DOCUMENT RESUME

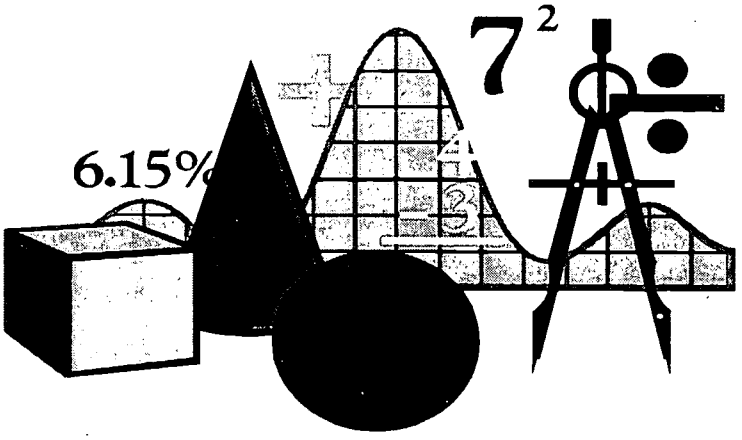
ED 424 391 CE 077 301

AUTHOR	Ruetz, Nancy
TITLE	SPC-Prep 1. Participant's Manual. Workplace Education. Project ALERT.
INSTITUTION	Wayne State Univ., Detroit, MI. Coll. of Education.
SPONS AGENCY	Office of Vocational and Adult Education (ED), Washington, DC. National Workplace Literacy Program.
PUB DATE	1996-00-00
NOTE	65p.; For related documents, see CE 077 287-302.
CONTRACT	V198A40082-95
AVAILABLE FROM	Workplace Education: Project ALERT, Wayne State University, 373 College of Education, Detroit, MI 48202 ($40 plus $5 shipping).
PUB TYPE	Guides - Classroom - Learner (051)
EDRS PRICE	MF01/PC03 Plus Postage.
DESCRIPTORS	Adult Basic Education; *Arithmetic; Basic Skills; *Decimal Fractions; Instructional Materials; Learning Activities; *Mathematics Instruction; Percentage; *Place Value; Staff Development; Statistics; *Workplace Literacy
IDENTIFIERS	*Statistical Process Control

ABSTRACT

This companion document to the instructor's guide for a course designed to prepare employees for statistical process control (SPC) training given at their workplace by refreshing math skills and building the concepts and vocabulary necessary to understand SPC in manufacturing environments. SPC-Prep 1 addresses the math skills necessary to perform SPC calculations. The manual provides materials on these topics: math memories; keeping track of learning; math operations; place value; rounding off numbers; finding an average; decimals; and positive and negative numbers. Information sheets and exercise sheets are provided. A word list and answer key for the exercises are provided. (YLB)

WORKPLACE EDUCATION



SPC-Prep 1

Participant's Manual

Nancy Ruetz

Project ALERT

Wayne State University
College of Education

The material in this project was prepared under Grant No. V198A40082-95 from the National Workplace Literacy Program, Office of Vocational and Adult Education, US Department of Education, under authority of the Adult education Act P.L. 91-230. Federal funding has contributed 70% ($1,028,512) of the total cost. The remaining 30% ($471,688) has been provided by four partners of the project UAW - Chrysler National Training Center, City Management Corporation, Davis Tool and Engineering and Wayne State University in the form of cost-sharing in-kind. Grantees undertaking such projects under government sponsorship are encouraged to express freely their professional judgment. Therefore, points of view or opinions stated in this document do not necessarily represent the official position or policy of the Department of Education.

Introduction to SPC-Prep 1

Everyone uses numbers every day for many reasons. At home, at school, and on the job, numbers are part of our life. Think of the ways you have used numbers in the last week. Shopping, paying bills, and balancing your checking account are common activities that involve math.

Think of the times you have had to add, subtract, multiply, or divide numbers. Addition, subtraction, multiplication, and division are called *math operations* or *basic operations* in math. They are the foundation of all math.

The old saying, *If you don't use it, you lose it,* applies to math. This course will give you a chance to review, refresh, and maybe even learn some new math skills.

The goals of SPC-Prep 1 are:

- To demonstrate mastery of addition, subtraction, multiplication, and division of whole numbers, fractions, and decimals.
- To demonstrate mastery of place value in regard to decimals.
- To demonstrate mastery of addition and subtraction of positive and negative numbers.
- To calculate an average from a sum of positive and negative numbers.

Using the Participant's Manual

Your instructor will decide on lessons based on the experience and needs of you and your class. You may not do the lessons in the order they are presented in this manual. The instructor may also use exercises based on your specific job or company that do not appear in this book.

There are many reasons why employees have trouble understanding math. Many people have painful memories about class room experiences that happened long ago. This course is designed to help you learn in a safe atmosphere. Your life experiences will help you understand many concepts that were difficult for you before. Lessons are linked to common experiences. This will make learning more practical and easier to apply to life situations.

The *SPC-Prep Daily Report* helps the instructor understand if learning is going as planned. It gives you the opportunity to give important feedback to the instructor. Sometimes it is difficult to speak up in a class when something is not clear. This form gives you a chance to tell the instructor exactly what you need so you can understand the lessons.

It is helpful to write down what you have learned when you learn it. You can better understand how you learn. The more involved you are with the learning process, the easier learning will be. You will be asked to fill out the *SPC-Prep Daily Report* after each lesson.

SPC-Prep Daily Report

Name: _____ Date: _____ Time _____

Today's topic _____

What I learned today:

_____

_____

_____

_____

_____

_____

_____

Why do I need to know this? or How did I learn this?

_____

_____

_____

_____

_____

What I need more practice with: _____

_____

_____

_____

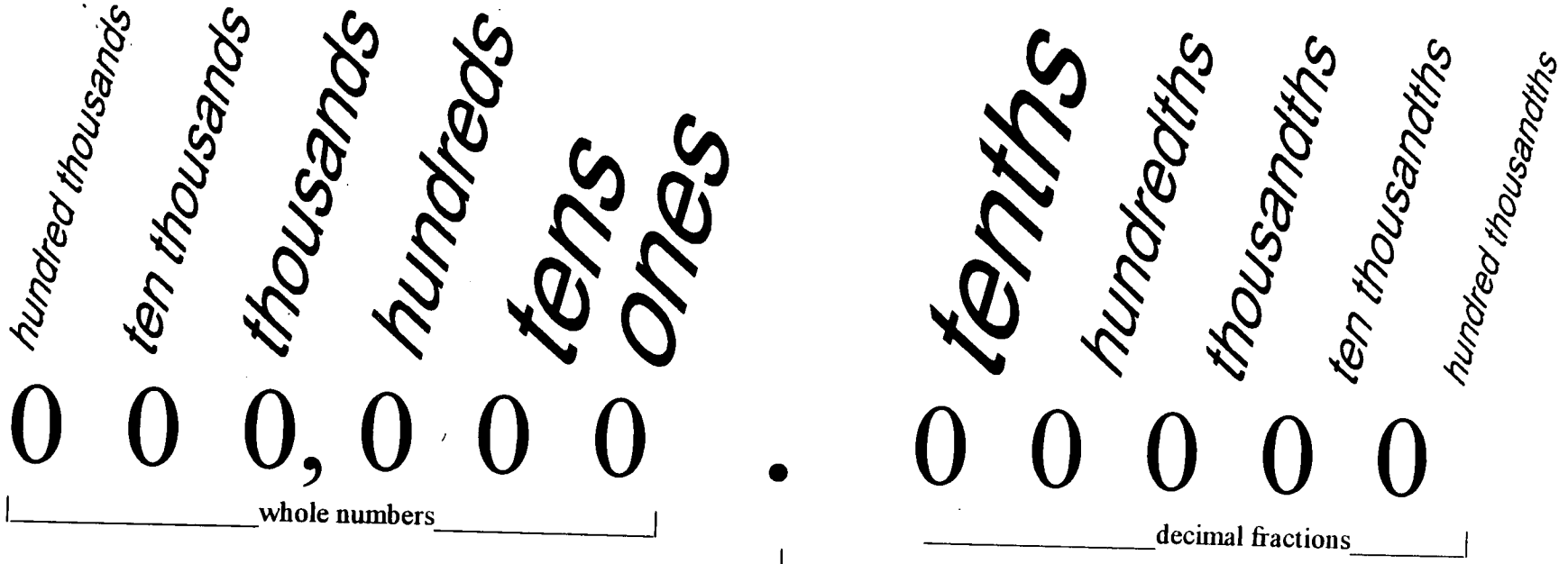
_____

What would be helpful for me to learn: _____

_____

I am ready to move on to the next topic. ❒ Yes ❒ No

Place Value


hundred thousands
ten thousands
thousands
hundreds
tens
ones
tenths
hundredths
thousandths
ten thousandths
hundred thousandths
0 0 0,0 0 0 . 0 0 0 0 0
whole numbers
decimal fractions
decimal point

Whole number Practice

Add the following:

1.
74
23
80
+ 22

2.
14
82
51
+ 46

3.
98
19
97
+ 73

4.
98
35
49
8
+ 93

5.
38
95
56
+ 97

6.
383
558
214
+ 635

7.
685
378
298
+ 419

8.
496
545
339
+ 108

9.
332
479
283
+ 476

10.
8613
8000
9678
3159
+ 2718

11.
41263
87190
36850
23367
+ 70201

Subtract

1. 71 - 38	**2.** 807 - 216	**3.** 4930 - 1038
4. 5671 - 1084	**5.** 67592 - 48111	**6.** 65758 - 26946
7. 54629 - 20099	**8.** 61287 - 20698	**9.** 21248 - 11447

Multiply

1. 16 x 20	**2.** 36 x 77	**3.** 89 x 99
4. 289 x 998	**5.** 8736 x 605	**6.** 2671 x 803
7. 2000 x 701	**8.** 9503 x 431	**9.** 10000 x 100

Divide the following:

1. 36 -:- 12 =

2. 57 -:- 19 =

3. 720 -:- 36 =

4. 26010 -:- 45 =

5. 1288 -:- 23 =

6. 70488 -:- 89 =

7. 1248 -:- 42 =

8. 6272 -:- 24 =

Rounding off numbers

Sometimes numbers are rounded off, to make them easier to remember. Try to remember how much you paid to the IRS this year? If it's not tax time, you can probably remember approximately what you paid, but it is unlikely that you remember the figure to the penny. Numbers are often rounded off to make them easier to understand, and when accuracy is not necessary.

Auto manufacturers publish reports of the number of cars sold in a given time with rounded off numbers. If 12,624,723 cars were sold in a 6-month period, the number may be rounded off to the nearest hundred thousand -- 12,600,000.

To round whole numbers, follow these steps:

Underline the number in the place you are rounding.
12,624,723 (6 is in the hundred thousand place)

Look at the number in the next place to the right of the underlined number. 12,624,723 (2 is next to the underlined number in this example.)

If the number to the right is less than 5, leave the underlined number as it is. (2 is less than 5)

If the number to the right of the underlined number is 5 or more, add 1 to the underlined number.

Change all numbers to the right of the underlined number to zero.

Practice Rounding Off Numbers:

1. Round to the nearest 10:

78 _____	53 _____	45 _____
32 _____	985 _____	817 _____
897 _____	432 _____	911 _____

2. Round to the nearest 100:

3,124 _____	6,598 _____	62,912 _____
8,555 _____	8,499 _____	45,150 _____

3. Round to the nearest 1000:

23,798 _____	65,073 _____	398,186 _____
67,599 _____	41,008 _____	994,499 _____

4. Round to the nearest 10,000:

123,456_____	456,987_____	1,983,129_____
793,108_____	497,296_____	3,928,376_____

5. Round to the nearest 100,000:

1,497,387 _____	109,477,498_____
8,399,832 _____	986,399,737_____
4,783,925 _____	843,399,000_____

6. Round to the nearest 1,000,000:

123,995,884 _____	165,376,984 _____
974,538,883 _____	170,802,840 _____

Divisible Number

Can you think of a time when there were several items to be divided among a group of children and there was some concern about how many each child would get? For example, there are five small boys in your family and you have 14 packs of baseball cards to divide between them. Can it be so everyone gets the same number of pack? Divisible numbers are an important skill to understand when working with fractions.

Practice with Divisible Numbers

1. 32 is divisible by which number?
   a. 5
   b. 3
   c. 8
   d. None of these

2. The sum of 21 and 12 is divisible by which number?
   a. 10
   b. 9
   c. 11
   d. None of these

3. 63 is divisible by which number?
   a. 7
   b. 5
   c. 8
   d. None of these

4. The sum of 28 and 53 is divisible by which number?
   a. 9
   b. 8
   c. 6
   d. None of these

5. 120 is divisible by which number?
   a. 7
   b. 6
   c. 9
   d. None of these

6. The sum of 81 and 69 is divisible by which number?
   a. 6
   b. 5
   c. 4
   d. None of these

7. 104 is divisible by which number?
   a. 9
   b. 10
   c. 8
   d. None of these

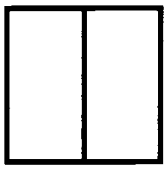
8. The sum of 125 and 69 is divisible by which number?
   a. 5
   b. 2
   c. 7
   d. None of these

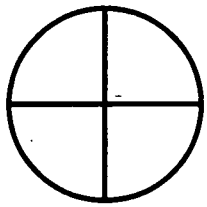
Introduction to Fractions

A fraction is a part of something. A dime is a fraction of a dollar. It is one of ten equal parts of one dollar or $\frac{1}{10}$ (one ten*th*) of a dollar. An inch is a fraction of a foot. It is one of 12 equal parts of a foot or $\frac{1}{12}$ (one twelf*th*) of a foot. Saturday and Sunday are a fraction of the week. They are 2 equal parts of the week or $\frac{2}{7}$ (two seven*th*s) of the week. The numbers in the fraction are called the

numerator -- which tells how many parts you have
denominator -- which tells how many equal parts in the whole

The square is divided into two equal parts. Each part is $\frac{1}{2}$.





The circle is divided into four equal parts. Each part is $\frac{1}{4}$.

Practice with fractions:

_____1. A foot contains 12 inches. 5 inches is what fraction of a foot?

_____2. 57¢ is what fraction of one dollar?

_____3. A pound contains 16 ounces. 9 ounces is what fraction of a pound?

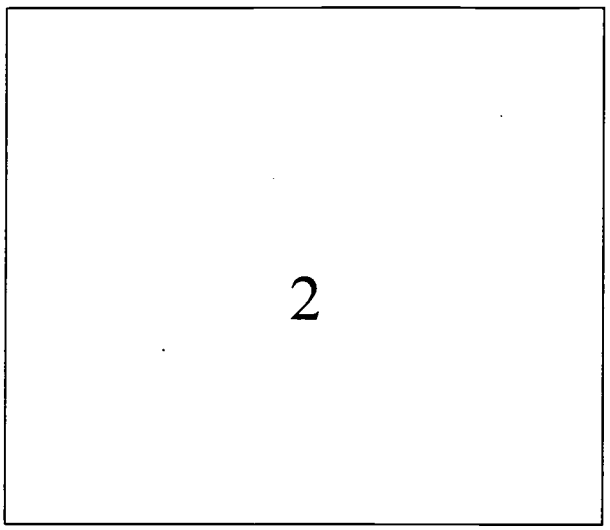
_____4. 7 months is what fraction of a year?

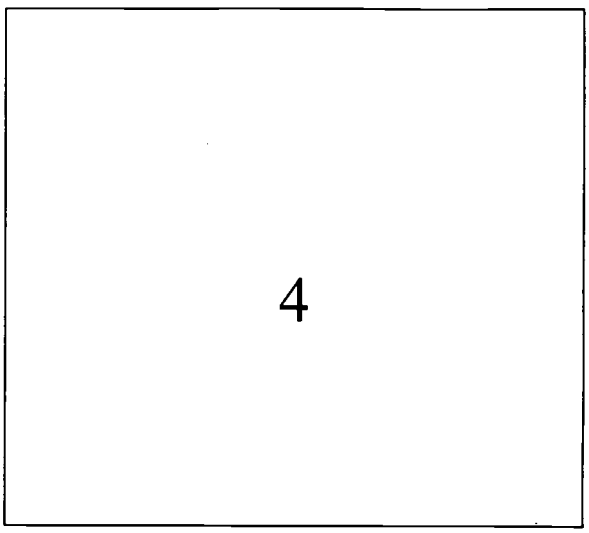
_____5. The work days, Monday through Friday, are what fraction of a week?

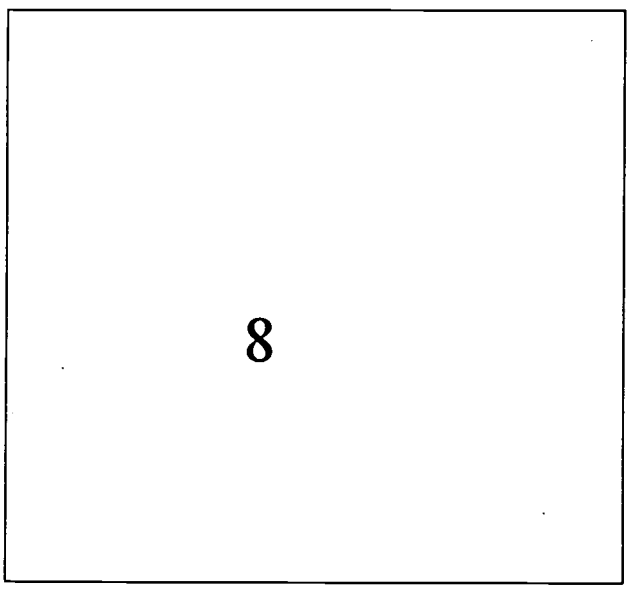
_____6. If 72 pages of a report 298 pages have been typed, what fraction of the report is typed?

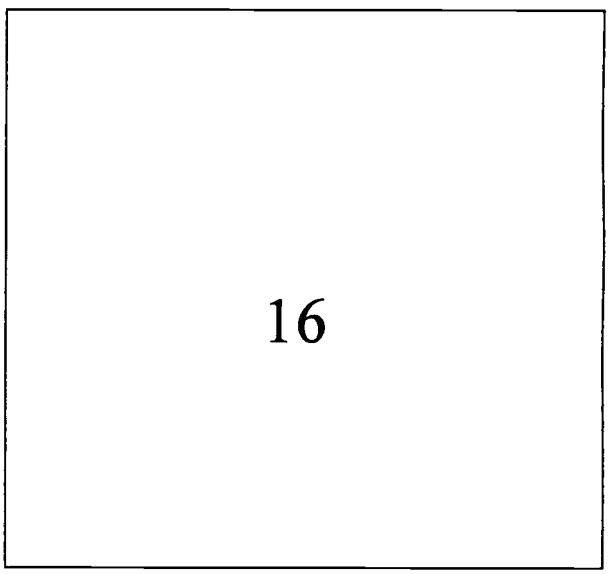
Practice with Fractions

Divide the boxes below into the number of equal parts stated in the box.









Using the boxes on the last page, answer the following questions.

1. How many fourths are there in one half? _____

2. How many eighths are there in one half? _____

3. How many sixteenths are there in one fourth? _____

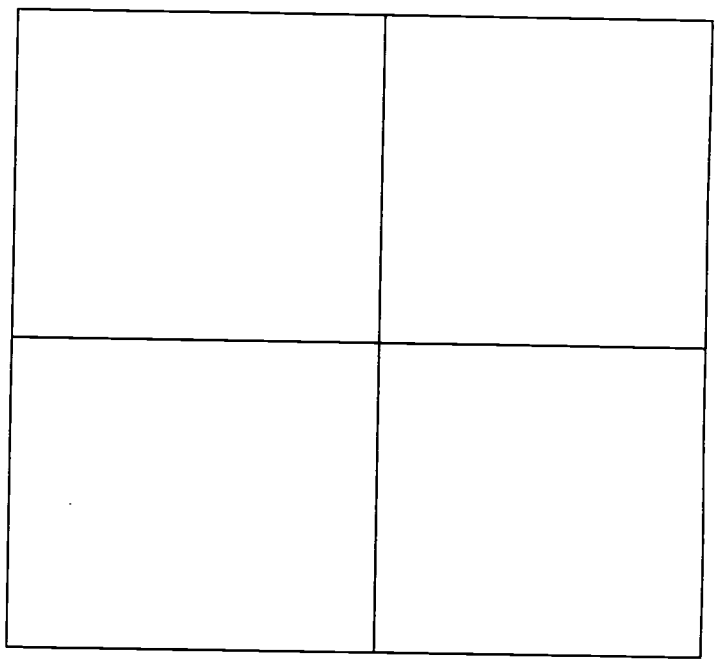
4. How many sixteenths are there in three fourths? _____

5. How many sixteenths are there in one half? _____

$\frac{1}{2} = \frac{2}{4} = \frac{4}{8} = \frac{8}{16}$

6) add $\frac{1}{4} + \frac{1}{4}$

Shade in your answer.



Math operations with fractions. Add the following fractions. Be sure to reduce your answer to the lowest terms.

1. $\frac{1}{2} + \frac{1}{2}$

2. $\frac{2}{3} + \frac{1}{3}$

3. $\frac{1}{5} + \frac{1}{5}$

4. $\frac{1}{9} + \frac{4}{9}$

5. $\frac{1}{8} + \frac{3}{8}$

6. $1\frac{1}{7} + 2\frac{1}{7}$

7. $3\frac{1}{4} + 1\frac{1}{4}$

8. $4\frac{1}{11} + 1\frac{2}{11}$

9. $9\frac{6}{15} + 2\frac{3}{15}$

10. $3\frac{1}{4} + 1\frac{1}{4}$

11. $3\frac{3}{8} + 2\frac{1}{8}$

12. $6\frac{1}{14} + 2\frac{1}{14}$

13. $12\frac{7}{8} + 11\frac{5}{8}$

14. $4\frac{4}{5} + 2\frac{3}{5}$

15. $3\frac{1}{8} + 6\frac{7}{8}$

16. $9\frac{1}{8} + 6\frac{7}{8} + 2\frac{5}{8}$

Lowest Common Denominator

Fractions must have the same bottom numbers (denominators) when adding or subtracting. If the fractions do not have the same bottom numbers, you must rewrite them so they do. This is called a finding *common denominator*. This means changing at least one of the fractions to higher terms. A *common denominator* is a number that can be divided *evenly* by all of the denominators in the problem.

The *lowest common denominator* is the *smallest* number that can be divided evenly by all of the denominators in the problem.

Find the *lowest common denominator* for the following fractions:

1.	$\frac{1}{2}$		$\frac{1}{4}$	_____
2.	$\frac{1}{3}$		$\frac{1}{9}$	_____
3.	$\frac{1}{4}$		$\frac{1}{6}$	_____
4.	$\frac{1}{9}$		$\frac{1}{6}$	_____
5.	$\frac{1}{5}$		$\frac{1}{10}$	_____
6.	$\frac{1}{3}$	$\frac{1}{4}$	$\frac{1}{6}$	_____
7.	$\frac{1}{5}$	$\frac{1}{10}$	$\frac{1}{20}$	_____
8.	$\frac{1}{7}$	$\frac{1}{9}$	$\frac{1}{3}$	_____
9.	$\frac{1}{9}$	$\frac{1}{3}$	$\frac{1}{6}$	_____
10.	$\frac{1}{12}$	$\frac{1}{5}$	$\frac{1}{3}$	_____

Add the following mixed fractions. Reduce your answer to the lowest possible terms.

1. $6\frac{1}{2} + 2\frac{1}{3}$

2. $2\frac{1}{4} + 1\frac{1}{8}$

3. $7\frac{1}{4} + 3\frac{1}{6}$

4. $9\frac{1}{5} + 1\frac{1}{10}$

5. $7\frac{1}{8} + 1\frac{1}{6}$

6. $8\frac{1}{4} + 1\frac{1}{2}$

7. $12\frac{1}{2} + 8\frac{1}{6}$

8. $14\frac{3}{7} + 12\frac{1}{3}$

9. $14\frac{9}{10} + 11\frac{4}{5}$

10. $17\frac{1}{8} + 12\frac{1}{3}$

11. $19\frac{3}{5} + 12\frac{7}{8}$

12. $23\frac{9}{10} + 10\frac{4}{6}$

13. $15\frac{4}{5} + 10\frac{11}{15}$

14. $35\frac{1}{7} + 12\frac{1}{9}$

15. $1\frac{1}{2} + 2\frac{1}{6} + 1\frac{1}{3}$

16. $11\frac{2}{7} + 8\frac{1}{3} + 4\frac{1}{6}$

Subtract these fractions. Reduce your answer to the lowest possible terms.

1. $3\frac{1}{4} - 1\frac{3}{4}$

2. $4\frac{1}{6} - 1\frac{5}{6}$

3. $2\frac{1}{9} - 1\frac{5}{9}$

4. $6\frac{1}{7} - 4\frac{3}{7}$

5. $12\frac{1}{9} - 6\frac{4}{9}$

6. $13\frac{1}{14} - 12\frac{5}{14}$

7. $12\frac{1}{25} - 11\frac{7}{25}$

8. $14\frac{1}{7} - 10\frac{2}{7}$

9. $7\frac{9}{16} - 2\frac{1}{3}$

10. $15 - 1\frac{1}{4}$

11. $36 - 5\frac{1}{9}$

12. $7\frac{1}{16} - 2\frac{5}{64}$

13. $12\frac{1}{4} - 6$

14. $7 - 2\frac{1}{4}$

15. $7\frac{1}{4} - 5\frac{3}{8}$

Subtract these fractions. Reduce your answer to the lowest possible terms.

1. $3\frac{2}{5} - 1\frac{1}{5}$

2. $4\frac{1}{2} - 1\frac{1}{6}$

3. $9\frac{7}{8} - 2\frac{7}{8}$

4. $12\frac{5}{6} - 8\frac{1}{6}$

5. $9\frac{4}{5} - 2\frac{1}{10}$

6. $11\frac{3}{4} - 3\frac{1}{6}$

7. $4\frac{7}{8} - 1\frac{1}{3}$

8. $12\frac{8}{15} - 1\frac{1}{3}$

9. $7\frac{2}{3} - 1\frac{5}{6}$

10. $12\frac{3}{5} - 1\frac{7}{10}$

11. $178\frac{4}{5} - 51\frac{1}{3}$

12. $52\frac{3}{8} - 16\frac{23}{32}$

Multiply these fractions. Reduce your answer to the lowest possible terms.

1. $\frac{1}{2} \times \frac{1}{2} =$

2. $\frac{1}{4} \times \frac{1}{4} =$

3. $\frac{4}{5} \times \frac{1}{6} =$

4. $\frac{1}{5} \times \frac{2}{5} =$

5. $\frac{4}{5} \times \frac{7}{10} =$

6. $\frac{3}{8} \times \frac{2}{5} =$

7. $\frac{4}{5} \times \frac{6}{10} =$

8. $\frac{8}{14} \times \frac{6}{12} =$

9. $\frac{3}{12} \times \frac{5}{20} =$

10. $\frac{4}{15} \times \frac{6}{10} =$

Multiply the following fractions. Reduce your answer to the lowest common denominator.

1. $1\frac{1}{2} \times 1\frac{1}{2} =$

2. $1\frac{5}{7} \times 2\frac{1}{24} =$

3. $2\frac{1}{7} \times 2\frac{4}{5} =$

4. $5\frac{1}{3} \times 2\frac{1}{4} =$

5. $1\frac{7}{9} \times 4\frac{1}{2} =$

6. $4\frac{2}{5} \times 2\frac{8}{11} =$

7. $1\frac{7}{10} \times 1\frac{11}{14} =$

8. $2\frac{2}{9} \times 5\frac{2}{5} =$

9. $2\frac{1}{5} \times 1\frac{13}{22} =$

10. $1\frac{3}{16} \times 1\frac{13}{19} =$

Divide the following fractions. Reduce your answer to the lowest possible terms.

1. $\frac{1}{2}$ -:- $\frac{1}{2}$ =

2. $\frac{1}{3}$ -:- $\frac{1}{3}$ =

3. $\frac{3}{4}$ -:- $\frac{2}{3}$ =

4. $\frac{3}{8}$ -:- $\frac{1}{2}$ =

5. $\frac{7}{8}$ -:- $\frac{3}{5}$ =

6. $\frac{7}{12}$ -:- $\frac{1}{3}$ =

7. $\frac{3}{4}$ -:- $\frac{4}{7}$ =

8. $\frac{5}{12}$ -:- $\frac{5}{6}$ =

Basic Operations with Mixed Fractions

1. Fred has the following lengths of $\frac{1}{2}$-inch copper pipe: $8\frac{5}{16}$ inches, $12\frac{1}{2}$ inches, $9\frac{3}{4}$ inches, and 26 inches. If he welds together the three shortest lengths, what will be the length in inches of this new piece of pipe?

A. $28\frac{7}{16}$

B. $30\frac{9}{16}$

C. $29\frac{1}{4}$

D. $28\frac{11}{16}$

2. Fred works for Davis Tool as a truck driver. His delivery route is tabulated each day. Last Friday he drove $10\frac{1}{2}$ miles for his first stop, $14\frac{6}{10}$ miles for the second stop, and $1\frac{3}{10}$ of a mile for the third stop. How many miles did he drive all together?

A. $25\frac{1}{2}$

B. $26\frac{7}{10}$

C. $26\frac{2}{5}$

D. $26\frac{1}{2}$

3. The following Friday Fred drove the same amount of miles (see problem 2) but he took the truck to the garage at the end of the day. The garage was 6 1/5 miles from his last stop on that day. How far did he have to drive?

A. $31\frac{2}{5}$

B. $33\frac{4}{5}$

C. $32\frac{3}{5}$

D. $32\frac{1}{5}$

4. The factory needed new security fencing around the plant. The land around the factory measured $3\frac{7}{10}$ miles on each of its four sides. How many miles of security fencing is needed to replace the old fencing?

A. $14\frac{1}{5}$ miles of fencing

B. $13\frac{8}{10}$ miles of fencing

C. $12\frac{3}{10}$ miles of fencing

D. $14\frac{8}{10}$ miles of fencing

5. The value of Davis stock went from $19\frac{3}{8}$ to $21\frac{1}{4}$ between June 1 and June 30. How many points in value did the stock change during the month of June?

A. $\frac{7}{8}$

B. $1\frac{1}{4}$

C. $1\frac{3}{8}$

D. $1\frac{7}{8}$

6. New rods for the welding machine had to be cut. One rod measured $10\frac{5}{16}$ and the other rod measured $5\frac{7}{8}$. What is the difference in length between the two rods?

A. $4\frac{7}{16}$

B. $5\frac{7}{16}$

C. $4\frac{3}{16}$

D. $5\frac{3}{16}$

7. The factory classroom needed to be painted. Tim mixed 5/6 of a pint of thinner in each gallon of paint he used. How many pints of thinner did Tim use to complete the job that requires 24 gallons of paint?

A. 18 pints
B. 20 pints
C. $18\frac{5}{6}$ pints
D. 22 pints

8. The hilo-driver clocks the distance traveled each day. He works 8 hours and drives $31\frac{7}{10}$ miles each day. How many miles does he drive each 5 day week?

A. 158 miles
B. $160\frac{7}{10}$ miles
C. 159 miles
D. 125 5/7 miles

9. If an oil drip pan weighed 10 1/2 pounds how many could you cut from an 840 pounds of steel (do not be concerned about scrap pieces) ?

A. 91 drip pans
B. 80 drip pans
C. 84 drip pans
D. 108 drip pans

10. If one box holds 14 machine brackets, how many boxes are needed to pack 430 machine brackets ?

A. 30 boxes
B. 42 boxes
C. 31 boxes
D. 45 boxes

Math Operations With Decimals

Add the following:

1. 6.1 + 2.5 + 4.6 =

2. 634.1 + 4.1 + 796.1 =

3. .614 + 3 + 2.8 + 743.1 =

4. 26 + 7.1 + 5 + 0071 =

5. 6.73 + 4 + .0006 =

Subtract the following decimals:

1. 6.71 - .50 =

2. 38.7 - 2.2 =

3. 47.6 - .40 =

4. 3.7010 - .9624 =

5. 64.7121 - .00375 =

6. 1267.83 - 94632 =

Multiply the following decimals:

1. 3.7 x 67

2. .36 x 2.6

3. .71 x. 86

4. .893 x .001

5. 783 x .023

6. .471 x .001

Divide the following decimals:

7. 6.9 -:- 2.3 =

8. 32.43 -:- .47 =

9. .3132 -:- .36 =

10. 84 -:- .00021 =

Math operations using decimals

1. A crate manufacturer uses wood that is 2.5 mm thick. To save money he plans to use wood that is 1.75 mm thick. How much thinner will the new wood be?

2. A worn floor at the plant must be covered with 1.5 inch plywood and another layer of .75 inch fiberboard. What is the thickness of the new flooring?

3. The odometer on Chris's car showed that one route to work was 7.7 miles round trip. Another route was 8.3 miles round trip. What is the difference in miles between routes for a 5 day work week?

4. A sign on a truck delivery door says, "Height limit = 11.5 feet." Sam's truck measures 11.2 feet tall when the tires are low. When the tires are full the truck is another 0.3 feet higher. Does Sam's truck clear the doorway when the tires are full?

5. By how much does Sam's truck clear the doorway when the tires are low?

6. Terry drove for 2.5 hours at an overage speed of 70 mph and for 1.5 hours at an average speed of 50 miles an hour. What is the total of the miles driven?

Rounding decimals

To round a decimal is to shorten it or make it easier to read. This is done by discarding the digits (numbers) that are not needed.

Example 1: Eric ears $7.68 for each hour of overtime he works. How much will he earn in 2.4 yours of overtime on Saturday?

Step 1: Solve the problem

$7.68

x 2.4

3072

1536

$18.432 Note that there are 3 decimal places in the answer.

Step 2: To write $18.432 as dollars and cents, we want to keep only 2 digits (numbers) to the right of the decimal point. Because 2 is less than 5, we drop the number and leave the answer as 43 cents.

If the number was 5 or more, you would drop the number and raise the digit to the left by one.

Example: $18.466 would be rounded to $18.47.

Practice rounding decimals:

1. Round to the nearest tenth:

0.32 _____ 0.67 _____ 0.65 _____ 0.81 _____
0.94 _____ 0.58 _____ 0.76 _____ 0.59 _____

2. Round to the nearest one hundredth:

0.321 _____ 0.679 _____ 0.652 _____ 0.818 _____
0.943 _____ 0.587 _____ 0.764 _____ 0.595 _____

3. Round to the nearest thousandth:

0.32191 _____ 0.67982 _____ 0.65237 _____
0.81862 _____ 0.94344 _____ 0.58799 _____
0.76469 _____ 0.59527 _____ 1.38585 _____

4. Round to the nearest ten thousandth:

0.32191 _____ 0.67982 _____ 0.65237 _____
0.81862 _____ 0.94344 _____ 0.58799 _____
0.76469 _____ 0.59527 _____ 1.38585 _____

Write each fraction as a decimal.

1. $\frac{1}{10}$ = _____

2. $\frac{1}{100}$ = _____

3. $\frac{1}{1000}$ = _____

4. $\frac{1}{10,000}$ = _____

5. $\frac{1}{100,000}$ = _____

Write each decimal as a fraction.

6. .7 _____

7. .07 _____

8. .007 _____

9. .0007 _____

10. .00007 _____

11. .000007 _____

Write each fraction as a decimal.

12. $\frac{23}{100} =$ _____

13. $\frac{8}{10} =$ _____

14. $\frac{7}{10,000} =$ _____

15. $\frac{475}{10,000} =$ _____

16. $\frac{32}{100} =$ _____

17. $\frac{6750}{10,000} =$ _____

18. $\frac{3}{10,000} =$ _____

19. $\frac{4}{1000} =$ _____

20. $\frac{6}{10,000} =$ _____

21. $\frac{95}{1000} =$ _____

22. $\frac{787}{10,000} =$ _____

23. $\frac{65}{100.000} =$ _____

24. $\frac{2}{100,000} =$ _____

Add the following decimals:

1. 6.80
+.02

2. 3.4
+ 1.7

3. 2.06
+ 1.1

4. 4.7
.01
.002
+ 3.0

5. 8.71
.121
+ 1.60

6. 3.1 + 2.8 + 4.3 =

7. 2.6 + 4 + .0072 =

8. 4.062 + 2.2 + .007 =

9. .386 + .002 + .5463 =

10. 916.3 + 20.6 + .066 =

11. 4.7 + 1.96 + .001 =

12. .006 + .00046 + 2.2 =

Subtract the following decimals

1. 9.6 - .002 =

2. 4.76 - 1.25 =

3. 15.6 - 3/3 =

4. 106.78 - 9.9 =

5. 387.1 - 132.26 =

6. .0934 - .0012 =

7. .00065 - .000347 =

8. 967.95 - 2.56 =

9. .0073 - .0028 =

10. .0006 - .00059 =

Multiply the following decimals:

1. 8.1
X 2.5

2. 2.6
X 1.7

3. 11.9
X .03

4. 1.78 X .21 =

5. .003 X .02 =

6. 175.1 X .00001 =

7. 93.1 X 10 =

8. 33.6 X .002 =

9. .0171 X .363 =

10. .00063 X .0027 =

Divide the following decimals:

1. .06 -:- 2 =

2. 6 -:- .02 =

3. .06 -:- .02 =

4. 3.60 -:- .06 =

5. .360 -:- .006 =

6. 19.88 -:- .28 =

7. 2.346 -:- 5.1 =

8 3600 -:- .0009 =

9. 2.139 -:- 2.3 =

10. 74.8 -:- .44 =

Change the following fractions to decimals and to percents:

1. $\frac{1}{2}$ = .50 50%

2. $\frac{1}{4}$ = _____ _____

3. $\frac{1}{5}$ = _____ _____

4. $\frac{1}{8}$ = _____ _____

5. $\frac{2}{5}$ = _____ _____

6. $\frac{5}{8}$ = _____ _____

7. $\frac{9}{10}$ = _____ _____

8. $\frac{7}{12}$ = _____ _____

9. $\frac{7}{8}$ = _____ _____

10. $\frac{1}{3}$ = _____ _____

11. $\frac{2}{3}$ = _____ _____

12. $\frac{1}{6}$ = _____ _____

13. $\frac{4}{5}$ = _____ _____

14. $\frac{3}{16}$ = _____ _____

15. $\frac{9}{20}$ = _____ _____

16. $\frac{4}{25}$ = _____ _____

17. $\frac{7}{25}$ = _____ _____

18. $\frac{17}{20}$ = _____ _____

Change to a *fraction in lowest terms* and a *percent.*

1.	.40	$\frac{40}{100} = \frac{4}{10} = \frac{2}{5}$	40%
2.	.60	_____	_____
3.	.5	_____	_____
4.	.65	_____	_____
5.	.065	_____	_____
6.	.8	_____	_____
7.	.28	_____	_____
8.	.12	_____	_____
9.	.012	_____	_____
10.	.783	_____	_____

Find the percentage of the following whole numbers:

1. 5% of 100 = _____

2. 10% of 80 = _____

3. 16% of 80 = _____

4. 35% of 95 = _____

5. 30% of 600 = _____

6. 75% of 400 = _____

7. 60% of 36 = _____

8. 28% of 56 = _____

9. 19% of 400 = _____

10. $66\frac{2}{3}$% of 300 = _____

Rules for working with Positive and Negative Numbers

Addition Rule 1: To add two or more numbers with the same sign, add the numbers and give the answers the same sign.

Example: The X Company lost $50,000 in sales in May and $10,000 in sales in June. What was the total loss for Many and June?

$$\begin{array}{r} -\$50{,}000 \\ +\ -\$10{,}000 \\ \hline -\$60{,}000 \end{array}$$

Addition Rule 2: To add numbers with different signs, find the difference between the numbers. Then give the answer the sign of the larger number.

Example: Yesterday morning at 6 AM the temperature was 10 degrees below zero. By noon, the temperature at risen 12 degrees. What was the temperature at noon?

$$\begin{array}{r} -10 \\ +12 \\ \hline +2 \end{array}$$

Subtraction Rule: Change the sign of the "take away" number (the second number in the problem), and follow the rules for addition.

Example: The temperature at noon was -3 degrees. It was -18 degrees at midnight. What was the difference between the noon and the midnight temperature?

First write the problem.

$$\begin{array}{r} -3 \\ -\ \ -18 \\ \hline \end{array}$$

Change the subtraction sign to an addition sign. Also change the number after the subtraction sign to the opposite sign.

$$\begin{array}{r} -3 \\ +\ \ +18 \\ \hline \end{array}$$

15 degrees difference

Add or subtract the following positive and negative numbers:

1. $+5 + (-1) =$

2. $-12 + (-31) =$

3. $+14 + (-8) =$

4. $-10 - (+3) =$

5. $-3 - (-8) =$

6. $+9 - (+6) =$

7. $+16 - (-11) =$

8. $+6 - (-17) =$

9. $0 - \cdot (-2) =$

Rule for Adding 3 or more Signed Numbers

To add 3 or more signed numbers, add the positive numbers. Add the negative numbers. Then add the two totals and give the answer the sign of the largest number.

Example: $9 + (-10) + (-4) + 3 =$
Add the positive numbers $9 + 3 = 12$
Add the negative numbers $-10 + (-4) = -14$
Add the totals together $12 + (-14) = -2$

1. $-8 + (-2) + 6 =$

2. $4 + (-1) + (-3) =$

3. $-6 + 4 + (-10) =$

4. $12 + (-7) + (-7) =$

5. $-22 + (-4) + 3 + 9 =$

6. $40 + (-10) + (-20) + 10 =$

7. $16 + (-25) + 25 + (-16) =$

8. $-20 + (-19) + (-14) + 8 =$

9. $49 + (-54) + 6 + 9 =$

10. $-22 + (-8) + (-7) + 32 =$

Multiplication & Division Rules for Positive & Negative Numbers

Multiplication and Division Rule 1: When you multiply or divide numbers with the **same** sign, give the answer a POSITIVE (+) sign.

Example $-6 \times -3 = +18$ $+6 \times +3 = +18$

$-10 \div -2 = +5$ $+10 \div +2 = +5$

Multiplication and Division Rule 2:

When you multiply or divide numbers with **different** signs, give the answer a NEGATIVE (-) sign.

Example: $-5 \times +8 = -40$

$-24 \div +3 = -8$

$+24 \div -3 = -8$

Practice multiplying or dividing the following:

1. (-2) (3) =

2. -5 (4) =

3. -9 (0) =

4. -7 (2) =

5. (4) (-25) =

6. -21 -:- -3 =

7. 12 -:- 6 =

8. -18 -:- -3 =

9. -27 -:- 9 =

10. -14 -:- -7 =

11. 70 -:- 10 =

12. -81 -:- 9 =

13. -45 -:- -9 =

14. -16 -:- 2 =

15. 100 -:- -25 =

16. -28 -:- -7 =

Finding the Average or Mean:

The **average** or **mean** is a good measure to describe the middle amount of a set of data. To find the **average** or **mean,** divide the total by the number of parts.

Example: The East production line produced 100 flywheels during the first shift, 154 during the second shift, and 162 during the third shift. What was the average production for the East line that day?

100 First, find a total of the parts. In this case, the number

154 of parts produced during each shift.

\+ 160

414

414 -:- 3 = 138 Next, divide the total by the number of sets of data. In this case, the total is divided by 3, since there were 3 shifts that produced data.

Practive finding the average:

1. Tim's production of oil pans for the week was:

Monday	98
Tuesday	101
Wednesday	142
Thursday	158
Friday	139

What was his average for the week?

2. On her delivery route, Debbie used 8 gallons of gas on Monday,
10 gallons of gas on Tuesday,
9 gallons of gas on Wednesday,
14 gallons of gas on Thursday,
and 8 gallons of gas on Friday.

What was the average amount of gas used daily?

3. The Advise Company had sales of $103 million in 1990, $142 million in 1991, $98 million in 1992, $112 million in 1993, $138 million in 1994, and $156 million in 1995.

What is their average sales from 1990 to 1995?

What is their average sales from 1990 to 1992?

What is their average sales from 1993 to 1995?

Word List for SPC-Prep 1

Space has been left after each letter to add words that are helpful to you.

abbreviation: a short way of writing something. The abbreviation for Quality Control is QC.

average - the average of a set of numbers is found by adding a set numbers together and dividing by the amount of numbers that make up the sum.
Ex. 12 + 14 + 15 + 19 = 60 60 -:- 4 = 15

axes - the plural of *axis*, more than one axis

axis -- the line on a graph, there are usually 2 axes, one horizontal (left to right) and one vertical (up and down)

bar graph -- a graph that uses bars (stripes or bands) to picture the relationships among numbers. Bar graphs show data based on a vertical axis and a horizontal axis in the form of bars. They are very good for comparing information.
basic operations

basic math signs and operations -

+ addition or positive number
- subtraction or negative number
x multiplication or unknown number
/ division
-:- division
> greater than
< less than

canceling- a shortcut when multiplying fractions. It means dividing a top and a bottom number by a figure that goes evenly into both before actually multiplying. It is not necessary to cancel to get the right answer, but it makes multipling easier.

chart -- a graphic representation of data that lists exact numbers in columns and rows
common denominator

chart -- a graphic representation of data that lists exact numbers in columns and rows

column -- a group of numbers or words that are listed vertically, (up and down) in a table or chart

convert - change, Ex. *convert* a fraction to a decimal means to change a fraction to a decimal

communication -- the process of sending a message through selected channels to a receiver and then getting feedback to check for mutual understanding.

communication skills -- The way we give information to others and receive information from others. Reading, writing, speaking, and listening are communication skills.

compare -- to look at two or more numbers and see their similarities and differences; also to decide which is larger or smaller.

convert -- to change one thing to another. Sometimes it's necessary to convert meters to yards.

decimal

decimal point - a dot written in a series of numbers that has the placees of whole numbers to the left of it and decimal places to the right of it.

denominator - the bottom number of a fraction, it wills how many parts are in the whole

digit

dimensions -- the length, width, and/or depth of an object. The dimensions of the sheet of steel were: length, 10 feet; width, 5 feet

divisible number

equal - being the same or identical to in value

fraction -- a part of a whole, a number less than one but greater than zero
Ex. $\frac{1}{4}$

- **graphs** - a picture or map of numbers, tools for displaying data. There are many different kinds of graphs including bar graphs, line graphs, and pie charts or circle graphs.

higher terms - to change a fraction to larger numbers so you can continue with adding, subtracting, multiplying and dividing. $\frac{1}{5}$ can be raised to $\frac{2}{10}$ or $\frac{20}{100}$

improper fraction - the top number is *equal to or larger than* the bottom number.

intersect -- to meet and cross at a point, in a chart or table

invert - means to turn a fraction upside down. $\frac{7}{10}$ can be inverted to $\frac{10}{7}$

lowest terms - to change a fraction to the lowest numbers possible. $\frac{2}{8}$ can be reduced to the lowest terms of $\frac{1}{4}$.

math operations - are addition, subtraction, multiplication, and division

mean - the average of a set of numbers, calculated by adding a set numbers together and dividing by the number of sets in the sum. Ex. 12 + 14 + 15 + 19 = 60 60 -:-4 = 15

metric system -- a system of measurement based on tens, used by most people outside the Untied States. Unites such as centimeters, millimeters, grams, and kilograms are used in the metric system

minus sign (-) - The sign for subtraction or a negative number

mixed numbers - a whole number written next to a proper fraction, $3\frac{1}{3}$. To perform math operations to some mixed numbers, they must be changed to improper fractions.

$3\frac{1}{3}$ is changed to $\frac{10}{3}$.

multiplication sign (x) - the sign for multiplication.

negative number - a number less than zero

numerator - the upper number of a fractions, it tells how many parts you have

proper fraction the top number is less than the bottom number -- $\frac{1}{3}$

plus sign (+) - the sign for addition or a positive number

positive number - a number greater than zero

reduce (a fraction) - means writing it with smaller numbers. $\frac{25}{100}$ can be reduced to $\frac{1}{4}$

relationship -- a connection between people or things. Graphs and charts show the relationships of numbers

rounding off -

SPC -- Statistical Process Control is a method companies use to achieve quality; a method of gathering and analyzing data to solve practical quality problems. Controlling the process with statistical methods to guide in the outcome of quality products or partswhole numbers

statistics -- summaries of data; the science of collecting, organizing, and analyzing data to draw conclusions

table -- a graphic representation of data that lists exact numbers in columns and rows

technology -- Machines and ways of doing things that improve the speed and/or quality of work. The use of computers in manufacturing is an example of modern technology.

U. S. customary units -- the way people in the United States usually measure, using units such as inches, feet, miles, ounces, and pounds. In many industries, U. S. customary units are being replaced by the metric system.

whole numbers - the numbers most commonly used in counting (0, 1, 2, 3, 4, . . .)

width -- the distance from one side to another of something. In rectangles, the shorter dimension. The length of the rectangle was 50 centimeters, the width was 20 centimeters

x - the sign for multiplication. Can also stand for an unknown number.

Bibliography

Bone, Diane and Rick Griggs. 1989. *Quality at Work: A personal guide to professional standards.* Los Altos, California: Crisp Publications.

Evans, James R. 1991. *Statistical Process Control for Quality Improvement-- A Training Guide to Learning SPC.* Englewood Cliffs, NJ: Prentice Hall.

Howett, Jerry. 1988. *Number Power 2--Fractions, Decimals, and Percents,* Chicago: Contemporary Books.

Industrial Technology Institute. 1989. *Quality and Inspection: Technology Application Guide.* Ann Arbor, Michigan.

Kelly, Michael R. *Everyone's Problem Solving Handbook,* White Plains, New York: Quality Resources.

Patterson, James G. 1995. *ISO 9000 Worldwide Quality Standard*, Menlo Park, California: Crisp Publications.

Perry Johnson, Inc. 1992. *ISO 9000: The Standard for World Class Quality.* Southfield Michigan.

Sprague, William Webb. 1994. *Problems in Manufacturing*, Portland Maine: J. Weston Walch, Publisher.

Sticht, Thomas G and Barbara A. McDonald. 1993. *Automotive Trades Information Processing Skills: Mathematics.* New York: Glencoe-Macmillian/McGraw-Hill.

Answer Key

p. 4: 1. 79 2. 193 3. 287 4. 283 5. 286 6. 1790 7. 1780 8. 1488 9. 1570 10. 32,168 11. 258,871

p. 5: 1. 33 2. 591 3. 3,892 4. 4,587 5. 19,481 6. 38,812 7. 34,530 8. 40,589 9. 9,801

p. 6: 1. 320 2. 2,772 3. 8,811 4. 288,422 5. 5,285,280 6. 2,144,813 7. 1,402,000 8. 4,095,793 9. 1,000,000

p. 7: 1. 3 2. 3 3. 20 4. 578 5. 56 6. 792 7. 29 R30 8. 261 R8

p. 8: 1. 80; 50; 50; 30; 990; 820; 900; 430; 910

2. 3,100; 6,600; 62,900; 8,600; 8,500; 45,200

3. 24,000; 65,000; 398,000; 68,000; 41,000; 994,000

4. 120,000; 460,000; 1,980,000; 790,000; 500,000; 3,930,000

5. 500,000; 109,500,000; 8,400,000; 986,400,000; 4,800,000; 843,400,000

6. 124,000,000; 165,000,000; 975,000,000; 171,000,000

p. 10: 1. c 8 2. c 11 3. a 7 4. d None 5. b 6. b 6 7. c 8 8. b 2

p. 11: 1. $\frac{5}{12}$ 2. $\frac{57}{100}$ 3. $\frac{9}{16}$ 4. $\frac{7}{12}$ 5. $\frac{5}{7}$ 6. $\frac{72}{298}$ or $\frac{36}{149}$

p. 13: 1. 2 2. 4 3. 4 4. 12 5. 8

p. 14: 1. $\frac{2}{2}=1$ 2. $\frac{3}{3}=1$ 3. $\frac{2}{5}$ 4. $\frac{5}{9}$ 5. $\frac{4}{8}=\frac{1}{2}$ 6. $3\frac{2}{7}$ 7. $4\frac{2}{4}=4\frac{1}{2}$ 8. $5\frac{3}{11}$ 9. $11\frac{9}{15}=11\frac{3}{5}$ 10. $4\frac{2}{4}=4\frac{1}{2}$ 11. $5\frac{4}{8}=5\frac{1}{2}$ 12. $8\frac{2}{14}=8\frac{1}{7}$

13. $23\frac{12}{8} = 24\frac{1}{2}$ 14. $6\frac{7}{5} = 7\frac{2}{5}$ 15. $9\frac{8}{8} = 10$ 16. $17\frac{13}{8} = 18\frac{5}{8}$

p. 15: 1. 4 2. 9 3. 12 4. 18 5. 10 6. 12 7. 20 8. 63 9. 18 10. 60

p. 16: 1. $8\frac{5}{6}$ 2. $3\frac{3}{8}$ 3. $10\frac{5}{12}$ 4. $10\frac{3}{10}$ 5. $8\frac{7}{24}$ 6. $9\frac{3}{4}$ 7. $20\frac{2}{3}$ 8. $26\frac{16}{21}$ 9. $26\frac{7}{10}$ 10. $29\frac{11}{24}$ 11. $32\frac{19}{40}$ 12. $34\frac{9}{10}$ 13. $26\frac{8}{15}$ 14. $47\frac{16}{63}$ 15. 5 16. $23\frac{33}{42}$

p. 17: 1. $1\frac{3}{4}$ 2. $2\frac{1}{3}$ 3. $\frac{5}{9}$ 4. $1\frac{5}{7}$ 5. $5\frac{2}{3}$ 6. $\frac{5}{7}$ 7. $\frac{19}{25}$ 8. $3\frac{6}{7}$ 9. $5\frac{11}{48}$ 10. $13\frac{3}{4}$ 11. $30\frac{8}{9}$ 12. $4\frac{63}{64}$ 13. $6\frac{1}{4}$ 14. $4\frac{3}{4}$ 15. $1\frac{7}{8}$

p. 18: 1. $2\frac{1}{5}$ 2. $3\frac{1}{3}$ 3. 7 4. $4\frac{2}{3}$ 5. $7\frac{7}{10}$ 6. $8\frac{7}{12}$ 7. $3\frac{13}{24}$ 8. $11\frac{1}{5}$ 9. $5\frac{5}{6}$ 10. $10\frac{9}{10}$ 11. $127\frac{7}{15}$ 12. $35\frac{21}{32}$

p. 19: 1. $\frac{1}{4}$ 2. $\frac{1}{16}$ 3. $\frac{4}{30} = \frac{2}{15}$ 4. $\frac{2}{25}$ 5. $\frac{28}{50} = \frac{14}{25}$ 6. $\frac{6}{40} = \frac{3}{20}$ 7. $\frac{24}{50} = \frac{12}{25}$ 8. $\frac{48}{168} = \frac{2}{7}$ 9. $\frac{15}{240} = \frac{1}{16}$ 10. $\frac{12}{75} = \frac{4}{25}$

p. 20: 1. $2\frac{1}{4}$ 2. $3\frac{2}{3}$ 3. 6 4. 12 5. 8 6. 12 7. $3\frac{1}{28}$ 8. 12 9. $3\frac{1}{2}$ 10. 2

p. 21: 1. 1 2. 1 3. $1\frac{1}{8}$ 4. $\frac{3}{4}$ 5. $1\frac{11}{24}$ 6. $1\frac{3}{4}$ 7. $1\frac{5}{16}$ 8. 1/2

p. 22-24: 1. b $30\frac{9}{16}$. 2. c $26\frac{2}{5}$ 3. c. $32\frac{3}{5}$ 4. a $14\frac{1}{5}$ miles of fencing 5. d $1\frac{7}{8}$ 6. a $4\frac{7}{16}$ 7. b 20 pints 8. 125 5/7 miles 9. 80 drip pans 10. 31 boxes

p.25: 1. 13.2 2. 1.434.3 3. 749.514 4. 38.1071 5. 10.7306

p. 26: 1. 6.21 2. 36.5 3. 47.2 4. 2.7386 5. 64.70835 6. 1,173.198

p. 27: 1. 247.9 2. 93.6 3. 61.06 4. .000893 5. 18.009 6. .000471 7. 3 8. 69 9. .87 10. 400,000

p. 28: 1. .75 mm thinner 2. 2.25 inches thick 3. 3 miles difference 4. No, the truck measures 11.5 feet. 5. The truck clears the door by .03 feet. 6. 250 miles

p. 30: 1. .3; .7; .7; .8; .9; .6; .8; .6

2. .32; .68; .65; .82; .94; .59; .76; .60

3. .322; .680; .652; .819; .943; .588; .765; .595; 1.386

4. .3219; .6798; .6524; .8186; .9434; .5880; .7647; .5953; 1.3859

p. 31: 1. .1 2. .01 3. .001 4. .0001 5. 00001 6. 7/10

7. 7/100 8. 7/1000 9. 7/10,000 10. 7/100,000

11. 7/1,000,000

p. 32: 12. .23 13. .8 14. .0007 15. .0475 16. .32

17. .6750 18. .0003 19. .0004 20. .0066 21. .095

22. .0787 23. .00065 24. .00002

p. 33: 1. 6.82 2. 5.1 3. 3.16 4. 7.712 5. 10.431 6. 10.2

7. 6.6072 8. 6.269 9. .9343 10. 936.966 11. 6.661

12. 2.20646

p. 34: 1. 9.598 2. 3.51 3. 12.3 4. 96.88 5. 254.84
6. .0922 7. .000303 8. 965.39 9. .0045 10. .00001

p. 35: 1. 20.25 2. 4.42 3. .357 4. .3738 5. .00006
6. .001751 7. 931 8. .0672 9. .0062073 10. .0000017

p. 36: 1. .03 2. 300 3. 3 4. 60 5. 60 6. 71 7. .46
8. 4,000,000 9. .93 10. 170

p. 37-38: 2. .25 25% 3. .20 20% 4. .125 12.5% 5. .40 40%
6. .625 62.5% 7. .90 90% 8. .58333 58.3% 9. .875 87.5%
10. .333 33.3% 11. .666 66.6% 12. .1666 16.6%
13. .80 80% 14. .1875 18.75% 15. .45 45% 16 .16 16%
17. .28 28% 18 .85 85%

p. 39: 2. $\frac{3}{5}$ 60% 3. $\frac{1}{2}$ 50% 4. $\frac{13}{20}$ 65% 5. $\frac{13}{200}$ 6.5%
6. $\frac{4}{5}$ 80% 7. $\frac{7}{25}$ 28% 8. $\frac{3}{25}$ 12% 9. $\frac{3}{250}$ 1.2%
10. $\frac{783}{1000}$ 78.3%

p. 40: 1. 5 2. 8 3. 12.8 4. 33.25 5. 180 6. 300 7. 21.6
8. 15.68 9. 76 10. 200

p. 42: 1. +4 2. -43 3. +6 4. -7 5. +5 6. +3 7. +27

8. +23 9. 0

p. 43: 1. -4 2. 0 3. -12 4. -2 5. -14 6. +20 7. 0 8. -45 9. +10 10. -5

p.45: 1. -6 2. -20 3. 0 4. -14 5. -100 6. +7 7. +2 8. +6 9. -3 10. +2 11. +7 12. -9 13. +5 14. -8 15. -4 16. +4

p. 47: 1. 127.6 2. $9\frac{4}{5}$ gal. 3. \$124.8$\frac{1}{3}$million \$114$\frac{1}{3}$ million \$135$\frac{1}{3}$ million

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

NOTICE

REPRODUCTION BASIS

☐ This document is covered by a signed "Reproduction Release (Blanket) form (on file within the ERIC system), encompassing all or classes of documents from its source organization and, therefore, does not require a "Specific Document" Release form.

☒ This document is Federally-funded, or carries its own permission to reproduce, or is otherwise in the public domain and, therefore, may be reproduced by ERIC without a signed Reproduction Release form (either "Specific Document" or "Blanket").