in 500 gives what? Compare 5 and 500.

> *Moving the decimal point one place to the left divides a number by* 10; *moving it two places to the left divides by* 100; *moving it three places to the left divides by* 1000.

Divide by moving the decimal point:

29. $9750 by 100.	**33.** $5.50 by 100.
30. 3465 ft. by 1000.	**34.** 3.54 by 100.
31. 693.5 by 100.	**35.** 34.6 by 1000.
32. 67.3 by 100.	**36.** 0.06 by 10.

70. MULTIPLYING A DECIMAL BY A DECIMAL

1. When you divide a number by 10 the quotient is what part of the dividend?

2. 0.1 of 85 is found by dividing 85 by ——.

3. 0.4 of 20 means what? 0.05 of 100 means what?

4. What is 0.4 of 20? 0.05 of 100?

5. When we speak of multiplying a number by $\frac{1}{2}$, do we really multiply the number; that is, really increase it?

6. What do we do to multiply by $\frac{1}{2}$? by $\frac{1}{4}$? by $\frac{1}{5}$?

NOTE. — When the multiplier is a fraction the sign × does not mean "times," but means "of" and must be read "of." For example, 0.1 × 4.5 is read $\frac{1}{10}$ of $4\frac{5}{10}$.

7. $75 \div 100$, or $\frac{1}{100}$ of $75 =$ ——. (Written 0.01 × 75.)

Read and then find the value of:

8. 0.1 × 20.	14. 0.1 × 6.5.	20. 0.02 × 5.
9. 0.2 × 20.	15. 0.2 × 6.5.	21. 0.04 × 35.
10. 0.01 × 400.	16. 0.1 × 3.2.	22. 0.5 × 0.25.
11. 0.03 × 400.	17. 0.02 × 3.2.	23. 0.8 × 12.5.
12. 0.01 × 80.	18. 0.01 × 2.5.	24. 0.6 × 0.25.
13. 0.04 × 80.	19. 0.04 × 2.5.	25. 0.05 × 2.4.

Exercises

1. Multiply 8.42 by 2.6.

PROCESS

$$\begin{array}{r} 8.42 \\ \underline{2.6} \\ 5.052 \\ \underline{16.84} \\ 21.892 \end{array}$$

EXPLANATION. — 0.6 × 0.02 = 0.012; write 2 in *thousandths'* place and carry the 1 hundredth. 0.6 × 0.4 = 0.24; 0.24 + 0.01 = 0.25; and thus proceed, keeping each figure in its proper order.

Or we may multiply as in whole numbers and give the product as many decimal places as both multiplier and multiplicand contain.

Observe that when a decimal is multiplied by a decimal the product contains as many decimal places as the sum of the places in both multiplier and multiplicand.

Find the products in the following:

2. 0.26×37.5.
3. 4.5×90.8.
4. 6.5×37.2.
5. 0.35×9.6.
6. 0.82×10.8.
7. 0.37×86.
8. 40.5×9.32.
9. 7.03×98.2.
10. 0.97×96.3.
11. 0.092×125.
12. 0.34×90.2.
13. 1.908×62.
14. 1.25×62.5.
15. 0.85×0.24.
16. 0.83×26.4.
17. 0.19×40.4.
18. 0.37×8.4.
19. 0.82×62.5.

Practical Problems with Decimals

1. Water comprises 0.78 of a potato. How much water in 25.4 pounds of potatoes?

2. A bushel of onions weighs 57 lb., of which 0.88 is water. How many pounds of water in a bushel of onions?

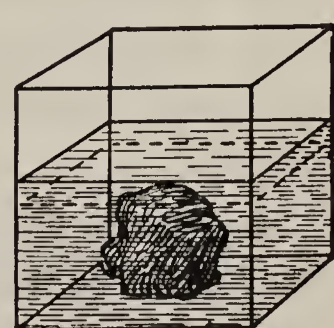
3. Find the area of a rectangle 7.3 in. long and 5.8 in. wide.

4. Find the area of a rectangle 15.43 in. long and 12.25 in. wide.

5. A box is 1.6 ft. deep, 2.5 ft. wide, and 3.2 ft. long. How many cubic feet does it hold?

6. How many cubic inches of soil will a flower box hold that is 5.5 in. deep, 7.5 in. wide, and 36 in. long?

7. The volume of any irregular shaped object may be found by immersing it under water and measuring the amount of water displaced by it. A glass jar is 6 in. wide and 10 in. long. It is filled partly full of water, and the depth of the water measured. A stone is then put into the water so that it is covered, and the depth of the water is again measured. Before the stone was put in, the



water was 5.2 in. deep, and after the stone was put in, it was 7.3 in. deep. How much did the water rise in the jar? How many cubic inches of water did the stone displace? This is the volume of the stone.

8. A piece of broken brick was put into this jar. Before it was put in, the water stood 4.4 in. deep, and after it was put in, the water stood 5.2 in. deep. How much did the water rise? How many cubic inches in the brick?

9. In the same jar a piece of iron was placed. The depths of the water were 6.7 in. and 7.2 in. How many cubic inches in the piece of iron?

10. A cubic foot of water weighs 62.5 lb. Find the weight of 9 cu. ft.

11. Find the weight of 12.25 cu. ft. of water.

12. Ice weighs 0.92 as much as water. Find the weight of a cubic foot of ice.

13. Steel weighs 7.83 times as much as water. Find the weight of a cubic foot of steel.

14. Gold weighs 19.36 times as much as water. Find the weight of a cubic foot of gold.

15. Cork weighs 0.24 times as much as water. Find the weight of a cubic foot of cork.

16. Coal weighs 1.3 times as much as water. What is the weight of 1 cu. ft. of coal?

17. Sheet lead $\frac{1}{16}$ in. thick weighs 3.69 lb. per square foot. How many pounds of this does it require to line the walls and bottom of a tank 2 ft. deep, 3 ft. wide, and 5 ft. long?

18. Sheet copper $\frac{1}{16}$ in. thick weighs 2.888 lb. per sq. ft. How many pounds of this does it require to make a teapot, if 1.3 sq. ft. are used?

19. A cubic foot of ice weighs 56.25 lb. How much will 8.5 cubic feet weigh?

20. How much will a cake of ice 2 ft. by $\frac{3}{4}$ ft. by $1\frac{1}{2}$ ft. weigh?

21. The distance around a wheel is 3.1416 times the distance across. If the distance across is 8.5 inches, what is the distance around?

22. A bushel of corn on the cob weighs 70 lb. If 0.2 of this is cob, how many pounds of shelled corn to the bushel?

23. A farmer who is raising but 85 bu. of potatoes per acre could by more attention to seed and soil raise 1.6 times as many. How many could he raise on a 15-acre field by thus increasing his yield?

24. In a few years the Germans by intensive farming increased the average yield of wheat per acre from 21.2 bu. to 31.2 bu. Allowing 89 cents a bushel for the grain, compute the increase in value of the crop on 35 acres.

25. They increased the average yield of oats per acre from 34.1 bu. to 57.5 bu. Allowing 50 cents a bushel for the crop, compute the increase in the value of the crop on a 28-acre field.

26. At the same time, the average yield of oats per acre in the United States was only increased from 25.6 bu. to 29 bu. Allowing 50 cents a bushel, find the increase in the value of the crop on a 28-acre field in the United States.

27. In the University of Illinois Experiment Field an application of potassium to the soil increased the yield of corn 36.8 bu. per acre. At 35 cents per bushel, how much would this increase amount to on a 68-acre field?

71. DIVIDING A DECIMAL BY AN INTEGER

1. What is $\frac{1}{3}$ of 6 tenths? $0.6 \div 3 =$ ——.

2. What is $\frac{1}{4}$ of 84 hundredths? $0.84 \div 4 =$ ——.

Find the value of the following:

3. $0.96 \div 8$.

4. $0.36 \div 9$.

5. $4.8 \div 4$.

6. $12.9 \div 3$.

7. $0.025 \div 5$.

8. $0.048 \div 8$.

9. $6.024 \div 6$.

10. $0.924 \div 12$.

11. $4.08 \div 8$.

12. $6.44 \div 7$.

13. $0.84 \div 12$.

14. $9.63 \div 9$.

> *Evidently, when the divisor is an integer, there are as many decimal places in the quotient as there are in the dividend.*

Give the quotients at sight:

15. $3\overline{)1.65}$.

16. $6\overline{)2.58}$.

17. $6\overline{)0.264}$.

18. $7\overline{)8.75}$.

19. $9\overline{)38.7}$.

20. $8\overline{)18.4}$.

21. $5\overline{)12.5}$.

22. $6\overline{)27.6}$.

23. $8\overline{)0.384}$.

24. $5\overline{)2.85}$.

25. $6\overline{)5.28}$.

26. $7\overline{)6.44}$.

27. $8\overline{)2.72}$.

28. $12\overline{)38.4}$.

29. $8\overline{)0.352}$.

30. $8\overline{)3.52}$.

31. $9\overline{)46.8}$.

32. $9\overline{)4.68}$.

33. $9\overline{)0.468}$.

34. $7\overline{)46.9}$.

35. $7\overline{)4.69}$.

Divide:

36. $65.62 \div 17$.

37. $10.95 \div 25$.

38. $7.446 \div 34$.

39. $10.476 \div 36$.

40. $21.19 \div 26$.

41. $33.726 \div 42$.

42. $73.386 \div 81$.

43. $458.06 \div 74$.

44. $459.27 \div 63$.

45. When a train runs 435.24 miles in 9 hours, what is the average rate per hour?

46. A farmer raised 763.75 bu. of corn from a 13-acre field. What was the average yield per acre?

47. A dairyman made 2.75 lb. of butter from 50 lb. of milk. Find the yield of butter for 1 lb. of milk.

48. If a farmer raises 1140.75 bu. of potatoes from 9 acres, what is the average yield per acre?

49. A farmer cut 27.75 tons of hay from a field containing 15 acres. Find the average yield per acre.

50. If a farmer raises 4013.8 bu. of corn from a 47-acre field, what is the average yield per acre?

51. If a man raises 2360 bushels of potatoes on a field containing 16 acres, what is the average yield per acre?

72. DIVIDING A DECIMAL BY A DECIMAL

1. How many 3's in 9? How many 6's in 18? How many 12's in 36? How many 30's in 90?

2. $4 \div 2 = ?$ $40 \div 20 = ?$ $400 \div 200 = ?$

3. How is the quotient affected when we multiply both dividend and divisor by the same number?

Evidently, multiplying both dividend and divisor by the same number does not change the quotient.

4. How many times is 0.2 contained in 2.4?

SUGGESTION.—0.2 is contained in 2.4 as many times as 2 is contained in 24, for both dividend and divisor have been multiplied by 10 to get 2 and 24.

Give the quotients:

5. $4.2 \div 0.7.$	**8.** $6.3 \div 0.9.$	**11.** $3.4 \div 1.7.$
6. $6.4 \div 0.8.$	**9.** $8.4 \div 1.2.$	**12.** $6.4 \div 3.2.$
7. $7.2 \div 0.9.$	**10.** $9.6 \div 1.2.$	**13.** $4.8 \div 2.4.$

14. How many times is 0.06 contained in 1.44?

WORK

$$0.06\overline{)1.44} = 6.\overline{)144.}$$
$$24.$$

EXPLANATION. — Here we multiply both dividend and divisor by 100.

Find the value of the following:

15. $3.28 \div 0.4.$	**19.** $300 \div 0.06.$	**23.** $25 \div 0.005.$
16. $0.049 \div 0.7.$	**20.** $7.2 \div 12.$	**24.** $0.125 \div 0.005.$
17. $0.216 \div 0.9.$	**21.** $14.4 \div 1.2.$	**25.** $0.096 \div 0.08.$
18. $6.4 \div 0.08.$	**22.** $10.8 \div 0.009.$	**26.** $0.108 \div 0.09.$

27. How many times is 1.44 contained in 1.728?

WORK

$$\begin{array}{r} 1.2 \\ 1.44\overline{)1.728} = 144\overline{)172.8} \\ \underline{144} \\ 28.8 \\ \underline{28.8} \end{array}$$

EXPLANATION. — We multiply both dividend and divisor by 100 by moving the point two places to the right, to get an integral divisor.

The point in the quotient is directly over the point in the dividend.

Should there be a remainder, zeros may be annexed in the dividend and the division continued.

28. $26.6 \div 1.6.$	**35.** $12.6 \div 0.36.$
29. $32 \div 0.625.$	**36.** $2.5 \div 0.625.$
30. $1.6 \div 0.625.$	**37.** $0.399 \div 1.9.$
31. $17.28 \div 1.44.$	**38.** $6.75 \div 0.125.$
32. $0.8 \div 1.6.$	**39.** $8.4 \div 0.14.$
33. $1.296 \div 0.36.$	**40.** $17.5 \div 0.25.$
34. $7.2 \div 120.$	**41.** $2.56 \div 0.016.$

42. Divide 3.78 by 15.3.

WORK

$$\begin{array}{r} 0.247^{+} \\ 15.3\overline{)3.78} = 153.\overline{)37.8} \\ 30\ 6 \\ \hline 7\ 20 \\ 6\ 12 \\ \hline 1\ 080 \\ 1\ 071 \\ \hline 9 \end{array}$$

EXPLANATION. — We multiply both dividend and divisor by 10 to get an integral divisor.

There being a remainder after each division, we annex zeros.

After carrying the division to thousandths, there is still a remainder. We indicate this by a plus sign ($^{+}$) in the quotient.

43. $34.6 \div 1.75$.

44. $89.3 \div 2.68$.

45. $8.47 \div 36.5$.

46. $96.7 \div 17.3$.

47. $36.8 \div 9.6$.

48. $4.35 \div 62.7$.

49. $8.63 \div 4.27$.

50. $8.64 \div 1.65$.

NOTE. — Making an integer of the divisor lessens the number of the decimal places in the dividend. Hence, *without making any change before division, we may divide as in integers, and point off as many decimal places in the quotient as the number of places in the dividend exceeds those in the divisor.* In using this method, remember that every zero annexed to the dividend is counted as one of the places in the dividend.

Practical Problems in Division

1. The average yield of corn in the United States in 1908 was 26.2 bu. per acre. The total yield was 2,668,651,000 bu. On how many acres was corn raised?

2. The average yield of corn in Illinois in 1908 was 31.6 bu. per acre. The total yield of the state was 298,620,000 bu. How many acres of corn were planted in Illinois in 1908?

3. The average yield of corn in Maryland in 1908 was 36.6 bu. per acre. The total yield of the state was 24,705,000 bu. How many acres of corn were planted in Maryland?

4. In 1908–1909 the United States produced 380,000 tons of beet sugar. This was 0.055 of the total amount produced by the world. How many tons were produced by the whole world?

5. In 1908 Louisiana produced 11,550,000 bushels of rice. This was 0.527 of the total amount produced in the United States. How many bushels were produced in the United States?

6. In 1908 Indiana produced 45,169,000 bu. of wheat on 2,721,000 acres. Find to the tenth of a bushel the average amount produced to the acre.

7. Idaho produced 10,897,000 bu. of wheat on 387,000 acres. Find to the tenth of a bushel the average amount produced per acre in Idaho.

8. In 1908 Nevada produced an average of 30 bu. of wheat per acre, which was the greatest yield per acre of all the states. South Carolina produced an average of 9 bu. to the acre, which was the least yield per acre of all the states. Find to hundredths what the yield per acre in South Carolina was to the yield per acre in Nevada.

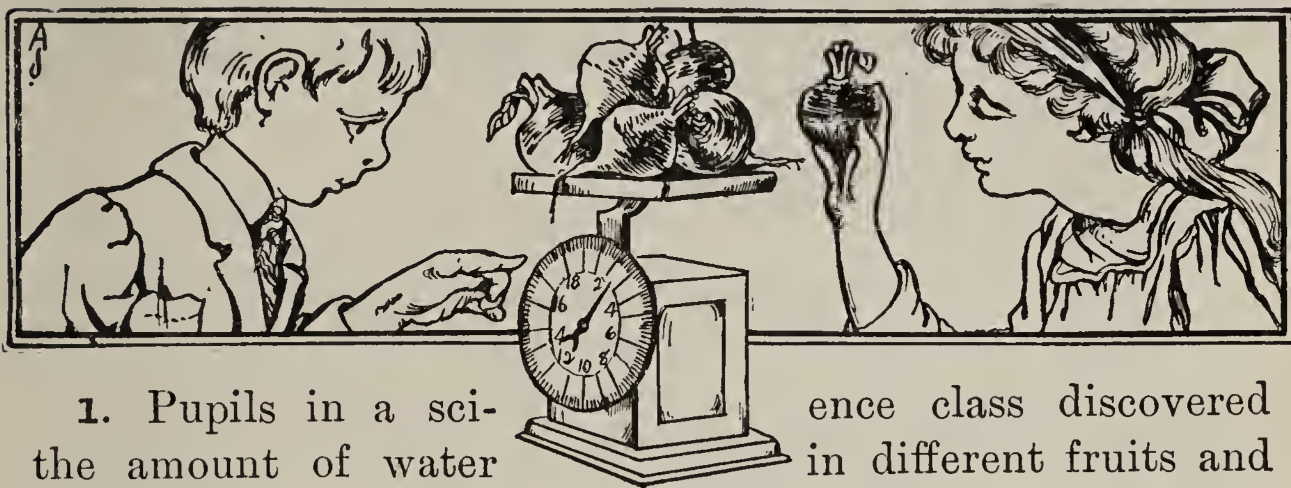
9. At an average speed of 28.4 mi. per hour, how long would it take a train to go from Chicago to New York, a distance of 952 mi.?

10. The United States battleship *Indiana* showed a trial speed of 15.55 knots per hour. At this speed, how long would it take the *Indiana* to go a distance of 260 knots?

11. The trial speed of the battleship *Nebraska* was 19.06 knots per hour. At this speed how long would it take the *Nebraska* to go a distance of 286 knots?

12. Calling a knot 1.15 mi., find the trial speed of the *Indiana* and also of the *Nebraska* in miles.

Water in Fruit and Vegetables



1. Pupils in a science class discovered the amount of water in different fruits and vegetables.

They found the weight of some beets to be 46.75 oz. When these were cut up and dried, they weighed only 4.5 oz. How many ounces of water evaporated? Find to hundredths what part of the beets was water.

2. Carrots that weighed 23.5 oz. were found when dried to weigh 2.9 oz. Find to hundredths what part of carrots is water.

3. Cucumbers that weighed 14.75 oz. were found when sliced and dried to weigh only 0.7 oz. Find to hundredths the part of cucumbers that is water.

4. Parsnips that weighed 20 oz. were found to weigh only 3.5 oz. when sliced and thoroughly dried. Find to hundredths the part of parsnips that is water.

5. Potatoes weighing 24.25 oz. were sliced and thoroughly dried. When dried they weighed 5.35 oz. Find to hundredths the part of potatoes that is water.

6. A bushel of potatoes weighs 60 lb. How many pounds of water in a bushel of potatoes? (See result of Ex. 5.)

7. One pound of apples when dried weighed only 3.2 oz. Find to hundredths the part of apples that is water.

73. COMMON FRACTIONS CHANGED TO DECIMALS

Since a common fraction may be considered an indicated division, we may change a common fraction to a decimal by proceeding as in division.

1. Change $\frac{3}{4}$ to a decimal.

WORK

$$4\overline{)3.00}$$
$$0.75$$

Since $3 \div 4 = 0.75$, $\frac{3}{4} = 0.75$.

Change the following to decimals:

2. $\frac{1}{2}$.	**4.** $\frac{1}{5}$.	**6.** $\frac{3}{5}$.	**8.** $\frac{17}{20}$.	**10.** $\frac{6}{25}$.
3. $\frac{1}{4}$.	**5.** $\frac{2}{5}$.	**7.** $\frac{4}{5}$.	**9.** $\frac{11}{20}$.	**11.** $\frac{17}{40}$.

12. Change $\frac{5}{7}$ to a decimal.

WORK

$$7\overline{)5.00}$$
$$0.71+$$

The quotient is 0.71 with a remainder of .03. Since the next figure of the quotient, were the division carried on, is less than 5, the result is said to be "*true to the nearest hundredth.*" The plus sign indicates a remainder.

13. Change $\frac{2}{3}$ to a decimal.

WORK

$$3\overline{)2.00}$$
$$0.66+$$
$$0.67-$$

Since the third figure of the quotient is 6, we say that "to the nearest hundredth," $\frac{2}{3} = 0.67^-$. The minus sign indicates that 7 is larger than the real quotient.

When the next quotient figure, were the division continued, is less than 5, *a plus sign may be used to indicate the fact; but if it is equal to or greater than* 5, *the preceding figure is increased by* 1 *and a minus sign written.*

Thus, 0.374 is written 0.37+, while 0.375, 0.376, etc., are written 0.38−, when the result is wanted to the nearest hundredth.

Change to decimals, carrying the results to the nearest hundredth:

14. $\frac{2}{3}$.	**17.** $\frac{5}{12}$.	**20.** $\frac{2}{13}$.	**23.** $\frac{11}{12}$.
15. $\frac{1}{6}$.	**18.** $\frac{7}{12}$.	**21.** $\frac{5}{7}$.	**24.** $\frac{3}{17}$.
16. $\frac{2}{7}$.	**19.** $\frac{4}{9}$.	**22.** $\frac{6}{13}$.	**25.** $\frac{5}{11}$.

26. Reduce $5\frac{3}{4}$ to a whole number and decimal, *i.e. a mixed decimal.*

$$\tfrac{3}{4} = 0.75, \text{ then } 5\tfrac{3}{4} = 5.75.$$

Reduce to mixed decimals:

27. $5\frac{11}{32}$.	**30.** $4\frac{19}{20}$.	**33.** $6\frac{14}{29}$.	**36.** $12\frac{7}{16}$.
28. $3\frac{13}{16}$.	**31.** $13\frac{7}{8}$.	**34.** $17\frac{2}{3}$.	**37.** $8\frac{9}{32}$.
29. $9\frac{54}{125}$.	**32.** $7\frac{4}{13}$.	**35.** $19\frac{5}{11}$.	**38.** $19\frac{17}{48}$.

74. A RATIO EXPRESSED IN DECIMALS

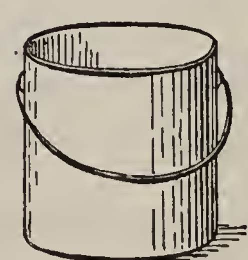
Since a ratio is the quotient of one number divided by another, the ratio may be expressed as a decimal.

Express to hundredths the ratio of:

1. 36 to 15.	**4.** 26 to 65.	**7.** 36 to 131.
2. 84 to 36.	**5.** 84 to 126.	**8.** 87 to 26.
3. 17 to 43.	**6.** 98 to 144.	**9.** 120 to 53.

Practical Problems in Ratio

1. The diameter, or the width across the top of a bucket, is measured and found to be 6 in. By measuring around it with a tape line, the circumference, or the distance around it, is found to be 18.85 in. Find the ratio of the distance around to the distance across, carrying the answer to hundredths.



2. The diameter of a silver half dollar is 1.2 in. The circumference, or distance around it, is found to be 3.77 in. Find the ratio of the circumference to the diameter, carrying the answer to hundredths.

3. A boy measures the wheel of his bicycle, and finds that its diameter is 28 in., and circumference 88 in. Find the ratio of the circumference to the diameter.

4. Measure to 16ths of an inch the diameters and the circumferences of various circular objects of different sizes, and compute the ratios of the circumferences to the diameters.

5. Find the average of these ratios by adding them together and dividing the sum by the number of them. If the work is accurately done, the average of the ratios should be found to be just a little more than 3.14.

6. Calling the ratio of the circumference to the diameter of any circular object 3.14, find the circumference of a wheel whose diameter is 8.5 in.

7. Find the circumference of a grindstone of which the diameter is 38 in.

8. A piece of round steel shafting is 4 in. in diameter. What is the distance around it?

9. The distance around a circular pond is found to be 287 yd. How far is it across the pond?

10. Wishing to know the diameter of a circular water tank, I measured the distance around it, and found it to be 49.5 ft. What was the diameter?

11. The diameter of a wagon wheel is 4 ft. 8 in. How long a tire will be required if we allow 4 in. for welding?

Specific Gravity

The *specific gravity* of any solid or liquid substance is the ratio of its weight to the weight of an equal volume of water. One cubic foot of water weighs 62.5 lb.

1–8. The following table gives the weights in pounds of 1 cu. ft. of each of a number of the most common metals. Compute the specific gravity of each, carrying the answer to the nearest thousandth, and complete the table.

Metal	Weight in Pounds of 1 Cu. Ft.	Specific Gravity
Steel	490	
Cast Iron	450	
Brass	523.8	
Copper	552	
Silver	655.1	
Gold	1200.9	
Lead	709.4	
Platinum	1347	

9–16. The following table gives the weights in pounds of 1 cu. ft. of each of a number of the most common varieties of wood. Find the specific gravity of each, carrying the answer to the nearest thousandth.

Wood	Weight in Pounds of 1 Cu. Ft.	Specific Gravity
Oak	55	
Ash	52.8	
Yellow Pine	34.6	
White Pine	28	
Beech	53.25	
Maple	46.88	
Walnut	41.9	
Cork	15	

VI. WHOLE NUMBERS

75. READING AND WRITING LARGER NUMBERS

1. In 5, 50, 500, and 5000, how does 5 change in value?

2. What value has the zero? What use has it?

3. Which of the following figures has the greatest value, 7, 3, 5, 9, 8? Which of the following, 30, 3, or 300?

4. The value of a figure then depends upon what two things?

5. Write the largest number you can, using just 0, 3, 5, and 8.

6. In Exercise 5, tell why you placed each figure where you did.

7. How many units of any order does it take to make one unit of the next higher order?

8. In the United States system of money, how many cents equal one dime? How many dimes in a dollar?

We call our system of writing numbers and our money system a **decimal system**. *The word* **decimal** *is taken from the Latin* **decem**, *meaning "ten."*

In a decimal system ten units of any order make one unit of the next higher order.

9. Read 9,009,000. Of what use are the zeros?

10. How many orders higher is the 9 at the left than the other 9?

11. How many times as great in value is the left-hand 9?

12. How would the 9's be affected in value by removing the zeros in the first period?

13. How is 4000 changed in value when we remove the last zero? The last two? All three?

14. How can you give 387 a value a thousand times as great?

15. Write the largest possible number using these nine figures only: 0, 1, 3, 3, 7, 7, 8, 8, 9.

16. Another zero would enable you to write a number how many times as large?

17. How could you make 365,000 represent a number only one-thousandth part as large?

18. Each zero annexed to a number changes its value how?

19. Each zero removed from the right of a number makes what change?

20. Write 1 thousand 1 hundred 1.

21. Write ten million, two thousand, sixty.

22. Without writing in columns give the sum of 18,000; 200,000; 520; 6.

23. Write the sum of 340; 2,000,000; 700,000; 48,000; 9.

24. Read without using the word *and:* 3005; 2806; 1,003,008.

25. In 281,249,944 why are the figures grouped in threes?

26. Each group is sometimes called a **period.** Give the name of each period beginning with the lowest.

27. What is the value of the highest period? Of the next? Of the lowest? Read the entire number.

Sometimes we need a number of four periods. The next period higher than *millions* is called **billions.**

28. Read:

3,475,635,320	125,370,000,000
15,065,703,490	840,730,045,000

Some Farm Products: The Sugar Industry

NOTE. — This set of problems shows the use of large numbers and gives practice in reading them, without giving difficult computations.

1. In 1909 the world produced 6,775,000 tons of beet sugar and 7,935,000 tons of cane sugar. How much more cane sugar was produced than beet sugar?

2. Germany produces about $\frac{1}{4}$ of the beet sugar of the whole world. If $\frac{1}{4}$ of the product of 1909 was produced by Germany, how many tons did she produce? How much did the rest of the world produce?

3. Cuba produces about $\frac{1}{5}$ of the cane sugar of the world. If she produced $\frac{1}{5}$ of the product of 1909, find the number of tons she produced.

4. Louisiana produces about $\frac{1}{4}$ as much cane sugar as Cuba. What part of the world's product does Louisiana produce?

5. The United States produces about $\frac{1}{7}$ as much beet sugar as Germany. In a recent year the product of the United States was as follows: Colorado, 103,159 tons; Michigan, 79,597 tons; California, 88,347 tons; Utah, 40,820 tons; Idaho, 23,353 tons; and seven other states together produced 48,725 tons. If this was $\frac{1}{7}$ of the product of Germany for that year, how much did she produce? If Germany produced $\frac{1}{4}$ of the world's product that year, find the world's product.

6. The Philippines produce about $\frac{1}{2}$ as much cane sugar as Louisiana. During a recent year the Philippines produced 151,000 tons. If this is $\frac{1}{2}$ the product of Louisiana, and Louisiana produces $\frac{1}{4}$ as much as Cuba, and Cuba produces $\frac{1}{5}$ of the world's product, find the product for that year of Louisiana, Cuba, and of the world.

7. The United States during a recent year produced 384,010 tons of beet sugar and 390,880 tons of cane sugar. We imported that year $4\frac{1}{2}$ times this amount; find the amount imported and the total consumption of sugar in that year.

8. The numbers of tons in the above exercises were numbers of *long tons*. A long ton is 2240 lb. Estimating the population of the United States to be 88,000,000, from the facts of Example 7 find the average number of pounds of sugar consumed by each person.

The Cotton Industry

One of the most important farm products of the United States is cotton. It is our greatest export crop. The value of cotton exported during a recent year was $417,390,000.

1. A farmer in a Southern state gave the following estimate of the cost and income of 3 acres. Cost of production: plowing ground and seeding $4.50; 3 sacks guano at $1; seed $5; four plowings at $1; 3 hoeings at $1.50; picking, hauling, and ginning $10. The income was 600 pounds lint at 9¢ and 36 bushels of seed at 25¢. Find the total cost, income, and profit.

2. At the rate of profit found in Example 1, find the profit from a plantation of 870 acres.

3. After the lint cotton is separated from the seed it is packed into bales of an average weight of about 500 pounds. How many bales on the plantation described in Example 2?

4. The United States produces most of the world's supply of cotton. In 1909 the total cotton product of the world was 17,105,000 bales. Of this the United States produced 13,828,000 bales and the East Indies about one third of the remainder. How many bales did the East Indies produce?

5. Texas produces a little more than one fourth of the cotton produced in the United States. Considering that she produces $\frac{1}{4}$ of the whole crop, how much does she produce when all the rest of the country produces 10,053,000 bales?

6. Mississippi ranks next to Texas in cotton production and produces about half as much. If Mississippi produces $\frac{1}{2}$ as much as Texas, and Texas produces $\frac{1}{4}$ as much as the whole country, find the total product if Mississippi produces 1,735,000 bales.

7. The price of cotton during a single year may vary from $8\frac{3}{4}$ cents to $14\frac{1}{8}$ cents per pound. How will the price of a bale vary at this rate?

8. When the crop of this country is 13,828,000 bales what is the difference between its values at the prices given in Example 7?

The Corn Industry

Our greatest grain crop is corn. In 1909 the corn product of this country was estimated at 2,767,000,000 bushels.

1. The five states having the largest crops of corn in 1908 were as follows: Illinois, 298,620,000 bu.; Iowa, 287,456,000 bu.; Nebraska, 205,767,000 bu.; Missouri, 203,634,000 bu.; and Texas, 201,848,000 bu. If these five states produced as much as all the rest of the country together, what was the total product for that year?

2. When this country produced 2,668,651,000 bushels of corn the estimated price was 60.6¢ per bushel. Find the total value of the crop.

3. If more scientific farming would have increased the value of the crop by $\frac{1}{5}$, how much would that have added to the total wealth of this country?

4. It was estimated that the average yield per acre in 1908 was 26.2 bu. Using the facts of Problem 2, find the number of acres devoted to the cultivation of corn.

5. If in a certain year 108,645,000 acres produced 2,661,502,500 bushels of corn, find the yield per acre.

The Wheat Industry

The wheat crop is our second greatest grain crop, the corn crop being first. In 1909 the United States produced 724,768,000 bushels of wheat. "Enough wheat, when made into bread, to provide $1\frac{1}{3}$ loaves a day for each inhabitant of the United States for a year; enough, when made into loaves a foot long, to girdle the earth."

1. The United States produces about $\frac{1}{5}$ of the world's product of wheat. Russia ranks next and produces almost $\frac{4}{5}$ as much as the United States. British India ranks third and produces about $\frac{1}{3}$ as much as the United States.

Find the product of Russia, of British India, and of the rest of the world, exclusive of Russia, British India, and United States, when our production was 664,602,000 bushels (in 1907).

2. The three states producing the greatest number of bushels of wheat in 1908 were: Kansas 79,282,000 bushels; Minnesota 68,557,000 bushels; and North Dakota 68,428,000 bushels. This was nearly $\frac{1}{3}$ of the whole product of the country during that year. At this rate, find the total product.

3. At an average price of $87\frac{1}{2}$ cents a bushel, find the value of the crop in each of the three states named in Example 2.

4. The average yield in Minnesota is 14 bushels per acre. How many acres were required to produce the crop named in Example 2?

5. It has been shown by experiment that care in selecting seed will give an average increase of $\frac{1}{4}$ of the former production. What effect would this have upon the value of the crop in each of the states named in Example 2?

6. How would such an increase in production affect the value of the total crop in this country? Call the average yearly yield 664,540,000 bushels, and the average price $88\frac{3}{4}$ cents.

76. Rapid Work in Addition

Rapid and accurate work in arithmetic comes only through much practice. We learn to recognize groups of figures as standing for a sum, just as we recognize a group of letters as standing for a word.

NOTE. — The following tables are to be used for daily drill until a sum can be recognized instantly.

All Possible Combinations of Two Figures

Announce the 45 *sums in half a minute:*

1	1	2	2	4	1	3	3	4	3	1	4	2	4	7
1	3	1	2	1	5	2	3	2	6	7	3	5	6	7
8	9	8	5	6	4	5	5	7	1	5	6	6	8	9
9	9	8	5	1	4	3	4	2	8	6	6	9	6	1
8	7	7	4	9	7	6	7	5	3	2	4	5	7	6
2	3	5	8	3	8	7	9	9	8	9	9	8	4	2

Drill in "Adding by Endings"

NOTE. — The automatic control of the 45 primary facts is not sufficient for efficient work in adding columns. Such drills as the following should be used until results can be given automatically.

Practice until you can announce the 80 *results in one minute :*

12 3	25 6	48 3	76 9	92 1	87 7	39 4	95 5	61 3	22 3
19 5	65 4	66 3	51 1	62 8	47 4	11 9	16 7	83 3	46 6
61 7	82 6	88 4	37 3	87 8	41 4	98 8	14 2	25 1	63 5
99 2	56 8	34 6	98 1	87 5	42 2	89 3	75 8	96 1	77 2
88 9	43 4	84 4	67 9	82 5	95 2	89 7	64 3	79 8	92 7
51 6	93 9	85 7	91 8	86 4	78 6	92 9	88 7	63 7	86 8
97 6	94 7	96 5	98 2	95 9	86 7	49 8	67 5	96 9	83 8
89 5	72 9	63 8	98 9	99 7	64 9	59 4	67 4	96 8	43 8

Combinations of Two Numbers of Two Figures Each

So much of our work is with two numbers of but two figures each, that we ought to be able to announce at sight the sum of any two such numbers.

It is better to add the tens first and then the units.

Thus in adding 35 and 27, we say 35 and 20 are 55 and 7 are 62.

Announce the 60 *results in two minutes or less:*

12	11	18	17	14	15	17	12	13	16
15	11	13	14	16	16	17	12	14	13
13	14	15	17	12	16	15	12	16	18
17	16	14	15	18	19	15	17	17	18
16	14	19	11	17	19	18	19	12	15
16	13	19	15	18	13	14	18	19	18
14	14	27	19	17	12	18	13	15	21
14	16	18	11	19	14	12	13	19	19
21	76	52	43	32	87	64	87	53	48
18	13	19	17	17	14	12	15	14	19
43	56	43	57	64	47	39	48	78	67
19	14	18	18	19	19	19	18	16	17

When a figure is repeated several times the sum is more quickly found by multiplication than by addition.

Thus in

7	think $4 \times 7 + 6$,
6	or $5 \times 7 - 1$.
7	Why?
7	
7	
34	

At sight give sums:

1.	2.	3.	4.	5.	6.	7.	8.
8	7	5	6	8	7	8	8
6	7	9	6	8	9	4	8
6	7	5	8	5	9	4	3
6	9	5	6	8	9	4	8
6	7	5	6	8	9	4	8

In adding columns try to look out for the combinations that make 10, such as $6 + 4$, $3 + 7$, $3 + 2 + 5$, and the rest.

It is useful sometimes to remember that the sum of a sequence of three or five numbers is 3 or 5 times the middle number in the sequence. Thus the sum of 5, 6, 7 is 3×6, or 18; the sum of 5, 6, 7, 8, 9 is 5×7, or 35.

Copy and find the sum of:

1.	2.	3.	4.	5.	6.
197	757	1345	4787	46,768	48,748
928	836	2769	6432	14,693	98,396
873	793	3876	8978	24,768	47,874
417	581	4245	6479	71,293	56,832
652	629	8347	9463	60,037	91,478
765	924	9038	8779	73,407	16,923
739	786	6705	3678	19,386	94,873
984	937	9477	6482	47,682	73,689
859	724	6841	5962	86,573	69,798
487	692	7238	7389	94,775	54,991
529	496	5467	8917	89,238	98,346
843	739	3094	8998	64,839	79,819
468	496	6298	9843	29,466	54,433

Drill Table in Addition

Practice until you can find the thirty-five sums in 10 *minutes:*

	A	*B*	*C*	*D*	*E*	*F*	*G*
	196	572	389	479	729	961	589
	847	346	865	347	943	840	643
1.	635	985	749	839	658	257	275
	489	697	568	685	865	874	834
	752	438	437	658	314	536	796
	458	794	527	839	649	794	974
	267	536	498	356	381	968	586
2.	395	389	619	467	925	587	938
	673	647	478	583	467	346	743
	194	852	356	582	578	853	856
	743	279	762	964	752	749	691
	597	568	854	592	895	578	984
3.	836	493	419	138	436	983	257
	658	685	593	746	348	865	748
	491	134	397	857	767	634	536
	469	285	986	275	598	258	865
	295	479	364	784	634	635	149
4.	831	938	578	619	257	983	374
	647	764	749	563	769	497	759
	758	653	835	948	843	746	683
	875	938	347	627	491	946	972
	389	764	194	548	762	875	865
5.	947	285	856	763	854	183	586
	568	653	795	935	593	529	349
	436	479	638	914	376	764	431

77. RAPID WORK IN SUBTRACTION

Note. — To subtract accurately and rapidly pupils should be able to call the primary facts automatically.

Give the 80 *differences in one minute or less:*

5 2	11 5	11 3	15 9	17 8	12 3	9 2	7 6	10 5	13 4
11 4	12 6	5 1	10 2	15 7	5 3	12 7	10 3	13 8	15 8
9 5	10 9	4 1	6 4	14 7	9 6	10 7	10 6	12 5	14 9
6 3	13 7	8 2	14 5	16 9	8 7	13 9	9 8	11 8	14 8
3 2	8 1	11 6	16 8	8 5	11 7	12 8	10 8	9 4	10 1
4 3	12 4	6 5	8 3	11 2	13 6	14 6	15 6	8 6	10 4
9 3	16 7	11 9	9 1	12 9	7 1	9 7	17 9	5 4	13 5
3 1	7 3	18 9	8 4	6 2	13 5	7 2	6 1	7 5	2 1

Drill Table in Subtraction

Practice until you can find the eighty-four differences in 8 minutes:

	A	B	C	D	E	F	G
1.	4802 3779	2093 1374	5002 3456	9086 7695	6906 2647	7206 5628	8050 3162
2.	8001 4932	6013 2376	5605 1248	1901 1173	9016 4259	4806 1875	6072 2693
3.	4071 2734	7004 5536	8201 5646	2208 1329	6002 3567	1506 958	9509 3648
4.	6024 4457	7503 3987	2901 2528	8006 5317	3016 2357	5002 1364	4036 2643
5.	3790 1982	7008 3619	4500 3212	9605 7276	5023 2891	7008 5059	1101 1032
6.	7006 2594	3506 3028	8306 4067	4098 1929	2600 2429	8401 6574	2007 1098
7.	1800 1462	4803 2594	9080 5219	8100 5662	6007 3249	3501 2764	5002 2184
8.	8005 5208	2056 1547	5051 5036	3006 1429	9305 3147	7900 4527	6708 4482
9.	4091 2643	1408 1386	3005 1354	6039 5876	9806 4279	7065 5738	2010 1999
10.	3084 2129	5608 3794	8600 3433	7505 5312	4352 1929	6009 1896	2175 2016
11.	8803 7976	2509 1743	6071 5198	5007 4872	9620 6583	1906 1687	4017 1339
12.	9009 7399	3007 1889	1808 1199	6005 4236	2807 1965	8002 5698	7369 4027

Problems in Addition and Subtraction

The following table gives an estimate of the number of live stock in the different continents in 1909:

Continent	Cattle	Horses	Mules	Sheep	Hogs
North America	91,334,279	27,396,746	4,655,999	62,946,091	60,784,137
South America	75,592,773	9,511,594	865,793	90,075,858	5,742,989
Europe . . .	127,592,645	43,563,225	1,617,608	181,266,488	71,630,599
Asia	112,268,956	11,630,302	56,256	90,590,694	4,824,187
Africa . . .	9,474,115	885,113	296,294	43,901,330	1,276,917
Oceania . . .	12,068,681	2,232,408	1,899	108,646,123	999,976

1. Find the total number of each kind of animal.

2. How many more cattle are in Europe than in North America?

3. How many more horses are in Europe than in North America?

4. How many more sheep are in Europe than in North America?

5. How many more hogs are in Europe than in North America?

The following table is a record of the cheese industry of the United States in a recent year:

State	Factories	Pounds Produced	Value
New York	1,198	132,836,482	$10,812,747
Wisconsin	1,454	109,423,856	10,488,853
Iowa	48	2,829,745	282,078
Illinois	41	5,301,211	426,026
Minnesota	59	3,090,055	307,117
Pennsylvania . . .	120	11,453,424	1,007,815
Other states	690	52,210,099	5,287,124

6. How many cheese factories in the United States? How many pounds of cheese were produced in the United States during that year? What was the total value of the cheese produced?

7. If the United States exported 10,341,335 lb. of American cheese during the same year, how many pounds of this cheese were consumed in the United States?

8. In the same year the United States imported 34,238,459 lb. of cheese from other countries. What was the total amount of cheese consumed in the United States in the year?

9. The total number of male immigrants entering the United States in 1909 was 519,969. Of these 453,297 came from Europe. How many were from other continents?

10. The total number of female immigrants in the same year was 231,817, of which 201,578 came from the countries of Europe. How many came from other countries?

11. How many immigrants in all entered the United States in 1909? How many in all came from Europe?

The following table gives the number of immigrants in 1909 from the different parts of Asia:

NATIONALITY	MALE	FEMALE	TOTAL
China	1,773	170	
Japan	1,291	1,820	
India	164	39	
Turkey in Asia	5,792	1,714	
Other Asiatic Countries	112	29	
Total			

12. Find the total number of each nationality, the total number of males, the total number of females, and the grand total from all Asia.

13. In the Chicago public schools the attendance in certain years was as follows: in 1880, 59,562; in 1890, 135,541; in 1900, 255,861; in 1909, 296,427. Find the increase from one period to the next.

78. THE KEEPING OF ACCOUNTS

When a person does not pay cash for goods bought at a store, but has a record kept of the purchases, and pays for all of them at the end of each month or some other period of time, the record of the purchases and payment is called an **account.** Men engaged in business keep accounts of their receipts (money received) and expenditures (money spent).

In every account the record is in two columns, separated by a line running down the middle of the page, or it is kept on opposite pages of the account book.

The debit side of an account. All records of *debt* are called *debits*, and are placed in the *left-hand* column or page of the account.

The credit side of an account. All records of money, or its equivalent, received from a debtor on his account by the one who keeps the account, are called *credits*, and are placed in the *right-hand* column or page.

Balancing an account. The person who keeps an account *balances* it at the end of each month or at the end of some other period of time. That is, he finds the sum of all debits and the sum of all credits, and then finds the difference between these two sums. This difference is called the *balance.* This is entered on the smaller side of the account, thus making the total footings or sums of the two columns equal.

The following illustration shows the form of a ledger account kept by E. L. Holmes & Co., merchants, with Robt. L. Ray, debtor:

Dr.		Robt. L. Ray						Cr.	
1910					1910				
Jan.	2	Mdse.	28	00	Jan.	6	Cash	20	00
"	7	"	36	00	"	15	"	35	00
"	10	"	10	00	Feb.	15	"	20	00
"	15	"	32	50	Mar.	1	Balance	92	50
Feb.	12	"	18	75					
"	14	"	42	25					
			167	50				167	50

1. Who has bought goods as shown by the above account? Of whom has he bought them?

2. What do the "Mdse." items of the debit side show?

3. What do the "Cash" items of the credit side show?

4. What does the "Balance" on the credit side show?

5. What would a "Balance" on the debit side have meant?

Exercises

Rule paper, make out the following accounts in the above form, and balance them:

1. John V. Farwell & Co., in account with B. L. Gray, debtor: June 1, 1910, Mdse. $25.48; June 7, Mdse. $76.25; June 25, Mdse. $43.75. Credits, June 15, cash $45; June 20, cash $50.50; June 28, goods returned $24.67. Balance the account July 1, 1910.

2. R. C. Randall & Co., in account with W. R. Brooks, debtor: Mdse. $38.40, Mdse. $96.23, Mdse. $84.68, Mdse. $34.50, Mdse. $26.84. Credits by cash and goods returned, $120, $26.84, $90, $38.50, $84.20. Assign dates.

3. Miller Bros., in account with Wm. R. West, debtor: Mdse. $84.60, Mdse. $96.80, Mdse. $64.98, Mdse. $134.18. Credits by cash and goods returned, $100, $34.60, $75, $26.80. Assign dates.

4. Prepare an account between *The Fair* and yourself as debtor, and balance it.

5. Prepare an account between Mandel Bros. and your teacher as debtor, and balance it.

Find the balance of each of the following accounts:

6. Dr.	6. Cr.	7. Dr.	7. Cr.	8. Dr.	8. Cr.
$987.65	$629.55	$4768.82	$468.34	$649.81	$82.46
1839.76	83.74	947.61	984.59	8439.87	981.32
6482.91	968.71	847.77	1483.22	648.38	641.25
478.85	28.46	3998.64		91.76	239.86
698.47	318.93	8372.91			728.41

9. Dr.	9. Cr.	10. Dr.	10. Cr.	11. Dr.	11. Cr.
$246.94	$839.75	$698.32	$649.83	$356.78	$135.72
839.76	646.81	376.59	478.88	938.12	873.54
842.94	794.32	843.26	694.31	45.23	137.92
327.68	546.78	695.98	883.24	938.83	7639.85
946.32	937.89	831.96	695.64	876.23	736.29

12. The following is the open account of E. R. Walker with the First National Bank:

Dr. E. R. WALKER Cr.

Jan.	11	Check Paid	$500	00	Jan.	4	Balance	$486	87
"	12	" "	57	30	"	10	Deposit	290	00
"	20	" "	235	75	"	11	"	198	75
"	22	" "	11	80	"	21	"	773	40
"	28	" "	97	30	"	25	"	110	00

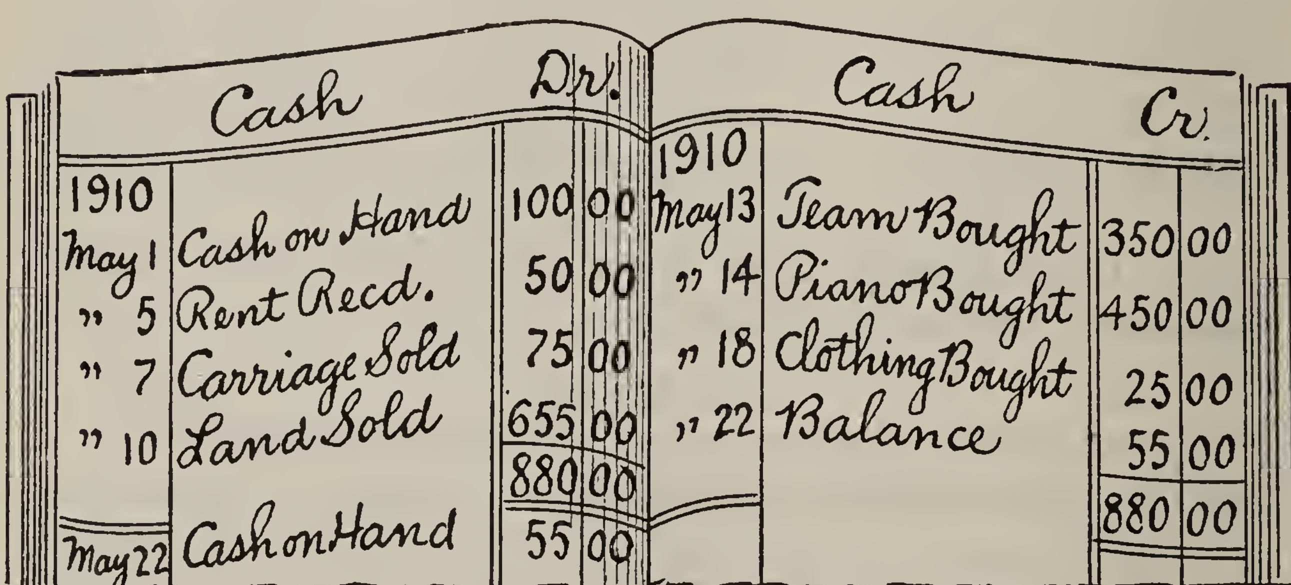
Find the balance. What would a balance on the credit side show?

13. Balance the following and tell what it shows:

On May 1, E. F. Mason had a balance of $4370.28 to his account in the bank. He deposited on May 1, $269; May 6, $165; May 10, $175; May 15, $180.50; May 20, $290. He withdrew by check the following amounts: May 1, $156; May 10, $450; May 13, $125; May 27, $675.50. What was his balance June 1?

79. AN ACCOUNT WITH CASH

When a man keeps an account of the cash that he receives or spends, he is said to keep a *cash account*, or an *account with Cash*. It is as if he were keeping an account between himself and his pocketbook or his cash drawer. "Cash" becomes *debtor* for all money that a man receives, and "cash" is *credited* with all that he spends.



1. Cash is charged with having received four amounts, which it owes me; that is, for which it is my debtor. How much on hand at the beginning?

2. What is the total amount that Cash has received?

3. When I take out \$450 with which to purchase a piano, Cash has paid back to me how much that it owes me?

4. What other amounts has Cash paid me; that is, for what other amounts should Cash be credited? How much has Cash paid me in all?

5. How much more has Cash received than paid out?

6. For how much is Cash debtor at the beginning of the new account?

Exercises

1. At the beginning of a month, Charles Watson has on hand \$4.21. During the month he receives at various times \$6.24, \$7.36, \$8.49, \$7.34, \$6.75; and he pays out \$8.75, \$9.81, \$8.39.

Rule paper, make out his cash account in the form on page 204, and find his balance at the end of the month.

2. On Monday morning a merchant begins business with \$247.84 on hand. He receives \$24.75, \$86.91, \$84.28, \$97.25, \$164.29. He pays out \$18.99, \$37.49, \$64.91, \$83.15. Prepare his cash account for the day in the above form, and balance it.

3. Make out the following account for a day and balance it: Cash on hand at the beginning, \$165.28; receipts, \$24.35, \$6.85, \$35.40, \$15.87, \$42.23, \$10.60; expenses, \$6.45, \$8.75, \$25.65, \$9.78.

4. Make out and balance the following merchant's account for a week: Cash on hand, \$145.35; Monday, Oct. 1, sales, \$223.87; Tuesday sales, \$194.36; Wednesday sales, \$142.95; Thursday sales, \$210.12; Friday sales, \$187.25; Saturday sales, \$364.57. Oct. 2, paid bill of \$93.40 for goods. Oct. 3, paid electric light bill of \$31.72. Oct. 5, bought new counter, \$45.40. Oct. 6, clerks' salaries paid, \$80.

5. Make out and balance a cash account of your own for a week, including items of car fare, books, earnings for selling papers, gifts from your father, etc.

Drill Tables in Multiplication

Without copying, see how many products you can find in 4 *minutes. Score* 5 *for each correct answer and see who makes the highest score.*

	A	*B*	*C*	*D*	*E*	*F*
1.	378 7	469 7	952 7	863 8	927 8	564 8
2.	286 9	379 9	518 9	863 6	947 6	384 6
3.	936 5	847 9	768 8	591 7	846 9	785 7
4.	978 4	349 7	846 7	397 5	846 5	392 9

Calling each correct product 10, *see what score you can make in* 10 *minutes, beginning where your teacher directs:*

	A	*B*	*C*	*D*	*E*
1.	27 × 368	46 × 947	29 × 738	49 × 519	72 × 784
2.	38 × 479	53 × 784	63 × 649	52 × 938	89 × 937
3.	46 × 926	96 × 827	87 × 534	87 × 591	81 × 249
4.	54 × 783	68 × 436	91 × 546	92 × 778	95 × 935
5.	84 × 926	75 × 978	46 × 879	69 × 539	82 × 496
6.	72 × 783	89 × 738	59 × 738	58 × 621	73 × 927
7.	86 × 936	92 × 649	64 × 936	89 × 743	39 × 719

Problems in Multiplication

1. A farm that produced an average of 1680 lb. of wheat per acre was made to produce 2370 lb. What would the increase be on a field of 48 acres?

2. A farmer who was raising but 480 lb. of cotton per acre increased his yield to 965 lb. Find the increase upon 195 acres.

3. A stock raiser sold horses at an average price of $34.26 in 1903. In 1913 he received $96.87 for the same grade of animal. Find the increased receipts on 28 horses.

4. A man bought 19 city lots at an average price of $384.60 and sold them in two years at an average price of $436.35. How much did he make?

5. During one year a cow gave 19,630 lb. of milk. At this rate how much would a herd of 38 cows give?

6. A White Leghorn hen laid 198 eggs in one year. If 48 hens each lay as many, how many will they lay in a year?

7. Fred sold 485 lb. of poultry one year at an average price of 18 ¢ per pound. How much did he receive for it?

8. If the feed cost an average of $4.25 per month, and other expenses were $9.85 for the year, how much profit did Fred make on his poultry?

9. A lady rented a piano for two years for $3.75 per month. How much rent did she pay?

10. A dealer sold 86 horses at an average price of $82.75 each. If they cost him an average price of $68.90 each, how much did he make?

11. A farmer found that the feed of a flock of sheep cost him $3.85 for each 100 pounds of increase in weight. If the sheep were worth $6.70 per 100 pounds, what was gained by feeding 240 sheep that gained 24 pounds each?

Drill Table in Division

Score 10 *for each correct answer. See what score you can make in* 10 *minutes.*

	A	*B*	*C*	*D*	*E*	*F*	
1.	211,998	312,924	484,872	175,686	303,312	471,522	÷ 534
2.	639,846	621,027	489,294	486,506	566,661	605,693	÷ 697
3.	302,940	389,385	603,585	150,705	518,670	435,285	÷ 765
4.	354,618	199,398	261,884	361,782	314,022	174,722	÷ 398
5.	787,703	522,272	164,928	679,469	685,482	505,951	÷ 859
6.	677,502	398,181	736,083	466,101	303,942	578,169	÷ 849
7.	428,048	619,634	781,878	331,392	235,599	592,018	÷ 863
8.	391,128	452,526	595,788	611,706	695,086	675,378	÷ 758
9.	281,637	272,853	381,006	448,533	542,961	495,747	÷ 549
10.	283,392	302,976	520,704	217,728	196,416	504,576	÷ 576
11.	237,524	231,812	337,960	141,372	439,824	329,392	÷ 476
12.	640,764	822,528	639,846	730,728	366,282	549,882	÷ 918
13.	169,506	203,562	291,798	292,959	154,026	195,048	÷ 387
14.	664,686	334,954	468,488	566,214	441,632	284,226	÷ 746
15.	507,069	338,046	451,275	269,671	446,352	521,291	÷ 547
16.	405,713	590,359	226,149	730,961	802,109	625,933	÷ 847
17.	566,662	753,293	461,259	867,399	645,956	317,176	÷ 967
18.	147,356	388,212	253,572	296,956	670,956	139,128	÷ 748
19.	385,659	527,571	314,703	413,253	339,669	255,573	÷ 657
20.	335,054	427,788	409,148	222,282	102,054	148,188	÷ 466
21.	440,022	600,030	587,826	329,508	193,230	500,364	÷ 678
22.	258,808	158,122	183,034	216,942	120,408	63,664	÷ 346
23.	424,116	391,797	475,713	514,269	464,373	493,290	÷ 567
24.	448,098	347,272	269,798	424,982	407,338	482,586	÷ 598
25.	387,604	527,996	623,371	723,324	602,007	679,070	÷ 763
26.	159,874	225,654	169,026	177,034	234,806	277,420	÷ 286

Problems in Division

1. If an automobile travels 352 miles in 16 hours, what is the average rate per hour?

2. If a field containing 27 acres yields 945 bushels of wheat, what is the average yield per acre?

3. If a 38-acre field yields 1710 bushels of corn, what is the average yield per acre?

4. A man had two fields of oats. One field of 26 acres averaged 36 bu. per acre, and the other field of 17 acres averaged 42 bu. per acre. What was the average yield from the two fields?

5. If 42 lb. of silage is the average daily ration for a dairy cow, how long will 5166 lb. last?

6. A man sold his 165-acre farm for $7920. How much was that per acre?

7. 56 lb. of shelled corn makes a bushel. At 42¢ per bushel, how much is a load weighing 2520 pounds worth?

8. At 36¢ per bushel, how much is a load of oats weighing 2720 pounds worth? (32 lb. = 1 bu. of oats.)

9. A man sold three loads of wheat. The first load weighed 2860 lb.; the second 2690 lb.; and the third 1950 lb. What was it worth at 98¢ a bushel? (60 lb. = 1 bu. of wheat.)

10. A factory pays out $1053 daily for wages. If the number of persons employed is 468, what is the average wage of each?

11. A factory employing 248 men pays out $2604 per week (6 days). What is the average wages paid per day?

80. ALIQUOT PARTS; SHORT METHODS IN MULTIPLICATION

Give the following:

$\frac{1}{2}$ of 10.	$\frac{1}{3}$ of 100.	$\frac{1}{8}$ of 100.	$\frac{1}{7}$ of 100.
$\frac{1}{3}$ of 10.	$\frac{1}{4}$ of 100.	$\frac{1}{12}$ of 100.	$\frac{1}{9}$ of 100.
$\frac{1}{4}$ of 10.	$\frac{1}{6}$ of 100.	$\frac{1}{16}$ of 100.	$\frac{1}{8}$ of 1000.

An **aliquot part** of a number is the quotient resulting from the division of the number by an integer. Thus $16\frac{2}{3}$ is an aliquot part of 100 because $100 \div 6 = 16\frac{2}{3}$.

Name some other aliquot parts of 100:

Memorize this table of aliquot parts:

$25 = \frac{1}{4}$ of 100.	$16\frac{2}{3} = \frac{1}{6}$ of 100.	$6\frac{1}{4} = \frac{1}{16}$ of 100.	$2\frac{1}{2} = \frac{1}{4}$ of 10.
$33\frac{1}{3} = \frac{1}{3}$ of 100.	$12\frac{1}{2} = \frac{1}{8}$ of 100.	$3\frac{1}{3} = \frac{1}{3}$ of 10.	$125 = \frac{1}{8}$ of 1000.

$$25 \times 72 = \tfrac{1}{4} \text{ of } 100 \times 72, \text{ or } \tfrac{1}{4} \text{ of } 7200 = 1800$$

or $$25 \times 72 = \tfrac{1}{4} \text{ of } 72 \times 100, \text{ or } 18 \times 100 = 1800.$$

1. Tell how to multiply by 25; by $33\frac{1}{3}$; by $16\frac{2}{3}$; by $12\frac{1}{2}$; by 125; by $6\frac{1}{4}$; by $3\frac{1}{3}$; by $2\frac{1}{2}$.

Give products at sight:

2. $33\frac{1}{3} \times 18$.	**7.** $16\frac{2}{3} \times 36$.	**12.** 25×84.
3. 25×24.	**8.** $33\frac{1}{3} \times 42$.	**13.** $12\frac{1}{2} \times 24$.
4. $16\frac{2}{3} \times 54$.	**9.** $12\frac{1}{2} \times 72$.	**14.** $16\frac{2}{3} \times 24$.
5. 25×96.	**10.** 25×32.	**15.** $12\frac{1}{2} \times 96$.
6. $6\frac{1}{4} \times 48$.	**11.** $33\frac{1}{3} \times 63$.	**16.** $6\frac{1}{4} \times 64$.

At sight, give the cost of:

1. 21 lb. coffee at $33\frac{1}{3}$¢.	**4.** 32 lb. rice at $6\frac{1}{4}$¢.
2. 48 lb. tea at 25¢.	**5.** 48 lb. raisins at $16\frac{2}{3}$¢.
3. 24 lb. prunes at $16\frac{2}{3}$¢.	**6.** 48 lb. prunes at $12\frac{1}{2}$¢.

7. 54 lb. steak at $16\frac{2}{3}$¢.
8. 72 lb. lard at $16\frac{2}{3}$¢.
9. 96 lb. butter at 25¢.
10. 48 qt. berries at $12\frac{1}{2}$¢.
11. 9 yd. cloth at 50¢.
12. 16 yd. cloth at 25¢.
13. 12 yd. lace at $8\frac{1}{3}$¢.
14. 36 yd. braid at $8\frac{1}{3}$¢.
15. 24 yd. cloth at $16\frac{2}{3}$¢.
16. 96 yd. cloth at $12\frac{1}{2}$¢.

Find the products:

1. $3\frac{1}{3} \times 63.72$.
2. $2\frac{1}{2} \times 86.48$.
3. $16\frac{2}{3} \times 193.52$.
4. $16\frac{2}{3} \times 384.54$.
5. 25×36.978.
6. 25×32.847.
7. $33\frac{1}{3} \times 96.126$.
8. $33\frac{1}{3} \times 73.245$.
9. 25×9.368.
10. 25×73.46.
11. $12\frac{1}{2} \times 6.344$.
12. $12\frac{1}{2} \times 73.824$.
13. $6\frac{1}{4} \times 86.375$.
14. $16\frac{2}{3} \times 42.963$.
15. $33\frac{1}{3} \times 19.634$.
16. 25×263.45.
17. $33\frac{1}{3} \times 46.751$.
18. $16\frac{2}{3} \times 32.968$.
19. $12\frac{1}{2} \times 175.32$.
20. $12\frac{1}{2} \times 134.56$.
21. 25×643.96.
22. 125×34.69.
23. 125×28.34.
24. 125×36.82.

81. SPECIAL FRACTIONS

Memorize the following table:

$0.50 = \frac{1}{2}$	$0.33\frac{1}{3} = \frac{1}{3}$	$0.62\frac{1}{2} = \frac{5}{8}$
$0.25 = \frac{1}{4}$	$0.66\frac{2}{3} = \frac{2}{3}$	$0.87\frac{1}{2} = \frac{7}{8}$
$0.12\frac{1}{2} = \frac{1}{8}$	$0.16\frac{2}{3} = \frac{1}{6}$	$0.14\frac{2}{7} = \frac{1}{7}$
$0.06\frac{1}{4} = \frac{1}{16}$	$0.08\frac{1}{3} = \frac{1}{12}$	$0.11\frac{1}{9} = \frac{1}{9}$
$1.25 = 1\frac{1}{4}$	$0.37\frac{1}{2} = \frac{3}{8}$	$0.83\frac{1}{3} = \frac{5}{6}$

NOTE. — There are other relations that are readily seen from these. Thus, $0.28\frac{4}{7} = \frac{2}{7}$; $0.56\frac{1}{4} = \frac{9}{16}$; $0.58\frac{1}{3} = \frac{7}{12}$; etc.

Give products at sight:

1. 28×0.25.
2. 0.75×84.
3. 32×1.25.
4. 96×0.75.
5. 12×2.25.
6. 16×1.75.
7. 24×2.50.
8. 36×1.25.
9. 14×2.50.

10. 3.5×42.

11. 1.25×64.

12. $24 \times 0.33\frac{1}{3}$.

13. $36 \times 1.33\frac{1}{3}$.

14. $18 \times 0.66\frac{2}{3}$.

15. $48 \times 1.66\frac{2}{3}$.

Problems in Bills

(Use short methods of multiplication.)

1. Check the following bill:

KANSAS CITY, MO., *April 1*, 19*11*

RANDOLPH MARKET AND GROCERY

52–54 OLIVE ST.

SOLD TO *Harold Johnson,*
56 W. 43d St.

March 14	4 pkg. rolled oats	@ 12½¢		50		
"	3 lb. cheese	@ 16⅔¢		50		
"	1 sack G. Med. flour	@ 95¢		95	1	95
March 21	6 cans peas	@ 12½¢		75		
"	2½ lb. crackers	@ 10¢		25		
"	8 lb. sugar	@ 6¼¢		50		
"	4 lb. sirloin steak	@ 16⅔¢		67	2	17
					4	12

Make out bills for the following:

2. 3 sacks flour at \$1.25; 4 lb. sirloin roast at $12\frac{1}{2}$¢; 3 lb. sugar-cured corned beef at $8\frac{1}{3}$¢; $3\frac{1}{2}$ lb. loin lamb chops at 18¢; 4 cans Maine lobster at $33\frac{1}{3}$¢.

3. 10 lb. sugar at $6\frac{1}{4}$¢; 6 cans asparagus at $33\frac{1}{3}$¢; 4 pkgs. macaroni at $16\frac{2}{3}$¢; $2\frac{1}{2}$ lb. fancy Japan rice at 8¢; 3 pkgs. prepared flour at $8\frac{1}{3}$¢.

4. 12 lb. prunes at $16\frac{2}{3}$¢; 6 lb. coffee at $33\frac{1}{3}$¢; 48 lb. steak at $12\frac{1}{2}$¢; 32 lb. rice at $6\frac{1}{4}$¢.

5. 48 lb. butter at 25¢; 24 qt. berries at $12\frac{1}{2}$¢; 36 lb. lard at $16\frac{2}{3}$¢; 3 lb. tea at $66\frac{2}{3}$¢.

6. 12 yd. cloth at 50¢; 15 yd. lace at $8\frac{1}{3}$¢; 21 yd. ribbon at $14\frac{2}{7}$¢; 8 yd. silk at $1.25.

7. Make at least four other bills involving the use of the special fractions in the table of Section 81.

82. SHORT METHODS IN DIVISION

The divisors 5, 10, 25 (2.5 or $2\frac{1}{2}$), $33\frac{1}{3}$, 100, and 125 (12.5 or $12\frac{1}{2}$) occur so often in business that a short method of dividing by them should be learned.

1. Divide the following by 10 in the shortest way:
   $160; $2.40; $36.50; 125 lb.; 5280 ft.; 324 tons.

2. How is a number divided by 10?

3. Divide the following by 100 by moving the point:
   $1520; $27; $52; 1250 rd.; 2.6; 36 hr.; $14,000.

4. How is a number divided by 100?

5. $\frac{1}{5}$ = how many 10ths? To find $\frac{1}{5}$ of a number, we find $\frac{2}{10}$ of it. That is, to divide by 5, multiply by 2 and divide by 10, by moving the decimal point.

6. Divide the following by 5:
   1260; $740; $12.50; $445; $1.35; 5280 ft.

7. 25 is what part of 100? Hence, to divide by 25, multiply by —— and move the decimal point ——.

8. Divide the following by 25:
   720; $19.50; $1242; $48.25; 940 lb.; 550 yd.

9. $2\frac{1}{2}$ or 2.5 is what part of 25? Hence, to divide by $2\frac{1}{2}$ or 2.5, multiply by 4 and move the decimal point ——.

10. Divide each number in Ex. 8 by $2\frac{1}{2}$.

11. $33\frac{1}{3}$ is what part of 100? To divide by $33\frac{1}{3}$, multiply by —— and move the decimal point ——.

12. Divide the following by $33\frac{1}{3}$:

400; 1300; $64; 48 ft.; 1600 lb.; $270.

13. 125 is what part of 1000? To divide by 125, multiply by —— and move the decimal point ——.

14. Give the short method of dividing by $12\frac{1}{2}$ or 12.5.

15. Divide the following by 125:

12,000; $25,000; $420; 7200 lb.; $19.25; $126.75.

16. A merchant has a stock of goods worth $5262. The store fixtures are worth $\frac{1}{10}$ as much. What is the value of the fixtures?

17. For $6.50, how many yards of cloth can be bought at 25¢ a yard?

18. At $33\frac{1}{3}$¢ a yard, how many yards of carpet can be bought for $15?

19. How many yards of ribbon at $12\frac{1}{2}$¢ a yard can be bought for 75¢?

20. At 25 mi. an hour, how long will it take an automobile to go 160 miles?

21. At 40 mi. an hour, how far will a train run in 12 min.? In 36 min.?

22. At $33\frac{1}{3}$¢ a hundred, how many picture post cards can be bought for $5?

23. How many pieces each $12\frac{1}{2}$ in. long can be cut from a piece of ribbon containing 10 yd.?

24. See how many seconds it takes you to divide 98,500 by 125 by long division. See how much less time it takes to perform the division by the short method worked out above.

Miscellaneous Problems

1. One year a flock of 26 hens laid 3744 eggs. What was the average laying record per hen?

2. If the average price of eggs was 24¢ per dozen, what was the average income from each hen (Problem 1)?

3. James raised 78 bu. of potatoes upon a half-acre lot. He sold $\frac{3}{4}$ of them at 65¢ a bushel and the rest at 56¢ per bushel. At this rate, what was the income per acre?

4. An unskilled farmer had an income of \$3240 from his farm. Later by more scientific methods the income was $\frac{2}{5}$ greater. Find the increase.

5. If a newsboy pays $\frac{3}{5}$ of a cent for each newspaper that he sells for 1 cent, how much does he make on 1000 papers?

6. An automobile traveled for 6 hours as follows: first hour 28 miles, second hour 32 miles, third hour 29 miles, fourth hour 30 miles, fifth hour 36 miles, and the sixth hour 31 miles. Find the average rate per hour for the 6 hours.

7. If a boat travels 18 miles in $2\frac{1}{2}$ hours, what is the rate per hour?

8. If Mrs. Brown pays 48¢ for a remnant containing $\frac{5}{6}$ yd., how much is the price per yard?

9. At 25¢ per hour, how much should a man receive for six days as follows: 8 hr., $8\frac{3}{4}$ hr., $7\frac{3}{4}$ hr., $8\frac{1}{2}$ hr., $8\frac{1}{4}$ hr., and $7\frac{1}{2}$ hr.?

10. A farmer has a bin containing $126\frac{1}{2}$ cu. ft. Counting $\frac{4}{5}$ bu. per cubic foot, how many bushels will it contain?

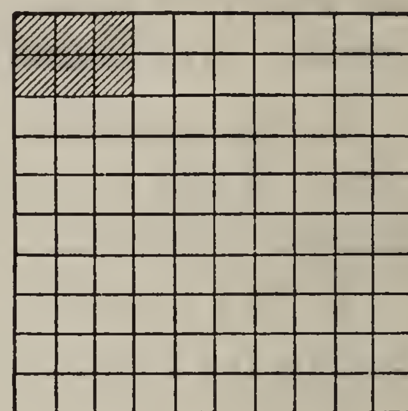
11. In one year a herd of 28 cows gave 490,000 lb. of milk worth $2\frac{3}{4}$¢ per pound. Find the average income from each cow.

VII. PERCENTAGE

83. THE MEANING OF PER CENT

Hundredths are also written in another way. Instead of speaking of so many hundredths of anything, we more commonly speak of so many *per cent* of it, which means the same thing.

Thus, if this square is divided into 100 equal parts, each part is 1 *hundredth* of the square, or 1 *per cent* of it.



We write 1 *per cent thus*, 1%.

The shaded part of this square is $\frac{6}{100}$, 0.06, or 6% of it. Which is more easily pronounced, *six hundredths*, or *six per cent?* Which is more easily written?

Exercises

Write as per cent:

1. $\frac{15}{100}$.	**4.** $\frac{7}{100}$.	**7.** 0.03.	**10.** 0.15.
2. $\frac{75}{100}$.	**5.** $\frac{8}{100}$.	**8.** 0.08.	**11.** 0.60.
3. $\frac{6}{100}$.	**6.** $\frac{50}{100}$.	**9.** 0.07.	**12.** 0.40.

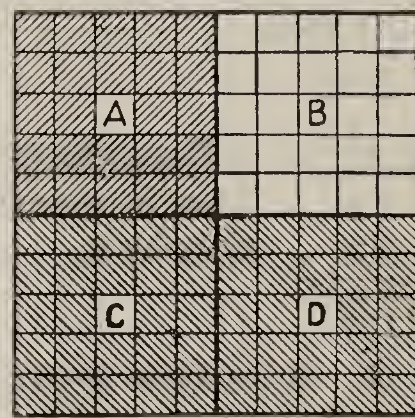
13. Draw a square and divide it into 100 equal parts. Shade 5% of them. Shade 15% of them. Shade 25%.

14. Draw a square and divide it into 10 equal parts. Shade 10% of it. 20% of it. 30% of it. 50% of it.

15. If you have 100 words in a spelling "review," and miss 8 of them, how many hundredths do you miss? How many per cent of them do you miss? What per cent is your mark?

16. If you miss 5, what per cent do you have right? If you miss 15? If you miss 20?

17. Out of 100 school days, if you are absent 3 days, what per cent of the 100 days is this? What is your mark of attendance?



18. This square is divided into 100 small squares. How many in the square marked A? Then A = 25% of the whole square. Describe B, C, and D in the same way.

19. The two squares, C and D are what part of the whole square? What per cent of it?

20. Write as per cent:

A = —— of the whole square.
A + B = —— of the whole square.
A + B + C = —— of the whole square.

21. Draw a circle and shade 25% of it. Shade 50% of it. Shade 75% of it.

22. Draw a rectangle whose width is 50% of its length.

23. The width of a certain rectangle is 25% of its length. What is the width if the length is 20 inches? If its length is 24 inches? If its length is 16 feet?

24. If you have 100 marbles, describe in per cent the part you lose when you lose any of the following:

5, 10, 20, 25, 40, 50.

25. If you have a dollar, or 100 cents, and spend 15¢, what per cent of it do you spend?

26. George had 100 pigeons and sold 10% of them. How many did he sell? How many if he sold 15% of them? 25% of them?

Problems in Percentage

1. James bought a boat for \$48. After one year he sold it to George for 15 % less than he gave for it. How much less than the cost did he receive?

SOLUTION

$$\begin{array}{r} \$48 \\ .15 \\ \hline 2\,40 \\ 4\,8 \\ \hline \$7.20 \end{array}$$

EXPLANATION. — Since 15 % = .15, we find .15 of \$48. That is, we express the per cent as a decimal fraction and multiply by it.

2. A farmer raised 1680 bushels of oats last year. This year he increased his yield by 15 %. Find the yield this year.

3. The attendance in a certain school last year was 950. This year it is 8 % greater. Find the attendance this year. (8 % = .08.)

4. A man bought a farm for \$3200. The improvements cost him $4\frac{1}{2}$ % of the cost of the farm. Find the cost of the improvements.

SOLUTION

$$\begin{array}{r} \$3200 \\ .045 \\ \hline 16\,000 \\ 128\,00 \\ \hline \$144.000 \end{array}$$

EXPLANATION. — $4\frac{1}{2}$ % = .045, for $4\frac{1}{2}$ hundredths means 4 hundredths and $\frac{1}{2}$ of a hundredth, which is 5 thousandths. That is, the whole number of per cent is written as hundredths and the fraction of a per cent is changed to a decimal and annexed. Thus $3\frac{1}{4}$% = .0325.

5. Express as decimal fractions:

$3\frac{1}{2}$ %; $6\frac{1}{2}$ %; $15\frac{1}{2}$ %; $27\frac{1}{2}$ %; $8\frac{1}{2}$ %; $9\frac{1}{4}$ %; $26\frac{1}{4}$ %.

6. Find $8\frac{1}{2}$ % of \$4860.

7. A boy had a flock of 80 hens. If he increases the flock $17\frac{1}{2}$ %, how many hens will he have?

8. A dealer offers to deduct $2\frac{1}{2}$ % from the price of a \$120 launch if I pay cash. How much will it then cost me?

9. By planting his crops in rotation a farmer increased the income from his farm by 18 %. If at first the income was $ 5400, what was it after the increase?

10. A boy delivered milk and vegetables for a farmer to some summer campers and was paid for his work 15 % of all the money received. During July and August he sold $ 450 worth. How much did he earn?

11. A man put 900 eggs in incubators. 18 % of them did not hatch. How many hatched?

12. A city has a population of 22,400. $14\frac{1}{2}$ % of the population are pupils in school. How many are in school?

13. The capacity of an old high school building is 900 pupils. The city is going to erect a new building with a 40 % greater capacity. How many pupils will the new building accommodate?

Drill Exercises

Express as common fractions, whole numbers, or mixed numbers:

1. 10 %.	**4.** 65 %.	**7.** 200 %.	**10.** 17 %.
2. 20 %.	**5.** 85 %.	**8.** 350 %.	**11.** 19 %.
3. 40 %.	**6.** 32 %.	**9.** 675 %.	**12.** 41 %.

Express as decimals:

13. 16 %.	**16.** 300 %.	**19.** $16\frac{1}{2}$ %.	**22.** 16.5 %.
14. 26 %.	**17.** 350 %.	**20.** $7\frac{1}{4}$ %.	**23.** 34.2 %.
15. 43 %.	**18.** 475 %.	**21.** $12\frac{1}{2}$ %.	**24.** 19.7 %.

Express as per cents:

25. 0.25.	**28.** 1.16.	**31.** 0.375.	**34.** 2.5.
26. 0.36.	**29.** 3.04.	**32.** 0.184.	**35.** 3.8.
27. 0.84.	**30.** 6.38.	**33.** 0.936.	**36.** 5.1.

84. FRACTIONAL EQUIVALENTS OF CERTAIN PER CENTS

1. Look at the square on page 217 and tell how many per cent in $\frac{1}{2}$ of it. In $\frac{1}{4}$ of it.

50 % of anything is $\frac{1}{2}$ of it.
25 % of anything is $\frac{1}{4}$ of it.

2. Henry's kite string was 400 ft. long, but he lost 50 % of it. How much remained?

3. Mr. Sloan bought 20 tons of coal for the winter. In the spring he had 25 % of it left. How much did he use?

4. A pint is what per cent of a quart? Of a gallon?

Give the following:

5. 25 % of 12. **7.** 25 % of 50. **9.** 25 % of 9.

6. 50 % of 8. **8.** 50 % of 84. **10.** 50 % of 11.

Find:

11. $\frac{1}{3}$ of 100. **13.** $\frac{1}{8}$ of 100. **15.** $\frac{1}{12}$ of 100.

12. $\frac{1}{5}$ of 100. **14.** $\frac{1}{6}$ of 100. **16.** $\frac{3}{4}$ of 100.

17. Since $3 \times 33\frac{1}{3} = 100$, $33\frac{1}{3}$ % of anything is $\frac{1}{3}$ of it.

18. Since $5 \times 20 = 100$, 20 % of anything is $\frac{1}{5}$ of it.

19. Since $8 \times 12\frac{1}{2} = 100$, $12\frac{1}{2}$ % of anything is $\frac{1}{8}$ of it.

20. Make similar statements about $16\frac{2}{3}$ %, $8\frac{1}{3}$ %, and 75 %.

A Table of Equivalents

50 % of anything = $\frac{1}{2}$ of it.	$33\frac{1}{3}$ % of anything = $\frac{1}{3}$ of it.
25 % of anything = $\frac{1}{4}$ of it.	$16\frac{2}{3}$ % of anything = $\frac{1}{6}$ of it.
$12\frac{1}{2}$ % of anything = $\frac{1}{8}$ of it.	$66\frac{2}{3}$ % of anything = $\frac{2}{3}$ of it.
20 % of anything = $\frac{1}{5}$ of it.	75 % of anything = $\frac{3}{4}$ of it.

Give the following:

21. 50 % of 17 yd.	**27.** $66\frac{2}{3}$ % of 30 bu.	**33.** $66\frac{2}{3}$ % of 36.
22. 25 % of 18 bu.	**28.** 75 % of 100 ft.	**34.** $16\frac{2}{3}$ % of 24.
23. $12\frac{1}{2}$ % of 24 qt.	**29.** 50 % of 12 yr.	**35.** $12\frac{1}{2}$ % of 48.
24. 20 % of $30.	**30.** $33\frac{1}{3}$ % of 30 da.	**36.** 20 % of 35.
25. $33\frac{1}{3}$ % of 15 yd.	**31.** 25 % of 15 mi.	**37.** 75 % of 16.
26. $16\frac{2}{3}$ % of 12 rd.	**32.** $12\frac{1}{2}$ % of $15.	**38.** 50 % of 98.

85. A RELATION EXPRESSED IN PER CENT

1. A peck is what part of a bushel? What per cent of it?

2. A foot is what part of a yard? What per cent of it?

3. Two are what part of a dozen? What per cent of it?

4. 2 oz. are what part of a pound? What per cent of it?

5. Since $2 \times 3 = 6$, 2 is what part of 6? What per cent?

Give the relation of the first number to the second as a per cent:

6. 4 and 8.	**12.** 3 and 9.	**18.** 6 and 36.
7. 5 and 10.	**13.** 6 and 18.	**19.** 7 and 42.
8. 5 and 15.	**14.** 9 and 36.	**20.** 12 and 16.
9. 6 and 18.	**15.** 8 and 32.	**21.** 30 and 40.
10. 4 and 16.	**16.** 8 and 40.	**22.** 20 and 30.
11. 5 and 20.	**17.** 10 and 30.	**23.** 12 and 18.

24. What per cent of 356 is 124.6?

WORK

$$\begin{array}{r} .35 = 35\,\% \\ 356\overline{)124.60} \\ \underline{106\ 8} \\ 17\ 80 \\ \underline{17\ 80} \end{array}$$

EXPLANATION. — We find the relation by dividing 124.6 by 356, as in division of decimals. Then the quotient is expressed in per cent.

Give the relations in per cent:

25. 76.8 to 480.
26. 290 to 725.
27. 301 to 860.
28. 414 to 920.
29. 896 to 1120.
30. 117 to 156.
31. 236.4 to 985.
32. 1014 to 1560.
33. 84 to 560.
34. 572 to 715.
35. 589 to 950.
36. 171 to 684.

37. What per cent of 1575 is 367.

WORK

```
         .233+ = 23.3+%
1575)367.000
      3150
       5200
       4725
        4750
        4725
          25
```

Explanation. — Here the division was carried to thousandths, then the quotient expressed as per cent. .233 = 23.3+%.

Give the relations in per cent:

38. 385 to 968.
39. 276 to 842.
40. 398 to 1096.
41. 847 to 1586.
42. 735 to 987.
43. 623 to 1685.
44. 538 to 1126.
45. 693 to 1384.
46. 863 to 947.
47. 786 to 834.
48. 692 to 985.
49. 586 to 738.

50. A man bought a farm for $11,750 and sold it for $15,500. What per cent of the cost did he make?

51. If you buy a canoe for $54.50 and sell it for $45 after using it 3 months, what per cent of the price paid do you lose?

52. A house that cost $8450 was sold for $11,000. What per cent was gained?

Problems in Percentage

1. In selling sugar, a dealer estimates that he will lose 10% of it in down weight and drying out. From 600 pounds bought, how many pounds does he expect to sell?

2. By paying cash for a piano I got a reduction of 5%. That is, the dealer deducted 5% of the price of the piano. How much did I save by paying cash for a $400 piano?

3. A dealer sold me a $20 lamp for $18. How much reduction was this? The $2 reduction was what part of the price? What per cent of it?

4. A 12-lb. ham weighed but 9 lb. when roasted. How many pounds were lost in cooking? What per cent of the first weight was this?

5. I have 10 trees on my lawn. 5 are maples, 3 are elms, and 2 are oaks. What per cent of the trees are maples? What per cent are elms? What per cent are oaks?

6. A certain field produced 40 bu. of corn per acre. It was estimated that careful cultivation would have increased the crop 20%. What would the yield have been?

7. Last year 100 pupils graduated from the 8th grade of a certain school. This year 120 will graduate. What is the per cent of increase?

8. James bought a $35 sleigh for 20% below the regular price. How much did it cost him?

9. At a special sale, suits and overcoats were sold 25% below the regular price. Give the prices you must pay for suits or overcoats marked regularly as follows:

$16; $12; $20; $24; $32; $28.

10. During the annual "August Sale," a furniture dealer gave a 10% reduction on goods. Below are given the regular prices. What are the August prices?

Desk, $20; Dining-room table, $50; Bookcase, $30; Brass bed, $40; Parlor suit, $120; Kitchen cabinet, $10; Morris chair, $15.

11. During an "After Christmas Sale," some articles were marked $33\frac{1}{3}\%$ below the regular price. Give the special prices of the following:

A \$30 overcoat;	A \$1.50 shirt;
A \$45 business suit;	A \$4.50 pair of shoes;
A \$12 boy's overcoat;	A \$9 boy's suit.

12. Some kinds of American hemp lose 40% when manufactured into twine. How many pounds of twine will a ton of such hemp make?

13. With some Italian hemp, the loss is but 20%. How many pounds of twine will 2 tons of such hemp make?

14. After scouring 600 lb. of wool, it weighed but 200 lb. What per cent was lost?

15. Another lot of wool weighing 1000 lb. weighed 450 lb. when scoured. What per cent was lost?

16. A man failing in business pays me 25% of what he owes me. How much do I lose if he owes me \$1200? How much if he owes me \$1800?

17. A man sold a house and lot that cost him \$8500. He made 15% of the cost. How much did he get for them?

18. Four men bought a carload of coal weighing 65,700 lb. One man took 25% of it, another 27% of it, and another 21% of it, and the fourth man, the remainder. How many pounds did each man get?

19. If the total cost of the load of coal described in Problem 18 was \$118, how much of it should each man pay?

86. DISCOUNT

When for any reason a deduction is made from a former price, or from the regular price, a **discount** is said to be given.

87. TRADE DISCOUNT

It is the custom among certain wholesale dealers, manufacturers, and publishers, to fix a price, called the **list price**, on their goods and then allow a certain deduction from this price to "the trade," *i.e.* to retail dealers handling their kinds of goods. This deduction, or *discount*, is usually a *per cent* of the *list price.* The remainder is the **net price.**

Problems in Discount

1. Goods listed at \$450 were sold to a dealer at a discount of 15%. Find the net price.

SOLUTION

First method:

$$\begin{array}{r} \$450 \\ 0.15 \\ \hline 2250 \\ 450 \\ \hline \$67.50 \end{array} = \text{the discount}$$

$$\begin{array}{r} \$450.00 \\ 67.50 \\ \hline \$382.50 \end{array} = \text{net price}$$

Second method:

$$\begin{array}{r} \$450 \\ 0.85 \\ \hline 2250 \\ 3600 \\ \hline \$382.50 \end{array} = \text{net price}$$

Explanation. — In the first method, we found the discount which was 15%, or 0.15 of the list price. Then we subtracted this from the list price.

In the second method, we reasoned as follows: since a discount of 15% is deducted from the list price, the net price is only 85% (100% − 15%) of the list price. Which method do you prefer?

2. During a single month a merchant received goods amounting to \$10,650. By paying cash he got an average discount of 4%. Find how much he saved by paying cash.

3. George's father bought a motor boat last October. It being late in the season, he was allowed a discount of 20%. The price earlier in the summer was \$475. How much was saved? Find the net cost.

4. Whitney saved money to buy a canoe. He bought a \$36 canoe, but the dealer gave him a discount of 10%. How much did it cost him?

5. Sydney bought a tent from Donald. Having used it one year, he gave Sydney a discount of $12\frac{1}{2}$% from what it first cost. It cost Donald \$24. How much did it cost Sydney?

6. James bought a new \$85 pony cart. His father being a dealer in carts and buggies, James got a discount of 25%. How much did it cost him?

7. When coal was selling for \$7.25 a ton, Mr. Harvey got a discount of 10% by having his coal drawn direct from the car to his cellar. How much did he save on 12 tons?

8. A publishing house sold Arithmetics, of which the regular or list price was 40¢, at a discount of 20%. What was the actual price paid for a book? What did 2640 books used in one city cost?

9. A clothing merchant placed a lot of boys' suits on special sale at a reduction of 25% from the regular price. Find the prices paid for suits whose regular prices were:

\$12; \$8.60; \$10; \$14.80; \$9.20.

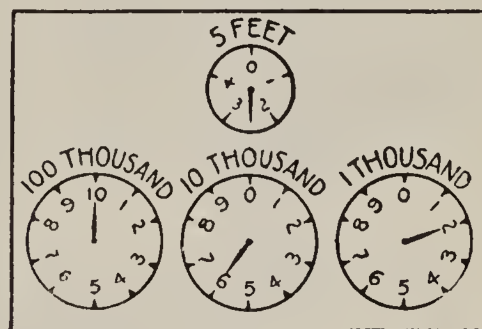
10. A milliner made a special sale of hats at a reduction of 30% from the regular price. Find the price paid for a hat formerly marked \$6; a hat formerly marked \$10; a hat formerly marked \$14; a hat formerly marked \$9.20.

11. After Christmas holidays, a merchant marked his toys, etc., to sell at a discount of 40%. Find how much you must pay for a pair of skates whose regular price was

$1.75. Find how much you must pay for a sled whose regular price was $2.95.

12. My electric light bill for one month amounted to $1.98, less a discount of 10%, if paid within 10 days. What did the bill amount to if paid within 10 days?

13. On May 1, the reading on my gas meter was 65,000. On June 1, it was 68,500. The price is $1.25 per 1000 cubic feet, less 10% discount if paid before June 10. How much is saved by paying before June 10?



14. A certain company advertises gas as follows:

100 to 2000 cu. ft., monthly, $1.25 per 1000, net.
2000 to 5000 cu. ft., monthly, $1.25 per 1000, less 10%.
5000 to 10,000 cu. ft., monthly, $1.25 per 1000, less 20%.
10,000 to 20,000 cu. ft., monthly, $1.25 per 1000, less 25%.

Find the net cost of the following:

1800 cu. ft.	6300 cu. ft.	9500 cu. ft.
2600 cu. ft.	4500 cu. ft.	12,000 cu. ft.

Drill Table

	List Price	Rate of Discount	Net Price		List Price	Rate of Discount	Net Price
1.	$ 40	25%		9.	$ 240	$8\frac{1}{3}$%	
2.	$ 65	20%		10.	$ 640	$12\frac{1}{2}$%	
3.	$150	$33\frac{1}{3}$%		11.	$ 750	20%	
4.	$600	$16\frac{2}{3}$%		12.	$ 800	40%	
5.	$960	$16\frac{2}{3}$%		13.	$ 900	$11\frac{1}{9}$%	
6.	$175	10%		14.	$ 420	$14\frac{2}{7}$%	
7.	$450	$16\frac{2}{3}$%		15.	$1200	$16\frac{2}{3}$%	
8.	$960	$33\frac{1}{3}$%		16.	$ 720	25%	

Problems in Finding the Rate of Discount

1. I received a discount of \$294 from a bill of goods listed at \$840. What was the rate of discount?

SOLUTION

$$\begin{array}{r} 0.35 = 35\,\% \\ 840\overline{)294.00} \\ \underline{252.0} \\ 42.00 \\ \underline{42.00} \end{array}$$

EXPLANATION. — Since it is required to find the rate per cent that one number is of the other, we first find the ratio of \$294 to \$840, which is $\frac{294}{840}$, and then express it as *hundredths.*

The discount divided by the list price is the **rate of discount.**

2. I bought goods that were listed at \$1150 for \$920. What rate of discount was this?

3. Mrs. Baker bought a \$12 bed hammock, but as it was slightly damaged, the clerk sold it to her for \$10. What was the rate of discount?

4. John's father bought him a suit at a special suit sale for \$7.60. The regular price was \$9.50. What rate of discount was given?

5. I was given a discount of \$238 from a bill of goods listed by a wholesale house at \$680. What rate of discount was I allowed?

6. At a fire sale, goods slightly soiled by smoke and water were sold as follows:

ARTICLES	BOYS' SUITS	MEN'S SUITS	SHIRTS	HATS
Regular price	\$8.50	\$25.00	\$1.50	\$3.00
Price sold	5.10	16.25	0.60	0.75

Find the rate of discount for each kind of goods.

7. I bought an automobile listed at \$1150 for \$865. What rate of discount did I get?

SOLUTION

$$\begin{array}{r} \$1150 \\ \underline{865} \\ \$285 = \text{Dis.} \end{array}$$

$$\begin{array}{r} 0.248^{-} = 24.8^{-}\% \\ 1150\overline{)285.00} \\ \underline{230.0} \\ 55.00 \\ \underline{46.00} \\ 9.000 \\ \underline{9.200} \end{array}$$

EXPLANATION. — Here the discount, \$285, did not contain the list price, \$1150, without a remainder when carried to hundredths. It was carried to the nearest thousandth. $0.248^{-} = 24.8^{-}\%$.

8–17. Pianos that had been used were offered for sale by Siegel, Cooper & Co., Oct. 17, 1910, as follows:

INSTRUMENT	ORIGINAL PRICE	SELLING PRICE
Decker & Son	\$375	\$110
J. & C. Fischer	400	125
Emerson	425	125
Krakauer	450	160
Chickering	600	165
Sterling	350	175
Steinway	550	185
Weber	500	240
Eberhardt player piano . . .	650	385
Hasbrouck player piano . . .	700	425

Find the rate of discount on each instrument.

18. Smith, Gray & Co., of New York, on Oct. 24, 1910, advertised the following:

\$40 suits and overcoats, \$27.50.
\$30 suits and overcoats, \$22.50.

Upon which lot is the largest per cent of discount given?

19–24. The Detroit House Wrecking Co. advertised rugs, etc., for sale as follows:

Articles	Regular Price	Selling Price
Royal Wilton Rugs	$45.00	$21.35
Wilton Velvet Rugs	32.50	14.65
Axminster Rugs	32.50	15.95
Brussels Rugs	19.00	8.95
Oriental Rugs	155.00	62.50
Brussels Carpets	1.60	0.75

Find the rate of discount on each kind of article.

25–26. W. V. Snyder & Co., Newark, N.J., gave the following special prices on rugs:

$55 Seamless Wilton rugs, 9×12, $42.50.
$37.50 Royal Wilton rugs, 8.3×10.6, $28.50.

Find the rate of discount on each rug.

Problems in Percentage

1. Our social club bought a croquet set and a tennis net. The price of the two was $10.80, but we were given a discount of 15 %. How much did they cost us?

2. Our baseball club earned money for suits by selling *The Saturday Evening Post.* Ten boys each sold 75 papers at 5¢ each. If they got 40 % of all the money received, how much did they earn?

3. Some girls held a fair to raise money for "The Fresh Air Home." They bought raffia and reed for making baskets. The material would have cost them $9.50, but the dealer gave them a discount of 15 %. Find how much they paid for it.

4. Some boys wanted a tennis court. A man offered to furnish the clay, and grade and roll the court for \$12.50. The boys decided to do the work themselves. They bought twelve loads of clay at 50¢ a load and hired a roller and other tools for two days at 75¢ a day. Find what per cent of the cost they saved.

5. The manager of a baseball team bought ten suits at \$6 each. He found later that another firm would have furnished them at \$4.75 each. What per cent could he have saved?

6. One firm offers a canoe for \$35. Another firm offers the same kind of canoe for \$38, subject to a 10% discount for cash. Which is cheaper and how much?

7. James sold balloons for a man at the circus. He sold 100 at 5¢ each and received 40% of the money. How much did he earn?

8. Our ball team wants to buy 10 suits. The local dealer offers them for \$5 each. We have a catalogue in which suits are quoted at \$5.50, subject to a 10% discount. If the express is 75¢, which is cheaper, to send for them or buy from the local dealer?

9. Our school wishes to buy some manual training benches. One firm offers them at \$20 each, subject to a discount of 25%, and another firm offers them for \$18 each, subject to a 15% discount. How much is saved by accepting the better offer?

10. Frank collects bills for his father. One week he collected \$180 and was allowed $2\frac{1}{2}$% of it for his work. How much did he keep and how much of it did he give his father?

11. Harry wishes to buy a canoe listed at \$48. He finds that after August 15th he can get it for 10% less. How much can he save by waiting?

12. Mary wants a dress which will cost $12 if bought "ready made." She can buy the material for $6 and hire a dressmaker for $3. What per cent of the $12 can she save by buying the goods and hiring the dressmaker?

13. The girls' basketball team raised money for supplies by selling 400 copies of a magazine at 15¢ each. They were given a commission of 40%. How much did they raise in this way?

14. Arthur's mother gave him $30 with which to buy a bicycle. He bought the bicycle for $25, but paid $1.50 railroad fare in going to the city to purchase it. What per cent of the $30 had he left?

15. Our school wants to buy 15 doz. geraniums. The price is $1.20 per doz. with a discount of $12\frac{1}{2}$% for lots of 5 doz. How much will they cost?

16. The sixth grade is going to buy a picture for the schoolroom. The picture is listed at $28, but the dealer allows a discount of 15%. How much will it cost?

17. If we buy 3 tents at $18.50 each for our camp this summer and the floors cost $3.50 each, what is the total cost if 5% is allowed for cash payment?

18. On "circus day" George sold $45 worth of peanuts and popcorn, and made 35% of the amount. How much did he make?

19. During July a store sold all goods in its Sporting Goods department at a discount of 10%. Our boys' club bought 3 tents marked $19.50 each; a canoe marked $38; and a camp kit marked $8.50. Find how much was saved and the total cost.

20. A ball team bought suits which would have cost the boys $6 each if bought individually, but buying them as a team, they got 20% discount. Find the total saving on nine suits.

21. Harry is taking subscriptions for a magazine worth $1.50 per year. He gets a commission of 30 %. How many subscriptions must he get in order to earn money enough to buy a $11.25 watch?

22. Mrs. Brown bought goods at a store which gave a trading stamp for every 10¢ purchase. When she had spent $100 the stamps which she received were worth $2.50. What per cent did she save by getting stamps?

23. At a certain auction sale 2 % off was given for cash payments. Mr. Hawkins bought a wagon for $35, a horse for $150, and a cow for $75. If he paid cash, how much did all cost?

24. The Boys' Camping Club wishes to buy an outfit amounting to $220. They are allowed 15 % discount. If there are 16 boys in the club, how much will it cost each?

25. A boy bought a second-hand bicycle for $5.80 and after repainting it sold it for $8. What per cent did he make if the paint cost 20¢?

Problems in Billing Goods

1. Complete the following bill:

BARNETT–SIMPSON HOSIERY CO.

MANUFACTURERS OF SEAMLESS AND FULL–FASHIONED HOSIERY

Sold to Messrs. J. R. Doe & Co., Denver, Col.

TERMS { 2 per cent 10 days. Net 30 days. July 15, 1911.

2½ doz.	Boys' Stockings @ $1.90			
1½ "	" " @ 2.00			
7½ "	" " @ 2.10			
4 "	" " @ 2.25			

2. The terms "2 per cent 10 days; net 30 days" mean that if J. R. Doe & Co. choose to pay the bill within 10 days of the date, a discount of 2% will be allowed. But they need not pay the bill for 30 days. After 10 days they are not allowed a discount.

If Doe & Co. remit before July 25, what should be the amount of the remittance? What must they remit any time between July 25 and Aug. 15?

3. Bill from the same firm to A. L. Dickson & Son, Jan. 4/'11, the following: $3\frac{1}{2}$ doz. pr. hose at \$3.25; $7\frac{1}{2}$ doz. pr. children's stockings at \$1.80; $12\frac{1}{2}$ doz. pr. men's half hose at \$2.50; $8\frac{1}{2}$ doz. pr. boys' stockings at \$2.25. What amount will settle the bill within 10 days? Within 30 days?

Make out a bill for the following:

4. Butler Bros., Chicago, Ill., sold to E. M. Rose & Co., Jan. 3, 1911, the following: 240 yd. matting at $17\frac{1}{2}$ cents; 360 yd. matting at 18 cents; 8 rugs at \$3; 2 matting rugs at \$0.78; 5 couch covers at \$3.25; 6 pr. curtains at \$1.50; 12 pr. curtains at \$2.75. Terms: 1% in 20 days; net 40 days.

What sum will settle the bill before Jan. 23? Feb. 8?

5. Sidney Shepherd and Co., Buffalo, N.Y., sold to H. M. Murphy & Son, March 13, 1910, the following:

$\frac{1}{4}$ gro. pails at \$39.60; $\frac{1}{12}$ gro. steamers at \$28.80; $\frac{1}{12}$ gro. steamers at \$32.40; all less 10%. Also $1\frac{1}{2}$ doz. drip pans at \$4.45 less 60%. Terms: 2% off 10 days; net 60 days.

What sum will settle the bill before March 23? What within 60 days?

6. Rollin & Rollin, importers, New York, sold to J. R. Wilson & Co., St. Paul, Minn., Oct. 20, 1910, the following:

84 boys' suits at \$6.25,
20 doz. shirts at \$7.00.
Terms: 2% 10 days, net 30 days.

Prepare the bill, and find what sum will settle it if paid before Oct. 30.

Note. — It will be found interesting and profitable for pupils to play *going into business*, some acting as wholesale and some as retail firms. Let the retail firms buy bills of goods of the wholesale firms, the latter making out complete bills in the preceding form. The retail firms work through and check their bills before paying them.

General Problems in Percentage

1. 70 % of round steak is water. How much water in 8 lb. of steak?

2. If you sleep 8 hr. each day, what per cent of your time do you sleep?

3. If the coal in your coal bin is 6 ft. deep at the beginning of the winter and you use all but 1 ft. in depth, what per cent is left? What per cent have you used?

4. 1000 lb. of potatoes contain 180 lb. of starch. What per cent of potatoes is starch?

5. In 1000 lb. of rice there are 790 lb. of starch. What per cent of rice is starch?

6. Children studying soils find that 325 grams of a certain kind of soil contain 112 grams of water. What per cent of the soil is water?

7. They find that 325 grams of another kind of soil contain 95 grams of water. What per cent of this soil is water?

8. If you buy a canoe listed at \$48.50 for \$41.22, what rate of discount do you receive?

9. If a farmer increased his yield of corn on a certain field from 36.4 bu. per acre to 45.5 bu. per acre, what was the per cent of increase? If the total yield was 1250 bu. before the increase, what was it after the increase? At 55 ¢ per bushel what did he receive for the total increased yield?

10. A boy who weighed 85 lb. last year weighs 93.5 lb. this year. What is the per cent of increase?

11. 78 % of potatoes is water. How many pounds of water in a bushel of potatoes which weighs 60 lb.?

12. About $77\frac{1}{2}$ % of a cabbage is water. How much water in a head of cabbage weighing 3 lb.?

13. Of grapes, 58 % is water. How much water in a basket of grapes weighing 5 lb.?

14. The following table contains a record of the milk given by one of a farmer's cows in 9 mo. Find the yield of butter fat for 9 mo. from this cow.

Month	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.
Lb. milk . .	720	750	710	680	650	620	540	450	420
% butter fat .	4.4	4.4	4.2	4	4.2	4	3.8	3.5	3

15. Some children studying the composition of foods found that 8 oz. of green butter beans weighed only 5.7 oz. when thoroughly dried in an oven. What per cent of green butter beans is water?

16. When the beans were burned, the ash weighed only 0.08 oz. What per cent of the beans is ash?

17. The children found that 12 oz. of fresh beets weighed only 3.6 oz. when thoroughly dried. What per cent of beets is water?

18. They found that 24 oz. of cucumbers weighed only 5 oz. when dried. What per cent of cucumbers is water?

19. 10 oz. of lettuce leaves weighed only 2 oz. when dried. What per cent of lettuce is water?

20. 24 oz. of sweet potatoes weighed only 11 oz. when dried. Find the per cent of water in sweet potatoes.

21. Apples weighing 18 oz. weighed only 7 oz. when dried. Find the per cent of water in apples.

22. A car will carry 1150 bu. of wheat. What per cent of it is yet to be filled when 987 bushels have been loaded?

23. A family wish to furnish a dining room and living room with Mission furniture. It will cost them $385. They can save 10% by waiting for the "June Sale." How much is the saving?

The Woman's Exchange

A woman's exchange is a place where women offer for sale foods that they have prepared.

1. A woman bought at the meat market 15 lb. of meat at 18¢ a pound. She roasted it, and then sold it at the exchange at 40¢ a pound. If the meat lost 30% of its weight in cooking, how much did she make for her work?

2. A woman paid 23¢ a pound for a ham weighing 12 lb. She cooked it, and it was retailed at the exchange at 45¢ a pound. Allowing 35% of the weight for loss in cooking and for bone, how much profit did she make on it?

3. A sirloin beef roast weighing $16\frac{1}{4}$ lb. cost 20¢ a pound. When cooked it was sold for 45¢ a pound. If 33% of its weight was lost in cooking, how much profit was made on it?

4. Leg of lamb cost 18¢ a pound, and when cooked sold for 35¢ a pound. How much profit was made on a leg weighing 6 lb. if 36% of the weight was lost in cooking?

5. Veal roast weighing $7\frac{1}{4}$ lb. cost 22¢ a pound, and when cooked sold at 45¢ a pound. It lost 34% of its weight in cooking. How much was the profit on it?

6. A chicken weighing $3\frac{1}{2}$ lb. cost 20¢ a pound. It lost 40% of the weight in roasting, and was sold at 45¢ a pound. How much profit was made on it?

Shrinkage of Grain

Grain raised on a farm loses weight for a few months after it is harvested because of the evaporation of water from it.

1. It was found at the state agricultural experiment station of Illinois that ear corn lost 6 % of its weight from November to March. At this rate of shrinkage corn that weighed 85,450 lb. in November would weigh how much by March?

2. In most states 70 lb. of ear corn make a bushel. How many pounds in 2450 bu.? If this was the weight in November, at the rate of shrinkage in Problem 1 how much would it weigh by March?

3. A farmer harvested 1200 bu. of corn in the fall. If it lost 6 % by shrinkage before he sold it, how many bushels did he sell? If he sold it for 50 cents a bushel, how much did he receive for the crop?

4. Which would have yielded him the greater income, to sell it as he did, or to have sold it as soon as it was harvested at 45 cents a bushel? How much?

5. A man could have sold his crop of 3475 bu. of corn when harvested at 38 cents a bushel. But he waited for six months to sell it, hoping to get a higher price. After it had lost $7\frac{1}{2}$ % by shrinkage, he sold it at 42 cents a bushel. Did he gain or lose by holding the corn? How much?

6. A grain dealer bought 5500 bu. of corn at 35 cents a bushel, and after holding it five months, he sold it at 50 cents a bushel. If it lost 7 % through shrinkage, how much profit did he make?

7. Which is more profitable and how much, to sell 3600 bu. of wheat when threshed at 88 ¢ per bushel, or to sell for 91 ¢ after 8 % is lost through shrinkage?

Shipping Stock to the Market

1. A cattle raiser shipped 30 head of his cattle to the city market. The animals weighed an average of 1490 lb. each when they left the farm, and weighed only an average of 1470 lb. each when they reached the city. What per cent did they lose in weight in shipping?

2. He could have sold them to a local buyer for 6 cents a pound, weighed at the farm. But by shipping to the city market he got $6\frac{1}{4}$ cents a pound, city weight. How much did he make by not selling to the local buyer?

3. Records show that fat steers weighing an average of 1539 lb. each on the farm lost an average of 22.5 lb. each when shipped from Champaign, Ill., to the Chicago Stockyards. What per cent of their weight did they lose?

4. At the rate of shrinkage in shipping found in Problem 3, what would be the weight at the Stockyards of steers that weighed a total of 58,790 lb. when they left the farm?

5. If the shipper in Problem 4 received $6.25 a hundred pounds, city weight, for his cattle, and could have sold them to a local buyer for $6.10 a hundred pounds, weighed at the farm, did he gain or lose by shipping to the city market?

6. A Montana sheep grower shipped lambs to the Chicago market. The lambs lost 7.6 % of their weight in shipping. A lamb weighing 86 lb. when shipped would weigh how much when it reached Chicago?

7. At the same time two-year-old sheep lost 6.8 % of their weight when shipped from Montana to Chicago. A sheep weighing 138 lb. when shipped would weigh how much when it reached Chicago?

8. If a man shipped a carload of sheep weighing 12,875 lb. to the city market, and they lost 4.6 % of their weight in shipping, find his loss at $5.85 a hundred pounds.

Problems of the Dairy

The following record was obtained at one of the state agricultural experiment stations. It gives the quantity of milk and butter fat produced annually by a single cow of each of the following five breeds. It also gives the cost of food consumed.

	Pounds Milk	Pounds Butter Fat	Cost of Feed
Jersey	5,773	303	$35.97
Shorthorn	6,920	272	37.58
Holstein-Friesian . .	11,184	382	41.49
Guernsey	6,273	312	36.63
Brown Swiss	6,971	273	34.51

1–5. Find the per cent of butter fat in the milk of each breed of cow. Which cow produced the greatest per cent of butter fat? Which produced the least per cent?

6–10. Find to tenths of a mill the cost of the feed, in the case of each breed of cow, to produce 1 pound of milk. Which was the most expensive? Which the least?

11–15. Find to tenths of a cent the cost of the feed, in the case of each breed of cow, to produce 1 pound of butter fat. Which was the most expensive? Which the least? From these results, which breed of dairy cows do you think it would best pay a farmer to own?

16. A man had a herd of dairy cows that yielded annually an average of 3000 lb. of milk each. But in a few years, by studying the feed consumption and milk and butter fat production of the individual cows, he was able to produce a herd that yielded an average of 7000 lb. of milk each. This was a gain of what per cent in the yield of milk?

SIMPLE INTEREST

88. MEANING OF SIMPLE INTEREST

1. If I pay $60 a month for the *use* of another man's house, how much *rent* do I pay in 3 months? In 6 months? In 1 year?

2. If I pay a livery-stable keeper $1 an hour for the *use* of his horse, how much *horse-hire* do I pay for 3 hours at the same rate?

3. If I pay $5 an hour for the *use* of an automobile, how much do I pay for the use of it for 5 hours?

4. If I pay Mr. Brown $6 a year for the *use* of $100 belonging to him, how much must I pay for the use of it for 2 years?

> *Money paid for the use of money is called* **Interest.** *It is usually a per cent of the sum used.*

Thus, when one says money is worth 5 %, he means that the one *hiring* it, or borrowing it, pays 5 % of the amount borrowed for 1 year's use of it.

5. How much must I pay for 1 year's use of $100 at 5 %? How much at 6 %? How much at 7 %?

5 % and 6 % are very common rates of interest.

Exercises in Interest

1. What is one year's interest of $100 at 6 %?

2. At 6 %, what is the interest of $200 for 1 year? For 2 years?

3. At 6 %, what is the interest of $300 for 2 years? For 3 years?

4. What is 1 year's interest of \$300 at 5 %? At 7 %?

5. At 5 %, what is the interest of \$500 for 2 years? For 4 years?

6. At 5 %, what is the interest of \$400 for 1 year? For 6 months?

7. What is the interest of \$600 for 6 months at 5 %?

8. At 6 %, what is a year's interest of \$500? 3 years'?

9. At 5 %, what is 3 years' interest of \$80? 5 years'?

At 6 %, what is the interest of:

10. \$500 for 6 mo.?

11. \$300 for 8 mo.?

12. \$400 for $1\frac{1}{2}$ years?

13. \$250 for 1 year?

14. \$150 for $2\frac{1}{2}$ years?

15. \$350 for 1 year?

At 5 %, what is the interest of:

16. \$800 for 1 yr. 6 mo.?

17. \$200 for 2 yr. 6 mo.?

18. \$300 for 2 yr. 6 mo.?

19. \$600 for 2 yr. 4 mo.?

20. \$400 for 2 yr. 3 mo.?

21. \$800 for 1 yr. 4 mo.?

22. \$700 for 2 years?

23. \$90 for 2 yr. 4 mo.?

At 5 %, what is the interest of:

24. \$340 for 1 year? For 2 years? For 3 years?

25. \$80 for 6 mo.? For 3 mo.? For 9 mo.?

26. \$90 for 4 mo.? For 8 mo.? For 1 year 4 mo.?

27. \$450 for 4 mo.? For 1 yr. 4 mo.? For 1 yr. 8 mo.?

28. \$240 for 1 yr.? For 4 mo.? For 1 yr. 4 mo.?

29. \$360 for 1 month? For 3 mo.?

At 4 %, what is the interest of:

30. \$500 for 1 year? For $1\frac{1}{2}$ years? $2\frac{1}{2}$ years?

31. \$600 for 1 yr.? For 1 yr. 6 mo.? For 1 yr. 8 mo.?

Time Between Dates

It is often desirable to find the time in years, months, and days, between two dates. Bankers usually find the exact number of days by use of tables. In working without tables, 360 days are considered a year, and 30 days a month, and it is customary to subtract as in the following problem:

1. Find the time between July 4, 1897, and Feb. 22, 1910.

WORK

1910 yr.	2 mo.	22 da.
1897	7	4
12 yr.	7 mo.	18 da.

EXPLANATION. — February is the 2d month and July the 7th month of the year. Since 7 mo. cannot be taken from 2 mo., 1 yr. of the 1910 yr. is changed to 12 mo., which added to 2 mo. gives 14 mo. 14 mo. – 7 mo. = 7 mo. 1909 yr. – 1897 yr. = 12 yr.

Find the time between the following dates:

2. March 4, 1904 and June 20, 1910.

3. August 17, 1902 and April 9, 1905.

4. May 12, 1872 and January 1, 1897.

5. Oct. 16, 1899 and June 2, 1904.

6. December 25, 1908 and April 14, 1909.

7. September 30, 1856 and March 9, 1857.

8. Columbus discovered America Oct. 12, 1492. How long ago was that?

9. When were you born? Find your age to-day in years, months, and days.

10. Lincoln was born Feb. 12, 1809, and became President of the United States March 4, 1861. At what age did he become President?

11. War with Spain was declared by the United States April 25, 1898, and the treaty of peace ending the war was signed Dec. 12, 1898. How long did the war last?

Problems in Interest

1. I borrowed some money April 27, 1911, and paid it back January 27, 1913. How long did I have to pay interest on it?

2. If a man loaned some money October 16, 1910, and it was paid back December 16, 1913, how long did he receive interest on it?

3. Mr. Dunlap borrowed \$450 at 6 % interest May 14, 1912, and paid it back November 14, 1913. How much interest did he pay?

Suggestion. — How long did he keep the money? What is the interest of \$450 at 6 % for one year? What is the interest for $1\frac{1}{2}$ yr.?

4. Mr. Martin loaned \$500 at 8 % interest from February 10, 1910, to August 10, 1912. How much interest did he receive?

5. Mr. Coffing borrowed \$800 at 6 % interest July 6, 1911, and paid it back October 6, 1911. Find the interest.

6. If you borrowed \$250 at 6 % interest March 12, 1913, and paid it back August 12, 1913, how much interest would it cost you?

Suggestion. — How many months would you have the money? This is what part of a year? $\frac{5}{12}$ of \$15 = ?

7. I loaned \$1200 at 8 % interest May 20, 1908, and it was returned October 20, 1910. How much interest did it earn?

8. A boy put \$50 in a savings bank which paid 3 % interest on the money. How much interest did it earn in a half year? How much money did he have at the end of the half year? (\$50 + interest.)

9. If a boy put \$120 in a savings bank that paid 3 % interest, how much would the money and the interest together amount to at the end of a half year?

10. If Sydney has \$165 in a savings bank, how much interest at 4 % will he get in one half year?

11. Savings banks usually pay interest each half year on money deposited, on January 1 and on July 1. If the interest is not drawn when due, it is added to the amount on deposit. If you deposit $40 February 1, in a savings bank that pays 3 % interest, how much will it be worth July 1?

12. On July 1 John had $25 in a savings bank that paid 4 % interest. By working during summer vacation he saved $15 more, which he deposited in the savings bank on September 1. How much was his bank account worth January 1?

SUGGESTION. — Find the interest on $25 for 6 mo. and on $15 for 4 mo. Add all of the interest and $25 and $15.

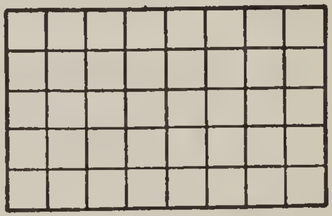
The money upon which the interest is paid is called the **Principal**. *The sum of the principal and interest is called the* **Amount**.

VIII. MENSURATION

89. THE AREA OF A RECTANGLE

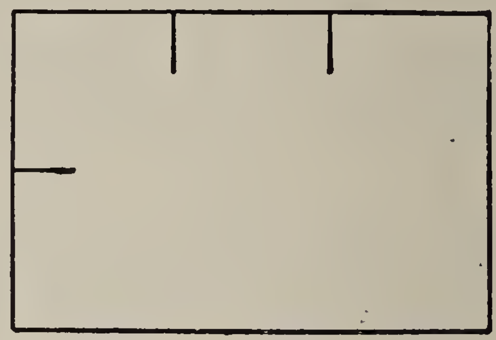
The area of any surface is the **number of units of measure** that it contains, such as square inches, square feet, or square miles.

The unit of measure may be of any size, but it is always a **square**.



How many squares are there in this rectangle? If each of these squares represents a square inch, what is the area of the rectangle? How many squares are in each row? How many such rows of squares are there? How can the whole number of squares in the rectangle be obtained from the number in each row and the number of rows?

1. If one side of a rectangle is 3 ft., and the side adjacent 2 ft., into how many square feet may it be divided? What is the area?



2. Two adjacent sides of a rectangle are sometimes called the **base** and the **altitude**.

If the length of the base is 6 inches, and of the altitude 4 inches, what is the area?

3. Find the area if the base is 20 ft. and the altitude 17 ft.

4. Complete: *The area of a rectangle is the product of* ——.

Problems in Finding Areas

1. A rectangular field is 40 rods long and 35 rods wide. What is its area? How many acres? How much is it worth at $80 per acre?

2. The sidewalk in front of a house is 5 ft. wide and 66 ft. long. How many square feet in it? How much did it cost at 27¢ a square foot?

3. Find the cost of linoleum for a kitchen which is 18 ft. long and 15 ft. wide, at $1.20 a square yard.

4. The area of a rectangle is 320 sq. in., and it is 16 in. wide. How long is it?

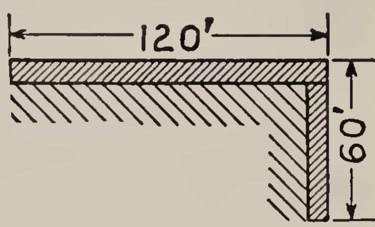
5. One side of a square is 8 yd. What is its area?

6. A bathroom is 6 ft. 8 in. by 10 ft. How many 1-inch square tiles will it take for the floor?

7. A boy in a class in woodwork uses a whitewood board 9 in. wide and 96 in. long. How many square inches in it? How many square feet? How much does it cost him at 9¢ a square foot?

8. A boy uses 6 whitewood boards, each 8 in. wide and 36 in. long. How many square inches in them? How many square feet? Find the cost at 12¢ a square foot.

9. I have a corner lot and wish to make a concrete walk 4 ft. wide across the front and side. The greatest lengths of the walks are 60′ and 120′, as shown in the figure. Find the cost at $1.35 per square yard.

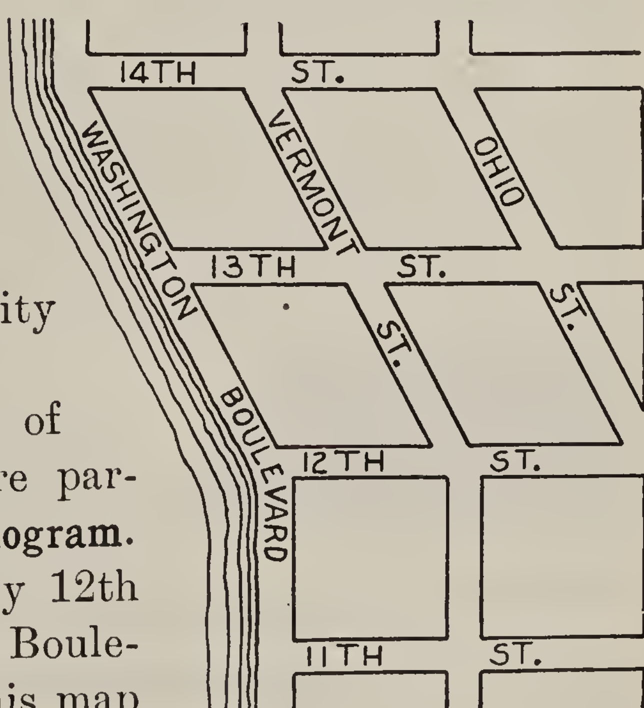


10. How many square feet in the cement floor of a garage 20′ × 26′? How much did it cost at $16\frac{1}{2}$¢ a square foot?

90. THE AREA OF A PARALLELOGRAM

Two straight lines that cannot meet, however far they may be extended, are called **parallel**. Thus, the top and bottom edges of this leaf are parallel. Point out the parallel lines in the room.

What are some other parallel lines of which you can think? What are some parallel lines in this city map?



A figure of four sides, of which the opposite sides are parallel, is called a **parallelogram**. Thus, the block bounded by 12th St., 13th St., Washington Boulevard, and Vermont St., in this map is a parallelogram.

How many parallelograms are shown in the map?

1. Is a rectangle a parallelogram? Is a square a parallelogram?

2. Any one of the sides of a parallelogram may be called the **base**. What kind of angles does the dotted line in the figure make with the lower side?

The width of a parallelogram measured at right angles to the base is called the **altitude**.

3. Draw a parallelogram on paper, and cut it out. Draw an altitude of it. Cut the parallelogram into two parts by cutting along the altitude.

4. Now fit the two parts together so that they make a rectangle.

5. Compare the area of the rectangle with that of the parallelogram before it was divided. Compare their bases. Compare their altitudes.

6. How is the area of the rectangle found? Then how may the area of the parallelogram be found without cutting it? Give the method of finding the area of any parallelogram.

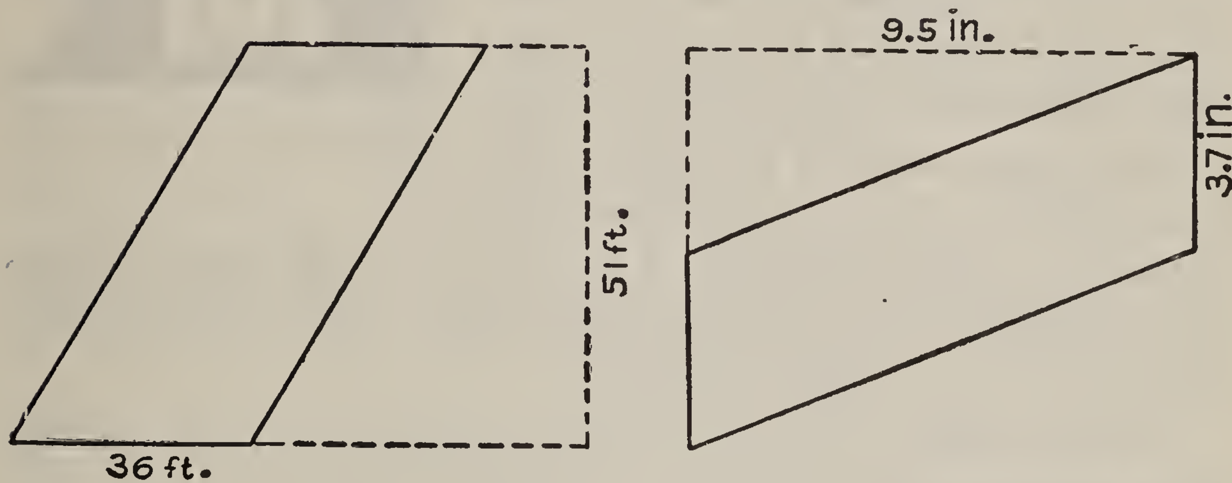
7. Cut out another parallelogram whose base is 4 in. and altitude 3 in. and make it into a rectangle. What is its area?

Problems

1. Find the areas of parallelograms with the following dimensions:

Altitude 12 in., base 16 in.;
Altitude 49 ft., base 28 ft.;
Altitude $6\frac{1}{3}$ yd., base 15 yd.;
Altitude 256 ft., base 1284 ft.

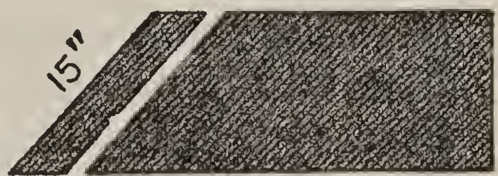
2. Find the area of each of the following parallelograms:



3. In the city map, p. 247, if the length of the block along 12th St., between Washington Boulevard and Vermont St., is 480 ft., and the width of the block from 12th St. to 13th St. is 426 ft., how many square feet in the block? How many square rods? How many acres?

4. If the pavement of 13th St. is 54 ft. wide and the length of the block from Washington Boulevard to Vermont St. is 480 ft., how many square feet of pavement does it take for 13th St. between Washington Boulevard and Vermont St.?

5. If the distance along Vermont St. from 12th St. to 14th St. is 1020 ft. and the width of the street 54 ft., how many square feet of pavement in Vermont St. between 12th St. and 14th St.?



6. Strips are cut bias from a piece of velvet, as shown in the picture. Each strip is 15 in. long and 3 in. wide. How many square inches of velvet does it take for 12 of these bias pieces?

7. A band on a dress is made of six pieces of goods cut bias, each piece being 22 in. long and 2 in. wide. How many square inches of cloth does the band take?

8. A boy makes pennants to sell. The picture shows one made of blue felt, upon which is sewed the letter M in white felt. The letter is made of four pieces, each $1\frac{1}{2}$ in. wide. The height of the letter is 4 in., and each of the two middle pieces is 2 in. long. How many square inches of white felt does the letter take? How many square yards in 6 doz. of these letters?

9. The letter K on a pennant is made of three pieces of white felt, as in the picture. The rectangular piece is 6 in. long and $1\frac{1}{4}$ in. wide. Each of the other pieces is $3\frac{3}{4}$ in. long and $1\frac{1}{4}$ in. wide. How many square inches of felt in the letter? How many square yards in 10 doz. of these letters?

10. A man has a garden in the form of a parallelogram. One side, taken as the base, is 180 feet long. From this side to the other, taken as altitude, is 95 feet. How many square feet does it contain?

11. Find some area in the form of a parallelogram and measure it.

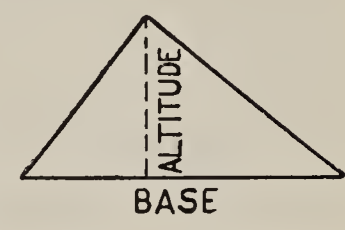
12. Find the area of each of the following parallelograms:

Base, $17\frac{1}{2}$ ft.; altitude, 14 ft.
Base, 24 rd.; altitude, $19\frac{7}{8}$ rd.
Base, $6\frac{3}{4}$ in.; altitude, $3\frac{2}{3}$ in.
Base, $7\frac{2}{3}$ yd.; altitude, 18 ft.
Base, 12 mi.; altitude, 376 rd.

13. A road runs diagonally across a man's farm. The road is 76 rods long and 4 rods wide. How many acres does the road occupy?

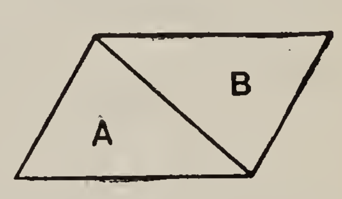
91. THE AREA OF A TRIANGLE

A figure formed by three straight lines, as shown in the drawing, is a **triangle**. How many corners has a triangle? How many angles?



When one side of a triangle is called the **base**, the distance from the opposite corner, or **vertex**, to this side is called the **altitude**. In a right triangle, one of the sides is the altitude.

1. Draw a parallelogram. Draw a line joining two opposite corners, or vertices, thus dividing the parallelogram into two triangles, such as A and B.



2. Cut out the triangles into which your parallelogram is divided. By placing one triangle upon the other, show that they are equal. Then one triangle is what part of the parallelogram?

3. Compare the altitudes and bases of the triangle and the parallelogram.

4. How is the area of the parallelogram found? Then how is the area of the triangle found?

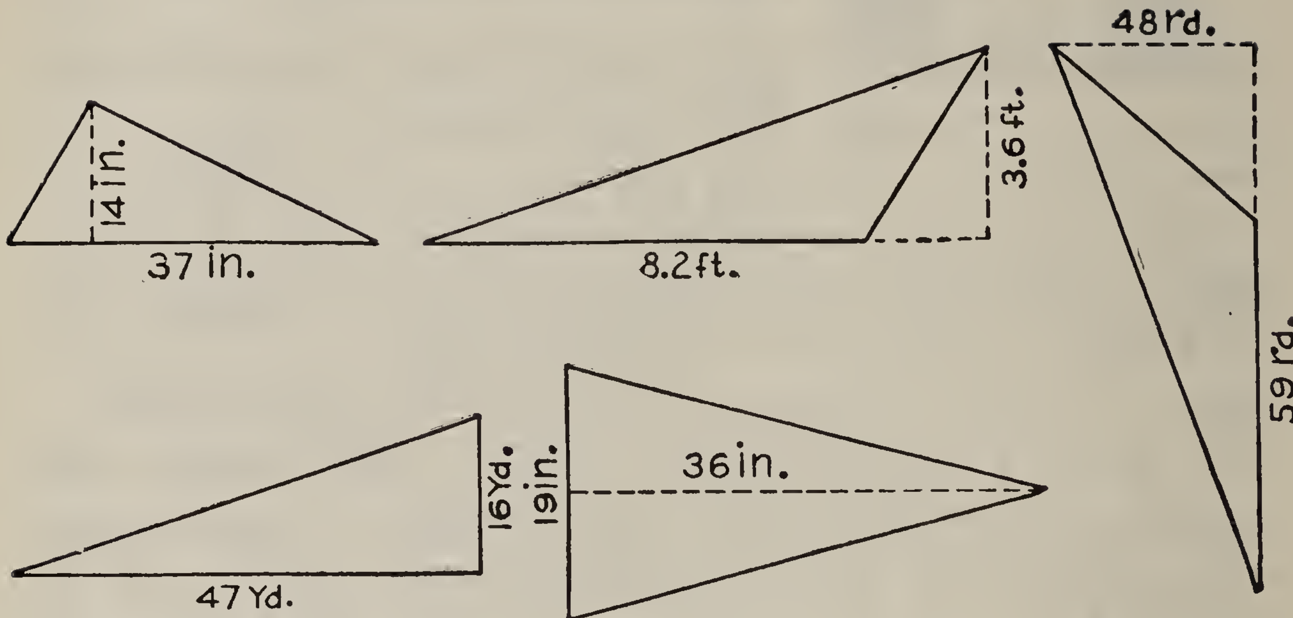
Problems

1. Find the area of a triangle whose base is 7 in. and altitude 6 in. Base 12 in. and altitude 9 in. Base 45 in. and altitude 37 in.

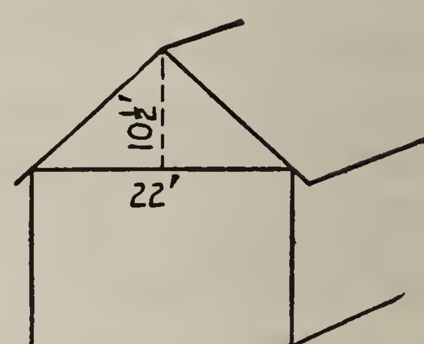
2. One of the short sides of a right triangle is 5 ft. and the other 3 ft. Find the area.

3. The area of a triangle is 56 sq. in., and its altitude 8 in. Find the base. If the area is 27 sq. yd. and base 6 yd., find the altitude.

4. Find the area of the following triangles:

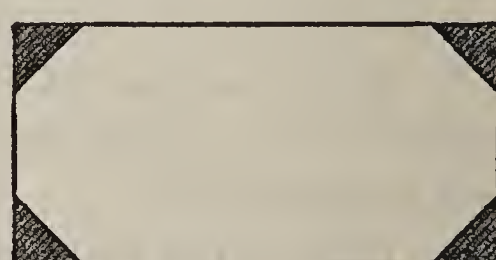


5. The gable of a house is 22 ft. wide and $10\frac{1}{2}$ ft. high. How many square feet of lumber does it take to side it?

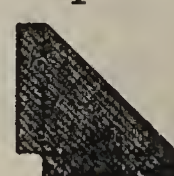


6. How many square feet of lumber does it take to board up the gable of a house if the gable is 30 ft. wide and 14 ft. high?

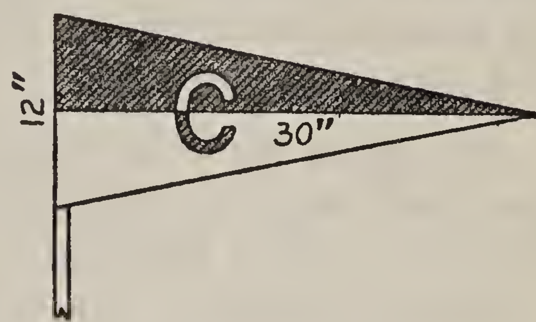
7. This figure shows a blotter. The corners are bound with triangular pieces of blue leather. Each piece of leather extends along the edge of the blotter 4 in. each way. How many square inches in the top surface of each piece of leather?



8. On each of the short sides of the leather corner pieces there is a strip 1 in. wide for folding and pasting. How many square inches of leather does it require for the blotters of a class of 24 pupils?

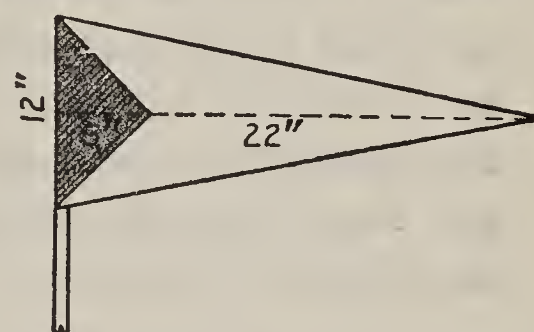


9. This pennant is made of a strip of blue and a strip of white felt. How many square inches of each color does it take?



10. How many square yards of each kind of felt would it take to make 3 doz. pennants of this kind?

11. This pennant is made of white and blue felt. Find how many square inches of each kind of felt it takes. How many square yards of each kind of felt will it take to make 3 doz. of these pennants?



12. Sydney made a triangular sail for his 17-foot canoe. His father told him that the sail must not exceed 35 sq. ft. The sail he made was 9 ft. long along the edge (base) and the altitude was $7\frac{1}{2}$ ft. How much did it lack of being 35 sq. ft.?

13. Robert had a sail 9 ft. long (base) and 8 ft. high (altitude), and Arthur had one 10 ft. long and 7 ft. high. Whose sail was larger and how much?

14. Donald made a sail in the shape of an equilateral triangle. That is, all the edges were the same length, which was 8 ft. By measuring, he found the altitude to be nearly 7 ft. About how many square feet in his sail?

15. Harold made a triangular sail for his boat with a base 8 ft. and altitude $6\frac{1}{2}$ ft. When the breeze blows 20 miles an hour the force against his sail is $1\frac{1}{2}$ lb. on each square foot. What is the total pressure on the sail?

16. John spaded up a plot of ground for a flower bed in the form of a triangle. One side was 16 ft. long and the distance to this side from the opposite corner was 9 ft. If he allowed one bulb to each square foot, how many bulbs did it take to plant it?

17. Anna made a triangular flower bed in the corner of her yard (square corner) that reached 12 ft. along one side of the yard and 12 ft. along the other. Allowing one bulb to each square foot, how many bulbs did it take to plant it?

Find the areas of the following triangles:

18. Base $12\frac{1}{2}$ ft. and altitude $7\frac{1}{2}$ ft.

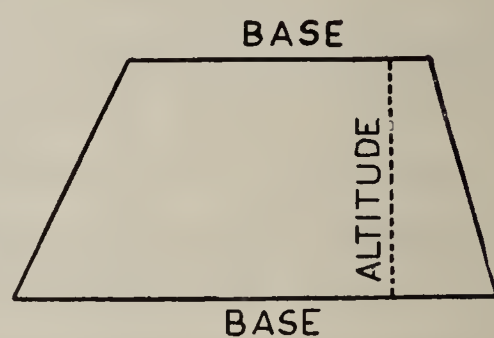
19. Base 4 ft. 8 in. and altitude 6 ft. 6 in.

20. Base 120 yd. and altitude 82 yd. 2 ft.

21. Base 80 rd. and altitude 70.6 rd.

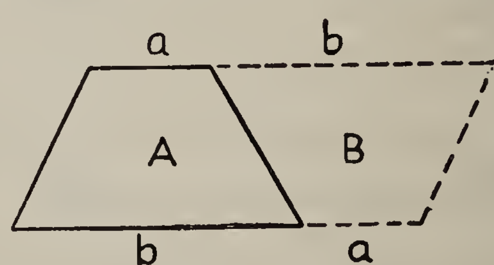
22. Base 16.9 mi. and altitude 20.25 mi.

92. THE AREA OF A TRAPEZOID



A trapezoid has two parallel sides called the **upper base** and the **lower base**, or the **bases**, and two sides that are not parallel. The distance at right angles between the bases is the **altitude**.

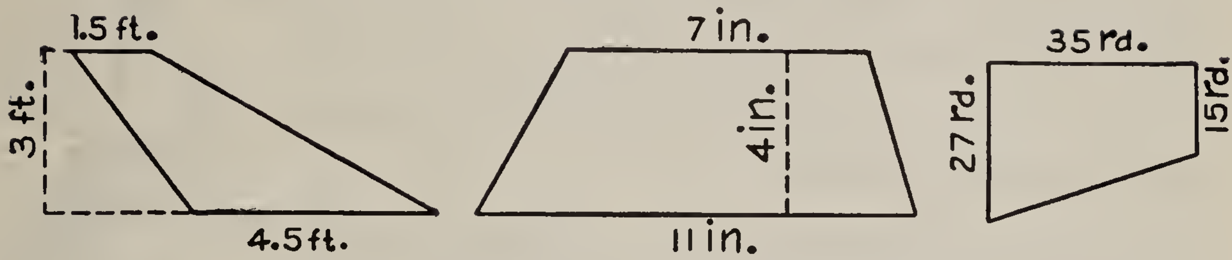
Cut from paper a trapezoid, as A in the figure. Cut out another from this as a pattern. Call it B. Place them as in the figure. What kind of a figure do A and B together form? Compare the altitude of the trapezoid A with that of the parallelogram now formed. Compare the bases of the trapezoid with the base of the parallelogram. Compare the areas of the two.



State the method of finding the area of any trapezoid.

Problems

1. Find the areas of the following trapezoids:



2. Find the area of a trapezoid whose altitude is 6 yd. and bases 12 yd. and 4 yd.

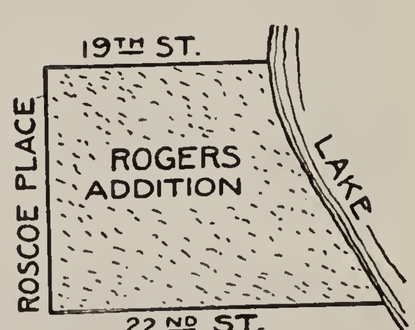
3. Find the area of a trapezoid whose parallel sides are 19.4 rd. and 28.6 rd., and the distance between them 12 rd.

4. By dividing a trapezoid into two triangles, show another way to find its area. Compare the bases of the triangles with the bases of the trapezoid. Compare their altitudes with the altitude of the trapezoid.

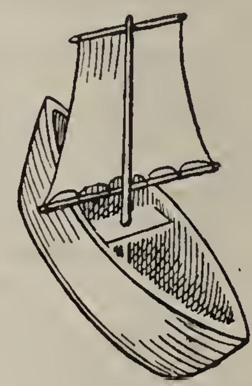
5. A farmer has a field in the form of a trapezoid whose altitude is 40 rd. and parallel sides 60 rd. and 94 rd. How many acres in it? How long does it take to plow it for sowing in wheat, if he has teams that plow 5 acres a day? How much wheat will it yield at 24 bu. an acre?

6. A farmer has a field of corn in the shape of a trapezoid whose altitude is 26 rd. and bases 45 rd. and 57 rd. How many bushels in the crop, if it yields 60 bu. to the acre? How much is it worth at 54¢ a bushel?

7. Rogers Addition, shown on this map, measures 1668 ft. on 19th St.; 2296 ft. on 22d St.; and 1618 ft. on Roscoe Place. How many square feet in the plot? How many acres? (43,560 sq. ft. = 1 A.) Find the cost at $350 per acre.

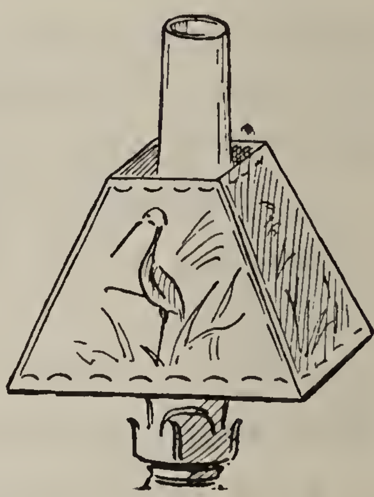


8. A boy made a boat with a sail, as in the picture. The sail was 8 in. wide at the top, 12 in. wide at the bottom, and 12 in. high. How many square inches of canvas in the sail? If he sails it on a pond where the pressure of the wind against the sail is 0.45 lb. per square foot, what is the pressure that moves the boat?



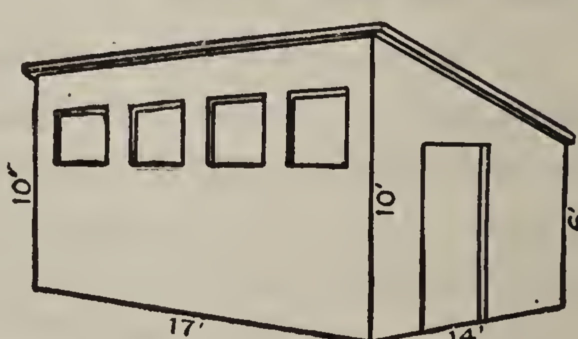
9. If the sail like this on a big ship is 28 ft. wide at the top, 38 ft. wide at the bottom, and 30 ft. high, how many square feet of surface does it have? When the wind is blowing at 20 mi. an hour, the pressure of the wind on the sail is about 2 lb. per square foot. What is the total pressure against the sail?

10. A lamp shade has 4 sides, each a trapezoid with altitude 8 in. and bases 10 in. and 4 in. It is made from one piece of material, by cutting, bending, and pasting it. If it is cut from a sheet of material 16 in. wide and 25 in. long, how much material is wasted?



Problems in Measurement

1. From the dimensions given in the picture find the number of square feet in the siding of this hen house. Do not deduct for the windows or door.



2. The roof is 15 ft. by 18 ft., including the projections. If it takes 9 shingles to cover a square foot, how many shingles will it require?

3. A double row of shingles is usually used for the first row. How many extra shingles each 4″ wide are required for this?

4. Shingles are sold in bunches of 250 each. How many bunches are required? If the shingles are $5 per 1000, how much will all the shingles cost?

5. At $ 25 per 1000 square feet, find the cost of the siding, allowing 54 square feet extra for waste in cutting. The lumber for rafters and the rest of the framework cost $8.50. Find the cost of all lumber for the hen house.

6. The floor was made of cement, and cost $1.25 per square yard. Find the cost of the floor.

7. Suppose the paint cost $4.50, the glass $1.60 for each of the 4 windows, and the hinges and nails 75 cents. Find the total cost of the hen house.

Many of our states are rectangles or nearly so. Find the area of the following, (1) in square miles; (2) in acres. (There are 640 acres in a square mile.)

NOTE. — These measurements are close approximates.

8. Colorado is almost a perfect rectangle 380 miles long and 275 miles wide.

9. Wyoming is 360 miles long and 270 miles wide.

10. The west boundary of Utah is 345 miles, the Colorado boundary 275 miles, the south boundary 270 miles, and the Idaho boundary is 160 miles.

SUGGESTION. — The area is either the sum of two rectangles or the difference between two rectangles. Find it both ways.

11. Oregon is equivalent to a rectangle 205 miles wide and 340 miles long.

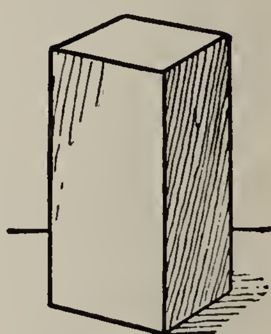
12. South Dakota is equivalent to a rectangle 205 miles by 390 miles.

13. The dimensions of North Dakota are 215 miles and 330 miles.

14. Nevada is equivalent to a rectangle the dimensions of which are 330 miles and 215 miles, and a triangle with a base of 330 miles and an altitude of 255 miles.

93. AREA AND VOLUME OF RIGHT PRISMS

The figure is that of a **right prism.** The surfaces are called **faces** of it, and where they meet, the **edges.** The face upon which this prism appears to stand and the opposite face are the **bases.** The distance between the bases is the **altitude.** The base of a prism may have three or more sides.



How many sides has the base of this prism?

Exercises

1. The base of a right prism is a square whose side is 4 in., and the altitude is 6 in. How many square inches in its whole surface?

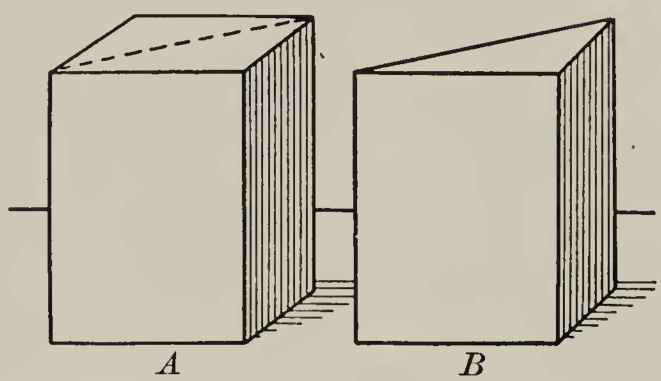
2. How many cubic inches in its volume? Could the prism be built of 1-inch cubes? How many in a layer? How many layers?

3. The base of a right prism is a rectangle 5 in. wide and 9 in. long, and its altitude is 8 in. Find the area of its whole surface.

4. Find the number of cubic inches in its volume.

5. A block of ice is 12 in. square and 22 in. long. Find its entire surface, and its volume.

6. The prism A in this figure is divided through two opposite edges into two prisms like B, with triangles as bases. Compare the volumes of A and B. Compare their altitudes. Compare their bases. Give a rule for finding the volume of a right prism whose bases are triangles.



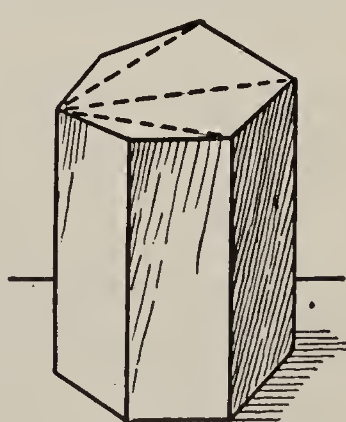
7. If you should construct two prisms of the same material, like A and B in Problem 6, and weigh them, what relation would you find between their weights?

8. If convenient, let the pupil make prisms and compare their volumes by comparing their weights in this way.

9. The altitude of a right prism is 16 in., and the bases are right triangles whose short sides are 9 in. and 14 in. Find the volume.

10. The altitude of a right prism is 24 in., and each base is a triangle whose altitude is 8 in. and base 12 in. Find the volume of the prism.

11. Any right prism may be divided into prisms with triangles for bases, as shown in the figure. Into how many prisms with triangular bases is this one divided? What is the sum of their volumes? How is the volume of each found?

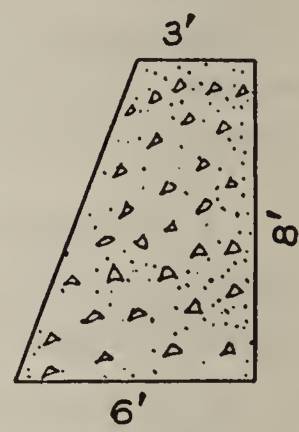


Compare the sum of their bases with the base of the given prism. Compare their altitudes with the altitude of the given prism. Then how may the volume of a right prism with any kind of base be found?

12. Find the volume of a right prism whose base is 25 sq. ft. and altitude 32 ft.

13. A stone pier is 14 ft. high, and has a triangular base whose area is 28 sq. ft. How many cubic feet of stone in it?

14. The figure shows the cross section or end view of a concrete retaining wall that is 50 ft. long. How many cubic feet of concrete in the wall? How many cubic yards?



15. A masonry dam across a river is 82 ft. long, 14 ft. high, 4 ft. wide at the top, and 8 ft. wide at the bottom. How many cubic feet of masonry does it contain? How many cubic yards? If the stone weighs 170 lb. per cubic foot, what is the weight of the whole dam?

16. In building a railroad, a cut 640 ft. long is made. The cut is 12 ft. deep, 14 ft. wide at the bottom, and 30 ft. wide at the top. How many cubic yards of earth are removed in its construction?

17. An irrigation ditch is 10 ft. deep, 10 ft. wide at the bottom, and 20 ft. wide at the top. If the water flows at a rate of 1 ft. a second, how many cubic feet of water will the ditch deliver in a minute?

94. DRAWING TO SCALE

A **plan** or **map** is a drawing of the same shape as the object or region which it represents. The distance on any part of a plan or map represents a fixed number of miles or other units of measure. If, for example, in a plan or map, 100 mi. is represented by 1 in., it is said to be drawn "to the scale of 100 mi. to 1 in."

Problems

1. In this map of Illinois, a distance of 200 mi. is represented by an inch. That is, the map is constructed "to the scale of 200 mi. to the inch."

The map is $1\frac{5}{6}$ in. long. What is the extreme length of the state?

2. The greatest width of the map is 1.05 in. How many miles wide is the state?

3. Measure on the map the distance from Chicago to Springfield. How many miles from Chicago to Springfield?

4. Find, similarly, the number of miles from Chicago to Peoria. From Chicago to St. Louis, Mo. From Chicago to Cairo.

5. From Chicago to Rock Island is approximately 170 mi. By what distance should it be represented on this map?

6. From Chicago to Danville, Ill., is approximately 135 mi. By what distance should this be represented on this map?

7. On a map drawn to the scale of 200 mi. to the inch, from Chicago to New York, in a straight line, is 3.4 in. How many miles from Chicago to New York?

8. On a map drawn 240 mi. to the inch the distance from Chicago to Denver is $3\frac{9}{16}$ in. How far does a wireless message between these cities travel?

9. Make and solve problems similar to these, using maps of some other states.

10. Draw the ground plan of a house, on a scale in which 4 feet are represented by an inch.

11. Measure the dimensions of the schoolroom, and draw a plan of it to a scale of 20 ft. to the inch.

12. Let each pupil draw to a convenient scale the floor plan of his home.

13. If a rectangular city lot has a frontage of 80 ft. and a depth of 200 ft., what will be the dimensions of a map of the lot drawn to the scale of 20 ft. to the inch? Make a map of this lot and represent the frontage by a line 2 in. long. What will represent the depth? What scale have you used in drawing the map?

14. If you represent a rectangular garden 16 ft. wide and 20 ft. long by a drawing 4 in. by 5 in., what will the scale be? If you represent the width of this garden by a line 2 in. long, by what must you represent the length? If you have a school garden, draw a map of it to some scale.

15. A certain school has a garden 32 ft. wide and 40 ft. long. Draw a map of this garden, letting 8 ft. be represented by 1 in. Draw to the same scale a 4-ft. walk running lengthwise through the garden, cutting it into two equal parts. Divide each part into six equal beds by 2-ft. walks running crosswise. From your drawing, read the size in feet of each bed.

16. Let each pupil draw to scale the plans of one article made in the wood shop, or that he expects to make.

17. On a map drawn to the scale of 110 mi. to the inch, the state of Colorado is represented by approximately a rectangle 3.4 in. long east and west and 2.5 in. wide north and south. How many square miles in the state?

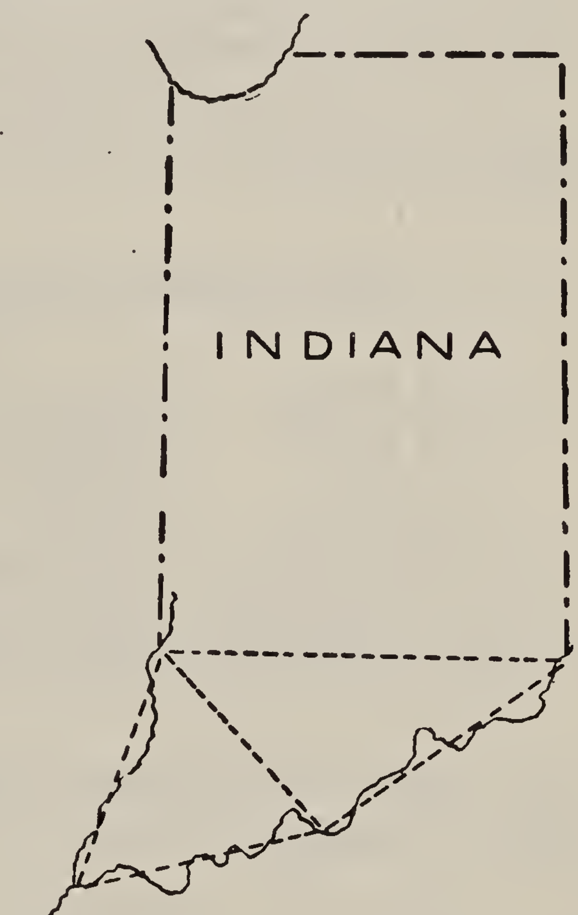
18. On the same map, the area of Wyoming is represented by approximately a rectangle 3.2 in. long and 2.5 in. wide. How many square miles does it contain?

19. On this same map, the state of Nevada is represented by approximately a trapezoid whose altitude is 2.88 in., and bases 2 in. and 4.16 in. How many square miles does it contain ?

20. Tennessee is approximately a trapezoid. On a map, measure its width north and south, and its length along the north and the south borders. Then compute its area in square miles using the scale of the map.

21. Pennsylvania is approximately a rectangle. Arkansas and Missouri are approximately trapezoids. By consulting a map, find their areas.

22. The area of an irregular region may be found approximately by dividing it into parts in the forms of triangles, parallelograms, or trapezoids, and finding the areas of the parts separately and adding.



Thus, this map of Indiana is drawn to the scale of 110 mi. to the inch. It may be divided into approximately a rectangle and two triangles. Find its area.

23. Find the areas of other regions by using your geography in this way.

24. By consulting a map, it is seen that the Mississippi River and its tributaries drain an area approximately a trapezoid. By using the scale to which the map is drawn, compute the area drained by these rivers.

25. The approximate area of the United States occupied by the Appalachian Mountains is that of the parallelogram in the map. Find this area in square miles.

NOTE. — Drill on the interpretation of geographical maps in the school, of architects' drawings that may be obtained, or of plans for the construction of articles in woodwork, may be supplied to supplement these exercises. There are two important kinds of problems in drawing to a scale: finding the actual distances or areas that are represented to a scale in the drawing, and drawing to a given scale a plan or a map from given dimensions.

Some Common Relations in Measurements

1 barrel	$\doteq$ 31.5 gal. = $4\frac{1}{7}$ cu. ft.
1 gal.	= 231 cu. in.
1 cu. ft.	= 7.5 gal. or $\frac{7}{29}$ bbl.
1 bushel	= 2150.42 cu. in. or about $1\frac{1}{4}$ cu. ft.
1 ton of coal	= 35 cu. ft. (approximately)
1 ton of hay	= 500 cu. ft. (approximately)

1. How many gallons in a tank 6 ft. long, $2\frac{1}{2}$ ft. wide, and 2 ft. deep?

2. How many tons of coal can be put into a bin 12 ft. long, 8 ft. wide, and 6 ft. deep?

3. How many tons of hay in a mow 36 ft. long, 30 ft. wide, and 18 ft. deep?

4. How many barrels will a watering tank 12 ft. long, 4 ft. wide, and $2\frac{1}{2}$ ft. deep contain?

5. How many barrels will fill a swimming pool 48 ft. long, 16 ft. wide, and 5 ft. deep?

6. How much coal can I put into a bin 14 ft. long, 7 ft. wide, and 5 ft. deep?

7. A box 54 inches long, 44 inches wide, and 38 inches deep will contain how many bushels?

8. How much hay in a mow 50 ft. long, 40 ft. wide, and 20 ft. deep?

9. How many bushels of oats can I put into a bin 18 ft. long, 14 ft. wide, and 8 ft. deep?

SUGGESTION. — When the dimensions are given in feet, use 1 bu. = $1\frac{1}{4}$ cu. ft., from which we get 1 cu. ft. = $\frac{4}{5}$ bu.

10. How many bushels will a bin 8 ft. by 6 ft. by 4 ft. contain?

11. How many tons of coal can be stored in a bin $12\frac{1}{2}$ ft. long, 8 ft. wide, and 7 ft. high?

12. A hay mow is $48\frac{1}{2}$ ft. long, 22 ft. wide, and 14 ft. deep. How many tons will it hold?

13. A freight car 36 ft. long, $8\frac{1}{2}$ ft. wide, is filled 5 ft. deep with wheat. How many bushels of wheat in the car? What is the weight of the load if each bushel weighs 60 pounds?

14. A car 36 ft. long and $8\frac{1}{2}$ ft. wide is filled to the depth of $6\frac{1}{2}$ ft. with oats weighing 32 pounds to the bushel. Find the weight of the load.

15. I had my coal bin, which is 12 ft. long and $3\frac{1}{2}$ ft. wide, filled to the depth of 5 ft. At $6.25 a ton, how much did the coal cost?

95. GENERAL REVIEW

NOTE. — Pages 266 to 276 inclusive give a general review of the work of the sixth year. The work is somewhat more difficult than the preceding work. This may also be used to supplement the topics studied throughout the year.

At sight, give the sums: —

A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*
$\frac{1}{8}$	$\frac{1}{6}$	$\frac{1}{12}$	$\frac{1}{7}$	$\frac{1}{5}$	$\frac{1}{6}$	$\frac{5}{8}$	$\frac{7}{8}$	$\frac{2}{7}$	$\frac{5}{6}$	$\frac{3}{7}$
$\frac{1}{16}$	$\frac{1}{9}$	$\frac{1}{6}$	$\frac{1}{14}$	$\frac{1}{15}$	$\frac{3}{8}$	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{1}{14}$	$\frac{7}{9}$	$\frac{5}{14}$
$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{8}$	$\frac{1}{21}$	$\frac{1}{10}$	$\frac{5}{12}$	$\frac{1}{16}$	$\frac{1}{24}$	$\frac{3}{28}$	$\frac{1}{18}$	$\frac{1}{28}$

L	*M*	*N*	*O*	*P*	*Q*	*R*	*S*	*T*	*U*	*V*	*W*
$\frac{7}{15}$	$\frac{7}{18}$	$\frac{31}{33}$	$\frac{7}{24}$	$\frac{7}{40}$	$\frac{1}{2}$	$\frac{1}{5}$	$\frac{3}{5}$	$\frac{1}{2}$	$\frac{1}{10}$	$\frac{7}{10}$	$\frac{5}{6}$
$\frac{11}{30}$	$\frac{17}{36}$	$\frac{29}{66}$	$\frac{23}{36}$	$\frac{9}{50}$	$\frac{1}{3}$	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{2}{3}$	$\frac{1}{12}$	$\frac{5}{12}$	$\frac{3}{7}$
$\frac{3}{10}$	$\frac{5}{12}$	$\frac{3}{11}$	$\frac{1}{72}$	$\frac{61}{30}$	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{7}{8}$	$\frac{3}{4}$	$\frac{1}{15}$	$\frac{8}{15}$	$\frac{7}{8}$

DRILL TABLE

At sight, add the two adjacent numbers in any two columns: —

	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*
1.	$\frac{1}{2}$	$\frac{4}{5}$	$\frac{3}{16}$	$\frac{5}{18}$	$4\frac{1}{3}$	$12\frac{1}{2}$	$19\frac{7}{8}$	$341\frac{4}{9}$
2.	$\frac{1}{3}$	$\frac{5}{8}$	$\frac{5}{18}$	$\frac{9}{20}$	$6\frac{3}{4}$	$16\frac{2}{3}$	$19\frac{5}{12}$	$482\frac{5}{10}$
3.	$\frac{1}{4}$	$\frac{3}{7}$	$\frac{1}{20}$	$\frac{2}{3}$	$8\frac{5}{6}$	$18\frac{3}{4}$	$16\frac{1}{2}$	$386\frac{5}{12}$
4.	$\frac{1}{5}$	$\frac{8}{15}$	$\frac{4}{25}$	$\frac{5}{6}$	$7\frac{5}{12}$	$31\frac{1}{4}$	$24\frac{1}{8}$	$521\frac{3}{4}$
5.	$\frac{1}{6}$	$\frac{7}{8}$	$\frac{6}{7}$	$\frac{8}{9}$	$8\frac{5}{9}$	$33\frac{1}{3}$	$24\frac{3}{4}$	$287\frac{1}{6}$
6.	$\frac{1}{8}$	$\frac{7}{12}$	$\frac{4}{9}$	$\frac{7}{16}$	$9\frac{11}{18}$	$37\frac{1}{2}$	$41\frac{2}{3}$	$272\frac{1}{4}$
7.	$\frac{1}{9}$	$\frac{5}{6}$	$\frac{7}{8}$	$\frac{14}{15}$	$6\frac{7}{8}$	$43\frac{3}{4}$	$36\frac{11}{12}$	$316\frac{7}{16}$
8.	$\frac{1}{10}$	$\frac{3}{25}$	$\frac{9}{10}$	$\frac{4}{9}$	$7\frac{7}{10}$	$56\frac{1}{4}$	$45\frac{4}{5}$	$382\frac{7}{8}$
9.	$\frac{1}{12}$	$\frac{11}{16}$	$\frac{3}{15}$	$\frac{7}{9}$	$10\frac{2}{5}$	$62\frac{1}{2}$	$48\frac{9}{16}$	$681\frac{2}{3}$
10.	$\frac{4}{15}$	$\frac{3}{5}$	$\frac{4}{25}$	$\frac{3}{8}$	$11\frac{13}{15}$	$66\frac{2}{3}$	$52\frac{3}{4}$	$218\frac{4}{5}$

At sight, give the difference between any two adjacent numbers in the above table.

Sight Work in Multiplication

At sight, give the products of: —

A	*B*	*C*	*D*	*E*	*F*	*G*
$\frac{1}{2} \times \frac{1}{3}$	$\frac{1}{2} \times \frac{2}{3}$	$\frac{1}{5} \times \frac{4}{7}$	$\frac{3}{4} \times \frac{7}{8}$	$\frac{5}{14} \times \frac{7}{9}$	$\frac{24}{25} \times \frac{5}{8}$	$\frac{3}{7} \times \frac{21}{24}$
$\frac{1}{3} \times \frac{1}{4}$	$\frac{2}{3} \times \frac{3}{4}$	$\frac{3}{8} \times \frac{2}{3}$	$\frac{3}{5} \times \frac{5}{9}$	$\frac{3}{16} \times \frac{8}{11}$	$\frac{14}{15} \times \frac{5}{3}$	$\frac{5}{6} \times \frac{18}{25}$
$\frac{1}{2} \times \frac{1}{4}$	$\frac{3}{4} \times \frac{5}{6}$	$\frac{1}{4} \times \frac{5}{8}$	$\frac{6}{7} \times \frac{3}{4}$	$\frac{7}{8} \times \frac{16}{21}$	$\frac{16}{17} \times \frac{11}{32}$	$\frac{19}{21} \times \frac{63}{76}$
$\frac{1}{3} \times \frac{1}{5}$	$\frac{2}{3} \times \frac{7}{8}$	$\frac{5}{6} \times \frac{7}{8}$	$\frac{3}{4} \times \frac{7}{9}$	$\frac{3}{5} \times \frac{10}{17}$	$\frac{9}{10} \times \frac{5}{6}$	$\frac{34}{35} \times \frac{105}{136}$
$\frac{1}{4} \times \frac{1}{5}$	$\frac{3}{4} \times \frac{5}{9}$	$\frac{8}{10} \times \frac{5}{8}$	$\frac{2}{9} \times \frac{7}{11}$	$\frac{2}{3} \times \frac{6}{11}$	$\frac{7}{8} \times \frac{16}{25}$	$\frac{53}{65} \times \frac{130}{159}$
$\frac{1}{2} \times \frac{4}{5}$	$\frac{3}{5} \times \frac{5}{6}$	$\frac{3}{4} \times \frac{12}{16}$	$\frac{3}{4} \times \frac{11}{12}$	$\frac{15}{16} \times \frac{2}{3}$	$\frac{5}{6} \times \frac{18}{23}$	$\frac{17}{18} \times \frac{54}{51}$

Work in Multiplication

Copy and find the products of: —

1.	2.	3.	4.	5.	6.	7.
425	165	368	247	397	246	263
$12\frac{1}{2}$	$24\frac{1}{4}$	$37\frac{1}{5}$	$28\frac{1}{6}$	$38\frac{1}{8}$	$35\frac{1}{9}$	$38\frac{1}{7}$
8.	**9.**	**10.**	**11.**	**12.**	**13.**	**14.**
268	174	984	374	572	624	186
$29\frac{2}{3}$	$36\frac{3}{4}$	$47\frac{2}{5}$	$76\frac{5}{6}$	$19\frac{7}{8}$	$93\frac{5}{7}$	$26\frac{8}{9}$
15.	**16.**	**17.**	**18.**	**19.**	**20.**	**21.**
$138\frac{3}{4}$	$753\frac{2}{3}$	$963\frac{4}{7}$	$375\frac{5}{9}$	$573\frac{7}{8}$	$575\frac{5}{7}$	$365\frac{2}{3}$
16	24	28	72	64	49	48
22.	**23.**	**24.**	**25.**	**26.**	**27.**	**28.**
$246\frac{2}{3}$	$598\frac{5}{7}$	$613\frac{5}{9}$	$378\frac{3}{7}$	$783\frac{7}{8}$	$963\frac{5}{6}$	$843\frac{7}{8}$
17	24	24	46	25	39	28

Multiplication shortened by Cancellation

Rewrite, cancel common factors, and simplify: —

1. $\frac{21}{32} \times \frac{4}{9} \times \frac{2}{3} \times \frac{6}{7} \times \frac{39}{54}$.
2. $\frac{1}{5} \times \frac{20}{29} \times \frac{13}{17} \times \frac{58}{91} \times \frac{51}{60}$.
3. $\frac{3}{4} \times \frac{19}{20} \times \frac{12}{35} \times \frac{23}{38} \times \frac{49}{63}$.
4. $\frac{21}{38} \times \frac{19}{35} \times \frac{2}{3} \times \frac{57}{84} \times \frac{24}{49}$.
5. $\frac{5}{11} \times \frac{13}{15} \times \frac{22}{39} \times \frac{21}{24} \times \frac{121}{132}$.
6. $\frac{3}{4} \times \frac{5}{7} \times \frac{16}{27} \times \frac{21}{35} \times \frac{16}{17}$.
7. $\frac{2}{3} \times \frac{7}{9} \times \frac{5}{6} \times \frac{9}{10} \times \frac{12}{35} \times \frac{20}{63}$.
8. $\frac{2}{7} \times \frac{5}{6} \times \frac{13}{17} \times \frac{21}{28} \times \frac{12}{35} \times \frac{34}{65}$.
9. $\frac{3}{8} \times \frac{5}{9} \times \frac{16}{27} \times \frac{18}{25} \times \frac{17}{19} \times \frac{38}{51}$.
10. $\frac{9}{10} \times \frac{20}{21} \times \frac{7}{36} \times \frac{4}{11} \times \frac{8}{17} \times \frac{51}{60}$.
11. $\frac{13}{21} \times \frac{35}{39}$.
12. $\frac{25}{36} \times \frac{24}{70}$.
13. $\frac{3}{22} \times \frac{55}{63}$.
14. $\frac{5}{13} \times \frac{65}{41}$.
15. $\frac{11}{12} \times \frac{96}{121}$.
16. $\frac{35}{64} \times \frac{72}{95}$.
17. $\frac{85}{96} \times \frac{42}{54}$.
18. $8\frac{3}{4} \times 6\frac{3}{7}$.
19. $\frac{2}{3} \times 7\frac{1}{2}$.
20. $2\frac{2}{3} \times 7\frac{5}{16}$.
21. $4\frac{4}{5} \times 15\frac{5}{8}$.
22. $6\frac{5}{8} \times 246$.
23. $\frac{4}{7} \times \frac{3}{8} \times 3\frac{1}{2}$.
24. $2\frac{2}{3} \times 4\frac{1}{5} \times 7\frac{1}{233}$.
25. $\frac{3}{4} \times 1\frac{2}{7} \times \frac{7}{9}$.
26. $1\frac{2}{5} \times 5\frac{1}{7} \times 1\frac{2}{935}$.
27. $1\frac{3}{8} \times \frac{7}{11} \times 3\frac{1}{16}$.
28. $2\frac{5}{8} \times 4\frac{2}{7} \times 6\frac{3}{5}$.

Sight Work in Division

At sight, give the quotient: —

1. $\frac{4}{3} \div \frac{2}{3}$.
2. $\frac{5}{6} \div \frac{2}{6}$.
3. $\frac{7}{8} \div \frac{3}{8}$.
4. $\frac{9}{11} \div \frac{3}{11}$.
5. $\frac{8}{9} \div \frac{5}{9}$.
6. $\frac{15}{16} \div \frac{3}{16}$.
7. $\frac{18}{11} \div \frac{2}{11}$.
8. $\frac{3}{4} \div \frac{1}{2}$.
9. $\frac{5}{8} \div \frac{1}{4}$.
10. $\frac{8}{9} \div \frac{1}{3}$.
11. $\frac{11}{6} \div \frac{2}{3}$.
12. $\frac{17}{9} \div \frac{2}{3}$.
13. $\frac{13}{10} \div \frac{3}{5}$.
14. $\frac{5}{6} \div \frac{5}{12}$.
15. $\frac{7}{8} \div \frac{3}{16}$.
16. $\frac{2}{3} \div \frac{5}{9}$.
17. $\frac{3}{4} \div \frac{5}{16}$.
18. $\frac{2}{3} \div \frac{3}{4}$.
19. $\frac{1}{2} \div \frac{2}{3}$.
20. $\frac{3}{4} \div \frac{2}{5}$.
21. $\frac{2}{5} \div \frac{2}{3}$.
22. $\frac{6}{7} \div \frac{2}{3}$.
23. $\frac{5}{7} \div \frac{3}{4}$.
24. $\frac{9}{12} \div \frac{15}{20}$.

Division

1. $5\frac{2}{9} \div \frac{17}{30}$.
2. $17\frac{2}{3} \div 53$.
3. $13\frac{1}{4} \div 8\frac{1}{3}$.
4. $22\frac{2}{9} \div 33\frac{1}{3}$.
5. $16\frac{2}{3} \div 3\frac{1}{3}$.
6. $15\frac{1}{2} \div 4\frac{1}{5}$.
7. $13\frac{3}{4} \div 2\frac{1}{3}$.
8. $2\frac{5}{6} \div 7\frac{1}{3}$.
9. $6\frac{3}{4} \div 3$.
10. $18\frac{3}{4} \div 2\frac{1}{3}$.
11. $11\frac{2}{3} \div 3\frac{1}{2}$.
12. $12\frac{3}{4} \div 1\frac{1}{5}$.
13. $6\frac{7}{8} \div 1\frac{2}{3}$.
14. $14 \div 8\frac{4}{7}$.
15. $21\frac{1}{4} \div 3\frac{5}{8}$.
16. $184\frac{2}{3} \div 46\frac{1}{6}$.

Problems Involving Fractions

1. Mary paid 72¢ for $\frac{3}{4}$ of a yard of silk. At this rate, how much will $18\frac{1}{2}$ yards cost?

2. James sold 36 *Saturday Evening Posts* at 5¢ each. He kept $\frac{2}{3}$ of the money, and with the rest bought daily papers at $\frac{3}{4}$ of a cent each. How many did he buy?

3. A boy's wages in a certain store were $12\frac{1}{2}$ cents an hour. How much is that a week (6 days) if he works 8 hours a day?

4. I hired two boys to mow my lawn for the season for \$18. One boy mowed it 5 times and the other 7 times. How much should each receive?

5. When $5\frac{1}{2}$ tons of coal cost \$35.75, how much will $8\frac{1}{4}$ tons cost at the same rate?

6. A man found that when his coal bin was filled to the depth of 6 feet, the coal cost him \$135. At the end of the winter the coal was yet $1\frac{1}{2}$ feet deep in the bin. Find the cost of what was used.

7. A dealer bought 80 bags of potatoes containing $2\frac{3}{4}$ bushels each. They cost 72¢ a bushel. Including \$14.50 freight and \$3.75 for hauling, find the total cost.

8. A dealer made \$6 on a suit of clothes. This was $\frac{2}{5}$ of what it cost him. For how much did he sell it?

9. After paying $\frac{3}{4}$ of a debt at one time, and $\frac{1}{3}$ of what remained at another, what part of it still remained unpaid?

10. An engine uses $\frac{1}{15}$ of a ton of coal for every mile. How far can it run on $5\frac{1}{3}$ tons?

11. New Jersey has $\frac{3}{5}$ as many silk mills as all other states combined. If there are 300 mills in all the other states, how many in New Jersey? How many in all?

12. Alice spent $\frac{1}{8}$ of her money for gloves, three times as much for a hat, and had \$6.60 left. How much did she spend for each?

13. Ten tons of flax are bought at $15\frac{1}{2}$ cents a pound. The loss in weight, in cleaning and bleaching is $\frac{1}{5}$. If the cleaned flax sells for $22\frac{3}{4}$ cents per pound, how much is gained or lost?

14. Find the income from 10 acres of flax which yield an average of $\frac{7}{8}$ of a ton per acre, if $\frac{8}{15}$ of this is fiber worth $12\frac{1}{2}$ cents per pound and the remainder seed worth \$0.98 a bushel (56 lb.).

15. How many rivets each weighing 2 oz. can be made from a 12-ft. bar of iron weighing $\frac{2}{3}$ lb. to the foot?

16. One year Montana produced 30,820,000 pounds of wool. If this was $\frac{2}{17}$ of the total production of the United States that year, how much did all other states produce?

17. In a certain city having 3792 pupils in its schools, $\frac{1}{2}$ of them are in the primary grades, $\frac{1}{3}$ of them in the grammar school, and the rest in the high school. Without a pencil, find how many in the high school.

18. At the rate of 2 quarts for $12\frac{1}{2}$¢, how much does a dealer receive for $3\frac{1}{2}$ bushels of beans?

19. When $16\frac{3}{4}$ yards of silk sold for \$12.06, how much was that a yard?

20. I can buy a $6\frac{1}{4}$ yard remnant of cloth for \$1.50. The regular price is 30¢ a yard. What is the saving on each yard?

21. I can buy an $8\frac{3}{4}$ yard remnant of Scotch gingham at 24¢ a yard, or I can buy any length I wish at 28¢ a yard. Which will cost less, and how much, if I need but 8 yards?

Decimals

1. Read 0.8 and 0.80. Compare them.

2. Read 2.35 and 23.5. Compare them.

3. Read: —

0.17; 12.35; 200.045; 0.245; 100.95; 0.195.

4. When is "and" used in reading numbers?

5. Write as decimals: —

$\frac{5}{10}$; $\frac{45}{100}$; $\frac{9}{100}$; $\frac{1}{4}$; $\frac{1}{2}$; $\frac{3}{5}$; $\frac{1}{3}$; $\frac{2}{3}$; $\frac{1}{8}$.

6. Change to decimals: —

$\frac{7}{20}$; $\frac{13}{40}$; $\frac{27}{80}$; $\frac{7}{16}$; $\frac{15}{16}$; $\frac{51}{80}$; $\frac{37}{40}$.

7. Change to decimals, carrying the result to the nearest thousandth: — $\frac{5}{7}$; $\frac{15}{22}$; $\frac{3}{59}$; $\frac{7}{65}$; $\frac{9}{11}$; $\frac{2}{19}$; $\frac{17}{346}$.

8. Change 7 hours to a decimal part of a day.

9. Change 5 ounces to a decimal part of a pound.

Drill in Multiplication and Division

NOTE. When necessary, carry the quotients to four figures.

1. 0.84×0.25.
2. 1.64×0.28.
3. 0.38×0.64.
4. 0.08×0.08.
5. 10.6×0.934.
6. 20.02×1.63.
7. 2.5×0.16.
8. 4.3×0.09.
9. 3.04×1.09.
10. 10.9×0.206.
11. 0.019×0.8.
12. 9.09×9.09.
13. $34.62 \div 32.4$.
14. $7.68 \div 2.4$.
15. $89.6 \div 0.42$.
16. $0.782 \div 0.032$.
17. $9.63 \div 0.25$.
18. $10.6 \div 0.72$.
19. $12.8 \div 4.2$.
20. $0.873 \div 1.46$.
21. $0.973 \div 2.61$.
22. $0.8 \div 0.73$.
23. $0.95 \div 0.012$.
24. $0.84 \div 0.009$.

PROBLEMS INVOLVING DECIMALS

1. After spending 0.34 of my money, what part was left?

2. A merchant lost 0.12 of the cost of an overcoat. What part of the cost did he receive?

3. Express as common fractions: —

0.5; 0.8; 0.16; 0.24; 0.25; 0.125; 0.84; 0.96.

4. After spending 0.28 of my money for rent, 0.32 of it for food, and 0.12 of it for heat and light, how much of it remained?

5. Reduce to decimal parts of a foot: —

(*a*) 7 in.; (*b*) $8\frac{1}{2}$ in.; (*c*) $10\frac{3}{8}$ in.; (*d*) $1\frac{7}{8}$ in.

6. When 19.4 tons of coal will run an engine 265.4 miles, how far will 14.6 tons run it?

7. Every pound of cotton gathered from the field yields 0.32 lb. of lint. How much lint will 8796 lb. yield?

8–13. Find the average to each depositor in savings banks in 1909: —

States	No. of Depositors	Amount Deposited	States	No. of Depositors	Amount Deposited
New Eng.	3,186,826	$1,261,949,227	Middle	902,676	$306,785,344
Eastern	3,837,650	1,780,646,935	Western	68,309	16,460,053
Southern	344,632	81,369,104	Pacific	491,770	266,195,044

14. When 3.4 ft. of an iron bar weighs 9.54 lb., how much will 17.8 ft. of the same bar weigh?

15. 64 cubic feet of water weigh 2 tons. How much will 345.76 cubic feet weigh?

16. If the grade on a section of railroad 348.8 yards long rises 3.75 ft., at the same rate, what is the rise on 1 mi.?

Percentage

1. What does per cent mean?

2. What part of anything is 50% of it? 25% of it? $12\frac{1}{2}$% of it?

3. If a man has paid 75% of the cost of his house, which was $1160, how much has he yet to pay?

4. A merchant retailed boys' overcoats for $7 that cost him $5.60. What per cent of the cost did he make? What per cent of the selling price did he make?

5. An overcoat that sold for $22.50 cost the dealer $216 a dozen. What per cent of the cost did he make?

6. Girls' coats marked to sell at $16.35 were sold at a discount of $33\frac{1}{3}$%. Find the selling price.

7. At a special sale, goods were sold as follows: —

	Boys' Suits	Men's Suits	Girls' Coats	Boys' Shoes	Men's Shoes
Regular price . . .	$12.50	$23.50	$9.78	$3.50	$5.50
Special price . . .	$10.00	$15.68	$6.85	$1.98	$4.25

Find the rate of discount on each.

At 5%, find the interest of: —

8. $850 for 6 mo. For 1 yr. 3 mo. For 9 mo.

9. $1450 for 4 mo. For 2 yr. 2 mo. For 10 mo.

10. $1540 for 5 mo. For 1 yr. 1 mo. For 11 mo.

11. $2400 for 2 mo. For 1 yr. 10 mo. For 5 mo.

12. If you borrow $1750 at 6% on June 6, 1910, and repay it Sept. 6, 1911, how much interest do you pay?

Miscellaneous Problems

1. On January 1, John had \$45 in the savings bank, which paid 3 % interest. By doing chores during the winter he earned \$10 more, which he deposited in the savings bank April 1. What was his account worth July 1 when the interest was added to the principal?

2. On July 1, Ruth had \$30 in the savings bank. During the summer, by picking berries and canning fruit, she earned \$15 more, which she deposited in the bank September 1. If the bank paid $3\frac{1}{2}$ % interest, how much did she have to her credit when the interest was added January 1?

3. A farmer's wheat crop last year averaged 25 bu. to the acre. By using selected seed and fertilizers he made it average 33 bu. to the acre this year. Find the per cent that the increase was of last year's yield.

4. A man who raised 45 bu. of corn to the acre one year used tested seed the following year and secured a yield of 70 bu. to the acre. Find the per cent of increase in the yield.

5. By using selected seed the yield of cotton on a certain plantation was increased from $\frac{5}{8}$ bale per acre to $1\frac{2}{5}$ bale per acre. Find the increase per acre. Find the value of the increase on 40 acres at 10 ¢ a pound, allowing 500 lb. to the bale.

6. A field of potatoes which was sprayed to prevent blight yielded 210 bu. to the acre. An adjoining field of unsprayed potatoes yielded only 140 bu. to the acre. If the spraying cost \$2.25 an acre and potatoes were worth 50 ¢ a bushel, how much was gained per acre by spraying the potatoes? What was the per cent of gain?

7. The state of Virginia is practically in the shape of a triangle whose base is 425 miles and altitude 200 miles. Find how many square miles it contains.

8. By looking at the maps in your geography, see if you can find the areas of other states or countries in the same way as in Problem 7.

9. The area of Indiana is 36,350 sq. mi. In a recent year its population was 2,700,876. Find the number of people per square mile.

10. During a season the rainfall on a roof 24 ft. by 40 ft. was 6 in. If it drained into a cistern 8 ft. square, what was the rise in the cistern?

11. Make a statement for the following bill of goods: $1\frac{1}{2}$ doz. eggs at 27¢ a dozen; 1 lb. of butter at 32¢ a pound; 1 bag of salt at 5¢; $2\frac{3}{4}$ lb. of prunes at $0.18 per pound; 1 one-pound box of cocoa at $0.40; $\frac{1}{2}$ bu. of potatoes at $0.25 per peck; 1 25-lb. sack of flour at $3\frac{2}{5}$¢ a pound.

12. How much would you pay the grocer on the above bill if he gave you 2 per cent off for cash?

13. What is the cost of a pound cake made with 10 eggs at 28¢ a dozen; 1 lb. of flour at 4¢; 2 lb. of sugar at 6¢; 1 lb. of butter at 30¢ per pound; and $\frac{1}{2}$ pt. of milk at 5¢ a pint?

14. What would be the cost to make double the following recipe for a fruit cake: 2 lb. of flour at $4\frac{1}{2}$¢ per lb.; 1 lb. of butter at 27¢ per lb.; 1 lb. of sugar at $6\frac{1}{2}$¢ per lb.; 2 lb. of currants at $12\frac{1}{2}$¢ per lb.; $\frac{3}{4}$ lb. of blanched almonds at 50¢ per lb.; 1 lb. citron at 35¢ per lb.; 12 eggs at 28¢ per doz.; and $\frac{1}{2}$ pt. of molasses at 10¢ per pt.?

15. From a rectangular piece of manila paper $14\frac{1}{2}'' \times 24''$, to be made into an envelope, $\frac{1}{4}$ sq. ft. is cut away. What per cent remains?

16. A boy lost $\frac{1}{3}$ of his kite string. He then added $24\frac{5}{6}$ ft. The string was then its original length. What was the length of the string?

17. How many coats can be made from $52\frac{1}{2}$ yd. of cloth if one coat requires 3.7 yd.?

18. What part of a sheet of strawboard $22\frac{1}{2}'' \times 28\frac{5}{8}''$ does a boy use for a book cover $7\frac{1}{2}'' \times 5\frac{3}{4}''$?

19. Compare the volume of a window box $32'' \times 5'' \times 7\frac{1}{2}''$ with that of another window box $28'' \times 6'' \times 5\frac{1}{2}''$.

20. If 40 cu. ft. of coal weighs a ton, how many tons in a vein 200 yd. long, 180 yd. wide and 5 ft. thick?

21. If 1 cu. ft. of iron weighs 480 lb., find the weight of a piece $16' \times 1\frac{1}{2}' \times 3''$.

22. At a special sale, tents were sold at a reduction of 20 % from the regular price. What must you pay for a tent the regular price of which was $18.50?

23. If milk sells for $0.05 a pint bottle, $0.08 a quart, and $0.30 a gallon, how much would be paid for 64 qt. if bought by the pint? By the quart? By the gallon?

24. How much money and what per cent would be saved if bought by the quart instead of by the pint?

25. If it were bought by the gallon instead of by the quart, what per cent would be saved?

26. W. V. Snyder & Co., Newark, N.J., gave the following special prices on rugs:

$55 Seamless Wilton rugs,	9×12,	$42.50.
$40 Royal Wilton rugs,	9×12,	$31.50.
$37.50 Royal Wilton rugs,	8.3×10.6,	$28.50.
$18 Tapestry Brussels rugs,	8×12,	$15.

Find the rate of discount on each rug.

27. A room is 18 ft. wide, 21 ft. long, and 9 ft. high. How much does it cost to plaster it at 40¢ a square yard? Deduct $\frac{1}{5}$ of the surface of walls for doors, windows, mantel, and baseboards.

28. An 8-inch cube is what part of a cubic foot?

Linear Measure

12 inches (in. or ″)	= 1 foot (ft. or ′)
3 feet	= 1 yard (yd.)
16.5 feet	= 1 rod (rd.)
320 rods	= 1 mile (mi.)
1760 yards	= 1 mile
5280 feet	= 1 mile

Liquid Measure

4 gills (gi.)	= 1 pint (pt.)
2 pints	= 1 quart (qt.)
4 quarts	= 1 gallon (gal.)

Dry Measure

2 pints (pt.)	= 1 quart (qt.)
8 quarts	= 1 peck (pk.)
4 pecks	= 1 bushel (bu.)
32 quarts	= 1 bushel

Avoirdupois Weight

16 ounces (oz.)	= 1 pound (lb.)
2000 pounds	= 1 ton (T.)

Measure of Time

60 seconds (sec.)	= 1 minute (min.)
60 minutes	= 1 hour (hr.)
24 hours	= 1 day (da.)
7 days	= 1 week (wk.)
365 days	= 1 common year (yr.)
366 days	= 1 leap year
12 months	= 1 year
10 years	= 1 decade
100 years	= 1 century

Counting

12 things	= 1 dozen (doz.)
12 dozen	= 1 gross (gr.)
12 gross	= 1 great gross
20 things	= 1 score
24 sheets (paper)	= 1 quire
20 quires or 480 sheets	= 1 ream

Surface or Square

144 square inches (sq. in.)	= 1 square foot (sq. ft.)
9 square feet	= 1 square yard (sq. yd.)
$30\frac{1}{4}$ square yards $272\frac{1}{4}$ square feet	= 1 square rod (sq. rd.)
160 square rods 43,560 square feet	= 1 acre (A.)
640 acres	= 1 square mile (sq. m.)
1 square mile	= 1 section
36 square miles	= 1 township
100 square feet	= 1 square (in roofs, floors, etc.)

Solid or Cubic

1728 cubic inches (cu. in.)	= 1 cubic foot (cu. ft.)
27 cubic feet	= 1 cubic yard (cu. yd.)

Wood Measures

16 cubic feet	= 1 cord foot (cd. ft.)
128 cubic feet 8 cord feet	= 1 cord (cd.)

Some Useful Relations

1 gallon	= 231 cu. in.
1 bushel	= 2150.42 cu. in. or about $1\frac{1}{4}$ cu. ft.
1 barrel	= 31.5 gal. = $4\frac{1}{7}$ cu. ft.
1 cu. ft.	= $7\frac{1}{2}$ gal. or $\frac{7}{29}$ bbl.
1 ton of coal	= 35 cu. ft. (approximately)
1 ton of hay	= 500 cu. ft. (approximately)

*60 pounds	= 1 bushel	wheat or potatoes
*56 "	= 1 "	corn or rye
*32 "	= 1 "	oats
196 "	= 1 barrel	flour
200 "	= 1 "	beef or pork

* In most States.

Troy Weight

(For precious metals, jewels, etc.)

24 grains	= 1 pennyweight (pwt.)
20 pennyweights	= 1 ounce
12 ounces	= 1 pound

$437\frac{1}{2}$ grains	= 1 ounce	Av.
7000 "	= 1 pound	Av.
480 "	= 1 ounce	Troy
5760 "	= 1 pound	Troy

Apothecaries' Weight

20 grains	= 1 scruple (sc. or ℈)
3 scruples	= 1 dram (dr. or ʒ)
8 drams	= 1 ounce (oz. or ℥)
12 ounces / 5760 grains	= 1 pound (lb. or ℔.)

Circular Measure

60 seconds ($''$)	= 1 minute ($'$)
60 minutes	= 1 degree
360 degrees	= 1 circumference
$69\frac{1}{6}$ miles or 60 geographic miles	= 1° of latitude; or 1° of longitude on the equator

ANSWERS: INTERMEDIATE BOOK

NOTE: — In commercial transactions final results are given to the nearest cent.

Pages 2–5

1. 2; $\frac{1}{2}$.
2. 5¢.
3. 4; $\frac{1}{4}$.
4. 9¢.
5. 2; $\frac{1}{2}$.
6. 10¢.
7. 4; 2; 1.
8. $\frac{1}{4}$.
9. 20¢.
10. 16; 8.
11. $\frac{1}{2}$; 20¢.
12. 15¢.
13. 12¢.
14. 4; $\frac{1}{4}$; 15¢.
15. 48¢.
18. 54¢.
19. 36; 18; 9.
20. $\frac{1}{4}$; 4.
21. 9 in.; $1\frac{1}{4}$ yd.
22. 72 in.; $2\frac{1}{2}$ yd.
23. $2\frac{1}{4}$ yd.
24. $\frac{1}{2}$ yd.; 12¢.
25. 15¢.
26. 10¢.
27. $2\frac{1}{4}$ yd.; 27¢.
28. 5 yd.; $1.10.
29. $\frac{1}{4}$ yd.; $\frac{1}{4}$ yd.
30. $1\frac{1}{4}$ yd.; 15¢.

Pages 5–7

5. 9; 6; 12; 18.
9. 18¢.
10. 16; $\frac{1}{4}$; $\frac{1}{2}$ $\frac{3}{4}$.
11. $\frac{1}{4}$; $\frac{1}{2}$; $\frac{3}{4}$.
12. $\frac{1}{4}$ ft.
13. $\frac{1}{2}$ ft.; $\frac{3}{4}$ ft.
14. $\frac{1}{4}$ yd.
15. $\frac{1}{2}$ yd.; $\frac{3}{4}$ yd.
17. 246; 348; 438; 552; 729.
18. 9 in.
19. 3; $\frac{1}{4}$ doz.; $\frac{3}{4}$ doz.
20. $\frac{1}{3}$ doz.; $\frac{2}{3}$ doz.; 1 doz.
21. $1\frac{1}{3}$ doz.; $1\frac{1}{2}$ doz.; $1\frac{3}{4}$ doz.
22. $1\frac{1}{4}$ lb.; $1\frac{1}{2}$ lb.; $1\frac{3}{4}$ lb.
23. 24 hr.; 6 hr.; 12 hr.; 18 hr.
24. 8 qt.; 2 qt.; 4 qt.; 6 qt.
25. 2 qt.
26. 9.
27. 36 in.
28. 21 gal.

Page 8

8. $\frac{1}{8}$ pk.; $\frac{3}{8}$ pk.
9. $\frac{3}{8}$ pk.; $\frac{4}{8}$ or $\frac{1}{2}$ pk.
10. $\frac{5}{8}$ pk.; $\frac{6}{8}$ or $\frac{3}{4}$ pk.; $\frac{7}{8}$ pk.
11. 6; 9; 12; 15; 18; 21; 24; 27; 30.
12. 6; 9; 12; 15; 18; 21; 24; 27; 30.
13. 10; 15; 20; 25; 30; 35; 40; 45; 50.
14. 14; 21; 28; 35; 42; 49; 56; 63; 70.
15. 36.
16. 69.
17. 108.
18. 213.
19. 36.
20. 51.
21. 282.
22. 366.
23. 165.
24. 230.
25. 588.
26. 833.
28. 1113.
29. 1656.
30. 2268.
31. 2673.
32. 1645.
33. 5452.
34. 2583.
35. 1054.
36. 1691.
37. 5566.
38. 2697.
39. 1260.
40. 3774.
41. 3807.

Page 9

1. 3 hr.; 9 hr.; 15 hr.
2. 9 hr.; 6 hr.; 3 hr.
3. 2 oz.
4. 14¢.
5. 15¢; 10 yd.; $2.40.
6. $1.05.
7. $1.80; $6.60.
8. 28¢.
9. 70¢.
10. 84¢.
11. $1.40.

Page 13

1. 2; 4.
2. 20¢; 40¢; 80¢.
3. 2; 4; 8.
4. $\frac{1}{8}$ pk.; 4.
5. 2.
6. $\frac{1}{16}$ gal.; $\frac{1}{4}$ gal.; 4.
7. 8.
8. 2.

Page 16

10. $1\frac{7}{8}$.
11. $1\frac{3}{16}$.
12. $2\frac{1}{16}$.
13. $1\frac{3}{16}$.

14. $1\frac{5}{16}$.
15. $1\frac{7}{16}$.
16. $1\frac{5}{16}$.

Page 17

1. $\frac{2}{4}$ yd. or $\frac{1}{2}$ yd.
2. $\frac{2}{8}$ yd. or $\frac{1}{4}$ yd.
3. $\frac{1}{8}$ yd.
4. $\frac{3}{8}$ yd.
5. $1\frac{1}{4}$ yd.
6. $\frac{5}{8}$.
7. 80¢.
8. $1\frac{1}{4}$ yd.
9. $\frac{7}{8}$ lb.; 14 oz.; 1 oz.
10. $\frac{3}{8}$ lb. plain; $\frac{3}{4}$ lb. colored.
11. $1\frac{1}{4}$ yd.; 20¢.

Page 18

2. $42\frac{3}{8}$.
3. $62\frac{3}{4}$.
4. $84\frac{7}{8}$.
5. $74\frac{3}{16}$.
6. $177\frac{3}{8}$.
7. $176\frac{7}{16}$.
8. $213\frac{11}{16}$.
9. $256\frac{3}{16}$.
11. $15\frac{7}{16}$.
12. $38\frac{1}{4}$.
13. $38\frac{5}{16}$.
14. $48\frac{3}{8}$.
15. $38\frac{1}{8}$.
16. $30\frac{7}{16}$.
17. $61\frac{1}{16}$.
18. $22\frac{3}{8}$.

Pages 19–20

1. $2\frac{1}{8}$ yd.
2. $\frac{3}{8}$.
3. $\frac{1}{8}$ mi.
4. $\frac{11}{16}$.
5. $2\frac{1}{8}$ in.
6. $3\frac{3}{16}$ in.
7. $22\frac{5}{8}$ lb.
8. $2\frac{1}{8}$ lb.
9. 68¢.
10. $61\frac{1}{2}$ ft.
11. $\frac{7}{8}$ yd.

Pages 20–21

6. 3 ft.; $\frac{1}{3}$ yd.
7. 12 in.; 6 in.; 4 in.
8. $\frac{3}{6}$; $\frac{3}{6}$; $\frac{7}{9}$.
9. $\frac{5}{6}$.
10. $1\frac{2}{9}$.
11. $\frac{5}{9}$.
12. $1\frac{1}{2}$.
13. $44\frac{1}{2}$.
14. $117\frac{5}{9}$.
15. $102\frac{7}{9}$.
16. $44\frac{8}{9}$.
17. $\frac{1}{2}$.
18. $\frac{1}{6}$.
19. $12\frac{1}{9}$.
20. $8\frac{2}{9}$.

Pages 21–22

1. $\frac{5}{6}$.
2. Sister, $\frac{1}{9}$ more.
3. $\frac{1}{2}$.
4. 4; 8; 2; 10.
5. 12¢.
6. 48¢.
7. 66¢.
8. 51¢.
9. $2.28.
10. $\frac{2}{9}$ yd.
11. $\frac{5}{9}$.
12. 10 lb.
13. 18¢.
14. 10¢.
15. $8; $15.

Pages 22–23

3. $1\frac{1}{8}$.
4. $1\frac{3}{4}$.
5. $2\frac{5}{12}$.
6. $2\frac{1}{8}$.
7. $1\frac{3}{8}$.
8. $1\frac{5}{12}$.
9. $1\frac{9}{10}$.
10. $1\frac{7}{12}$.
11. $1\frac{5}{8}$.
12. $\frac{1}{12}$ hr.
13. $\frac{1}{12}$ yd.
14. $\frac{7}{8}$.
15. $1\frac{5}{8}$.
16. $2\frac{1}{8}$.
17. $1\frac{3}{4}$.
18. $2\frac{3}{4}$.
19. $\frac{1}{4}$.
20. $\frac{1}{8}$.
21. $\frac{1}{8}$.
22. $\frac{1}{8}$.
23. $\frac{5}{12}$.
24. $\frac{1}{2}$.
25. $1\frac{1}{2}$.
26. $\frac{3}{4}$.
27. $1\frac{1}{6}$.
28. $1\frac{7}{12}$.
29. $\frac{13}{16}$.
30. $1\frac{9}{16}$.
31. $\frac{13}{16}$.
32. $1\frac{7}{16}$
33. $1\frac{9}{16}$.
34. $2\frac{1}{16}$.

Pages 23–25

1. $3\frac{1}{8}$ yd.
2. 42¢.
3. $3\frac{2}{3}$ yd.
4. $3\frac{1}{6}$ yd.
5. $2.27.
6. $10.15.
7. $\frac{3}{4}$.
8. $1\frac{1}{2}$.
9. $\frac{1}{2}$.
10. Robert $\frac{1}{6}$.
11. $2\frac{1}{2}$.
13. $1\frac{1}{8}$ yd.
14. $3\frac{1}{8}$ A.
15. $1\frac{1}{2}$ mi.
16. $\frac{3}{8}$ yd.

Pages 25–26

3. 9.
4. 18.
5. 21.
6. 24.
7. 12.
8. 14.
9. 24.
10. 36.
11. 27.
12. 14.
13. 20.
14. 15.
15. 8.
16. 18.
17. 16.
18. 40.
20. 75 ft.
21. 25 ft.
22. 16 yd.
23. $14.
24. 36 bu.
25. 27.
26. $45.
27. 38 lb.
28. 39 qt.
29. 52 qt.

30. 75¢.
31. 78¢.
32. 80¢.
33. 45 qt.
34. 38 ft.
35. $74.
36. 108 yd.

Pages 26–27

2. 925.
3. 7163.
4. 5481.
5. 5460.
6. 4641.
7. $11,175.
8. 17,423 ft.
9. 12,100 yd.
10. 33,867.
11. 5280 ft.
13. $2.16.
14. $5.88.
15. $2.57.
16. $12.11.

Pages 27–29

1. 95¢.
2. $17\frac{3}{16}$ lb.
3. $66\frac{5}{8}$ A.
4. $6093.75.
5. 1071 bu.
6. $2.27.
7. $1.18.
8. $7.50.
9. $1\frac{1}{8}$ in.; $13\frac{1}{2}$ in.
10. $1\frac{1}{3}$ ft.; 32 ft.
11. $2\frac{1}{8}$ ft.
12. $45\frac{1}{12}$ ft.
13. $4\frac{1}{6}$ ft.
14. 638 ft.
15. $8.52.
16. $2.10.
17. $1.24.
18. $1204.

Page 30

5. $4.10.
6. $3.43.
7. $3.55.
8. $3.25.
9. $14.37.
10. $3.10.

Page 31

6. 60¢.
7. $4.14.
8. $24.08.
9. $14.85.
10. 6 yd.; 11¢.
11. 72 yd.
12. $12.60.

Pages 32–33

4. $\frac{1}{16}$ lb.
5. 2 oz.
6. $\frac{1}{4}$ lb.
7. $\frac{1}{2}$ lb.
8. 12 oz.
9. $\frac{7}{8}$ lb.
10. 25¢.
11. 40¢.
12. 40.
13. $2.15.
15. $1.80.
16. $1.12.
17. 45¢.
18. $1.47.

Pages 33–34

1. 49 lb.; 294 lb.
2. $10.50; $21.
3. $12,800.
4. 60 bu.
5. $8.40.
6. 95¢; $2.85; $8.55.
7. 270 A.
8. 290 rd.
9. $8.25; $123.75.
10. $61.20.
11. 301 bu.

Pages 34–35

1. 9 in.
2. $\frac{1}{4}$ bu.
3. $4\frac{3}{4}$ ft.
4. 16 hr.
5. 9 pt.
6. 40¢.
7. 15 yr.
8. 85¢.
9. 27¢.
10. 35¢.
11. $\frac{2}{3}$ hr.
12. 9 in.
13. 49.
14. 40¢.
15. 9.
16. 9.
17. $15.
18. $24\frac{1}{2}$ gal.
19. $\frac{3}{4}$; $\frac{5}{6}$; $\frac{7}{8}$; $\frac{3}{4}$; $1\frac{2}{9}$.
20. $\frac{1}{3}$; $\frac{2}{9}$; $\frac{1}{3}$; $\frac{1}{4}$; $\frac{1}{8}$.
21. 884 bu.
22. 56 bu.
23. 42 yr.
24. 2.15 o'clock.
25. 90¢.
26. 669 bu.

Page 42

	a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*l*	*m*	*n*	*o*
1.	41	35	42	37	46	38	41	45	47	29	49	47	38	32	48
2.	32	33	37	39	50	40	49	49	51	48	39	41	42	49	45
3.	38	38	58	38	48	52	41	51	39	51	40	42	46	45	45

Page 43

1. 26.
2. 19.
3. 22.
4. 22.
5. 28.
6. 19.
7. 35.
8. 30.
9. 29.
10. 26.
11. 23.

12. 26.
13. 22.
14. 22.
15. 32.
16. 25.
17. 24.
18. 35.
19. 33.
20. 35.
21. 32.
22. 31.
23. 30.
24. 33.
25. 32.
26. 29.
27. 31.
28. 28.
29. 38.
30. 31.
31. 40.
32. 32.
33. 31.
34. 28.
35. 29.
36. 33.
37. 36.
38. 34.
39. 31.
40. 34.
41. 38.
42. 32.
43. 28.
44. 37.
45. 33.
46. 37.
47. 30.
48. 37.

Page 44

1. 42,143.
2. 38,941.
3. 36,933.
4. 37,327.
5. 43,502.
6. 40,029.
7. 41,534.
8. 45,089.
9. 38,011.
10. 33,509.
11. 40,213.
12. 42,737.
13. 35,627.
14. 48,110.
15. 33,611.
16. 39,038.
17. 34,859.
18. 37,313.
19. 42,580.
20. 38,364.

Page 45

1. $13,798.
2. 20,673 lb.; $344\frac{11}{20}$ bu.
3. $34,231.
4. 2239; $783.65.
5. $2.83.
6. $107.54; $1290.48.
7. 3408; 2556 gal.

Pages 47–48

1. $1.20.
2. 82.
3. 72.
4. 121.
5. 44.
6. 43.
7. 71 tons.
8. 99 mi.
9. 94 hr.
10. $52.
11. $47.
12. $39.
13. $29.
14. $41.

Page 50

1. 82,211.
2. 22,314.
3. 21,441.
4. 71,221.
5. 72,134.
6. 62,272.
7. 22,813.
8. 71,232.
9. 739.
10. 806.
11. 426.
12. 216.
13. 215.
14. 662.
15. 584.
16. 472.
17. 662.
18. 344.
19. 567.
20. 756.
21. 346.
22. 247.
23. 648.

Page 51

1. 1958.
2. 4454.
3. 3292.
4. 793.
5. 1916.
6. 1317.
7. 6653.
8. 4738.
9. 3855.
10. 1442.
11. 2077.
12. 2036.
13. 6457.
14. 981.
15. 1994.
16. 2427.
17. 1952.
18. 5216.
19. 869.
20. 1656.
21. 66.
22. 326.
23. 4674.
24. 6089.
25. 2435.

Page 52

1. 4324 lb.
2. 413 lb.
3. 4135 lb.
4. 1364 lb.
5. 235 bu.
6. $13.87.
7. 3837.
8. 17,043,156.
9. 7812 mi.

Pages 54–55

1. 7 in.
2. 8.
3. 14¢.
4. 29 yr.
5. 14 oz.
6. 36 oz.
7. $26.
8. 27 bu.
9. 23 bu.
10. 8 in.
11. 284 ft.; 472 ft.; 533 ft.; 696 ft.

12. 56 ft.; 147 ft.; 161 ft.
13. 18 ft.; 163 ft.
14. 43¢.
15. 66¢.
16. 28¢.
17. 55¢.
18. 36¢.
19. 62¢.
20. 19¢.
21. 27¢.
22. 53¢.
23. 61¢.
24. $1.15.
25. $1.52.

Page 57

1. 2079.
2. 1418.
3. 4396.
4. 1761.
5. 3744.
6. 4842.
7. 2412.
8. 3016.
9. 6419.
10. 5670.
11. 3540.
12. 2056.
13. 2076.
14. 2702.
15. 5232.
16. 2952.
17. 3245.
18. 3460.
19. 4518.
20. 1576.
21. 6741.
22. 5454.
23. 6000.
24. 5859.
25. 5358.
26. 5929.
27. 68,886.
28. 65,422.
29. 49,940.
30. 35,636.
31. 56,184.
32. 88,524.
33. 32,384.
34. 59,199.
35. 33,385.
36. 12,105.
37. 50,850.
38. 44,835.
39. 66,976.
40. 78,624.
41. 57,516.
42. 64,323.
43. 29,536.
44. 26,685.
45. 44,184.
46. 60,753.
47. 41,725.
48. 38,740.
49. 71,649.
50. 63,252.
51. 53,382.
52. 80,847.
53. 187,348.
54. 123,425.
55. 103,896.
56. 430,101.
57. 169,158.
58. 518,526.
59. 358,172.
60. 191,800.
61. 178,955.
62. 158,734.
63. 585,186.
64. 313,460.
65. 574,578.
66. 296,193.
67. 327,740.
68. 888,885.
69. 74,037.
70. 489,320.
71. 825,615.
72. 551,160.
73. 271,941.
74. 778,112.
75. 251,797.

Page 58

1. $23.85.
2. 1008 bu.
4. 858 lb.
5. 1428 mi.; 1904 mi.
6. 8190 pr.
7. 1940 bu.
8. $30,100.
9. $600.
10. 6430 yd.; 25,720 yd.
11. $20.25; $121.50.

Page 60

1. 334,875.
2. 363,918.
3. 205,003.
4. 504,755.
5. 814,264.
6. 257,562.
7. 636,378.
8. 671,028.
9. 369,792.

Pages 60–61

2. 288,530.
3. 186,912.
4. 344,430.
5. 342,258.
6. 307,489.
7. 491,052.
8. 256,500.
9. 352,350.
10. 199,548.
11. 224,952.
12. 470,850.
13. 691,968.
14. 329,832.
15. 665,280.
16. 809,951.
17. 239,765.
18. 561,446.
19. 587,736.
20. 345,144.
21. 410,163.
22. 300,352.
23. 803,656.
24. 621,453.
25. 599,256.
26. 672,670.
27. 564,682.
28. 690,656.
29. 7,883,106.
30. 7,324,332.
31. 5,489,727.
32. 2,548,623.
33. 3,346,830.
34. 7,350,260.

Pages 61–62

1. $84.50.
2. $72.25.
3. $58,751.68.
4. $518.84.
5. $351.12.
6. 9044.
7. $1108.38.
8. $844.35.
9. $162.50.
10. $38.88.

Page 64

1. $1932.
2. $985.
3. $4361.
4. $7785.
5. $2768.
6. 2975 da.
7. 2355 ft.
8. 2596 qt.
9. 10,248 hr.
10. 6656 oz.

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5. 4, 7; 4, 8; 3, 11.
6. 5, 7; 4, 9; 3, 13.
7. 6, 7; 5, 9; 6, 8.
8. 7, 7; 4, 13; 6, 9.
9. 5, 13; 6, 11; 6, 12.
10. 7, 11; 6, 13; 9, 9.
11. 7, 12; 8, 11; 7, 13.
12. 8, 12; 9, 11; 8, 13.
13. 9, 12; 10, 11.
14. 9, 13; 11, 11.
15. 10, 13; 11, 12.
16. 11, 13; 12, 13.

Page 68
(*First List*)

1. 438.
2. 474.
3. 378.
4. 467.
5. 252.
6. 275.
7. 297.
8. 255.
9. 191.
10. 157.
11. 234.
12. 248.
13. 163.
14. 141.
15. 167.
16. 97.
17. 163.
18. 133.
19. 146.
20. 132.
21. 153.
22. 182.
23. 192.
24. 133.
25. 192.
26. 173.
27. 192.
28. 171.
29. 183.
30. 152.

Page 68
(*Second List*)

1. 34.
2. 47.
3. 67.
4. 78.
5. 75.
6. 93.
7. 47.
8. 87.
9. 58.
10. 36.
11. 76.
12. 35.
13. 123.
14. 138.
15. 245.
16. 843.
17. 729.
18. 394.
19. 936.
20. 827.
21. 846.
22. 306.
23. 643.
24. 845.
25. 846.
26. 268.
27. 643.
28. 962.
29. 796.
30. 867.

Page 69

1. 1161 bu.
2. 691 bu.
3. $297.
4. Oats; $72.
5. $80.75.
6. 10,000 bu.

Page 70

1. 306.
2. 305.
3. 708.
4. 406.
5. 403.
6. 906.
7. 207.
8. 309.
9. 901.
10. 509.
11. 704.
12. 907.
13. 607.
14. 809.
15. 907.
16. 608.
17. 904.
18. 707.
19. 609.
20. 809.
21. $504.
22. 706 ft.
23. 72 in.
24. 67 ft.
25. 76; 16 yd. rem.
26. 164 mi.; 24 mi. rem.
27. 124; 44 rem.
28. 1900.
29. 800.
30. $461.
31. 46; 18 rem.
32. 123; 51 rem.
33. 99; 80 rem.
34. 56; 24 rem.
35. 79; 15 rem.
36. 147; 76 rem.
37. 151; 50 rem.
38. 403; 3 rem.
39. 191; 90 rem.
40. 423; 22 rem.
41. 2029; 17 rem.
42. 1218; 514 rem.
43. 596; 263 rem.
44. 770; 558 rem.
45. 1011; 585 rem.
46. 516; 513 rem.
47. 555; 671 rem.
48. 651; 618 rem.
49. 703; 378 rem.
50. 958; 725 rem.
51. 765; 57 rem.

Page 71

1. 29 doz.
2. $8.12.
3. $1.74.
4. 360 ; 6480.
5. 94,367,880 doz.
6. $21,704,612.40.
7. 3¢.

Page 73

1. 900 sec.; 3600 sec.
2. 480 min.; 1440 min.
3. 168 hr.; 744 hr.
4. 42 da.
5. 84 da.
6. 132 mo.
7. 30 mo.
8. $\frac{1}{12}$ yr.
9. $\frac{1}{6}$ yr.; $\frac{1}{4}$ yr.; $\frac{1}{3}$ yr.; $\frac{5}{12}$ yr.; $\frac{1}{2}$ yr.; $\frac{7}{12}$ yr.; $\frac{2}{3}$ yr.; $\frac{3}{4}$ yr.; $\frac{5}{6}$ yr.; $\frac{11}{12}$ yr.
10. $300 ; $150 ; $450 ; $100.
11. $\frac{3}{4}$ yr.; $\frac{1}{4}$ yr.
12. $\frac{1}{6}$ yr.

Page 74

1. 192 oz.; 320 oz.
2. 16,000 lb.; 70,000 lb.
3. 24 T.; 36 T.
4. 5 T.; $26 ; $7.75.
5. $500 ; $33.33.
6. 3000 lb.
7. $81.

Page 76

1. 20¢.
2. 38¢.
3. Fifth ; 56¢ ; 50¢.
4. $1.20.
5. $1.08 ; 84¢.
6. 84¢.

Pages 77–78

2. $14.65.
3. $9.42.
4. $266.
5. $20.68.
6. $3.27.
7. $4.10.
8. $3.74.
9. $2.83.
10. $3.96.

Pages 80–81

11. $7\frac{1}{4}$ in.
12. $4\frac{7}{8}$ in.
13. $4\frac{7}{8}$ in.
14. $5\frac{1}{4}$ in.
15. 8 in.
16. $\frac{1}{4}$ in.
17. $\frac{3}{8}$ in.
18. $\frac{1}{8}$ in.
19. $\frac{1}{8}$ in.
20. $\frac{1}{4}$ in.
21. $\frac{3}{4}$ in.
22. $\frac{7}{8}$ in.
23. $\frac{3}{4}$ in.
24. 8 in.

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12. $\frac{5}{6}$.
13. $35 ; $35 ; 8 ft. ; 10 in.
14. $\frac{1}{16}$ lb. ; $\frac{1}{4}$ lb. ; $\frac{1}{2}$ lb.
15. 7¢.
16. 42¢.
17. 18¢; 3¢; 21¢.
18. 36¢; 6¢; 42¢.
19. 70¢.

Pages 82–83

4. $30.
5. 25 ft.
6. 12 mi.
7. 18 lb.
8. 9 oz.
9. 12 doz.
10. $25.
11. 30 yd.
12. 49 gal.
13. 10 T.
14. 36 qt.
15. $63.
16. $56.
17. $22.
18. 45 hr.
19. $36.
20. 49 hr.
21. $32.
22. 48.
23. 45.
24. 84.
25. 44.
26. 300.
27. 500.
28. 150.
29. 300.
30. 400.
31. 20.
32. 40.
33. $\frac{1}{3}$; $\frac{1}{4}$; $\frac{1}{5}$.
34. $\frac{1}{8}$ hr. ; $\frac{1}{6}$ hr.
35. $\frac{3}{4}$ lb.
36. 2000 lb. ; $\frac{1}{2}$ T. ; $\frac{1}{4}$ T. ; $\frac{3}{4}$ T.
37. 6¢; 54¢.
38. 30¢.
39. 20.
40. $2.
41. 80¢.

Page 84

7. 7 in.
8. $\frac{7}{12}$ ft.
10. $\frac{1}{2}$; $\frac{6}{12}$; $\frac{5}{6}$.
11. $\frac{5}{6}$.
12. $\frac{11}{12}$.
13. $\frac{7}{12}$.
14. $\frac{11}{12}$.
15. $\frac{3}{4}$.
16. $\frac{5}{6}$.
17. 1 ft. 3 in.
18. $1\frac{5}{12}$.

Page 86

19. $\frac{1}{6}$; $\frac{5}{6}$; $\frac{1}{4}$; $\frac{3}{4}$; $\frac{1}{3}$; $\frac{2}{3}$.
20. $\frac{1}{6}$; $\frac{5}{6}$; $\frac{1}{3}$; $\frac{2}{3}$; $\frac{1}{2}$; $\frac{8}{9}$.
21. $\frac{1}{4}$; $\frac{3}{4}$; $\frac{1}{6}$; $\frac{5}{6}$; $\frac{1}{3}$; $\frac{2}{3}$.
22. $\frac{1}{5}$; $\frac{2}{5}$; $\frac{3}{5}$; $\frac{4}{5}$; $\frac{1}{4}$; $\frac{5}{6}$.
23. $\frac{1}{5}$; $\frac{2}{5}$; $\frac{3}{5}$; $\frac{4}{5}$.
24. $\frac{1}{6}$; $\frac{5}{6}$; $\frac{1}{9}$; $\frac{2}{9}$.
25. $\frac{7}{9}$; $\frac{8}{9}$; $\frac{1}{12}$; $\frac{5}{12}$.
26. $\frac{1}{10}$; $\frac{3}{10}$; $\frac{7}{10}$; $\frac{9}{10}$.
30. Fourths.

31. $\frac{2}{3}$; $\frac{3}{4}$; $\frac{5}{6}$; $\frac{3}{4}$; $\frac{7}{8}$; $\frac{3}{8}$; $\frac{5}{6}$; $\frac{3}{5}$; $\frac{2}{3}$.
32. $\frac{7}{16}$; $\frac{5}{8}$; $\frac{5}{6}$; $\frac{3}{7}$; $\frac{6}{7}$; $\frac{3}{4}$; $\frac{4}{9}$; $\frac{2}{5}$; $\frac{3}{8}$.

Pages 86–87

2. $\frac{2}{3}$.
3. $\frac{1}{4}$.
4. $\frac{1}{2}$.
5. $\frac{3}{4}$.
6. $\frac{3}{4}$.
7. $\frac{5}{8}$.
8. $\frac{5}{6}$.
9. $\frac{2}{3}$.
10. $\frac{7}{8}$.
11. $\frac{4}{5}$.
12. $\frac{2}{3}$.
13. $\frac{9}{10}$.
14. $\frac{3}{4}$.
15. $\frac{3}{5}$.
16. $\frac{1}{2}$.
17. $\frac{3}{9}$.
18. $\frac{4}{10}$.
19. $\frac{6}{16}$.
20. $\frac{8}{12}$.
21. $\frac{9}{12}$.
22. $\frac{14}{16}$.
23. $\frac{6}{9}$.
24. $\frac{10}{15}$.
25. $\frac{6}{8}$.
26. $\frac{12}{16}$.
27. $\frac{10}{12}$.
28. $\frac{15}{18}$.
29. $\frac{12}{15}$.
30. $\frac{16}{20}$.
31. $\frac{15}{24}$.
32. $\frac{12}{14}$.

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1. $\frac{3}{10}$; $\frac{1}{10}$.
2. $\frac{5}{6}$; $\frac{1}{6}$.
3. $\frac{7}{18}$; $\frac{1}{18}$.
4. $1\frac{2}{15}$; $\frac{8}{15}$.
5. $1\frac{1}{6}$; $\frac{1}{6}$.
6. $1\frac{1}{12}$; $\frac{7}{12}$.
7. $\frac{19}{36}$; $\frac{13}{36}$.
8. $1\frac{1}{45}$; $\frac{26}{45}$.
9. $1\frac{5}{24}$; $\frac{11}{24}$.
10. $\frac{11}{18}$; $\frac{5}{18}$.
11. $1\frac{55}{72}$; $\frac{1}{72}$.
12. $\frac{9}{10}$; $\frac{3}{10}$.
14. 10.
15. $9\frac{1}{3}$.
16. $15\frac{1}{2}$.
17. $15\frac{1}{8}$.
18. $12\frac{3}{4}$.
19. 29.

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10. $7\frac{7}{8}$.
11. $4\frac{7}{9}$.
12. $7\frac{1}{6}$.
13. $8\frac{11}{12}$.
14. $26\frac{9}{13}$.
15. $8\frac{11}{14}$.
16. $63\frac{1}{10}$.
17. $35\frac{1}{8}$.
18. $2\frac{15}{16}$.
19. $3\frac{13}{14}$.
20. $7\frac{6}{11}$.
21. $2\frac{14}{17}$.
22. $4\frac{9}{14}$.
23. $8\frac{10}{11}$.
24. $4\frac{4}{15}$.
25. $5\frac{11}{12}$.
26. $6\frac{8}{13}$.
27. $4\frac{11}{16}$.
28. $6\frac{1}{16}$.
29. $3\frac{11}{14}$.
30. $\frac{234}{16}$ ft., $\frac{1}{16}$ ft. more.
31. $2\frac{1}{2}$.
32. 3.
33. $2\frac{9}{16}$.
34. 3.
35. $2\frac{7}{10}$.

Pages 91–92

2. $135\frac{1}{6}$.
3. $179\frac{3}{16}$.
4. $141\frac{5}{6}$.
5. $318\frac{5}{8}$.
6. $1157\frac{15}{16}$.
7. $216\frac{3}{16}$.
8. $331\frac{9}{16}$.
9. $316\frac{1}{4}$.
10. $124\frac{11}{20}$.
11. $108\frac{7}{8}$.
13. $92\frac{5}{12}$.
14. $29\frac{7}{12}$.
15. $212\frac{5}{16}$.
16. $59\frac{7}{12}$.
17. $50\frac{1}{8}$.
18. $32\frac{7}{15}$.
19. $7\frac{7}{15}$.
20. $69\frac{1}{12}$.
21. $39\frac{1}{8}$.
22. $19\frac{2}{15}$.
24. $12\frac{5}{6}$.
25. $35\frac{7}{12}$.
26. $12\frac{5}{8}$.
27. $21\frac{8}{15}$.
28. $26\frac{3}{8}$.
29. $34\frac{5}{12}$.
30. $67\frac{5}{6}$.
31. $63\frac{1}{2}$.
32. $24\frac{13}{16}$.
33. $36\frac{3}{8}$.

Page 93

1. $1\frac{1}{12}$.
2. $1\frac{11}{12}$.
3. $2\frac{1}{4}$.
4. $1\frac{5}{12}$.
5. $1\frac{7}{12}$.
6. 2.
7. $2\frac{1}{6}$.
8. $2\frac{1}{8}$.
9. $1\frac{3}{8}$.
10. $1\frac{3}{4}$
11. $1\frac{3}{8}$.
12. $2\frac{1}{8}$.
13. $1\frac{7}{16}$.
14. $1\frac{13}{16}$.
15. $2\frac{1}{5}$.
16. $1\frac{14}{15}$.
17. 2.
18. $2\frac{9}{16}$.
19. $2\frac{7}{18}$.
20. $1\frac{1}{9}$.
21. $1\frac{17}{20}$.
22. $101\frac{5}{8}$.
23. $78\frac{3}{4}$.
24. $138\frac{5}{12}$.
25. $226\frac{7}{12}$.
26. $270\frac{9}{16}$.
27. $149\frac{17}{20}$.
28. $225\frac{7}{20}$.
29. $201\frac{17}{18}$.
30. $184\frac{1}{18}$.
31. $201\frac{3}{20}$.

Page 94

1. $\frac{1}{6}$.
2. $\frac{1}{12}$.
3. $\frac{2}{15}$.
4. $\frac{5}{18}$.
5. $\frac{1}{12}$.
6. $\frac{1}{8}$.
7. $\frac{5}{16}$.
8. $\frac{1}{3}$.
9. $\frac{1}{20}$.
10. $\frac{4}{15}$.
11. $\frac{7}{18}$.
12. $\frac{5}{14}$.

13. $\frac{1}{8}$.
14. $\frac{1}{6}$.
15. $\frac{3}{14}$.
16. $\frac{5}{12}$.
17. $\frac{5}{24}$.
18. $\frac{13}{24}$.
19. $\frac{5}{16}$.
20. $\frac{1}{4}$.
21. $\frac{7}{15}$.
22. $\frac{11}{20}$.
23. $\frac{7}{24}$.
24. $\frac{11}{24}$.
25. $\frac{11}{24}$.
26. $\frac{13}{24}$.
27. $\frac{1}{3}$.
28. $\frac{5}{24}$.
29. $9\frac{11}{20}$.
30. $67\frac{13}{20}$.
31. $256\frac{5}{12}$.
32. $168\frac{7}{12}$.
33. $391\frac{23}{24}$.
34. $64\frac{11}{24}$.
35. $604\frac{5}{12}$.
36. $183\frac{3}{4}$.
37. $275\frac{13}{24}$.
38. $328\frac{20}{21}$.
39. $7\frac{7}{15}$.
40. $12\frac{23}{30}$.
41. $11\frac{7}{24}$.
42. $11\frac{19}{24}$.
43. $22\frac{5}{12}$.
44. $23\frac{7}{24}$.
45. $14\frac{10}{21}$.
46. $8\frac{11}{24}$.

Pages 94–95

1. $\frac{5}{12}$.
2. $7\frac{5}{8}$ yd.
3. $\frac{1}{2}$.
4. $12\frac{1}{2}$ yd.
5. $\frac{7}{12}$.
6. $1\frac{1}{2}$ yd.
7. $24.60.
8. $\frac{5}{8}$ yd.
9. $\frac{3}{8}$ mi.
10. 5 ft.
11. $5\frac{3}{4}$ lb.
12. $29\frac{1}{3}$ in.

Page 95

1. $1\frac{1}{4}$.
2. $1\frac{5}{12}$.
3. $1\frac{4}{15}$.
4. $1\frac{1}{6}$.
5. $1\frac{1}{10}$.
6. $1\frac{1}{3}$.
7. $1\frac{7}{15}$.
8. $1\frac{1}{12}$.
9. $1\frac{1}{12}$.
10. $1\frac{11}{12}$.
11. $1\frac{2}{5}$.
12. $2\frac{1}{4}$.
13. $1\frac{5}{8}$.
14. $2\frac{1}{5}$.
15. $2\frac{1}{6}$.
16. $1\frac{5}{8}$.
17. $\frac{1}{4}$.
18. $\frac{1}{8}$.
19. $\frac{1}{2}$.
20. $\frac{3}{10}$.
21. $\frac{11}{16}$.
22. $\frac{1}{3}$.
23. $\frac{1}{9}$.
24. $\frac{1}{2}$.
25. $\frac{9}{16}$.
26. $\frac{9}{16}$.
27. $\frac{1}{2}$.
28. $\frac{1}{2}$.
29. $\frac{1}{8}$.
30. $\frac{5}{12}$.
31. $\frac{1}{3}$.
32. $\frac{11}{16}$.

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1. $13\frac{1}{8}$.
2. $18\frac{1}{8}$.
3. $22\frac{5}{9}$.
4. $23\frac{3}{16}$.
5. $20\frac{11}{12}$.
6. 15.
7. $18\frac{1}{4}$.
8. $2\frac{1}{2}$.
9. $2\frac{1}{4}$.
10. $1\frac{1}{8}$.
11. $4\frac{5}{12}$.
12. $6\frac{1}{3}$.
13. $9\frac{7}{12}$.
14. $9\frac{2}{9}$.
15. $3\frac{1}{4}$.
16. $2\frac{3}{8}$.
17. $3\frac{1}{8}$.
18. $2\frac{1}{2}$.
19. $2\frac{5}{12}$.
20. $2\frac{1}{12}$.
21. $2\frac{1}{4}$.
23. $2\frac{5}{8}$.
24. $4\frac{1}{6}$.
25. $1\frac{1}{6}$.
26. $2\frac{1}{4}$.
27. $5\frac{1}{4}$.
28. $8\frac{1}{6}$.
29. $3\frac{1}{4}$.
30. $2\frac{9}{16}$.
31. $4\frac{5}{16}$.
32. $\frac{3}{4}$ lb.

Pages 97–98

1. $3\frac{1}{3}$.
2. $3\frac{3}{5}$.
3. $1\frac{3}{5}$.
4. $3\frac{1}{3}$.
5. $2\frac{6}{7}$.
6. $4\frac{4}{5}$.
7. $\frac{8}{9}$.
8. $2\frac{8}{11}$.
9. $1\frac{5}{7}$.
10. $6\frac{1}{8}$.
11. $\frac{9}{11}$.
12. $3\frac{1}{8}$.
13. $6\frac{3}{10}$.
14. $4\frac{4}{5}$.
15. $6\frac{2}{9}$.
16. $8\frac{4}{7}$.
18. $1.30.
19. $1.02.
20. 51¢.
21. 85¢.
22. $1.32.
23. $2.44.
24. $1.50.
25. $21.
26. $45.
27. $7.
28. $7.50.

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6. 8¢.
7. 11¢.
8. 21¢.
9. 7¢.
10. 18¢.
11. 28¢.
12. 25¢.
13. 33¢.
14. 62¢.
15. $1.38.

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3. $3\frac{3}{4}$.
4. $3\frac{6}{7}$.
5. $2\frac{2}{11}$.
6. $2\frac{2}{3}$.
7. 12.
8. $4\frac{2}{3}$.
9. 21.

10. $8\frac{8}{9}$.
11. 16 mi.
12. 4 P.M.

Page 100

3. 400.
4. 3125.
5. 4500.
6. 959.
7. 1428.
8. 856.
9. 3584.
10. 628.
11. 1808.
12. 2482.
14. $ 18.46.
15. $ 3.37.
16. $ 4.41.
17. $ 16.15.

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16. $\frac{1}{6}$.
17. $\frac{1}{2}$.
18. $\frac{5}{9}$.
19. $\frac{1}{2}$.
20. $\frac{3}{8}$.
21. $\frac{3}{16}$.
22. $\frac{2}{5}$.
23. $\frac{2}{5}$.
24. $\frac{8}{15}$.

Pages 102–103

1. 10.
2. $13\frac{1}{2}$.
3. $9\frac{1}{3}$.
4. 12.
5. $17\frac{1}{2}$.
6. 14.
7. $24\frac{1}{2}$.
8. $17\frac{1}{2}$.
9. $22\frac{3}{4}$.
10. 9.
11. 15.
12. 28.
13. $13\frac{1}{3}$.
14. $13\frac{1}{3}$.
15. $15\frac{3}{4}$.
16. 15.
17. $11\frac{2}{3}$.
18. $12\frac{1}{2}$.
19. $56\frac{1}{4}$.
20. $\frac{2}{3}$.
21. $\frac{5}{8}$.
22. $\frac{5}{12}$.
23. $\frac{7}{9}$.
24. $\frac{1}{6}$.
25. $\frac{1}{3}$.
26. $\frac{7}{16}$.
27. $\frac{1}{10}$.
28. $\frac{1}{12}$.
29. $\frac{4}{15}$.
30. $\frac{2}{7}$.
31. $\frac{1}{4}$.
32. $\frac{2}{5}$.
33. $\frac{7}{33}$.
34. $\frac{4}{7}$.
35. $\frac{1}{4}$.
36. $\frac{5}{8}$.
37. $\frac{1}{4}$.
38. $\frac{18}{25}$.
39. $11\frac{2}{3}$.
40. $31\frac{1}{2}$.
41. 20.
42. $15\frac{3}{4}$.
43. 12.
44. 28.
45. 25.
46. $52\frac{1}{2}$.
47. $13\frac{1}{3}$.
48. $22\frac{1}{2}$.
49. $\frac{11}{12}$.
50. $\frac{51}{100}$.
51. $3\frac{1}{8}$.
52. $\frac{25}{27}$.
53. $\frac{14}{15}$.
54. 1.
55. $\frac{9}{10}$.
56. $\frac{8}{21}$.
57. $\frac{3}{7}$.

Page 103

1. $\frac{11}{4}$.
2. $3\frac{1}{3}$.
3. 12.
4. $21\frac{5}{16}$.
5. $6\frac{1}{9}$.
6. $8\frac{1}{8}$.
7. $44\frac{17}{32}$.
8. $8\frac{1}{15}$.
9. $9\frac{7}{9}$.
10. $11\frac{11}{12}$.
11. $9\frac{7}{12}$.
12. 12.
13. $12\frac{3}{16}$.

Page 104

1. 49¢.
2. $11\frac{1}{14}$ lb.
3. $31\frac{5}{8}$ A.
4. $541\frac{7}{8}$ bu.
5. $25\frac{13}{16}$ bu.
6. 94¢.
7. $312\frac{11}{32}$ lb.
8. $1238\frac{7}{8}$ mi.
9. $ 4.27.
10. $ 10.95.
11. $5\frac{27}{32}$ in.
12. $28\frac{7}{16}$ lb.
13. $10\frac{11}{16}$ mi.
14. $66\frac{7}{8}$ bu.

Page 106

1. $ 2.10.
2. $ 1.27.
3. $ 2.46.
4. $ 2.11.
5. $ 1.71.
6. $ 2.83.
7. $ 2.30.
8. 70¢.
9. $ 2.69.
10. $ 1.08.

Page 107

1. $ 200.75.
2. $ 81.
3. $ 94.50.
4. $ 972.
5. $ 114.75.
6. $ 85.
7. $ 108.
8. $ 79.50.
9. $ 36.13.
10. $ 23.37.
11. $ 16.49.
12. $ 67.50.
13. $ 78.
14. $ 216.60.
15. $ 27.93.
16. $ 16.65.

Page 108

1. 33¢.
2. 22 hr.; $ 2.64.
3. $11\frac{1}{4}$ hr.
4. $17\frac{3}{4}$ hr.; $2.13.
5. 99¢.
6. $ 2.76.
7. $ 3.74.
8. 98¢.
9. 36-inch; 27¢.
10. 88¢.
11. 42 bu.
12. $ 4.13.

Page 109

1. $\frac{1}{3}$.
2. 544 bu.; 1088 bu.
3. 93 bu.
4. \$56.25.
5. $\frac{1}{2}$.
6. 180 bu.; \$64.80.
7. \$780.
8. 1400 bu.; \$300.
9. \$8204.

Page 110

1. 25¢.
2. 50¢.
3. 50¢.
4. 50¢.
5. 48¢.
6. 49¢.
7. 25¢.
8. 66¢.
9. 45¢.
10. 88¢.

Drill

1. $\frac{4}{7}$.
2. $\frac{7}{15}$.
3. $\frac{1}{2}$.
4. $\frac{2}{9}$.
5. $\frac{7}{10}$.
6. $\frac{8}{15}$.
7. $\frac{2}{5}$.
8. $\frac{8}{15}$.
9. $1\frac{1}{5}$.
10. $\frac{15}{28}$.
11. $\frac{2}{5}$.
12. $\frac{77}{90}$.
13. 4.
14. 6.
15. 10.
16. 16.
17. 15.
18. 18.
19. 30.
20. $3\frac{1}{2}$.
21. $10\frac{2}{3}$.
22. $3\frac{1}{5}$.
23. $20\frac{1}{4}$.
24. $13\frac{1}{3}$.
25. 8.
26. 15.
27. 9.
28. 21.
29. 15.
30. 28.
31. 6.
32. 42.
33. 8.
34. $11\frac{1}{4}$.
35. $17\frac{1}{2}$.
36. $11\frac{2}{3}$.
37. $3\frac{1}{2}$.
38. $17\frac{7}{8}$.
39. $10\frac{5}{12}$.
40. $26\frac{7}{18}$.
41. 225.
42. 800.
43. 2100.
44. $4\frac{5}{8}$.
45. $2\frac{3}{4}$.
46. $2\frac{7}{16}$.
47. $2\frac{11}{32}$.
48. $15\frac{5}{8}$.

Page 112

3. 20.
4. 48.
5. 16.
6. 28.
7. 24.
8. 63.
9. 40.
10. 64.
11. 54.
12. 48.
13. 63.
14. 56.
16. $4\frac{4}{5}$.
17. $6\frac{6}{7}$.
18. $9\frac{1}{3}$.
19. $6\frac{2}{3}$.
20. $7\frac{1}{2}$.
21. $10\frac{1}{2}$.
22. $11\frac{1}{4}$.
23. $13\frac{1}{3}$.
24. $10\frac{1}{2}$.
25. $14\frac{2}{3}$.
26. $26\frac{2}{3}$.
27. $17\frac{1}{2}$.
28. $16\frac{1}{2}$.
29. $9\frac{1}{3}$.
30. $32\frac{1}{2}$.
31. 21.
32. $18\frac{1}{3}$.
33. 21.
34. $17\frac{1}{2}$.
35. $18\frac{1}{3}$.

Page 112

1. 32.
2. 8.
3. 24.
4. 12.
5. 40.

Page 113

2. $1\frac{7}{8}$.
4. $\frac{7}{16}$.
5. $1\frac{3}{7}$.
6. $\frac{15}{28}$.
7. $\frac{20}{21}$.
8. $\frac{5}{16}$.
9. $1\frac{1}{10}$.
10. $\frac{2}{3}$.
11. $\frac{4}{9}$.
12. $\frac{5}{12}$.

Page 114

2. $\frac{3}{20}$.
3. $\frac{2}{21}$.
4. $\frac{4}{27}$.
5. $\frac{7}{80}$.
6. $\frac{1}{18}$.
7. $\frac{1}{64}$.
8. $\frac{7}{128}$.
9. $\frac{5}{162}$.
10. $\frac{1}{15}$.
11. $\frac{1}{45}$.
12. $\frac{1}{27}$.
13. $\frac{2}{15}$.
14. $\frac{1}{6}$.
15. $\frac{1}{10}$.

Page 115

1. $\frac{4}{5}$.
2. $1\frac{1}{5}$.
3. 3.
4. 4.
5. $4\frac{2}{3}$.
6. $1\frac{1}{2}$.
7. $1\frac{1}{6}$.
8. $2\frac{1}{2}$.
9. $3\frac{1}{2}$.
10. $1\frac{3}{8}$.
11. $\frac{7}{9}$.
12. $2\frac{1}{2}$.
13. $1\frac{5}{6}$.
14. $\frac{8}{9}$.
15. $\frac{5}{6}$.
16. $1\frac{1}{8}$.
17. 6.
18. 12.
19. $1\frac{3}{7}$.

20. $2\frac{1}{10}$.
21. 5.
22. 20.
23. 42.
24. $10\frac{4}{5}$.
25. $\frac{9}{20}$.
26. $\frac{1}{2}$.
27. 2.
28. $\frac{5}{9}$.
29. $\frac{7}{8}$.
30. $\frac{15}{22}$.
31. $3\frac{1}{9}$.
32. $7\frac{7}{8}$.
33. $4\frac{4}{9}$.
34. $10\frac{1}{6}$.
35. $23\frac{5}{9}$.
36. $\frac{3}{10}$.
37. $\frac{12}{35}$.
38. $\frac{3}{20}$.
39. $\frac{9}{160}$.
40. 2.
41. $1\frac{7}{9}$.
42. $2\frac{1}{10}$.
43. $4\frac{4}{9}$.
44. $1\frac{25}{68}$.
45. $\frac{7}{10}$.
46. $\frac{11}{30}$.
47. $2\frac{5}{6}$.
48. $2\frac{14}{15}$.
49. $4\frac{11}{16}$.
50. $7\frac{7}{18}$.
51. $2\frac{4}{5}$.
52. $3\frac{1}{3}$.
53. $7\frac{3}{7}$.
54. $6\frac{3}{10}$.
55. $4\frac{4}{15}$.
56. $3\frac{3}{25}$.
57. 12.
58. $\frac{21}{40}$.
59. $\frac{27}{100}$.
60. $\frac{20}{27}$.
61. $\frac{2}{5}$.
62. $\frac{25}{46}$.
63. $\frac{7}{8}$.
64. $\frac{16}{19}$.
65. $1\frac{3}{16}$.
66. $2\frac{4}{7}$.

Pages 116–117

2. 13.
3. 8.
4. $1\frac{7}{10}$ in.
5. $6\frac{1}{2}$ lb.
6. $17\frac{1}{7}$.
7. $56\frac{12}{23}$ bu.
8. $\frac{7}{8}$ qt.
9. $6\frac{1}{4}$ ft. by $7\frac{7}{8}$ ft.
10. $2\frac{3}{16}$ ft.
11. 12.
12. $6\frac{2}{3}$ (7).
13. 16.
14. 3; 11.
15. 25.
16. 23.
17. 11, $\frac{1}{8}$ yd. rem.
18. 62; 6¢.
19. 15.
20. 16.
21. 13, $\frac{1}{2}$ yd. rem.
22. 160.
23. 14.

Page 118

2. 384 bu.
3. 250 lb.
4. 8 da.
5. 30 lb.
6. \$6.30.

Page 119

23. 2; $\frac{1}{2}$.
24. 4; $\frac{1}{4}$.
25. 3; $\frac{1}{3}$.
26. 3; $\frac{1}{3}$.
27. 4; $\frac{1}{4}$.
28. 2; $\frac{1}{2}$.
29. $\frac{3}{10}$; $3\frac{1}{3}$.
30. $\frac{6}{7}$; $1\frac{1}{6}$.
31. $2\frac{2}{3}$; $\frac{3}{8}$.
32. $1\frac{1}{11}$; $\frac{11}{12}$.
33. $\frac{5}{6}$; $1\frac{1}{5}$.
34. $3\frac{1}{3}$; $\frac{3}{10}$.

Pages 119–121

1. \$2.42.
2. 10¢.
3. 9¢.
4. 20¢.
5. 40¢.
6. 5 bu.
7. 98 lb.
8. \$16; \$24.
9. 50¢; \$1.
10. \$180.
11. 50¢; 75¢; \$1.
12. \$1.28; 4¢.
13. 294 bu.
14. 95 bu.
15. \$140.40.
16. \$3.50; \$7.
17. \$6400.
18. 20 bu.
19. \$18.
20. \$1.20; \$2.40; \$6.00.

Pages 122–124

1. 36 in.; 432 in.
2. 5280 ft.
3. 1760 yd.
11. 33.
12. 240 ft.
13. 1120 ft. more.
14. 720 ft. more.
15. 78 in. by 96 in.; $6\frac{1}{2}$ ft. by 8 ft.
16. 29 ft.; $9\frac{2}{3}$ yd.
17. \$12.28; \$14.28.
18. $186\frac{5}{8}$ ft.
19. 1056.
20. 1920.
21. $176\frac{1}{2}$ rd.
22. 110 yd.; 330 ft.
23. 120 ft.; 660 ft.
24. $4\frac{1}{2}$ ft.
25. 40.
26. 160.
27. 8.
28. $\frac{1}{2}$ mi.
29. 495.
30. 1188.
31. $80\frac{80}{99}$ rd.

Pages 126–127

3. 4 sq. in.
4. 12 sq. in.
6. 60 sq. in.
7. 63 sq. in.
8. 192 sq. in.
9. 70 sq. in.
10. 96 sq. in.
11. 72 sq. in.
12. 192 sq. ft.
13. 108 sq. in.
14. 30 sq. yd.
15. 30 sq. ft.
16. \$31.50.
19. 48 sq. ft.
20. 10.
21. 10 A.; 10 A.; the latter, 4 rd.
22. 11,520.
23. \$27.08.

Pages 128–130

2. 16; 56 sq. in.
3. 21; 49 sq. in.
4. 15; 36 sq. in.
5. 19.
6. 4.
7. 42.
8. Yes; 16.
9. 12.
10. 48.
11. 18 sq. in.
12. $7\frac{3}{4}$ in. by $9\frac{1}{4}$ in.
13. 6 in. by $5\frac{1}{2}$ in.
15. 5000; $10\frac{1}{2}$ sq. in.
16. 9; 225; 2025.
17. 12; 5; 60.

Pages 130–132

1. 24.
2. 18.
3. 36.
5. 144 cu. in.; 1728 cu. in.
6. 3456 cu. in.
7. 864 cu. in.; 432 cu. in.
8. 216 cu. in.
9. 168.
10. 27 cu. ft.
11. 54 cu. ft.; 216 cu. ft.
12. 600 cu. ft.
13. 90 cu. yd.

Page 132

1. 120 cu. in.
2. Less; 608 cu. in.
3. 64 cu. in.; 27.
4 225 cu. ft.
5. Yes; 3 cu. ft.
6. $\frac{1}{3}$ cu. ft.
7. 24; 144.
8. 96 cu. ft.; 2592.

Pages 133–134

2. 320 cu. yd.
3. 72 bu.
4. 1152 bu.
5. 54 T.
6. 40.
7. 36.
8. 32.
9. 240.
10. 150.
11. 664 bu.
12. $1.05.
13. $6\frac{1}{3}$ da.
14. 70 bu.
15. 39 bu.
16. 360 mi.
17. $47\frac{11}{12}$ lb.
18. 18.
19. 110.
20. 13.
21. 588.
22. 192.
23. 20.
24. 8.
25. 7.
26 4.

Page 135

5. 22,626.
6. 31,300.
7. 27,800.
8. 27,322.
9. $230.58.
10. 1554.
11. 5489.
12. 5427.
13. $17.85.
14. $34.95.
15. 223,608.
16. 223,100.
17. 668,288.
18. 328,300.
19. 670,440.
20. 145,790.
21. 497,280.
22. 252,144.
23. 405,512.
24. 1073; 213 rem.
25. 804.
26. 963; 85 rem.
27. 133; 137 rem.
28. 83.
29. 470.
30. 52; 238 rem.
31. 33; 507 rem.
32. 142; 427 rem.

Page 136

2. $\frac{1}{2}$; $\frac{2}{3}$; $\frac{2}{3}$; $\frac{16}{25}$; $\frac{2}{3}$.
3. $3\frac{1}{2}$; $4\frac{1}{6}$; $2\frac{3}{7}$; $5\frac{5}{8}$; $20\frac{5}{6}$.
4. $\frac{5}{3}$; $\frac{25}{3}$; $\frac{9}{4}$; $\frac{25}{2}$; $\frac{100}{3}$.
5. $\frac{8}{16}$; $\frac{12}{16}$; $\frac{10}{16}$; $\frac{2}{16}$; $\frac{5}{16}$.
6. $\frac{7}{8}$.
7. $1\frac{11}{12}$.
8. $1\frac{17}{24}$.
9. $1\frac{19}{24}$.
10. $1\frac{5}{6}$.
11. $1\frac{7}{16}$.
12. $1\frac{5}{48}$.
13. $1\frac{11}{24}$.
14. $60\frac{7}{12}$.
15. $73\frac{5}{12}$.
16. $63\frac{5}{24}$.
17. $78\frac{5}{24}$.
18. $\frac{5}{8}$.
19. $\frac{5}{24}$.
20. $\frac{3}{16}$.
21. $\frac{7}{24}$.
22. $\frac{11}{18}$.
23. $\frac{7}{36}$.
24. $4\frac{1}{4}$.
25. $9\frac{1}{2}$.
26. $35\frac{3}{4}$.
27. $47\frac{11}{12}$.
28. $25\frac{4}{9}$.
29. $23\frac{5}{8}$.
31. $\frac{2}{15}$.
32. $\frac{7}{24}$.
33. $\frac{2}{5}$.
34. $\frac{2}{9}$.
35. $\frac{27}{80}$.
36. $\frac{5}{72}$.
37. 200.
38. $28\frac{1}{3}$.
39. $41\frac{2}{3}$.
40. 75.
41. $13\frac{7}{20}$.
42. 25.
43. $1\frac{1}{20}$.
44. $\frac{16}{27}$.
45. $\frac{9}{28}$.
46. $\frac{9}{10}$.
47. $\frac{2}{5}$.
48. $\frac{5}{14}$.
49. 6.
50. 12.
51. 64.
52. $\frac{1}{18}$.
53. 15.
54. $1\frac{1}{3}$.

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7. $6\frac{3}{4}$.
8. $7\frac{13}{16}$.
9. $26\frac{1}{3}$.

10. $36\frac{9}{20}$.
11. $17\frac{1}{6}$.
12. $6\frac{1}{4}$.
13. $15\frac{25}{36}$.
14. $24\frac{1}{15}$.
15. 54.
16. $195\frac{5}{9}$.

Pages 140–141

9. $\frac{40}{40}$; $\frac{28}{40}$; $\frac{50}{40}$; $\frac{72}{40}$; $\frac{20}{40}$; $\frac{6}{40}$; $\frac{8}{40}$; $\frac{6}{40}$; $\frac{30}{40}$; $\frac{8}{40}$; $\frac{8}{40}$.
10. $\frac{6}{12}$; $\frac{4}{12}$; $\frac{8}{12}$; $\frac{3}{12}$; $\frac{9}{12}$; $\frac{2}{12}$; $\frac{10}{12}$.
11. $\frac{12}{8}$; $\frac{6}{8}$; $\frac{3}{8}$; $\frac{5}{8}$; $\frac{2}{8}$.
12. $\frac{12}{18}$; $\frac{3}{18}$; $\frac{4}{18}$; $\frac{15}{18}$; $\frac{5}{18}$.
13. $\frac{18}{30}$; $\frac{21}{30}$; $\frac{8}{30}$; $\frac{20}{30}$; $\frac{25}{30}$.
14. 6; 20.
15. 12; 36.
16. 72.
17. $\frac{6}{12}$; $\frac{4}{12}$; $\frac{3}{12}$.
18. $\frac{6}{24}$; $\frac{4}{24}$; $\frac{3}{24}$.
19. $\frac{2}{20}$; $\frac{4}{20}$; $\frac{5}{20}$.
20. $\frac{8}{12}$; $\frac{9}{12}$; $\frac{2}{12}$.
21. $\frac{18}{24}$; $\frac{15}{24}$; $\frac{20}{24}$.
22. $\frac{21}{36}$; $\frac{10}{36}$; $\frac{16}{36}$.
23. $\frac{9}{48}$; $\frac{32}{48}$; $\frac{30}{48}$.
24. $\frac{21}{96}$; $\frac{80}{96}$; $\frac{36}{96}$.
25. $\frac{6}{54}$; $\frac{16}{54}$; $\frac{45}{54}$.
26. $\frac{21}{36}$; $\frac{22}{36}$; $\frac{27}{36}$.
27. $\frac{63}{72}$; $\frac{60}{72}$; $\frac{32}{72}$.
28. $\frac{40}{120}$; $\frac{45}{120}$; $\frac{48}{120}$.

Page 142

4. $2\frac{1}{6}$.
5. 2.
6. $2\frac{1}{9}$.
7. $2\frac{3}{16}$.
8. $1\frac{1}{18}$.
9. $2\frac{5}{18}$.
10. $1\frac{7}{12}$.
11. 2.
12. $1\frac{5}{24}$.
13. $1\frac{9}{10}$.
14. $2\frac{7}{24}$.
15. $\frac{5}{6}$.
16. $1\frac{2}{9}$.
17. $1\frac{5}{8}$.
18. $\frac{17}{18}$.
19. $1\frac{15}{16}$.
20. $1\frac{13}{48}$.
21. $1\frac{3}{8}$.
22. $30\frac{1}{6}$.
23. $11\frac{15}{16}$.
24. $8\frac{4}{15}$.
25. $10\frac{5}{24}$.
26. $14\frac{5}{12}$.
27. $20\frac{4}{15}$.
28. $19\frac{13}{15}$.
29. $11\frac{1}{12}$.
30. $11\frac{3}{10}$.
31. $13\frac{3}{14}$.
32. $14\frac{7}{12}$.
33. $17\frac{1}{6}$.
34. $\frac{1}{6}$.
35. $\frac{5}{12}$.
36. $\frac{17}{24}$.
37. $\frac{1}{18}$.
38. $\frac{11}{24}$.
39. $\frac{3}{16}$.
40. $\frac{13}{36}$.
41. $\frac{1}{18}$.
42. $\frac{17}{48}$.
43. $\frac{5}{24}$.
44. $\frac{11}{36}$.
45. $\frac{7}{16}$.
46. $\frac{7}{18}$.
47. $\frac{9}{16}$.
48. $\frac{5}{24}$.
49. $\frac{7}{48}$.
50. $1\frac{3}{4}$.
51. $3\frac{7}{12}$.
52. $1\frac{5}{6}$.
53. $2\frac{5}{24}$.
54. $5\frac{2}{3}$.
55. $3\frac{1}{12}$.
56. $3\frac{5}{24}$.
57. $5\frac{1}{20}$.

Pages 143–144

1. $2\frac{5}{16}$ lb.
2. $2\frac{1}{18}$ yd.
3. $19\frac{5}{12}$ yd.
4. $27\frac{1}{8}$ mi.
5. $4\frac{5}{16}$ in.
6. $97\frac{1}{12}$ yd.; $30\frac{1}{2}$ yd.
7. $\frac{13}{20}$.
8. $1\frac{7}{8}$ mi.
9. 7.05 P.M.
10. $28\frac{3}{4}$ in.
11. $343\frac{17}{24}$ ft.
12. $6\frac{1}{4}$ in.
13. $62\frac{1}{12}$ ft.
14. $53\frac{11}{12}$ ft.
15. $44\frac{5}{6}$ ft.
16. $45\frac{1}{2}$ ft.
17. $5\frac{11}{16}$ in.
18. $3\frac{13}{24}$ yd.
19. $28\frac{1}{8}$ in.

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9. $\frac{7}{2}$.
10. $\frac{11}{4}$.
11. $\frac{25}{3}$.
12. $\frac{49}{9}$.
13. $\frac{55}{8}$.
14. $\frac{47}{5}$.
15. $\frac{25}{4}$.
16. $\frac{44}{5}$.
17. $\frac{23}{12}$.
18. $\frac{91}{12}$.
19. $\frac{50}{3}$.
20. $\frac{100}{3}$.
21. $\frac{200}{3}$.
22. $\frac{75}{2}$.
23. $\frac{293}{6}$.
24. $\frac{147}{8}$.
25. $\frac{83}{4}$.
26. $\frac{509}{6}$.
27. $\frac{271}{8}$.
28. $\frac{248}{9}$.
29. $\frac{487}{12}$.
30. $\frac{513}{8}$.
31. $\frac{1477}{16}$.
32. $\frac{703}{25}$.
33. $\frac{611}{32}$.

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3. $2\frac{2}{5}$.
4. $1\frac{1}{2}$.
5. $1\frac{5}{7}$.
6. 4.
7. $3\frac{1}{2}$.
8. $1\frac{7}{8}$.
9. $2\frac{4}{7}$.
10. $1\frac{1}{2}$.
11. $7\frac{1}{2}$.
12. $3\frac{1}{2}$.
13. $9\frac{1}{2}$.
14. $7\frac{1}{2}$.
19. $\frac{18}{35}$.
20. $\frac{54}{77}$.
21. $\frac{21}{80}$.
22. $\frac{7}{20}$.
23. $\frac{10}{63}$.
24. $\frac{8}{21}$.
25. $\frac{8}{35}$.
26. $\frac{80}{99}$.
27. $\frac{11}{42}$.

Pages 147–148

1. $\frac{7}{18}$; 5.
3. $\frac{1}{6}$.
4. $\frac{11}{15}$.
5. $\frac{15}{19}$.
6. $\frac{2}{11}$.
7. $\frac{1}{4}$.
8. $\frac{5}{63}$.
9. $\frac{3}{7}$.
10. $\frac{7}{78}$.
11. $\frac{4}{5}$.
12. $\frac{3}{4}$.
13. $\frac{5}{24}$.
14. $\frac{1}{2}$.
15. $\frac{16}{63}$.
16. $\frac{5}{12}$.
17. $\frac{7}{18}$.
18. $\frac{2}{5}$.
19. $\frac{3}{20}$.
20. $\frac{9}{10}$.
21. $\frac{3}{10}$.
22. $\frac{3}{7}$.
23. $\frac{24}{35}$.
24. $\frac{7}{15}$.
25. $\frac{25}{51}$.
26. $\frac{217}{244}$.
28. $7\frac{1}{2}$.
29. 20.
30. $39\frac{7}{12}$.
31. $18\frac{3}{5}$.
32. $10\frac{1}{5}$.
33. $6\frac{8}{9}$.
34. $4\frac{7}{20}$.
35. 20.

Pages 148–149

2. $8.10.
3. 60 ¢.
4. 56 bu.
5. 285.
6. $77.14.
7. $2.52.
8. $3.60.
9. $26.
10. $30.
11. 35 A.
12. $1138\frac{2}{3}$ mi.
14. 20.
15. 12.

Pages 150–151

1. $7.25.
2. $9.31; $2.06.
3. $5.06.
4. $39.
5. $49.
6. $157.
7. $108.
8. $160.80; $39.20.
9. $65.80.
10. $4.64.
11. $1.58; $22.12.
12. $188\frac{1}{2}$ bu.
13. $39.88.
14. $2.80.

Pages 151–152

2. 7.
3. 15.
4. 20.
5. 3.
6. 10 A.
7. 6 lb.; 9 lb.; 15 lb.
8. 16 da.
13. $\frac{1}{2}$.
14. $\frac{3}{4}$.
15. $1\frac{1}{2}$.
16. $1\frac{1}{3}$.
17. 5.
18. $1\frac{5}{6}$.
19. $3\frac{2}{3}$.
20. $1\frac{1}{8}$.
21. 6.
22. $\frac{4}{5}$.
23. $1\frac{1}{2}$.
24. $\frac{1}{8}$.
26. $1\frac{2}{9}$.
27. $1\frac{2}{5}$.
28. $\frac{9}{10}$.
29. $\frac{7}{9}$.
30. $2\frac{1}{10}$.
31. $2\frac{7}{10}$.
32. $1\frac{11}{24}$.
33. $1\frac{5}{72}$.
34. $\frac{35}{48}$.
35. $3\frac{1}{3}$.
36. $\frac{5}{8}$.
37. $\frac{5}{12}$.
38. $\frac{9}{16}$.
39. $1\frac{5}{6}$.
40. $3\frac{23}{25}$.
41. $2\frac{1}{2}$.
42. 43; $\frac{5}{6}$ in. rem.
43. 20 wk.
44. 16 da.

Pages 153–154

1. 18.
2. 8.
3. 30.
4. 9.
5. 9; $1\frac{7}{8}$ yd. rem.
6. 2; $\frac{1}{8}$ yd. rem.
7. 2; $\frac{5}{8}$ yd. rem.
8. $1\frac{1}{4}$ ft.
9. $1\frac{1}{10}$ yd.
10. $3\frac{5}{14}$ ft.
11. 7.
12. 10.
13. 4.
14. $1\frac{3}{4}$ T.
15. 62 bu.
16. $1\frac{1}{2}$ lb.
17. $5\frac{4}{7}$ mi.
18. $1\frac{3}{4}$ bu.
19. 13.
20. 12.

Pages 154–155

1. 2; 2.
2. 1.
3. $1\frac{1}{3}$ cups; $\frac{2}{3}$ cup.
4. $3\frac{1}{3}$ cups; $1\frac{2}{3}$ cups.
5. $5\frac{2}{3}$ cups; $2\frac{5}{6}$ cups.
6. $3\frac{1}{9}$ cups; $1\frac{5}{9}$ cups.

Pages 155–157

1. $9.45.
2. 4; 4; $476.
3. 3; $33.75.
4. $\frac{1}{4}$; $59.25.
5. 5; $72.25.
6. 4; 5 hr.
7. 3; 855 T.
8. 6; $273.
9. $27.
10. $7.60.
11. $\frac{3}{4}$; $1.50.
12. $\frac{3}{8}$; 15 ¢.
13. 30 ¢.
14. $\frac{1}{2}$; $16.
15. 4; $4800.
16. $\frac{9}{16}$; 27 mi.
17. $1\frac{1}{3}$; $21.
18. $1\frac{1}{3}$; 248 T.
19. $1\frac{1}{9}$; $12.
20. $1200.

21. $\frac{1}{2}$; $1.20.
22. $\frac{1}{9}$.
23. 6.
24. $\frac{1}{8}$.
25. $\frac{1}{3}$.
26. 2.
27. $\frac{7}{10}$.
28. 4.
29. $\frac{1}{12}$.
30. $\frac{1}{5}$.
31. $\frac{1}{3}$.
33. $1\frac{1}{2}$.
34. $\frac{1}{9}$.
35. $\frac{8}{15}$.
36. $1\frac{1}{4}$.
37. 2.
38. $\frac{1}{4}$.
39. $\frac{1}{2}$.
40. $\frac{2}{3}$.
41. 15.
42. 8.
43. 15.
44. 10.
45. $7.

Pages 157–158

1. $66\frac{1}{36}$ ft.; $22\frac{1}{108}$ yd.
2. $16\frac{23}{24}$ ft.
3. $57\frac{17}{72}$ ft.
4. $119\frac{27}{40}$ T.
5. $19\frac{11}{72}$ ft.
6. $14\frac{25}{72}$ ft.
7. $1\frac{35}{36}$ ft.
8. $58\frac{3}{10}$ mi.
9. 12 da.; 10 da.
10. $\frac{3}{10}$; $\frac{9}{20}$.
11. 13.
12. 15 da.
13. $5\frac{55}{72}$ yd.; $3\frac{29}{72}$ yd.

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4. None.
6. 2, 17.
7. 5, 13.
8. 2, 23.
9. 5, 19.
10. 2, 37.
11. 3, 17.
12. 5, 17.
13. 2, 47.
14. 2, 3, 7.
15. 2, 5, 7.
16. 2, 2, 2, 3.
17. 2, 2, 2, 3, 3.
18. 2, 2, 5, 5.
19. 2, 2, 2, 2, 3, 3.
20. 2, 2, 2, 2, 2, 2, 2.
21. 3, 5, 7.
22. 2, 2, 3, 13.
23. 2, 3, 3, 7.
24. 2, 2, 5, 7.
25. 2, 2, 3, 3, 3, 3.
26. 2, 3, 3, 5, 5.
27. 2, 2, 7, 13.
28. 2, 2, 2, 2, 2, 2, 19.
29. 2, 2, 2, 2, 2, 2, 3, 3, 3.

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19. 420.
20. 240.
21. 225.
22. 576.
23. 280.
24. 336.
25. 315.
26. 96.
27. 54.
28. 144.
29. 210.
30. 144.

Page 161, § 62

2. $\frac{23}{35}$.
3. $1\frac{175}{198}$.
4. $\frac{137}{168}$.
5. $1\frac{49}{96}$.
6. $\frac{109}{210}$.
7. $\frac{461}{640}$.
8. $\frac{1447}{1584}$.
9. $\frac{1099}{1134}$.
10. $\frac{131}{204}$.
11. $1\frac{53}{360}$.
12. $1\frac{149}{360}$.
13. $\frac{179}{180}$.
14. $\frac{941}{1152}$.
15. $\frac{16}{45}$.
16. $\frac{251}{312}$.
17. $\frac{29}{112}$.
18. $\frac{373}{600}$.
19. $\frac{215}{1134}$.
20. $\frac{101}{231}$.
21. $\frac{247}{810}$.
22. $\frac{75}{224}$.

Page 164

27. 3.4.
28. 0.45.
29. 0.11.
30. 9.06.
31. 6.306.
32. 7.077.
33. $\frac{5}{10}$; $\frac{17}{100}$; $\frac{8}{100}$; $\frac{25}{100}$; $\frac{125}{1000}$; $\frac{8}{1000}$.
34. $\frac{36}{100}$; $\frac{3}{100}$; $\frac{3}{1000}$; $\frac{9}{10}$; $\frac{90}{100}$; $\frac{9}{100}$.
35. 0.3.
36. 0.17.
37. 0.45.
38. 0.7.
39. 3.4.
40. 5.8.
41. 6.24.
42. 7.13.
43. 9.16.
44. 4.545.
45. 7.603.
46. 8.708.

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2. 12.08.
3. 19.711.
4. 21.259.
5. 6.59.
6. 6.331.
7. 127.36.
8. 180.64.
9. 109.39.
10. 93.191.
11. 1504.68.
12. 190.303.
13. 221.267.
14. 234.661.
15. 84.869.
16. 121.407.
17. 176.939.
18. 745.312.
19. 1073.795.
20. 1376.8.
21. 128.121.
22. 304.963.
23. 286.735.
24. 294.125.
25. 930.355.

Page 166

1. 2.18.
2. 2.83.
3. 4.89.
4. 6.14.
5. 6.23.
6. 4.34.

8. 6.57.
9. 2.37.
10. 2.61.
11. 0.84.
12. 7.387.
13. 15.255.
14. 22.819.
15. 13.235.
16. 8.704.
17. 20.59.
18. 0.754.
19. 534.9.
20. 52.23.
21. 31.085.
22. 39.25.
23. 25.055.
24. 67.325.
25. 18.516.
26. 6.235.
27. 15.615.
28. 18.266.
29. 3.035.
30. 2.636.
31. 4.325.
32. 2.158.
33. 0.514.
34. 0.104.
35. 7.154.
36. 0.015.
37. 0.635.
38. 0.458.
39. 0.714.
40. 0.716.
41. 0.338.
42. 0.625.
43. 1.3679.
44. 0.3694.
45. 2.2964.
46. 0.8692.
47. 0.7955.
48. 1.8935.

Pages 167–168

1. 4.8 in.
2. 33.26 in.
3. 39.05 in.
4. 219.4 mi.
5. 305.4 lb.
6. 177.43 T.
7. 0.68 lb.
8. 1.82 ft.
9. 6.11 ft.
10. 0.6 in.
11. 0.686 lb.
12. 0.364 lb.
13. 85.9 lb.
14. 1.7 sec.
15. 1.7 sec.
16. 36.75 bu.
17. 1.3 lb.

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3. 34.74.
4. 38.36.
5. 55.44.
6. 133.2.
7. 118.3.
8. 293.4.
9. 119.54.
10. 4064.
11. 17.625.
12. 629.2.
13. 4487.6.
14. 81.855.

Pages 170–171

8. 365; 45; 80; 1060.
9. 5345; 7080; 8080; 9200.
10. 34.
11. 2.
12. 125.
13. 304.
14. 16.
15. 26.5.
16. 378.3.
17. 16.75.
18. 243.
19. 50.
20. 250.
21. 65.
22. 170.
23. 1930.
24. 670.
29. $97.50.
30. 3.465 ft.
31. 6.935.
32. 0.673.
33. $0.055.
34. 0.0354.
35. 0.0346.
36. 0.006.

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4. 8; 5.
8. 2.
9. 4.
10. 4.
11. 12.
12. 0.8.
13. 3.2.
14. 0.65.
15. 1.3.
16. 0.32.
17. 0.064.
18. 0.025.
19. 0.1.
20. 0.1.
21. 1.4.
22. 0.125.
23. 10.
24. 0.15.
25. 0.12.

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2. 9.75.
3. 408.6.
4. 241.8.
5. 3.36.
6. 8.856.
7. 31.82.
8. 377.46.
9. 690.346.
10. 93.411.
11. 11.5.
12. 30.668.
13. 118.296.
14. 78.125.
15. 0.204.
16. 21.912.
17. 7.676.
18. 3.108.
19. 51.25.

Pages 173–175

1. 19.812 lb.
2. 50.16 lb.
3. 42.34 sq. in.
4. 189.0175 sq. in.
5. 12.8 cu. ft.
6. 1485 cu. in.
7. 2.1 in.; 126 cu. in.
8. 0.8 in.; 48 cu. in.
9. 30 cu. in.
10. 562.5 lb.
11. 765.625 lb.
12. 57.5 lb.
13. 489.375 lb.
14. 1210 lb.
15. 15 lb.
16. 81.25 lb.
17. 173.43 lb.

18. 3.7544 lb.
19. 478.125 lb.
20. 126.5625 lb.
21. 26.7036 in.
22. 56 lb.
23. 2040 bu.
24. $311.50.
25. $327.60.
26. $47.60.
27. $875.84.

Pages 176–177

1. 2 tenths; 0.2.
2. 21 hundredths; 0.21.
3. 0.12.
4. 0.04.
5. 1.2.
6. 4.3.
7. 0.005.
8. 0.006.
9. 1.004.
10. 0.077.
11. 0.51.
12. 0.92.
13. 0.07.
14. 1.07.
15. 0.55.
16. 0.43.
17. 0.044.
18. 1.25.
19. 4.3.
20. 2.3.
21. 2.5.
22. 4.6.
23. 0.048.
24. 0.57.
25. 0.88.
26. 0.92.
27. 0.34.
28. 3.2.
29. 0.044.
30. 0.44.
31. 5.2.
32. 0.52.
33. 0.052.
34. 6.7.
35. 0.67.
36. 3.86.
37. 0.438.
38. 0.219.
39. 0.291.
40. 0.815.
41. 0.803.
42. 0.906.
43. 6.19.
44. 7.29.
45. 48.36 mi.
46. 58.75 bu.
47. 0.055 lb.
48. 126.75 bu.
49. 1.85 T.
50. 85.4 bu.
51. 147.5 bu.

Pages 177–179

4. 12.
5. 6.
6. 8.
7. 8.
8. 7.
9. 7.
10. 8.
11. 2.
12. 2.
13. 2.
15. 8.2.
16. 0.07.
17. 0.24.
18. 80.
19. 5000.
20. 0.6.
21. 12.
22. 1200.
23. 5000.
24. 25.
25. 1.2.
26. 1.2.
28. 16.625.
29. 51.2.
30. 2.56.
31. 12.
32. 0.5.
33. 3.6.
34. 0.06.
35. 35.
36. 4.
37. 0.21.
38. 54.
39. 60.
40. 70.
41. 160.
43. 19.77+.
44. 33.32+.
45. 0.232+.
46. 5.589+.
47. 3.833+.
48. 0.0693+.
49. 2.021+.
50. 5.236+.

Pages 179–180

1. 101,856,908 A.
2. 9,450,000 A.
3. 675,000 A.
4. 6,909,091 T.
5. 21,916,509 bu.
6. 16.6 bu.
7. 28.2 bu.
8. 3.33.
9. 33.5 hr.
10. 16.7 hr.
11. 15 hr.
12. 17.8825 mi. 21.919 mi.

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1. 42.25 oz.; 0.90.
2. 0.88.
3. 0.95.
4. 0.83.
5. 0.78.
6. 46.8 lb.
7. 0.80.

Pages 182–183

2. 0.5.
3. 0.25.
4. 0.2.
5. 0.4.
6. 0.6.
7. 0.8.
8. 0.85.
9. 0.55.
10. 0.24.
11. 0.425.
14. 0.67–.
15. 0.17–.
16. 0.29–.
17. 0.42–.
18. 0.58+.
19. 0.44+.
20. 0.15+.
21. 0.71+.
22. 0.46+.
23. 0.92–.
24. 0.18–.
25. 0.45+.
27. 5.34+.
28. 3.81+.
29. 9.43+.
30. 4.95.
31. 13.88–.

32. 7.31−.
33. 6.48+.
34. 17.67−.
35. 19.45+.
36. 12.44−.
37. 8.28+.
38. 19.35+.

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1. 2.40.
2. 2.33+.
3. 0.40−.
4. 0.40.
5. 0.67−.
6. 0.68+.
7. 0.27+.
8. 3.35−.
9. 2.26+.

Pages 183–184

1. 3.14+.
2. 3.14+.
3. 3.14+.
6. 26.69 in.
7. 119.32 in.
8. 12.56 in.
9. 91.4+ yd.
10. 15.76+ ft.
11. 14.99− ft.

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1. 7.840.
2. 7.200.
3. 8.381−.
4. 8.832.
5. 10.482−.
6. 19.214+.
7. 11.350+.
8. 21.552.
9. 1.040.
10. 0.845−.
11. 0.554−.
12. 0.448.
13. 0.854−.
14. 0.750+.
15. 0.670+.
16. 0.240.

Pages 188–189

1. 1,160,000 T.
2. 1,693,750 T.; 5,081,250 T.
3. 1,587,000 T.
4. $\frac{1}{20}$.
5. 2,688,007 T.; 10,752,028 T.
6. 302,000 T.; 1,208,000 T.; 6,040,000 T.
7. 3,487,005 T.; 4,261,895 T.
8. 108.5− lb.

Pages 189–190

1. $31; $63; $32.
2. $9280.
3. 348.
4. 1,092,333$\frac{1}{3}$.
5. 3,351,000.
6. 13,880,000.
7. From $43.75 to $70.625.
8. $371,627,500.

Pages 190–191

1. 2,394,650,000 bu.
2. $1,617,202,506.
3. $323,440,501.20.
4. 101,856,909 acres.
5. 24.5− bu.

Pages 191–192

1. 531,681,600 bu.; 221,534,000 bu.; 1,905,192,400 bu.
2. 648,801,000 bu.
3. $69,371,750; $59,987,375; $59,874,500.
4. 4,896,929 A.
5. Increase them $17,342,937.50; $14,996,843.75; $14,968,625.
6. Increase it $147,444,812.50.

Page 195
(Second List)

1. 8741.
2. 9390.
3. 74,740.
4. 96,187.
5. 722,925.
6. 886,200.

Page 196

	A	*B*	*C*	*D*	*E*	*F*	*G*
1.	2919	3038	3008	3008	3509	3468	3137
2.	1987	3218	2478	2827	3000	3548	4097
3.	3325	2159	3025	3297	3198	3809	3216
4.	3000	3119	3512	3189	3101	3119	2830
5.	3215	3119	2830	3787	3076	3297	3203

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	A	*B*	*C*	*D*	*E*	*F*	*G*
1.	1023	719	1546	1391	4259	1578	4888
2.	3069	3637	4357	728	4757	2931	3379

	A	*B*	*C*	*D*	*E*	*F*	*G*
3.	1337	1468	2555	879	2435	548	5861
4.	1567	3516	373	2689	659	3638	1393
5.	1808	3389	1288	2329	2132	1949	69
6.	4412	478	4239	2169	171	1827	909
7.	338	2209	3861	2438	2758	737	2818
8.	2797	509	15	1577	6158	3373	2226
9.	1448	22	1651	163	5527	1327	11
10.	955	1814	5167	2193	2423	4113	159
11.	827	766	873	135	3037	219	2678
12.	1610	1118	609	1769	842	2304	3342

Pages 199–201

1. 428,331,449; 95,219,388; 7,493,849; 577,426,584; 145,258,805.
2. 36,258,366.
3. 16,166,479.
4. 118,320,397.
5. 10,846,462.
6. 3610; 317,144,872 lb.; $28,611,760.
7. 306,803,537 lb.
8. 341,041,996 lb.
9. 66,672.
10. 30,239.
11. 751,786; 654,875.
12. 1943; 3111; 203; 7506; 141; 9132. 3772; 12,904.
13. 75,979; 120,320; 40,566.

Pages 202–204

1. $25.31.
2. $78.89.
3. $144.16.
6. $8458.25.
7. $15,999.60.
8. $7156.52.
9. $561.91.
10. $44.21.
11. $6368.13.
12. $956.87.
13. $4043.28.

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1. $13.44.
2. $500.78.
3. $249.95.
4. $1217.95.

Page 206

	A	*B*	*C*	*D*	*E*	*F*
1.	2646	3283	6664	6904	7416	4512
2.	2574	3411	4662	5178	5682	2304
3.	4680	7623	6144	4137	7614	5495
4.	3912	2443	5922	1985	4230	3528

	A	*B*	*C*	*D*	*E*
1.	9936	43,562	21,402	25,431	56,448
2.	18,202	41,552	40,887	48,776	83,393
3.	42,596	79,392	46,458	51,417	20,169
4.	42,282	29,648	49,686	71,576	88,825
5.	77,784	73,350	40,434	37,191	40,672
6.	56,376	65,682	43,542	36,018	67,671
7.	80,496	59,708	59,904	66,127	28,041

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1. 33,120 lb.
2. 94,575 lb.
3. $1753.08.
4. $983.25.
5. 745,940 lb.
6. 9504.
7. $87.30.
8. $26.45.
9. $90.00.
10. $1191.10.
11. $164.16.

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	A	B	C	D	E	F
1.	397	586	908	329	568	883
2.	918	891	702	698	813	869
3.	396	509	789	197	678	569
4.	891	501	658	909	789	439
5.	917	608	192	791	798	589
6.	798	469	867	549	358	681
7.	496	718	906	384	273	686
8.	516	597	786	807	917	891
9.	513	497	694	817	989	903
10.	492	526	904	378	341	876
11.	499	487	710	297	924	692
12.	698	896	697	796	399	599
13.	438	526	754	757	398	504
14.	891	449	628	759	592	381
15.	927	618	825	493	816	953
16.	479	697	267	863	947	739
17.	586	779	477	897	668	328
18.	197	519	239	397	897	186
19.	587	803	479	629	517	389
20.	719	918	878	477	219	318
21.	649	885	867	486	285	738
22.	748	457	529	627	348	184
23.	748	691	839	907	819	870
24.	749; 196	580; 432	451; 100	710; 402	681; 100	807
25.	508	692	817	948	789	890
26.	559	789	591	619	821	970

Page 209

1. 22 mi.
2. 35 bu.
3. 45 bu.
4. $38\frac{16}{43}$ bu.
5. 123 da.
6. $48.
7. $18.90.
8. $30.60.
9. $122.50.
10. $2.25.
11. $1.75.

Page 210

2. 600.
3. 600.
4. 900.
5. 2400.
6. 300.
7. 600.
8. 1400
9. 900.
10. 800.
11. 2100.
12. 2100.
13. 300.
14. 400.
15. 1200.
16. 400.

Pages 210–211

1. $7.
2. $12.
3. $4.
4. $2.
5. $8.
6. $6.
7. $9.
8. $12.
9. $24.
10. $6.
11. $4.50.
12. $4.
13. $1.
14. $3.
15. $4.
16. $12.

Page 211

1. 212.4.
2. 216.2.

3. 3225.33+.
4. 6409.
5. 924.45.
6. 821.175.
7. 3204.2.
8. 2441.5.
9. 234.2.
10. 1836.5.
11. 79.3.
12. 922.8.
13. 539.84+.
14. 716.05.
15. 654.467−.
16. 6586.25.
17. 1558.367−.
18. 549.467−.
19. 2191.5.
20. 1682.
21. 16,099.
22. 4336.25.
23. 3542.5.
24. 4602.5.

Pages 211–212

1. 7.
2. 63.
3. 40.
4. 72.
5. 27.
6. 28.
7. 60.
8. 45.
9. 35.
10. 147.
11. 80.
12. 8.
13. 48.
14. 12.
15. 80.

Pages 212–213

2. $6.46.
3. $3.75.
4. $12.
5. $23.
6. $20.25.

Pages 213–214

1. $16; $0.24; $3.65; 12.5 lb.; 528 ft.; 32.4 T.
3. $15.20; $0.27; $0.52; 12.5 rd.; 0.026; 0.36 hr.; $140.
6. 252; $148; $2.50; $89; $0.27; 1056 ft.
8. 28.8; $0.78; $49.68; $1.93; 37.6 lb.; 22 yd.
10. 288; $7.80; $496.80; $19.30; 376 lb.; 220 yd.
12. 12; 39; $1.92; 1.44 ft.; 48 lb.; $8.10.
15. 96; $200; $3.36; 57.6 lb.; $0.154; $1.014.
16. $526.20.
17. 26 yd.
18. 45 yd.
19. 6 yd.
20. 6.4 hr.
21. 8 mi.; 24 mi.
22. 1500.
23. 28; 10 in. rem.

Page 215

1. 144.
2. $2.88.
3. $97.90.
4. $1296.
5. $4.
6. 31 mi.
7. $7\frac{1}{5}$ mi.
8. $57\frac{3}{5}$¢.
9. $12.19.
10. $101\frac{1}{5}$ bu.
11. $481.25.

Pages 216–217

1. 15%.
2. 75%.
3. 6%.
4. 7%.
5. 8%.
6. 50%.
7. 3%.
8. 8%.
9. 7%.
10. 15%.
11. 60%.
12. 40%.
15. 8%; 92%.
16. 95%; 85%; 80%.
17. 3%; 97%.
19. $\frac{1}{2}$; 50%.
20. 25%; 50%; 75%.
23. 5 in.; 6 in.; 4 ft.
24. 5%; 10%; 20%; 25%; 40%; 50%.
25. 15%.
26. 10; 15; 25.

Pages 218–219

2. 1932 bu.
3. 1026.
5. 0.035; 0.065; 0.155; 0.275; 0.085; 0.0925; 0.2625.
6. $413.10.
7. 94.
8. $117.
9. $6372.
10. $67.50.
11. 738.
12. 3248.
13. 1260.

Page 219

1. $\frac{1}{10}$.
2. $\frac{1}{5}$.
3. $\frac{2}{5}$.
4. $\frac{13}{20}$.
5. $\frac{17}{20}$.
6. $\frac{8}{25}$.
7. 2.
8. $3\frac{1}{2}$.
9. $6\frac{3}{4}$.
10. $\frac{17}{100}$.
11. $\frac{19}{100}$.
12. $\frac{41}{100}$.
13. 0.16.
14. 0.26.
15. 0.43.
16. 3.
17. 3.5.
18. 4.75.
19. 0.165.
20. 0.0725.
21. 0.125.

22. 0.165.
23. 0.342.
24. 0.197.
25. 25 %.
26. 36 %.
27. 84 %.
28. 116 %.
29. 304 %.
30. 638 %.
31. 37.5 %.
32. 18.4 %.
33. 93.6 %.
34. 250 %.
35. 380 %.
36. 510 %.

Pages 220–221

2. 200 ft.
3. 15 tons.
4. 50 %; $12\frac{1}{2}$ %.
5. 3.
6. 4.
7. $12\frac{1}{2}$.
8. 42.
9. $2\frac{1}{4}$.
10. $5\frac{1}{2}$.
11. $33\frac{1}{3}$.
12. 20.
13. $12\frac{1}{2}$.
14. $16\frac{2}{3}$.
15. $8\frac{1}{3}$.
16. 75.
21. $8\frac{1}{2}$ yd.
22. $4\frac{1}{2}$ bu.
23. 3 qt.
24. $6.
25. 5 yd.
26. 2 rd.
27. 20 bu.
28. 75 ft.
29. 6 yr.
30. 10 da.
31. $3\frac{3}{4}$ mi.
32. $1.88.
33. 24.
34. 4.
35. 6.
36. 7.
37. 12.
38. 49.

Pages 221–222

1. $\frac{1}{4}$; 25 %.
2. $\frac{1}{3}$; $33\frac{1}{3}$ %.
3. $\frac{1}{6}$; $16\frac{2}{3}$ %.
4. $\frac{1}{8}$; $12\frac{1}{2}$ %.
5. $\frac{1}{3}$; $33\frac{1}{3}$ %.
6. 50 %.
7. 50 %.
8. $33\frac{1}{3}$ %.
9. $33\frac{1}{3}$ %.
10. 25 %.
11. 25 %.
12. $33\frac{1}{3}$ %.
13. $16\frac{2}{3}$ %.
14. 25 %.
15. 25 %.
16. 20 %.
17. $33\frac{1}{3}$ %.
18. $16\frac{2}{3}$ %.
19. $16\frac{2}{3}$ %.
20. 75 %.
21. 75 %.
22. $66\frac{2}{3}$ %.
23. $66\frac{2}{3}$ %.
25. 16 %.
26. 40 %.
27. 35 %.
28. 45 %.
29. 80 %.
30. 75 %.
31. 24 %.
32. 65 %.
33. 15 %.
34. 80 %.
35. 62 %.
36. 25 %.
38. 39.8− %.
39. 32.8− %.
40. 36.3+ %.
41. 53.4+ %.
42. 74.5− %.
43. 36.9+ %.
44. 47.8− %.
45. 50.1− %.
46. 91.1+ %.
47. 94.2+ %.
48. 70.3− %.
49. 79.4+ %.
50. 31.9+ %.
51. 17.4+ %.
52. 30.2− %.

Pages 222–224

1. 540 lb.
2. $20.
3. $2; $\frac{1}{10}$; 10 %.
4. 3 lb.; 25 %.
5. 50 %; 30 %; 20 %.
6. 48 bu.
7. 20 %.
8. $28.
9. $12; $9; $15; $18; $24; $21.
10. $18; $45; $27; $36; $108; $9; $13.50.
11. $20; $30; $8; $1; $3; $6.
12. 1200 lb.
13. 3200 lb.
14. $66\frac{2}{3}$ %.
15. 55 %.
16. $900; $1350.
17. $9775.
18. 16,425 lb.; 17,739 lb.; 13,797 lb.; 17,739 lb.
19. $29.50; $31.86; $24.78; $31.86.

Pages 225–227

2. $426.
3. $95; $380.
4. $32.40.
5. $21.
6. $63.75.
7. $8.70.
8. 32¢; $844.80.
9. $9; $6.45; $7.50; $11.10; $6.90.
10. $4.20; $7; $9.80; $6.44.
11. $1.05; $1.77.
12. $1.78.
13. 44¢.
14. $2.25; $2.93; $6.30; $5.06; $9.50; $11.25.

Page 227

1. $30.
2. $52.
3. $100.
4. $500.
5. $800.
6. $157.50.

7. $375.
8. $640.
9. $220.
10. $560.
11. $600.
12. $480.
13. $800.
14. $360.
15. $1000.
16. $540.

Pages 228–230

2. 20%.
3. $16\frac{2}{3}$%.
4. 20%.
5. 35%.
6. 40%; 35%; 60%; 75%.

8-17. $70\frac{2}{3}$%; $68\frac{3}{4}$%; $70\frac{10}{17}$%; $64\frac{4}{9}$%; 72.5%; 50%; $66\frac{4}{11}$%; 52%; 40.76+%; 39.29−%.

18. Largest discount on first lot $31\frac{1}{4}$%; second lot has discount of 25%.

19–24. 52.56−%; 54.92+%; 50.92+%; 52.89+%; 59.67+%; 53.12+%.

25–26. 22.72+%; 24%.

Pages 230–233

1. $9.18.
2. $15.
3. $8.07.
4. $66\frac{2}{3}$%.
5. 20.8+%.
6. Second; 80¢.
7. $2.
8. Buy from local dealer.
9. 30¢ on each.
10. $4.50; $175.50.
11. $4.80.
12. 25%.
13. $24.
14. $11\frac{2}{3}$%.
15. $15.75.
16. $23.80.
17. $62.70.
18. $15.75.
19. $10.50; $94.50.
20. $10.80.
21. 25.
22. $2\frac{1}{2}$%.
23. $254.80.
24. $11.69.
25. $33\frac{1}{3}$%.

Pages 233–234

1. $32.50.
2. $31.85; $32.50.
3. $73.75; $75.26.
4. $188.70; $190.61.
5. $15.85; $16.17.
6. $651.70.

Pages 235–237

1. 5.6 lb.
2. $33\frac{1}{3}$%.
3. $16\frac{2}{3}$%; $83\frac{1}{3}$%.
4. 18%.
5. 79%
6. 34.5−%.
7. 29.2+%.
8. 15%.
9. 25%; $1562\frac{1}{2}$ bu.; $859.38.
10. 10%.
11. 46.8 lb.
12. 2.325 lb.
13. 2.9 lb.
14. 222.67 lb.
15. 28.75%.
16. 1%.
17. 70.
18. 79.2−%.
19. 80%.
20. 54.2−%.
21. 61.1+%.
22. 14.2−%.
23. $38.50.

Page 237

1. $1.50.
2. $0.75.
3. $1.65.
4. $0.26.
5. $0.56.
6. $0.25.

Page 238

1. 80,323 lb.
2. 171,500 lb.; 161,210 lb.
3. 1128 bu.; $564.
4. $24 more first way.
5. Made $29.54.
6. $632.50.
7. First, $154.08.

Page 239

1. 1.34+%.
2. $74.25.
3. 1.46+%.
4. 57,932 lb. nearly.
5. Gain, $34.56.
6. 79.5 lb. nearly.
7. 128.6+ lb.
8. $34.65.

Page 240

1–5. 5.25−%. 3.93+%. 3.42−%. 4.97+%. 3.92−%.

6–10. 6.2+ mills. 5.4+ mills. 3.7+ mills. 5.8+ mills. 4.9+ mills.

11–15. 11.8+¢. 13.8+¢. 10.8+¢. 11.7+¢. 12.6+¢.

16. $133\frac{1}{3}$%.

Page 241

1. $180; $360; $720.
2. $3.

3. $25.
4. $12.
5. $5; $6; $7.

Pages 241–242

1. $6.
2. $12; $24.
3. $36; $54.
4. $15; $21.
5. $50; $100.
6. $20; $10.
7. $15.
8. $30; $90.
9. $12; $20.
10. $15.
11. $12.
12. $36.
13. $15.
14. $22.50.
15. $21.
16. $60.
17. $25.
18. $37.50.
19. $70.
20. $45.
21. $53.33.
22. $70.
23. $10.50.
24. $17; $34; $51.
25. $2; $1; $3.
26. $1.50; $3; $6.
27. $7.50; $30; $37.50.
28. $12; $4; $16.
29. $1.50; $4.50.
30. $20; $30; $50.
31. $24; $36; $40.

Page 243

2. 6 yr. 3 mo. 16 da.
3. 2 yr. 7 mo. 22 da.
4. 24 yr. 7 mo. 19 da.
5. 4 yr. 7 mo. 16 da.
6. 3 mo. 19 da.
7. 5 mo. 9 da.
10. 52 yr. 22 da.
11. 7 mo. 17 da.

Pages 244–245

1. 1 yr. 9 mo.
2. 3 yr. 2 mo.
3. $40.50.
4. $100.
5. $12.
6. $6.25.
7. $232.
8. $0.75; $50.75.
9. $121.80.
10. $3.30.
11. $40.50.
12. $40.70.

Pages 246–247

1. 1400 sq. rd.; 8.75 A.; $700.
2. 330 sq. ft.; $89.10.
3. $36.
4. 20 in.
5. 64 sq. yd.
6. 9600.
7. 864 sq. in.; 6 sq. ft.; 54¢.
8. 1728 sq. in.; 12 sq. ft.; $1.44.
9. $105.60.
10. 520 sq. ft.; $85.80.

Pages 248–250

1. 192 sq. in.; 1372 sq. ft.; 95 sq. yd.; 328,704 sq. ft.
2. 204 sq. yd.; 35.15 sq. in.
3. 204,480 sq. ft.; $751\frac{9}{121}$ sq. rd.; $4\frac{84}{121}$ A.
4. 25,920 sq. ft.
5. 55,080 sq. ft.
6. 540 sq. in.
7. 264 sq. in.
8. 18 sq. in.; 1 sq. yd.
9. $16\frac{7}{8}$ sq. in.; $1\frac{9}{16}$ sq. yd.
10. 17,100 sq. ft.
12. 245 sq. ft.; 477 sq. rd.; $24\frac{3}{4}$ sq. in.; 46 sq. yd.; $14\frac{1}{10}$ sq. mi.
13. 1.9 acres.

Pages 251–254

1. 21 sq. in.; 54 sq. in.; $832\frac{1}{2}$ sq. in.
2. $7\frac{1}{2}$ sq. ft.
3. 14 in.; 9 yd.
4. 259 sq. in.; 14.76 sq. ft.; 1416 sq. rd., or $8\frac{17}{20}$ A.; 376 sq. yd.; 342 sq. in., or $2\frac{3}{8}$ sq. ft.
5. $151\frac{1}{2}$ sq. ft.
6. 210 sq. ft.
7. 8 sq. in.
8. 1536 sq. in.
9. 90 sq. in.
10. $2\frac{1}{2}$ sq. yd.
11. 36 sq. in. blue, 132 sq. in. white; 1 sq. yd. blue, $3\frac{2}{3}$ sq. yd. white.
12. $1\frac{1}{4}$ sq. ft.
13. Robt., 1 sq. ft.
14. 28 sq. ft.
15. 39 lb.
16. 72.
17. 72.
18. $46\frac{7}{8}$ sq. ft.
19. $15\frac{1}{6}$ sq. ft.
20. 4960 sq. yd.
21. 2824 sq. rd.
22. 171.1125 sq. mi.

Pages 255–256

1. 9 sq. ft.; 36 sq. in.; 735 sq. rd.
2. 48 sq. yd.
3. 288 sq. rd.
5. $19\frac{1}{4}$ A.; $3\frac{17}{20}$ da.; 462 bu.
6. $497\frac{1}{4}$ bu.; $268.52.
7. 3,206,876 sq. ft.; 73.62 A.; $25,766.90.
8. 120 sq. in.; 0.375 lb.

9. 990 sq. ft.; 1980 lb.
10. $1\frac{2}{9}$ sq. ft.

Pages 256–258

1. 496 sq. ft.
2. 2430.
3. 54.
4. 10; \$12.50.
5. \$13.75; \$22.25.
6. \$33.06.
7. \$79.46.
8. 104,500 sq. mi.; 66,880,000 A.
9. 97,200 sq. mi.; 62,208,000 A.
10. 85,450 sq. mi.; 54,688,000 A.
11. 69,700 sq. mi.; 44,608,000 A.
12. 79,950 sq. mi.; 51,168,000 A.
13. 70,950 sq. mi.; 45,408,000 A.
14. 113,025 sq. mi.; 72,336,000 A.

Pages 258–260

1. 128 sq. in.
2. 96 cu. in.
3. 314 sq. in.
4. 360 cu. in.
5. 1344 sq. in.; 3168 cu. in.
9. 1008 cu. in.
10. 1152 cu. in.
12. 800 cu. ft.
13. 392 cu. ft.
14. 1800 cu. ft.; $66\frac{2}{3}$ cu. yd.
15. 6888 cu. ft.; $255\frac{1}{9}$ cu. yd.; 1,170,960 lb.
16. $6257\frac{7}{9}$ cu. yd.
17. 9000 cu. ft.

Pages 261–264

1. $366\frac{2}{3}$ mi.
2. 210 mi.
3. $\frac{3}{4}$ in.; 150 mi.
4. 150 mi.; 250 mi.; $312\frac{1}{2}$ mi.
5. $\frac{17}{20}$ in.
6. $\frac{27}{40}$ in.
7. 680 mi.
8. 855 mi.
17. 102,850 sq. mi.
18. 96,800 sq. mi.
19. 107,331.84 sq. mi.
20–24. Compare the areas you obtain with those given in geography.
25. 161,875 sq. mi.

Pages 264–265

1. 225 gal.
2. $16\frac{16}{35}$ T.
3. $38\frac{22}{25}$ T.
4. $28\frac{28}{29}$ bbl.
5. $926\frac{26}{29}$ bbl.
6. 14 T.
7. 42 bu. Approx.
8. 80 T.
9. 1613 bu. Approx.
10. $153\frac{3}{5}$ bu.
11. 20 T.
12. $29\frac{218}{250}$ T.
13. 1224 bu.; 73,440 lb.
14. $50,918\frac{2}{5}$ lb.
15. \$37.50

Page 267

1. $5312\frac{1}{2}$.
2. $4001\frac{1}{4}$.
3. $13,689\frac{3}{5}$.
4. $6957\frac{1}{6}$.
5. $15,135\frac{5}{8}$.
6. $8637\frac{1}{3}$.
7. $10,031\frac{4}{7}$.
8. $7950\frac{2}{3}$.
9. $6394\frac{1}{2}$.
10. $46,641\frac{3}{5}$.
11. $28,735\frac{2}{3}$.
12. $11,368\frac{1}{2}$.
13. $58,477\frac{5}{7}$.
14. $5001\frac{1}{3}$.
15. 2220.
16. 18,088.
17. 26,980.
18. 27,040.
19. 36,728.
20. 28,210.
21. 17,552.
22. $4193\frac{1}{3}$.
23. $14,369\frac{1}{7}$.
24. $14,725\frac{1}{3}$.
25. $17,407\frac{5}{7}$.
26. $19,596\frac{7}{8}$.
27. $37,589\frac{1}{2}$.
28. $23,628\frac{1}{2}$.

Page 268

1. $\frac{13}{108}$.
2. $\frac{2}{35}$.
3. $\frac{23}{200}$.
4. $\frac{114}{1715}$.
5. $\frac{77}{432}$.
6. $\frac{64}{537}$.
7. $\frac{8}{189}$.
8. $\frac{6}{245}$.
9. $\frac{8}{135}$.
10. $\frac{4}{165}$.
11. $\frac{5}{9}$.
12. $\frac{5}{21}$.
13. $\frac{5}{42}$.
14. $\frac{25}{41}$.
15. $\frac{8}{11}$.
16. $\frac{63}{152}$.
17. $\frac{595}{864}$.
18. $56\frac{1}{4}$.
19. 5.
20. $19\frac{1}{2}$.
21. 75.
22. $1629\frac{3}{4}$.
23. $\frac{3}{4}$.
24. $78\frac{522}{1165}$.
25. $\frac{3}{4}$.
26. $7\frac{1007}{4675}$.
27. $2\frac{87}{128}$.
28. $74\frac{1}{4}$.

Page 268 (Division)

1. $9\frac{11}{51}$.
2. $\frac{1}{3}$.
3. $1\frac{59}{100}$.
4. $\frac{2}{3}$.
5. 5.
6. $3\frac{29}{42}$.
7. $5\frac{25}{28}$.
8. $\frac{17}{44}$.
9. $2\frac{1}{4}$.
10. $8\frac{1}{28}$.
11. $3\frac{1}{3}$.
12. $10\frac{5}{8}$.
13. $4\frac{1}{8}$.
14. $1\frac{19}{30}$.
15. $5\frac{25}{29}$.
16. 4.

Pages 269–270

1. $17.76.
2. 80.
3. $6.
4. $7.50; $10.50.
5. $53.63.
6. $101.25.
7. $176.65.
8. $21.
9. $\frac{1}{6}$.
10. 80 mi.
11. 180; 480.
12. $1.65; $4.95.
13. $540 gain.
14. $1309.58
15. 64.
16. 231,150,000 lb.
17. 632.
18. $7.
19. $.72.
20. 6¢.
21. The remnant 14¢.

Page 271

1. 0.21.
2. 0.4592.
3. 0.2432.
4. 0.0064.
5. 9.9004.
6. 32.6326.
7. 0.4.
8. 0.387.
9. 3.3136.
10. 2.2454.
11. 0.0152.
12. 82.6281.
13. 1.0685+.
14. 3.2.
15. 213.33+.
16. 24.44–.
17. 38.52.
18. 14.722+.
19. 3.048–.
20. 0.598–.
21. 0.373–.
22. 1.096–.
23. 79.167–.
24. 93.333+.

Page 272

1. 0.66.
2. 0.88.
3. $\frac{1}{2}$; $\frac{4}{5}$; $\frac{4}{25}$; $\frac{6}{25}$; $\frac{1}{4}$; $\frac{1}{8}$; $\frac{21}{25}$; $\frac{24}{25}$.
4. 0.28.
5. 0.5833+ ft.; 0.7083+ ft.; 0.8646– ft.; 0.15625 ft.
6. 199.7+ mi.
7. 2814.72 lb.
8. $395.99.
9. $463.99.
10. $236.10.
11. $339.86.
12. $240.96.
13. $543.33.
14. 49.94+ lb.
15. 10.805 tons.
16. 18.92+ ft.

Page 273

3. $290.
4. 25 %; 20 %.
5. 25 %.
6. $10.90.
7. Boys', 20 %; Men's, 33.28 %; Girls', 29.96 %; Boys', 43.43 %; Men's, 22.73 %.
8. $21.25; $53.13; $31.87.
9. $24.17; $157.08; $60.42.
10. $32.08; $83.42; $70.58.
11. $20; $220; $50.
12. $131.25.

Pages 274–276

1. $55.75.
2. $45.70.
3. 32 %.
4. $55\frac{5}{9}$ %.
5. $\frac{31}{40}$ of a bale; $1550.
6. $32.75; $46\frac{11}{14}$ %.
7. 42,500 sq. mi.
9. About 74.
10. $7\frac{1}{2}$ ft.
11. $3.03.
12. $2.97.
13. $0.72.
14. $3.46.
15. 89.66– %.
16. $74\frac{1}{2}$ ft.
17. 14; 0.7 yd. rem.
18. 0.067 of it for each side.
19. Vol. of 1st $1\frac{23}{77}$ times vol. of 2d.
20. 40,500 tons.
21. 2880 lb.
22. $14.80.
23. $6.40; $5.12; $4.80.
24. $1.28; 20 %.
25. $6\frac{1}{4}$ %.
26. 22.7+ %; $21\frac{1}{4}$ %; 24 %; $16\frac{2}{3}$ %.
27. $41.76.
28. $\frac{8}{27}$ cu. ft.