DOCUMENT RESUME

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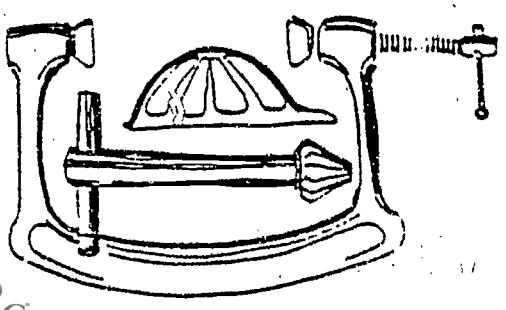
IDENTIFIERS	*ABCs of Construction Project; *Millwrights; Workplace Literacy

ABSTRACT

Developed by the ABCs of Construction National Workplace Literacy Project, these curriculum materials for the occupational area of millwright contain a lesson that deals with reading charts and tables. The lesson consists of an objective, instruction, and 10 exercises. Three types of problems are provided in each exercise: "try it," "apply it," and "go with it." The objective for the lesson is for the student to learn to locate and supply information from a table. (YLB)

Reading Charts & Tables

Millwright



Associated Builders & Contractors, Inc.
EBR Adult & Continuing Education

ABC's of Construction
National Demonstration Project in Workforce Literacy

The ABC's of Construction Project was funded in 1991 by the U.S. Department of Education as a grantee through the National Workplace Literacy Program (PR #198A10155). The program provided basic skills instruction to industrial construction workers employed by companies which are members of the Pelican Chapter of Associated Builders and Contractors (ABC). Located in Baton Rouge, Louisiana, ABC provides training to employees of over 60 member companies who perform contract work in the 58 petrochemical facilities located along the Mississippi River between Baton Rouge and New Orleans.

The grantee, the Adult Education Department of East Baton Rouge School Board, performed a comprehensive literacy task analysis of the apprenticeship training program for millwrights, pipefitters, electricians, instrumentation techs, and welders involved in the ABC training program. Over 20 modules of original, contextual curriculum were developed to teach the reading and math skills required for success in the craft training program.

Materials developed for instruction incorporated cognitive strategies for learning basic skills in the context of the craft and safety knowledge demanded by the industrial construction workplace. Instruction was written for a competency-based, open-entry/open-exit, individualized adult learning program that operated at the ABC training center in the evenings after work-hours.

READING CHARTS AND TABLES MILLWRIGHTS

OBJECTIVE: You will learn to locate and supply information from a table.

INSTRUCTION

The city economy was poor. A new company came to town. It advertised for workers. There were lots of applicants. The ad gave a telephone number. People could call for more information. Applicants called the number. They heard the following message:

Thanks for calling. This is Bigbucks Construction Company. We have many openings. They include millwrights, electricians, heavy machinery operators, pipefitters, and unskilled laborers. Do you have less than one year of experience? Your basic wage varies according to type. Do you have two to five years of experience? You start at the basic wage plus twenty-five percent. Do have more than five years of experience? You start at the basic wage plus fifty percent. The hourly basic wages follows: millwright, $10.00; electrician, $18.00; heavy machinery operator, $9.50; pipefitter, $11.50; laborers, $5.00. Apply at the front office by Friday, September 10.

Applicants called the number over and over. They tried to remember all the information. They tried to find out how much they would be paid. Some gave up. Others applied anyway. They needed the jobs.

Each applicant got the following information about wages:

	Mill-wright	Electrician	Heavy Equip. Operato	Pipe-Fitter	Laborer
EXPERIENCE < 1 year (base)	$10.00	$16.00	$9.50	$11.50	$5.00
2-5 years (base + 25%)	$10.00 +2.50	$16.00 +4.00	$8.00 +2.00	$12.00 +3.00	$5.00 +1.25
more than 5 years (base + 50%)	$10.00 +5.00	$16.00 +8.00	$8.00 +4.00	$12.00 +6.00	$5.00 +2.50

Now they understood. Organizing the pay schedule made the information more clear. The chart grouped types of workers by years of experience and wage. The format helped workers see what they might earn.

Tables (also called charts) show how information is sorted by one or more features. Tables are often part of written information. They are also used alone for finding specific facts. Tables organize many details for easy use. In some ways, reading a table is much like reading a paragraph. Tables have main ideas. Tables include many details. You can draw conclusions about the information in them. You must distinguish information you need from that which is not useful at that time. You may have to use more than one table. These help you make comparisons, draw conclusions, or synthesize information.

Charts contain clues to help you. The title shows a table's main idea. The title of this chart is BIGBUCKS CONSTRUCTION COMPANY, PAY SCHEDULE. The main idea is that is shows wage amounts. Organization is another clue. Tables organize information by rows and columns. A row runs horizontally across the page (left to right). Columns run vertically down the page (top to bottom). Headings or labels identify what rows or columns contain. You use the headings as key words. This helps you find what you need. The labels for this table are different job titles. They are MILLWRIGHT, ELECTRICIAN, HEAVY EQUIP. OPERATOR, PIPEFITTER, LABORER. This tells you what is in the columns. The rows are also labeled. These labels are show amounts of experience. They are LESS THAN ONE YEAR, 2-5 YEARS, and MORE THAN FIVE YEARS. These labels also include how the pay is figured. These are BASE, BASE + 25%, and BASE

+ 50%. The clues can be used in different ways.

For example, a pipfitter might use the chart to see how much his hourly wage would be. He has four years of experience. He finds the label PIPEFITTER. He finds the label 2-5 YEARS EXPERIENCE. He looks down the PIPEFITTER COLUMN. He looks across the 2-5 YEARS EXPERIENCE ROW. The place where the column and row meets is his answer. He would make the base rate, $12.00 plus $3.00 per hour. He would make $15.00 per hour. The following chart is marked to show you how he found the answer.

	Mill-wright	Electrician	Heavy Equip. Operato	Pipe-Fitter	Laborer
EXPERIENCE < 1 year (base)	$10.00	$16.00	$9.50	$11.50	$5.00
2-5 years (base + 25%)	$10.00 +2.50	$16.00 +4.00	$8.00 +2.00	$12.00 +3.00	$5.00 +1.25
more than 5 years (base + 50%)	$10.00 +5.00	$16.00 +8.00	$8.00 +4.00	$12.00 +6.00	$5.00 +2.50

The chart could be used in other ways. For example, a millwright might want to know the range of pay for a job. This would be the lowest to highest wages for that job. She would look only at the column for millwrights. She would look at each amount in the row. This is $10.00, $10.00 + $2.50 (or $12.50), and $10.00 + $5.00 (or $15.00). The lowest wage is $10.00. The highest is $15.00. The range is $10.00-$15.00 per hour. The chart below is marked to show you how to find that information.

	Mill-wright	Electrician	Heavy Equip. Operato	Pipe-Fitter	Laborer
EXPERIENCE < 1 year (base)	$10.00	$16.00	$9.50	$11.50	$5.00
2-5 years (base + 25%)	$10.00 +2.50	$16.00 +4.00	$8.00 +2.00	$12.00 +3.00	$5.00 +1.25
more than 5 years (base + 50%)	$10.00 +5.00	$16.00 +8.00	$8.00 +4.00	$12.00 +6.00	$5.00 +2.50

The following steps are used in reading a table.

1. READ THE TITLE OF THE TABLE. This tells you its subject or general content. Some tables have no titles. Then you look at the contents and headings. You then determine the table's main idea for yourself.

2. LOOK AT THE LABELS OR HEADINGS. These tell you two things. They tell what is being compared. They tell what features are used to compare them. They form key words. These words help you decide which column or row you need to find information.

3. DETERMINE YOUR PURPOSE FOR READING THE TABLE. Questions on the job often require you to refer to a table. Thus, tables are often used to find specific answers.

4. READ ANY ACCOMPANYING WRITTEN DESCRIPTIONS. Written descriptions provide the context for understanding the table. The description may highlight or explain information in the table.

5. RE-READ THE DESCRIPTION AND LABELS TO FIND INFORMATION. Tables may include information in abbreviated or shortened form. You may have to decide how features fit together. You may need to read and reread. This helps you decide what the information means.

Re-examine the steps in reading a table. Use the following example:

CONSTRUCTION MATERIAL SYMBOLS

Symbols that show the types of materials used in construction are shown in Figure 1-9. These are usually found on cross-sectional views of buildings. All craftworkers should be familiar with these basic symbols.

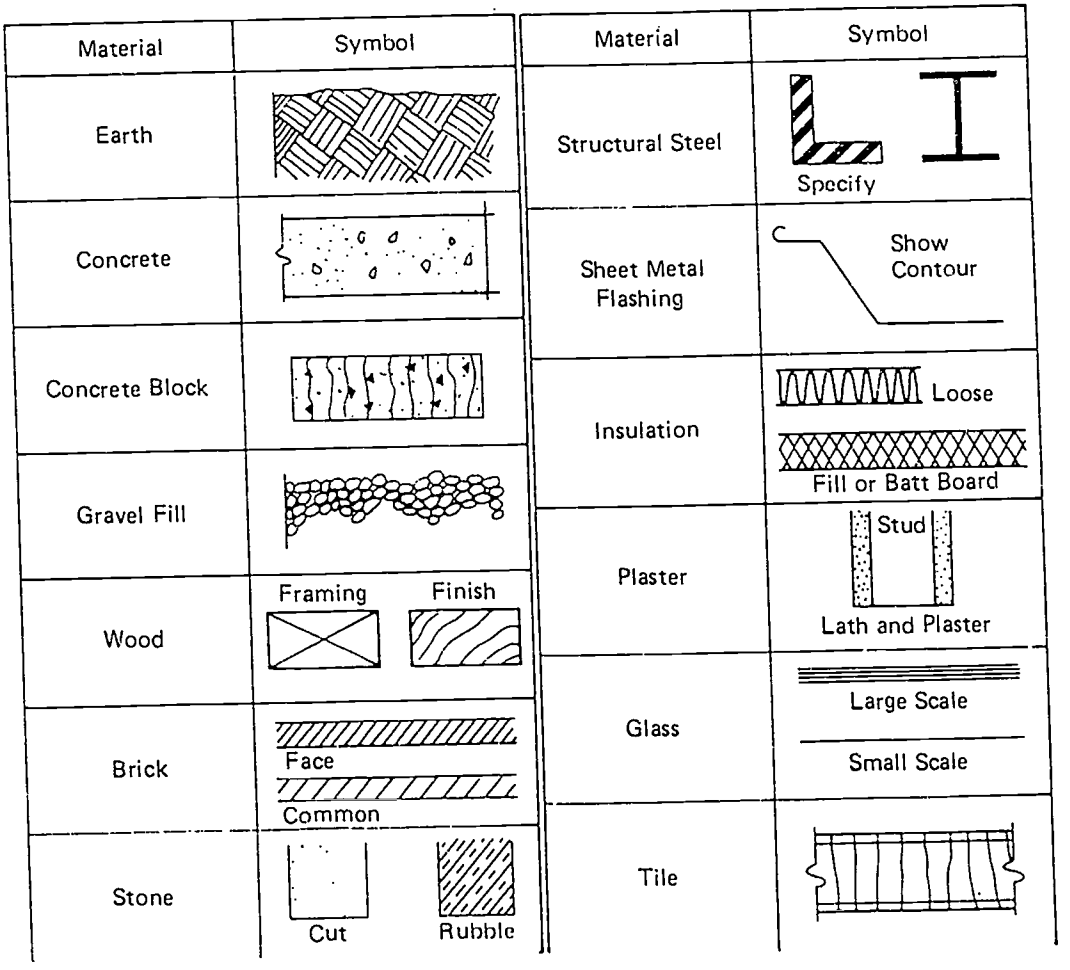


Figure 1-9. Basic Construction Material Symbols

1. READ THE TITLE OF THE TABLE. The title of this table is "Basic Construction Material Symbols."

2. LOOK AT THE LABELS OR HEADINGS. The headings are "Material," and "Symbol."

3. DETERMINE YOUR PURPOSE FOR READING THE TABLE. You might want to know the symbol for a particular material, such as stone. You would look down the materials column until you found the word "stone." Then you look to the right for the symbol.

4. READ ANY ACCOMPANYING WRITTEN DESCRIPTIONS. The written description tells where symbols are usually found. It also tells who needs to be familiar with them.

5. RE-READ THE DESCRIPTION AND LABELS TO FIND INFORMATION.

Charts provide basic units of information. You may have to take the information you find and do something with it in order to find the answer you need. For example, a chart may tell you how much a single piece of conduit weighs. You need to find out how much 10 pieces weighs. You must multiply the amount in the table by 10.

EXERCISE 1

Charlie's company bought a new lathe. It will be used for high-speed cutting. Charlie reviews the following before using it.

To set up a lathe properly for safe operation, you must understand cutting speeds. . .

CUTTING SPEED--the distance (in feet or meters) that the circumference of the work moves past the cutting tool in one minute. Cutting speed is measured in surface feet per minute or meters per minute. Cutting speed is affected by the type of material to be cut and the cutting tool material. Table 4-1 shows the cutting speeds for common metals using HSS cutting tools.

Table 4-1 Lathe Cutting Speeds for High-Speed Steel Cutting Tools

Type of Material	Surface Feet Per Minute		Meters Per Minute	
	Roughing Cut	Finishing Cut	Roughing Cut	Finishing Cut
Aluminum	200-400	300-500	60-120	90-150
Brass-free turning	100-200	200-300	30-60	60-90
Bronze (hard)	60-90	100-125	18-27	30-37
Cast iron				
Hard	60-70	80-100	18-21	24-30
Soft	80-90	90-100	24-27	27-30
Steel				
Mild or free machining	90-150	150-200	27-45	45-60
Medium carbon	60-80	80-120	18-24	24-36
High carbon or alloy	50-60	60-90	15-18	18-27

TRY IT!

1. Where is the title of the chart?

_____ _____

2. What is the title of the chart?

_____

3. This is a special kind of chart. List ALL the headings at the top.

_____

_____

_____

What do you notice about them? How is this different from other charts?

_____

How will this affect the way you will use the chart?

_____

4. This chart shows cutting speeds for different materials. How many different materials are shown on the chart?

How do you know?

APPLY IT!

1. Charlie uses a medium carbon steel blade. He wants to make a rough cut. How many meters will it cover per minute?

A. 60-80

B. 18-24

C. 80-120

D. 24-36

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

2. Charlie chooses a bronze cutting tool. He wants to make a finishing cut. How many surface feet per minute can he get?

A. 100-125

B. 60-90

C. 200-300

D. 100-200

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

3. Charlie wants to cut at as high speed as possible. Which of the following would be best for that purpose?

A. free-turning brass

B. hard cast iron

C. high carbon

D. bronze

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

4. Charlie chooses a soft cast iron cutting tool. He is making a rough cut. How many surface feet per minute will it cut?

A. 18-21

B. 80-100

C. 60-70

D. 80-90

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

5. Which is larger--a foot or a meter? How can you tell from information within the chart?

_____

_____

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

6. What is "cutting speed?"

_____

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

GO WITH IT!

You can describe what you find in a table in a sentence. Sometimes what people describe is incorrect.

EXAMPLE:

The lathe cutting speed for a roughing cut in aluminum is 200-300 surface feet per second.

Correction: the rate is described in feet per second but should be shown in feet per minute. The sentence should read as follows: The lathe cutting speed for A roughing cut in aluminum is 200-300 surface feet per minute.

Identify the mistake and correct the following sentences.

1. A roughing cut in hard cast iron is 18-21 feet per minute.

Correction: _____

_____

2. The chart shows cutting speeds for six different types of steel.

Correction: _____

_____

3. The speeds of roughing cuts are always faster than those of finishing cuts.

Correction: _____

_____

4. A roughing cut in bronze is 100-125 surface feet per minute.

Correction: _____

_____

5. Alloy steel can be cut faster than hard cast iron.

Correction: _____

_____

EXERCISE 2

Charlie reads more about his company's new lathe. This includes the following:

Table 4-2. Lathe Feed Rates for High-Speed Steel Cutting Tools

Type of Material	Inches		Millimeters	
	Roughing Cut	Finishing Cut	Roughing Cut	Finishing Cut
Aluminum	0.015-0.020	0.002-0.005	0.40-0.75	0.051-0.13
Brass-free turning	0.010-0.020	0.002-0.005	0.25-0.50	0.051-0.13
Bronze (hard)	0.010-0.020	0.002-0.005	0.25-0.50	0.051-0.13
Cast iron				
Hard	0.010-0.020	0.003-0.010	0.25-0.50	0.075-0.25
Soft	0.015-0.025	0.003-0.010	0.40-0.65	0.075-0.25
Steel				
Mild or free turning	0.010-0.020	0.002-0.005	0.25-0.50	0.051-0.13
Medium carbon	0.010-0.020	0.002-0.005	0.25-0.50	0.051-0.13
High carbon or alloy	0.005-0.015	0.002-0.005	0.13-0.40	0.051-0.13

TRY IT!

1. Where is the title of the chart?

_____

2. What is the title of the chart?

_____

3. How does this chart differ from the first one Charlie used?

_____

_____

How is it the same?

_____

_____

4. The numbers in the chart are very small. Does the chart show tenths, hundreds, or thousandths of an inch?

_____

How do you know?

APPLY IT!

1. Which is larger--an inch or a millimeter? How can you tell from information within the table?

_____

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

2. Charlie wants make a finishing cut of .003-.010 inches. What might he use?

A. bronze
B. aluminum
C. any kind of cast iron
D. steel alloy

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

3. Charlie wants to make a roughing cut of .25-.50 millimeters. How many materials will do that?

A. 5

B. 4

C. 3

D. 2

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

4. How many kinds of materials are shown on the chart?

A. 10

B. 13

C. 8

D. 6

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

5. Charlie wants a rough cut. It must be .13-.40 millimeters. What should he use?

A. mild steel

B. bronze

C. aluminum

D. high carbon steel

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

GO WITH IT!

Sometimes charts are rearranged. This gives you a different look at the information. Rearrange the information by roughing cut instead of material type. The first three have been done as an example. Complete the rest of the chart.

ROUGHING CUT	MATERIAL TYPE
0.005-0.015	High carbon or alloy
0.010-0.020	Medium carbon
0.010-0.020	Steel mild or free-turning

EXERCISE 3

J & J Construction Company is new. The owners must buy tools that they know they will use. Their first job requires them to buy an electric hammer. They also need attachments. They use the following information to decide which they need.

ELECTRIC HAMMER ATTACHMENTS

Many types of bits and attachments are used in rotary hammers and percussion hammers. Figure 3-19 shows some examples of these and describes the work each does.

Most of these bits are used for demolition work and must be used with caution. Always use safety goggles, as well as other protective clothing, specified for your job. Since some of these tools make a lot of noise, you may also have to wear ear protection.

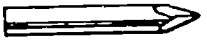
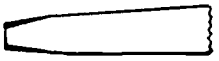
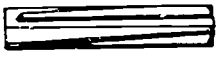
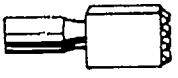
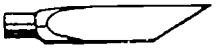
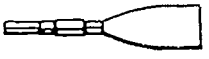
	Bull Point For Demolition
	Concrete Slotting Tool For Slotting In Concrete And Breaking Web Between Star Holes To Break Large Openings In Walls, Etc.
	4-Point Scaling Tool For Removing Scale
	Scaling Chisels For Removing Scale And Weld Splatter
	Cold Chisels For Chipping, Edging, Channeling
	Bushing Tool For Surfacing Concrete Bushing Head Only
	Seam Tool For Seaming, Caulking, And Pointing
	Clay Spade For Digging Holes In Dirt And Clay
	Flatwood Chisels For Flatwood Gouging And Shaping

Figure 3-19. Percussion Hammer Bits

TRY IT!

1. Where is the title of the chart?

_____

2. What is the title of the chart?

_____

3. How many attachments are shown on the chart?

_____

4. What one word always indicates the attachment use?

_____

5. Does this chart seem more difficult or easier to use? Explain your choice.

_____

_____

APPLY IT!

1. J & J workers must dig holes in dirt and clay. What attachment is needed?

A. cold chisel

B. flatwood chisel

C. bullpoint

D. clay spade

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

2. J & J will be demolishing a building. What attachment might they use?

A. seam tool

B. bull point

C. bushing tool

D. scaling chisel

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____ _____

_____ _____

3. J & J got a contract to install pipe. They must enlarge an opening in a concrete wall. They need a _____.

A. bushing tool

B. clay spade

C. 4-point scaling tool

D. concrete slotting tool

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

4. Some J & J workers used a seam tool to remove weld spatter. What should their supervisor say?

A. "Good job."

B. "You should have a cold chisel."

C. "You should have used a scaling chisel."

D. "You should have used a flatwood chisel."

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

5. J & J workers must remove scale. What could they use for this job?

A. a bull point or a scaling chisel

B. a clay space or a seam tool

C. a flatwood chisel or a cold chisel

D. a scaling chisel or a 4-point scaling tool

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

6. J & J is purchasing safety equipment for the workers. What 2 pieces of equipment should they purchase? Write your answer on the blank line.

_____

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

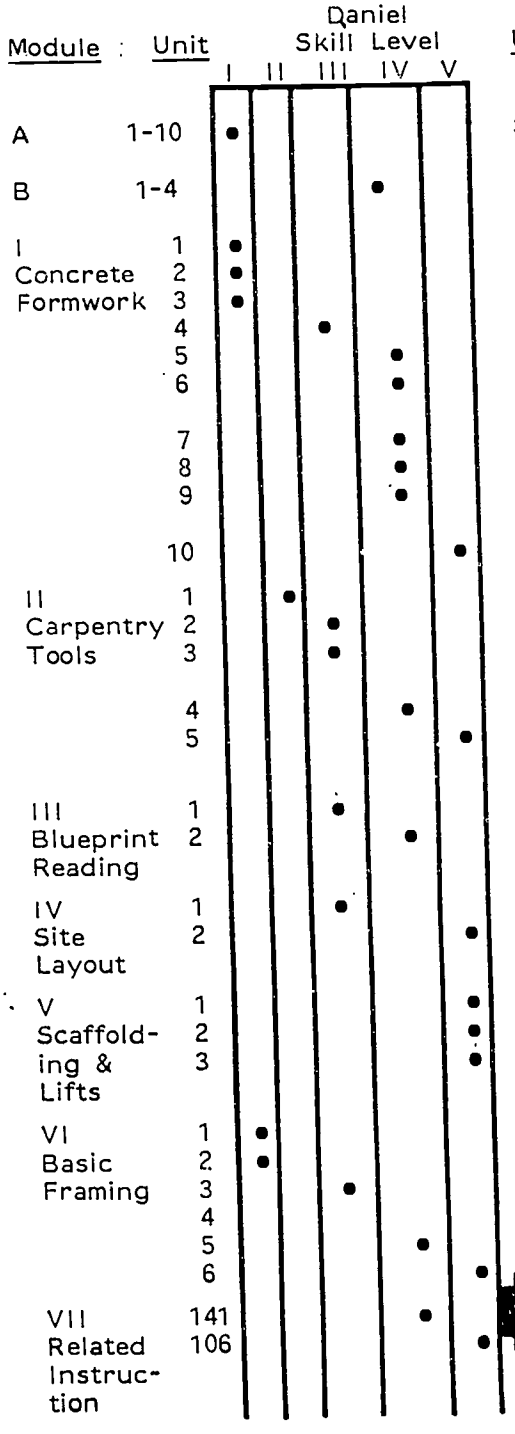
GO WITH IT!

This chart is helpful because it shows pictures of the attachments. What if the chart had explained what each attachment looked like instead? Choose any three attachments. Explain what they look like in a sentence.

EXAMPLE: A bull point attachment looks like a sharpened pencil.

EXERCISE 4

Luis is starting the ABC millwright training program. His ABC instructor tells him about what he will learn. He shows Luis the following table:



Module	Unit	Unit Title	Related Training Code
A	1-10	Safety in the Construction Trades (10 Units)	35705
B	1-4	Basic Math (4 Units)	35717
I Concrete Formwork	1	Introduction to Forming	-
	2	Inspect & Maintain Forms	35701
	3	Form Removal	35703-4
	4	Erect Patented Wall Forms	35713
	5	Construct Edge Forms on Grade	35715
	6	Construct Footing Forms & Vertical Piers	35715
	7	Construct Curb Forms	35715
	8	Construct Stair Forms	35715
	9	Construct Shoring and Bracing for Horizontal Beam Forms	35716
	10	Construct Framed Openings	35725
II Carpentry Tools	1	Use and Care of Hand Tools	35707
	2	Use and Care of Measuring Tools	35708
	3	Use and Care of Portable Power Tools	35710
	4	Use and Care of Shop Power Tools	35719
	5	Use and Care of Explosive Power Tools	35727
III Blueprint Reading	1	Basic Blueprint Reading	35712
	2	Advanced Blueprint Reading	35720
IV Site Layout	1	Basic Site Layout	35703
	2	Detailed Site Layout	35724
V Scaffolding & Lifts	1	Use of Commercial Scaffolding	35721
	2	Construct Job Built Scaffolding	35723
	3	Manlift Operation	35725
VI Basic Framing	1	Floor and Sill Framing	-
	2	Wall and Partition Framing	-
	3	Roof Framing	-
	4	Hang and Case Doors	-
	5	Install and Case Windows	-
	6	Construct Stairs & Railings	35726
VII Related Instruction	141	Basic Rigging	35713
	106	Install Anchor Bolts	35728

TRY IT!

1. Is there a title for this chart? Where is it?

_____

2. What is the main idea of the chart?

_____

3. How does this chart differ others in these exercises??

_____

_____

4. What do the black dots mean?

_____

5. What are the headings in the chart?

_____

APPLY IT!

1. What might Luis learn at a level I skill level?

A. Concrete Formwork, Unit 3

B. Blueprint reading, Unit 1

C. Site Layout, Unit 1

D. Basic Framing, Unit 3

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

2. What is the unit title of Concrete Formwork, Unit 8?

A. Form Removal

B. Construct Curb Forms

C. Construct Stair Forms

D. Inspect and Maintain Forms

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

3. Luis is interested in safety. What module covers that information?

A. Module A
B. Module B
C. Site Layout
D. Scaffolding and Lifts

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

4. Luis sees materials labeled "Training Code 35710." Those cover _____.

A. Use and Care of Hand Tools
B. Basic Math
C. Roof Framing
D. Use and care of Portable Power Tools

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

EXERCISE 3

Caleb is making a shaft for a conveyer belt. He uses a lathe center to support the work.

LATHE CENTERS are used to support work between the headstock and the tailstock. The center mounted in the headstock spindle is called the live center because it rotates with the workpiece. The center mounted in the tailstock spindle is called the dead center because it does not usually rotate. Tailstock centers make with antifriction bearings are called live centers. These centers permit heavier machining operations at higher rpms. All centers have a 60-degree included angle at the tapered point. This means the workpiece must have a 60-degree tapered hole drilled before it can be mounted between centers. Centers are used with a drive plate and lathe dog. Figure 4-28 shows a workpiece mounted between centers.

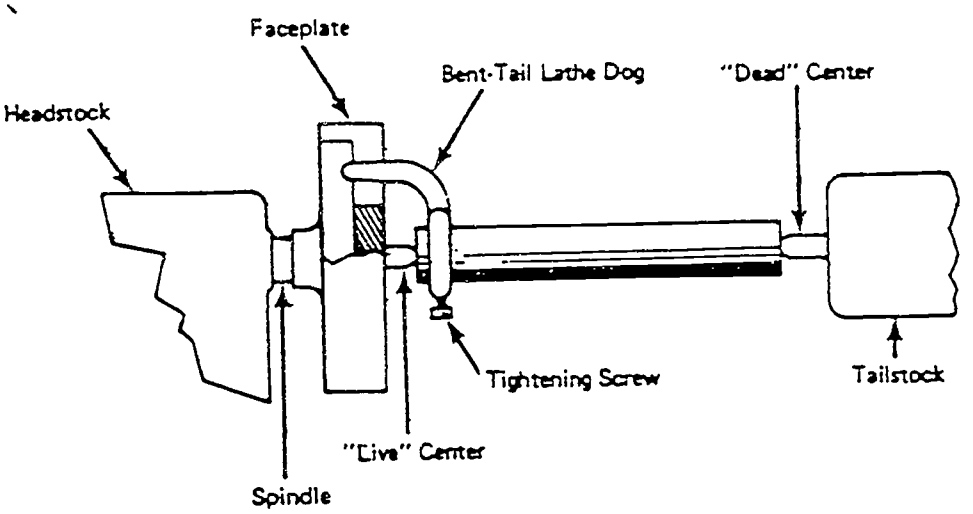


Figure 4-28. Work Mounted Between Centers

TRY IT!

1. Where is the title of the diagram?

_____

2. What is the title of the diagram?

_____

3. What labels are given?

_____

_____

4. What seems to be the purpose of the diagram?

_____

5. Does text accompany the diagram? _____ What is the relationship between the text and the diagram?

_____

_____

6. Where might you find the item shown in the diagram?

_____

APPLY IT!

1. Where is the "dead center?"

A. on the headstock

B. by the faceplate

C. on the tailstock

D. by the spindle

(a) Is the answer to this question found on the diagram?

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

2. Where is the spindle?

A. between the live center and the faceplate

B. between the head stock and the faceplate

C. between the faceplate and the tightening screw

D. between the dead center and the tailstock

(a) Is the answer to this question found on the diagram?

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

3. Where should Caleb mount the work?

A. between the live center and the dead center

B. on the faceplate

C. between the spindle and the live center

D. on the headstock

(a) Is the answer to this question found on the diagram?

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

4. According to the accompanying paragraph, before Caleb mounts the work he must_____.

A. rotate the dead center 60 degrees.

B. attach a tapered point to the work.

C. check the antifriction bearings.

D. drill a 60 degree tapered hole in the workpiece for mounting purposes.

(a) Is the answer to this question found on the diagram?

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

5. What two parts are used with the centers?

A. dead center and live center

B. headstock and tailstock

C. drive plate and lathe dog

D. none of the above are correct

(a) Is the answer to this question found on the diagram?

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

GO WITH IT!

Your coworker read the information about lathe centers. He does not understand some of the words. Explain the following:

rpm _____

_____

tapered _____

_____

live center _____

_____

dead center _____

_____

5. Luis wonders which skill level contains the most topics. He finds it to be _____.

A. Level 1

B. Level 3

C. Level 4

D. Level 5

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

EXERCISE 5

Jimmy supervises rigging and moving loads of steel pipe. He uses the following table to estimate weights.

ESTIMATING WEIGHT

In a lifting operation, you must also be able to estimate the weight of an object. The correct weight is very important. You must know the weight of an object within a few hundred pounds, or the wrong sling or cable could be used. This could cause accidents, damages, or injuries.

Sometimes the size and weight of an object is printed on a data plate, or on the crate the object comes in. However, this is not always true, so you should be able to estimate the weights of crates, boxes, bundles, and odd shaped objects.

Estimating the weight of pipe is difficult, because pipe is hollow and has different wall thicknesses. For certain types of pipe, the weights can be found in charts or tables. Table 1-1 shows weights of steel pipe.

Table 1-1. Steel Pipe Weights

	Nominal Size (Inches)	Weight in Pounds Per Foot
	1/8	0.24
	1/4	0.42
	3/8	0.57
	1/2	0.85
	3/4	1.13
STANDARD	1	1.68
	1-1/4	2.27
	1-1/2	2.72
	2	3.65
	2-1/2	5.79
	1/8	0.31
	1/4	0.54
	3/8	0.74
	1/2	1.09
EXTRA STRONG	3/4	1.47
	1	2.17
	1-1/4	3.00
	1-1/2	3.63
	2	5.02
	2-1/2	7.66

TRY IT!

1. Where is the title of the chart?

_____

2. What is the title of the chart?

_____

3. What two types of pipe are shown on this chart?

_____

4. What is the range of pipe sizes (largest size-smallest size) for standard pipe? What is the range for extra strong?

_____

5. What are the labels on the chart?

_____

6. What does nominal size mean?

_____

APPLY IT!

1. Jimmy orders standard 1 inch pipe. He gets a billing slip. It says the pipe weights 1.68 pounds per foot.

   What should Jimmy do?

A. Accept the delivery.

B. Reject the delivery because the pipe is extra strong.

C. Reject the delivery because it is 1 1/4 inch pipe.

D. Call his supervisor.

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

2. Jimmy weighs some pipe. It is extra strong pipe. IT weighs more than 5 pounds per foot. But, it weighs less than 7 pounds per foot. What size is the pipe?

A. 1 inch

B. 2 inch

C. 2 1/2 inch

D. 1 1/2 inch

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

3. Jimmy must use lightweight pipe. It must weigh less than one-half pound per foot. What kinds of standard pipe could he use?

A. 3/8 only

B. 1/8 only

C. either 1/8, 1/4 or 3/8

D. either 1/8 or 1/4

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

4. Jimmy orders 4 sizes of pipe: 3/4 inch standard, 1 1/4 inch extra-strong, 3/4 inch extra strong, and 1 1/2 inch standard. Jimmy wants to order them from lightest to heaviest weight in pounds per foot. What is the correct order?

A. 3/4 inch standard, 3/4 inch extra strong, 1 1/2 inch standard, 1 1/4 inch extra strong

B. 3/4 inch standard, 1 1/2 inch standard, 3/4 inch extra strong, 1 1/4 inch extra strong

C. 1 1/4 extra strong, 1 1/2 inch standard, 3/4 inch extra strong, 3/4 inch standard

D. 3/4 inch extra strong, 3/4 inch standard, 1 1/2 inch standard,1 1/4 inch extra strong

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

5. Jimmy orders 3/8 inch standard pipe. What is its weight in pound per foot?

A. 2.72

B. 1.47

C. .74

D. .57

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

GO WITH IT!

You have 1/2 inch, 1 inch, 1 1/2 inch, 2 inch, and 2 1/2 inch pipe. You have both standard and extra strong pipe in each size. Order them by weight. Identify each as standard or extra strong. The first one has been done as an example:

SIZE	WEIGHT IN POUNDS PER FOOT	TYPE
1/2 inch	.85	Standard

EXERCISE 6

Jimmy's crew is moving other materials. They must rig loads for each. They use the following information to estimate rigging:

Table 1-3. Weights of Common Materials

Metal	Weight lbs./cu. ft.
Aluminum	166
Antimony	418
Bismuth	613
Brass, cast	504
Brass, rolled	523
Copper, cast	550
Copper, rolled	555
Gold, 24-carat	1204
Iron, cast	450
Iron, wrought	480
Lead, commercial	712
Mercury, 60°F	846
Silver	655
Steel	490
Tin, cast	458
Zinc	437

Wood	Weight lbs./cu. ft.
Ash	35
Beech	37
Birch	40
Cedar	22
Cherry	30
Chestnut	26
Cork	15
Cypress	27
Ebony	71
Elm	30
Fir, Balsam	22
Hemlock	31

Name of Material	Weight lbs./cu. ft.
Bluestone	160
Brick, pressed	150
Brick, common	125
Cement, Portland (packed)	100 - 120
Cement, Portland (loose)	70 - 90
Cement, slag (packed)	80 - 100
Cement, slag (loose)	55 - 75
Chalk	156
Charcoal	15 - 34
Cinder concrete	110
Clay, ordinary	120 - 150
Coal, hard, solid	93.5
Coal, hard, broken	54
Coal, soft, solid	84
Coal, soft, broken	54
Coke, loose	23 - 32
Concrete, or stone	140 - 155
Earth, rammed	90 - 100
Granite	165 - 170
Gravel	117 - 125
Lime, quick (ground loose)	53
Limestone	170
Marble	164
Plaster of paris (cast)	80
Sand	90 - 106
Sandstone	151
Shale	162
Slate	160 - 180
Terra-cotta	110
Trap rock	170

TRY IT!

1. Where is the title of the chart?

_____

2. What is the title of the chart?

_____

3. What labels are used in this chart?

_____

4. What does lbs./cu. ft. mean?

_____

5. This chart is divided into three parts. Two are given specific labels. The third reads "name of material."
   What is another way you could identify the third part?

_____

APPLY IT!

1. What is the heaviest material to load?

A. Bismuth

B. Rolled Copper

C. 24 carat gold

D. Mercury

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

2. What is the lightest wood?

A. Cork

B. Ebony

C. Cypress

D. Cedar

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

3. Jimmy's crew has ten cubic feet of common brick. How much does the load weigh?

A. 125 pounds

B. 1250 pounds

C. 1500 pounds

D. 12500 pounds

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

4. Jimmy's crew is moving trap rock and limestone. How should they rig each load?

A. Rigging for trap rock needs to be greater.

B. Rigging for limestone needs to be greater.

C. There should be no difference in the rigging.

D. You cannot tell from this chart.

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

5. Jimmy's crew must move a load of concrete cinders. They must also move a load of terra-cotta. How should they rig each load?

A. Rigging for concrete cinders needs to be stronger.

B. Rigging for terra-cotta needs to be stronger.

C. There should be no difference in the rigging.

D. You cannot tell from this chart.

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

GO WITH IT!

Create a sentence which describes the weight of a material in the chart. Create 5 sentences in all.

EXAMPLE: Steel weighs 490 pounds per cubic foot.

EXERCISE 7

Ace Construction Company ordered identification tags for making chain slings. Les must match the right tag to the right sling. He uses the following identification codes:

FIRST LETTER	NUMBER OF BRANCHES
C or S	Single branch (1)
D	Double branch (2)
T	Triple branch (3)
Q	Quadruple branch (4)

SECOND LETTER	TOP END ATTACHMENT
O	Oblong link
P	Pear shaped link
S	Sling hook
G	Grab hook
F	Foundry hook

THIRD LETTER	LOWER END ATTACHMENT
O	Oblong link
P	Pear shaped link
S	Sling hook
G	Grab hook
F	Foundry hook

TRY IT!

1. Examine the items in the chart. What would be a good title for the chart?

_____

2. What labels are shown in this chart?

_____

3. What is the range of branches (from least to most) in a chain sling?

_____

4. How many kinds of links are shown on the chart?

_____

5. How many kinds of hooks are shown on the chart?

_____

APPLY IT!

A.	COP	1. double branch, top end sling hook, lower ends foundry hooks
B.	QPP	
C.	SPO	2. triple branch, top end grab hook, lower end oblong
D.	DSF	
E.	DOG	3. double branch, top end oblong link, lower end grab hooks
F.	SGO	
G.	TFP	4. single branch, top end oblong link, lower end pear-shaped link
H.	SGG	
I.	TGO	5. single branch, top end grab hook, lower end oval link
J.	QFO	

6. quadruple branch, top end pear-shaped link, lower ends pear-shaped link
7. triple branch, top end foundry hook, lower ends pear-shaped links
8. quadruple branch, top end foundry hook, lower ends oval link
9. single branch, top end grab hook, lower ends grab hook
10. single branch, top end pear-shaped link, lower ends oval links

(a) Were the answers to these questions found in the chart?

_____

(b) How did you know?

_____

_____

GO WITH IT!

Look at the codes for the first and second letters of an identification tag. How do you think these letters came to be used for the code?

EXERCISE 8

Keith has a new job. He works at a construction company which uses metric instruments and tools. Keith uses the following conversion table:

Table 4-4. Present-Day/Metric Conversions

When You Know:		You Can Find:	If You Multiply By:
LENGTH	inches	millimeters	25.0
	feet	millimeters	300.0
	yards	meters	0.9
	miles	kilometers	1.6
	millimeters	inches	0.04
	meters	yards	1.1
	kilometers	miles	0.6
WEIGHT (MASS)	ounces	grams	28.0
	pounds	kilograms	0.45
	tons	metric tons	0.9
	grams	ounces	0.04
	kilograms	pounds	2.2
	metric tons	tons	1.1
VOLUME	bushels	cubic meters	0.04
	cubic feet	cubic meters	0.03
	cubic inches	cubic centimeters	16.4
	cubic yards	cubic meters	0.8
FLUID VOLUME	ounces	milliliters	30.0
	pints	liters	0.47
	quarts	liters	0.95
	gallons	liters	3.8
	milliliters	ounces	0.03
	liters	pints	2.1
	liters	quarts	1.06
	liters	gallons	0.26
TEMPERATURE	degrees Fahrenheit	degrees Celsius	0.6 (after subtracting 32)
	degrees Celsius	degrees Fahrenheit	1.8 (then add 32)

TRY IT!

1. Where is the title of the chart?

_____

2. What is the title of the chart?

_____

3. What are the headings at the top of the chart?

_____

4. What kinds of measurements are shown in the left column?

_____

5. In what units can you measure length? Where do you find that information on this chart?

_____

6. In what units can you measure weight? Where do you find that information on this chart?

_____

7. In what units can you measure volume? Where do you find that information on this chart?

_____

8. In what units can you measure fluid volume? Where do you find that information on this chart?

_____

9. In what units can you measure temperature? Where do you find that information on this chart?

_____

10. What does conversion mean?

_____

11. What does metric mean?

_____

APPLY IT!

1. Keith looks at a thermometer. The temperature is 0 degrees C. Which of the following statements is true?

A. 0 degrees on a Fahrenheit scale is warmer.

B. 0 degrees on a Fahrenheit scale is cooler.

C. 0 degrees is 0 degrees, no matter which temperature scale Keith uses.

D. None of the above statements are true.

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

2. Keith compares weights. Which of the following is true?

A. A metric ton weighs more than a regular ton.

B. An ounce weighs more than a gram.

C. A pound weighs less than a kilogram.

D. None of the following are true.

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

3. Keith has 99 feet of copper tubing. How many meters does than equal?

A. 29.7

B. 90.1

C. 2970.0

D. 3.96

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

4. Keith must measure the volume of crude oil. What unit could he use?

A. bushels

B. liters

C. tons

D. ounces

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

5. Keith must put some measuring instruments into the correct sequence, from largest to smallest. Which of the following is correct?

A. millimeter, meter, kilometer

B. metric ton, kilogram, gram

C. gallon, pint, quart

D. mile, feet, yard, inch

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

GO WITH IT!

Combining the headings with information in the chart forms sentences. The following example uses the headings with the smallest length measurements (inches and millimeters):

EXAMPLE: When you know inches, you can find millimeters if you multiply by 25.0.

Construct 5 more sentences. Choose one unit each from length, weight, volume, fluid volume, and temperature.

EXERCISE 9

Kate often uses blueprints in her job. She is so used to them that she sometimes uses standard abbreviations in writing notes to her coworkers. Using the chart below, determine the meaning of each abbreviation in the following note:

TABLE 1-1. STANDARD ABBREVIATIONS

ADD.	addition	MEZZ	mezzanine
AGGR	aggregate	MO	masonry opening
L	angle	MECH	mechanical
B	bathroom	OC	on center
BR	bedroom	OPP	opposite
BM	bench mark	O.D.	out diameter
BRKT	bracket	PNL	panel
CLK	caulk	PSI	pounds per square inch
CHFR	chamfer	PWR	power
CND	conduit	REINF	reinforce
CU FT	cubic foot, feet	RH	right-hand
DIM.	dimension	SHTHG	sheathing
DR	drain	STR	structural
DWG	drawing	SYM	symbol
EL	elevation	THERMO	thermostat
ELEV	elevator	TYP	typical
ESC	escutcheon	UNFIN	unfinished
FAB	fabricate	VEL	velocity
FLGE	flange	WV	wall vent
FLR	floor	WHSE	warehouse
GR	grade	WH	weep hole
GYP	gypsum	WDW	window
HDW	hardware	WP	working pressure
HTR	heater		
" OR IN.	inch, inches		
I.D.	inside diameter		
LH	left-hand		
NO.	number		

TRY IT!

1. Where is the title of the chart?

_____

2. What is the title of the chart?

_____

3. This chart has no labels. What labels could be used?

_____

4. How are the abbreviations ordered in this list?

_____

APPLY IT!

SAM--

I have been working on the UNFIN plans for the apartment complex. I have already made CU FT conversions. What GR of plywood are needed for the FLR foundations in the Bs and the BRs? We may have to FAB special WDWs in the MEZZ. I noticed that the O.D. of them is a nonstandard size. Also check the DIM. of the ELEV. It may be too narrow for a wheelchair. If you need me, I'll be back soon. I'm just going to the WHSE for the HDW for the HTR, including the THERMO and installation PNL. See you later.

--KATE

1. UNFIN _____
2. CU FT _____
3. GR _____
4. FLR _____
5. B _____
6. BR _____
7. WDW _____
8. MEZZ _____
9. O.D. _____
10. DIM. _____
11. ELEV _____
12. WHSEN _____
13. HDW _____
14. THERMO _____
15. PNL _____

(a) Were the answers to these questions found in the chart?

_____

(b) How did you know?

_____

_____

GO WITH IT!

Write 5 sentences which include abbreviations from this chart. Use at least 10 abbreviations.

EXAMPLE: The PNL is next to the WDW.

EXERCISE 10

Aquila is teaching Phil to field sketch. She uses the following to judge his work:

FIELD MEASUREMENT ACCURACY

Every measurement contains some amount of error. However, a good field measurement reduces this error and increases accuracy. The craftworker should try to be as accurate as possible in all field measurements.

There are three types of errors in field measurement. These are:

* observational error
* manipulation error
* instrument error

Observational error is most often caused by shifting the alignment between the measuring instrument and the object being measured. This often happens when the observer moves or changes position. Manipulative error occurs when the measuring instrument is not used properly or is not correctly aligned or adjusted. Instrument error occurs when a poor quality measuring instrument or when it is inaccurately adjusted. The following table explains how to correct these errors:

Table 2-1. Measurement Error Correction

Types of Error	Methods of Correction
OBSERVATIONAL	a. Place the measuring instrument graduations close to the object being measured. b. Observe the measuring instrument from a point perpendicular to the plane of the graduations.
MANIPULATIVE	a. Use, adjust, and align the measuring instruments as instructed by the manufacturer. b. Practice using the measurement instrument until you know how to use it accurately.
INSTRUMENT	a. Use the right measuring instrument for the job. b. Use only quality measuring instruments. c. Make sure the measuring instrument is properly adjusted.

TRY IT!

1. Where is the title of the chart?

_____

2. What is the title of the chart?

_____

3. What headings and labels are used in this chart?

_____

4. What do the following words mean?

observational _____

manipulative _____

instrument _____

graduations _____

perpendicular _____

plane _____

APPLY IT!

1. Aquila watches Phil sketch an engine housing. Phil walks around it as he measures and sketches. Aquila suspects his sketch will show _____.

A. observational errors

B. manipulation errors

C. instrument errors

D. no basic errors

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

2. Phil uses a micrometer. He makes notes about his measurements. Aquila sees that Phil doesn't seem to know how to use the micrometer correctly. She thinks this will cause _____. A. observational errors

B. manipulation errors

C. instrument errors

D. no basic errors

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

3. Phil sometimes makes instrument errors. What should he do?

A. Practice using different kinds of measuring instruments.

B. Place the measuring instrument graduations closer to the object being measured.

C. Refer to the manufacturer's instructions to align the instrument.

D. Use the right measuring instrument for the job.

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

4. Phil purchased some measuring devices of his own. He finds some much cheaper models. He decides, however, to buy instruments known for quality. This will help Phil avoid _____.

A. observational errors

B. manipulation errors

C. instrument errors

D. breaking the equipment with the tools.

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

5. Phil compares types of errors. According to the chart, which type has the least methods of correction?

A. observational errors

B. manipulation errors

C. instrument errors

D. A or B

E. All of them have equal numbers of methods for correction.

(a) Is the answer to this question found in the table? _____

(b) How did you know?

_____

_____

GO WITH IT!

Reread the description of field measurement accuracy.

Construct a chart which defines each type.

TYPE	DEFINITION
observational error	
manipulation error	
instrument error	