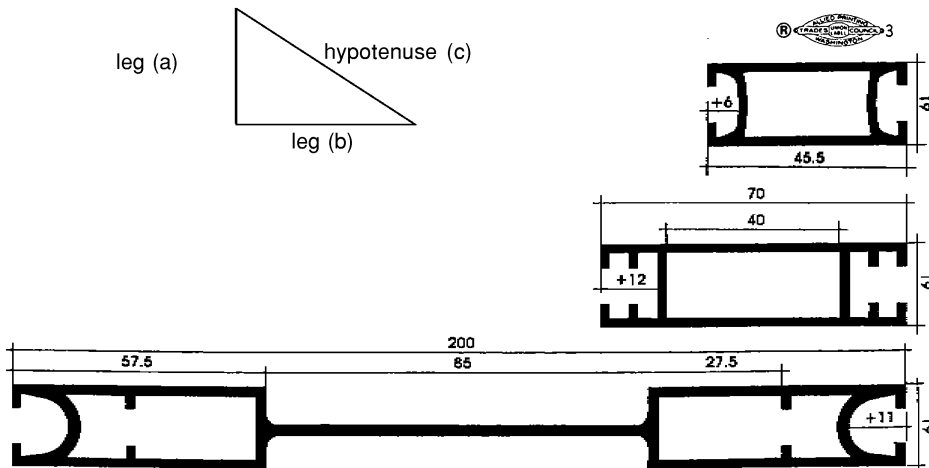


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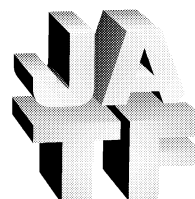
## STUDENT'S GUIDE

# Mathematics for the Sign & Display Trade

A Curriculum for Members of The International Brotherhood of Painters and Allied Trades



International Brotherhood  
of Painters and Allied Trades  
Joint Apprenticeship and Training Fund  
1-800-276-7289



*A Curriculum for the  
members of the  
International Brotherhood  
of Painters and Allied Trades AFB-CIO-GLC*

The IBPAT JATF Educational Program, which involves this series of instructional materials in conjunction with classroom or correspondence-type instruction and on-the-job training, is provided to help maintain a constant supply of qualified workers for the industry. Everyone who enters the trade makes a definite commitment to themselves as well as to the employer. This includes a commitment to work diligently, to learn new techniques as well as improve on those already learned, to maintain an attitude which promotes learning, and to exercise a high degree of maturity in all matters related to the job.

These instructional materials are provided as a supplement to the on-the-job training everyone receives while performing their job. Every journeyman and apprentice must seek to learn from any source at their disposal in a continuing effort to enhance and upgrade their skills. The Industry is in a constant state of change and only through efficient and continued education will our trades remain state-of-the-art.

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Joint Apprenticeship and Training Fund**  
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## **OBJECTIVES**

### **OBJECTIVES:**

By the completion of this module each student should be able to:

- Demonstrate basic math skills as they are applied to the sign and display trade.

## NOTES

**INTRODUCTION****INTRODUCTION**

The previous mathematics topics (“Basic Mathematics and Measurement” and “Fractions, Decimals, Percents and Angles Parts 1 & 2”) reviewed the basic arithmetic skills needed on the job. This topic, Mathematics for the Sign and Display Trades, will put that knowledge to work in trade specific applications. Mistakes in measuring, layout, fabrication, or in any other aspect of the job can be very costly. To avoid errors, it is critical that every worker understands the basics of sign and display mathematics. This topic is divided into six sections: Measurement, Addition, Subtraction, Multiplication, Division, and Integrated Math. Integrated math involves problems which require more than one function, for example, both addition and subtraction.

**MEASUREMENT****MEASUREMENT**

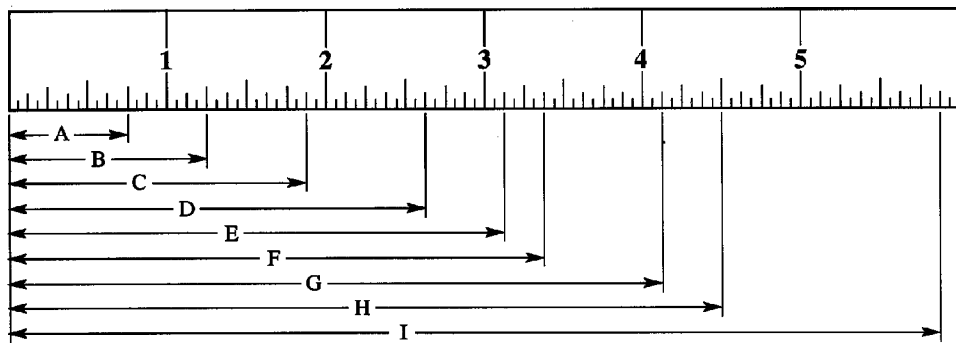
Reading a tape measure accurately is an important part of the sign trade. If mistakes are made in measuring, they most likely will be transferred to the fabrication table resulting in improperly cut material. In the American Standard of measurement the area is measured in square inches, square feet, square yards, and square miles. If the Metric system is used, the area is measured in square millimeters, centimeters, decimeters and meters.

**PRACTICE PROBLEMS  
AMERICAN STANDARD****PRACTICE PROBLEMS (AMERICAN STANDARD)**

Complete the following questions:

1. How many  $\frac{1}{16}$ ths of an inch equal  $\frac{3}{8}$ ths of an inch?
2. How many  $\frac{1}{16}$ ths of an inch equal  $\frac{5}{8}$ ths of an inch?
3. How many  $\frac{1}{16}$ ths of an inch equal  $\frac{3}{4}$  of an inch?
4. How many  $\frac{1}{16}$ ths of an inch equal  $\frac{1}{4}$  of an inch?

5. How many  $\frac{1}{16}$ ths of an inch equal  $\frac{7}{8}$ ths of an inch?
6. How many  $\frac{1}{8}$ ths of an inch equal  $\frac{1}{2}$  of an inch?
7. What is the width of a piece of plexiglass  $\frac{1}{8}$ th inch longer than a piece  $\frac{1}{4}$  of an inch?
8. What is the width of a piece of aluminum  $\frac{1}{16}$ th of an inch longer than  $\frac{1}{2}$  of an inch?
9. Give the rule reading in inches for each of the lettered dimensions:



- |         |         |
|---------|---------|
| A _____ | F _____ |
| B _____ | G _____ |
| C _____ | H _____ |
| D _____ | I _____ |
| E _____ |         |

10. How many square inches of plexiglass are in a circle with a diameter of 36 inches?
11. A piece of  $\frac{3}{4}$ " MDO plywood is cut to fit half of the gable end of a building. The plywood forms a right triangle with a 4 foot base and a 3 foot altitude. What is the area of the piece of plywood?
12. Express the following in inches:
- 3 feet 8 inches \_\_\_\_\_
  - 6 feet 2 inches \_\_\_\_\_
  - 5 feet 1 inch \_\_\_\_\_
  - 16 feet 11 inches \_\_\_\_\_
  - 27' 3" \_\_\_\_\_
13. Express the following as feet and inches:
- 39 inches \_\_\_\_\_
  - 120 inches \_\_\_\_\_
  - 297 inches \_\_\_\_\_
  - 15 inches \_\_\_\_\_
  - 50  $\frac{1}{4}$  inches \_\_\_\_\_
14. Using Figure 1, if the law office sign is centered on a 5' 10" opening, what is the distance from the left corner of the building to the center of the law office sign?

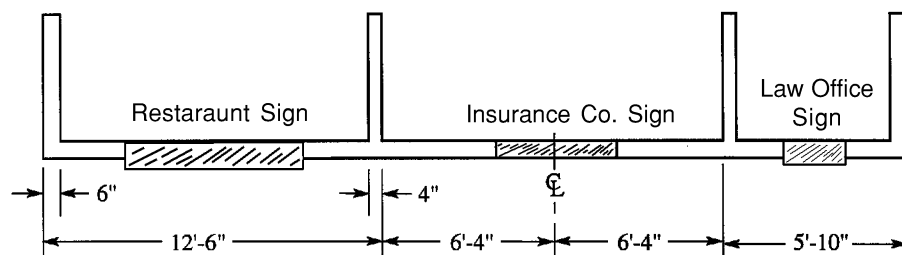


Figure 1

15. Using Figure 1, how far in feet and inches is the centerline of the insurance company sign from the right end of the building?
  
16. Referring to Figure 1, how long in feet and inches is the entire wall section?

**Metric Measurement**

As stated in “Basic Mathematics and Measurement,” the metric system is based on multiples of 10. For example:

- millimeter = 0.001 (1/1000 of a meter)
- centimeter = 0.01 (1/100 of a meter)
- decimeter = 0.1 (1/10 of a meter)
- meter = 1 meter

**PRACTICE PROBLEMS (METRIC SYSTEM)**

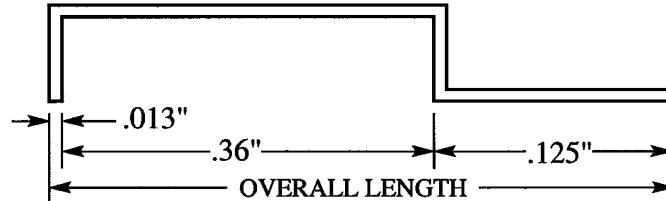
Solve the following problems:

17. 25 meters = \_\_\_\_\_ centimeters
18. 15 centimeters = \_\_\_\_\_ millimeters
19. 1 decimeter = \_\_\_\_\_ millimeters
20. 2 meters = \_\_\_\_\_ millimeters
21. 300 centimeters = \_\_\_\_\_ meters

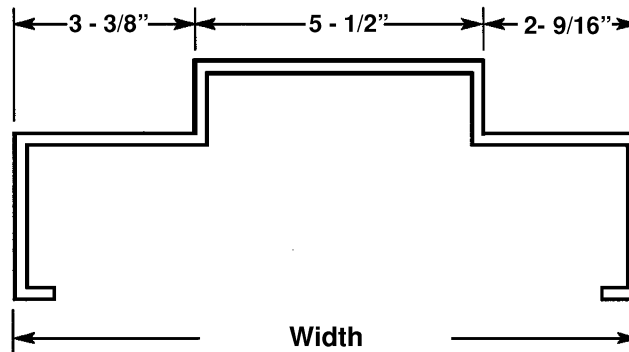
**ADDITION**

Solve the following addition problems:

1. What is the overall length of the brake metal shape drawn below?



2. What is the width of the following end view of extruded aluminum?



3. A beltsign measures  $43' 11''$  along its width and  $4' 6''$  in height. What is the perimeter of this sign?
4. What is the total length of the following pieces of metal? 3 pieces  $2 \text{ ft. } 4 \text{ in.}$  long 1 piece  $10 \text{ ft. } 2 \text{ in.}$  long 1 piece  $16 \text{ ft. } 3 \text{ in.}$  long and 2 pieces  $8 \text{ ft. } 5 \text{ in.}$  long

5. Add the following quantities:

$$13 \text{ feet} + 16 \text{ feet} + 8 \text{ feet} + 24 \text{ feet} + 51 \text{ feet} =$$

6. A sign installation crew of four worked the following hours to complete a job: 24 hours, 18 hours, 20 hours, and 22 hours. The employer bid the job for 100 hours. Was the job completed within the bid timeframe?

7. Find the perimeter of a square display measuring 4 feet 3 inches.

8. Find the perimeter of a triangular piece of 063 aluminum that has sides measuring 7 inches, 8 inches, and 9 inches.

9. Find the perimeter of a carpet square that measures 9 feet 9 inches a side.

10. What is the total of the following weekly paycheck deductions?

Social Security	\$53.99
Medicare:	\$12.63
Federal:	\$152.61
L & I:	\$14.35
Union Dues:	\$36.00

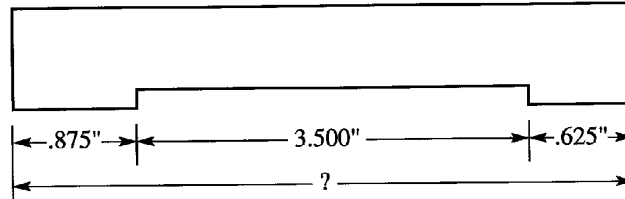
11. What is the total length of six pieces of extruded aluminum measuring 12 feet 4 inches each?

12. What would be the minimum required length of the aluminum extrusion needed if the following pieces were cut from it allowing  $\frac{3}{16}$ " for each saw cut?

$3 \frac{1}{8}$  inches,  $4 \frac{1}{2}$  inches, and  $8 \frac{3}{16}$  inches

13. A display builder purchases materials for 3 jobs. He spends \$125.67 for the first job, \$1,345.50 for the second job, and \$621.15 for the third. How much did the materials cost?

14. Determine the total length of the irregular template shown below:



15. What is the perimeter of a square neon sign with a measurement of  $14 \frac{1}{4}$ " per side?

16. What is the total of the following expenses?

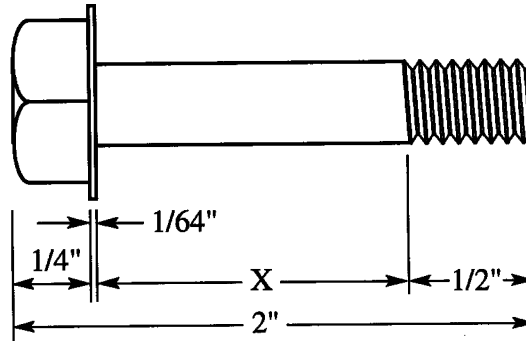
Materials:	\$1,255.50
Labor:	\$675.90
Overhead:	\$125.00

17. In one day, an apprentice installer travels 14 miles, 25 miles, 18 miles, 6 miles, 54 miles, and 22 miles to various jobs. What is the total mileage for the day?

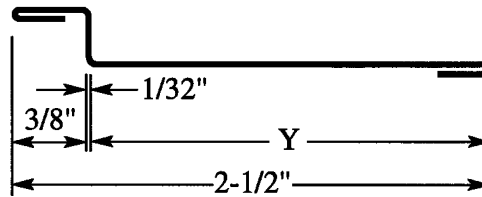
**SUBTRACTION**

Solve the following subtraction problems:

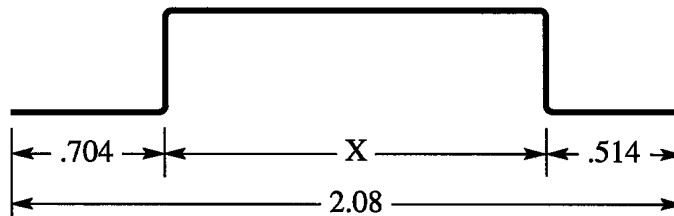
1. Find dimension "x":



2. Find dimension "y":

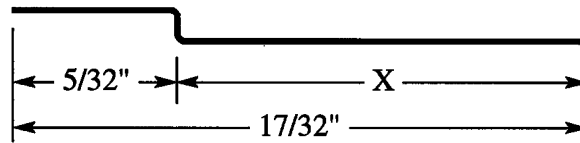


3. Find dimension "x":

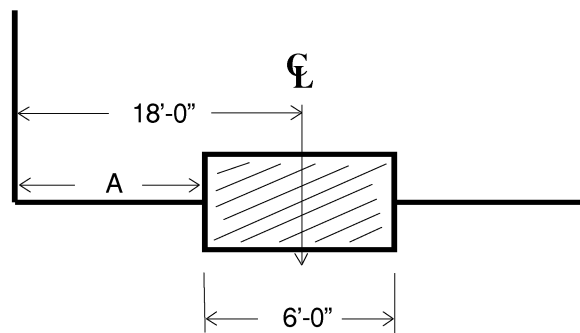


4. A sign estimate of \$1,450.75 is submitted for a job. The actual material cost is \$526.72. The labor and overhead come to \$628.95. What profit does the sign shop owner expect to realize?

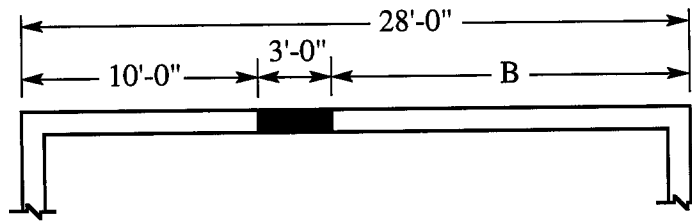
5. The labor for a crane truck rental is 31 hours and is charged to three different jobs. To the first job 16 hours are charged and to the second job 12.5 hours are charged. How much time is charged to the third job?
  
6. A small sign costs \$68.95 With molding it costs \$87.45. What is the additional cost of the decorative molding?
  
7. A journeyman and an apprentice work a total of 76.4 hours on a job. If the journeyman's time is 38.5 hours, how much time does the apprentice work?
  
8. Find dimension "x":



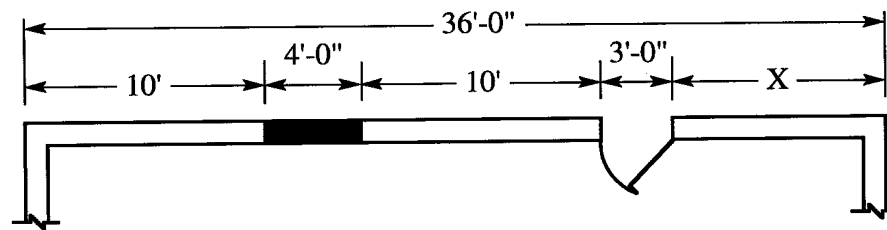
9. Determine missing dimension "A" in the drawing:



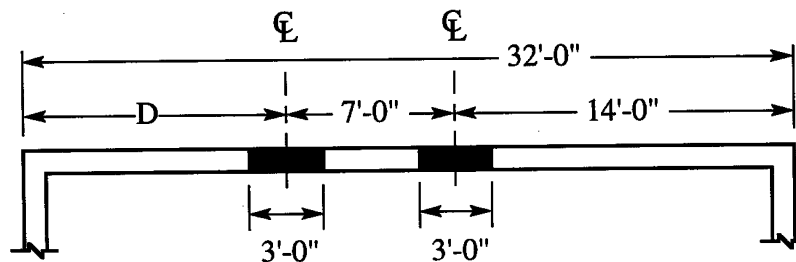
10. Determine missing dimension "B" in the drawing:



11. Find missing dimension "X":



12. Find missing dimension "D":



13. An exterior sign costs \$335.00 glazed with 1/4" plexiglass or \$399.80 using polycarbonate. What is the difference in price?

14. A general contractor's bank balance is \$13,426.38. A deposit is made of \$2,137.65. After the following subcontractor checks are drawn, what is the general contractor's final bank balance?

Sign and Display	\$1,946.16	Plaster	\$842.30
Masonry	\$1,702.58	Painting	\$527.68

15. A signshop owner bids a job for \$4,500.00. If the owner expects to pay \$1,900.00 in labor and wants to realize \$1,125.00 in profit, what is the limit on material expenses?

**MULTIPLICATION**

Solve the following multiplication problems:

1. Three tints are needed to achieve a particular color using a gallon of base white paint. They are:

1/4 oz. of tint A

1/8 oz. of tint B

1/2 oz. of tint C

If the tints are measured with a 1 oz. container that is graduated in 16 equal parts, how many parts of the measuring container will the following tints fill?

Tint A: \_\_\_\_\_

Tint B: \_\_\_\_\_

Tint C: \_\_\_\_\_

2. A sign crew installs 192 stadium seating signs each day. The job lasts for  $6\frac{1}{4}$  days. How many signs will be installed?
3. On the same stadium job, if  $5\frac{3}{4}$  cases of sealant (12 tubes per case) were used each day on a job that took  $3\frac{3}{4}$  days, how many tubes of sealant were used? How many cases of sealant were required for the job?
4. A sign shop receives an order for 35 banners. Each of these banners is 3'x 12' and requires grommets 12" on center along the top edge as well as all four corners. How many grommets will be needed to do the entire job?

5. A sign maker must make 27 signs. Each sign requires 48 rivets. If a box of rivets contains 100 rivets, how many boxes will be needed to complete the job?
  
6. In traveling to 4 job sites a sign installer logs 17.5 miles each way. He spends 10 days working on these jobs. How many miles does the installer drive?
  
7. What would be the area of a square piece of .063 bronze aluminum measuring 36" a side?
  
8. What would be the area of a rectangular piece of armor ply measuring 5 feet X 7 feet?
  
9. What would be the area of a rectangular sign face measuring 32 centimeters X 55 centimeters?
  
10. An employer must bid a job to replace a polycarbonate sign face that measures 8' X 10' 6". If materials cost \$4.55 a square foot, how much will the bid for materials be?
  
11. A journeyman works 40 hours at \$22.50 an hour plus 4 hours at 1 1/2 the hourly pay rate. How much will the paycheck be before taxes?
  
12. A journeyman's gross paycheck is \$870.80. How much is taken out for each deduction (round all amounts to the nearest cent)?

Social Security @ 6.2% : \_\_\_\_\_

Medicare @ 1.4% : \_\_\_\_\_

Federal @ 17% : \_\_\_\_\_

13. A signmaker earns \$21.77 per hour and wants to save 5% of each paycheck (gross) for vacation. How much would be saved for vacation on a 40 hour week?

How much would be saved at the end of a 50 week work year working 40 hour weeks?

14. A sign contractor bids a job for \$1,575.00. 35% of the bid is materials, 40% of the bid is labor and 25% of the bid is overhead and profit.

What portion is materials? \_\_\_\_\_

What portion is labor? \_\_\_\_\_

What portion is overhead/ profit? \_\_\_\_\_

15. Two display apprentices are comparing gross pay. The full scale rate is \$23.75 per hour. If one apprentice is at 48% and the other is at 52%, what is their gross hourly wage?

16. A neon shop owner has a bank balance of \$7,942.00. After the first year the interest brings the balance to \$9053.88. What rate of interest is earned?

17. A display repair costs \$154.00 after a 12% discount is allowed. Find the original amount of the bill.

**DIVISION**

Solve the following division problems:

1. A 15" roll of vinyl for the computer contains 10 yards and yields a total of 60 signs. If all the signs are the same size, what is the maximum size of material for each sign?
2. A 100 yard roll of banner stock weighs 188 lbs. If  $\frac{1}{4}$  of the material is used for a job, how much does the remainder weigh?
3. After receiving a wage increase, a display worker earns \$22.62 per hour. If this amount is 4 percent more than was earned previously, how much was earned per hour before receiving the raise?
4. In constructing a set of channel letters, 2% of the total cost is allowed for wiring. Find the cost of the sign if the wiring costs \$350.00
5. A sign contractor earns \$1,800 profit on a job. If this is 12% of the total charge, what was the cost of the sign?
6. If a sign maker has earned \$26,304.33 year-to-date and has paid \$1,630.85 to social security, what percent of earnings does social security receive (rounded to the nearest tenth)?
7. How many pieces of MDO 12" x 12" inches can be cut from a piece 12" x 96" inches long (allowing for  $\frac{1}{8}$ " saw cuts)?
8. If the scale reads on a blueprint  $\frac{1}{2}$  inch equals 1 foot, how many feet are represented by a line 4 inches long?

9. If the scale on a blueprint reads  $\frac{1}{4}$  inch equals 1 foot, how many feet are represented by  $10\frac{1}{8}$  inches?
10. How many 6" x 12" inch pieces can be cut on a shear from a 48" x 96" sheet of .040 aluminum?
11. If the company truck was driven 360 miles on 30 gallons of gas, what was the average number of miles per gallon?
12. A 55 gallon drum of laquer thinner is being used in the shop at the rate of 0.5 gallons per day. At this rate, how many days will the drum last?
13. If the gasoline powered generator uses .75 gallons of gasoline per hour, how many hours can the generator be used if the gasoline tank will hold 15 gallons?
14. An order is received for computer cut vinyl oval signs 12" x 18". How many signs can be cut from a ten yard roll of 15" material allowing  $\frac{1}{4}$  " inch between ovals?
15. The Union Sign Company uses cable for its banner installations. The cable weighs 1.25 lbs. per foot. A partly filled spool of the cable is weighed. It is found that the cable itself weighs 145 lbs. after taking off for the weight of the spool. To the nearest foot, how many feet of cable are on the spool?

**INTEGRATED MATH**

Solve the following problems:

1. Twelve electric signs are needed for a strip mall. Nine signs will be mounted on the west side and three will be in the east side. What fraction of the total number of signs must be installed in the east side?

2. How many stock lengths of extruded aluminum (each 21 feet long) does it take to cut the following?

4 pieces 9 feet long

2 pieces 5 feet long

1 piece 4 feet long

5 pieces 2 feet long

3. If a sign employer were bidding a job that required:

25 journeyman hours at \$21.75 per hour

17 apprentice hours at 50% of full scale (rounded up to the nearest cent)

How much would the labor portion of the job be?

How much would the total bid be if an additional 15% profit were added?

4. Due to lack of work, an employer is forced to lay off some of the crew. Normally the contractor employs 22 sign workers. Six who work in the fabrication shop, 10 in plastics and graphics, and 15 work as installers. If  $\frac{1}{6}$  of the fabrication crew,  $\frac{1}{2}$  of the plastics & graphics crew, and  $\frac{2}{3}$  of the installers are laid off, how many workers will remain on the payroll?

5. A piece of polycarbonate weighs 0.75 lbs. per square foot and is  $3\frac{1}{2}$  feet wide and  $5\frac{1}{4}$  feet long. How much does the polycarbonate weigh?
6. To renovate grocery store signs a sign company used 6.85 rolls of 15" blue vinyl, 4.65 rolls red vinyl ,  $8\frac{3}{4}$  rolls of black vinyl and  $20\frac{1}{2}$  rolls of transmask. How many rolls of material did the company use in total?
7. 46% of a \$23,000 signage contract provided for material while 26% provided for labor. The remainder was profit.

What was the total cost of the materials?

What was the total cost of labor?

How much profit was realized?

8. If a sign shop owner allows a 2% discount on all cash payments, how much must be paid on a bill for \$370.50?
9. Two bids are received on a 4' x 8' foot plywood sign. The low bid, \$300, is 20% less than the high bid. How much is the high bid?
10. After sandblasting graphics on six lites of  $\frac{1}{2}$ " glass, 72" X 120", weighing 6 lbs. per sq. ft. and 4 lites of  $\frac{1}{4}$ " glass, 48" X 96", weighing 3 lbs. per sq. ft. they are packed in a case that weighs 820 lbs. What is the total weight of the case and its contents in pounds?

11. If 4 installation clips are to be used on each sign larger than 2 sq. ft. and 2 clips are to be used on each sign smaller than 2 sq. ft., how many clips in all would be needed to install the following?

16 signs 12" X 12"

28 signs 24" X 48"

6 signs 12" X 20"

8 signs 48" X 50"

12. Metal for a display is cut by two workers. Which worker supplied the most and by how much?

Worker A supplied the following:

4 pieces 5 ft. 11 in. long

9 pieces 12 ft. 2 in. long

18 pieces 6 ft. 9 in. long

Worker B supplied the following:

19 pieces 1 ft. 3 in. long

18 pieces 9 ft. 4 in. long

2 pieces 1 ft. 10 in. long

10 pieces 5 ft. 5 in. long

4 pieces 1 ft. 3 in. long

13. The following pieces of material were cut from 10 stock lengths of extruded aluminum, each 21 ft. long. How many linear feet of the stock material remained after the pieces were cut?

2 pieces 4 ft. long

3 pieces 6  $\frac{1}{3}$  ft. long

4 pieces 54" long

14. If a contract specifies that only mileage of over 40 miles (one way) is reimbursable at \$.24 a mile, how much would a worker receive if he traveled 92 miles a day on a job that lasted 34 days?

15. To install a time and temperature sign on a bank labor and material is estimated to be \$48,500. Of this amount, 37% is for labor and 45% is for material.

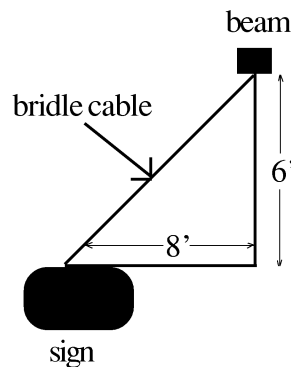
What is the allowance for labor?

What is the allowance for material?

How much is left for overhead and profit?

16. A fabricating tool is listed in a catalogue for \$22.50. A signworker purchases it at list price less 30 percent. What is the net cost of the tool?

17. A display sign is being hung using cable. The only tie-off point is a beam 6 feet above where the sign will be hung and 8 feet away from the horizontal placement. How long will the bridle cable be? (see drawing)



## NOTES

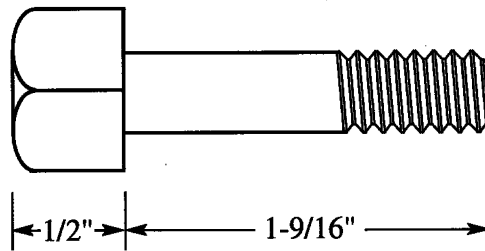
**REVIEW**

1. What is the length of a piece of aluminum  $\frac{1}{4}$  of an inch longer than  $\frac{5}{8}$ ths of an inch?
2. What is the length of a piece of stock  $\frac{1}{16}$ th of an inch longer than  $2\frac{3}{8}$ ths of an inch?
3. Solve the following:
  - a. 17 meters = \_\_\_\_\_ centimeters
  - b. 350 centimeters = \_\_\_\_\_ decimeters
  - c. 10 millimeters = \_\_\_\_\_ centimeter
4. A length of aluminum approximately 2.4 meters long is to be cut into 5 equal parts. How many centimeters long will each piece be?
5.  $\frac{1}{3}$  of a gallon of bulletin paint is required to coat out the north side of a building's sign,  $\frac{2}{3}$  of a gallon is required to coat out the south elevation,  $\frac{1}{6}$  of a gallon is required to coat the east portion, and  $\frac{1}{2}$  of a gallon is required to paint the west part. How many gallons will be needed to paint out all the sign faces on the building?
6. Find the perimeter of a sign with 2 sides measuring 8' 6" inches, and 2 sides measuring 3'4" inches.
7. An estimate of \$225.00 is submitted for a sign. If \$87.25 is for labor, and material cost is \$57.75 how much profit was made?

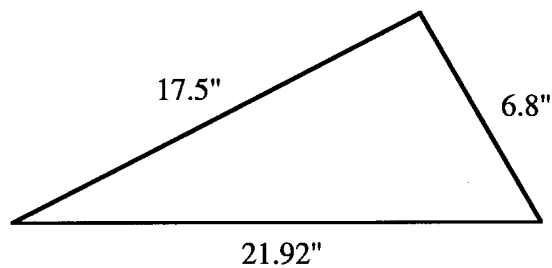
8. Four pieces of aluminum measuring 3' feet 9" inches with 45 degree mitered end needs to be cut from a length measuring 252". If you allow  $\frac{3}{4}$  of an inch for 8 (?) saw cuts, how much aluminum will remain after all cuts are made?
9. Subtract the following quantities:
- a.  $\frac{3}{8}$  inch from  $\frac{3}{4}$  inch \_\_\_\_\_
  - b.  $\frac{1}{4}$  inch from  $\frac{7}{8}$  inch \_\_\_\_\_
  - c.  $\frac{7}{8}$  inch from  $1 \frac{5}{8}$  inch \_\_\_\_\_
  - d.  $\frac{1}{4}$  yard from  $1 \frac{1}{8}$  yard \_\_\_\_\_
10. A sign installer travels 96 miles round trip to a job. The union contract states that mileage of 40 miles (one way) and over is reimbursable. How many miles should the installer be compensated?
11. Six workers were sent out to install signs at a new department store. Each man was paid  $\frac{2}{3}$  of an hour over time. How much total overtime did the employer pay if the job lasted 2 days?
12. If a display worker earns \$21.75 an hour, how much would an apprentice display worker earn at 42% of journeyman scale (rounded to the nearest cent)?
13. A crew of billboard painters used 15 quarts of bulletin paint for a job. The job lasted 3 days. How many quarts of paint did they use each day?
14. A sign fabricator used 16 feet of a 20 foot length of aluminum extrusion. What percent of the aluminum was used?

15. A journeyman's paycheck is \$850.50. This is one and one-half times as much as the apprentice's check. How much does the apprentice receive?

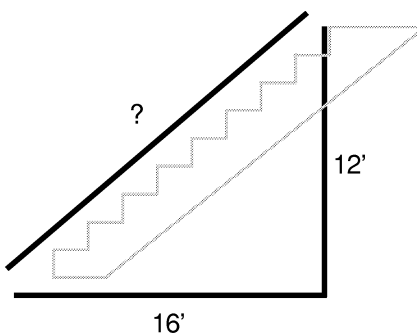
16. Find the total length of the bolt:



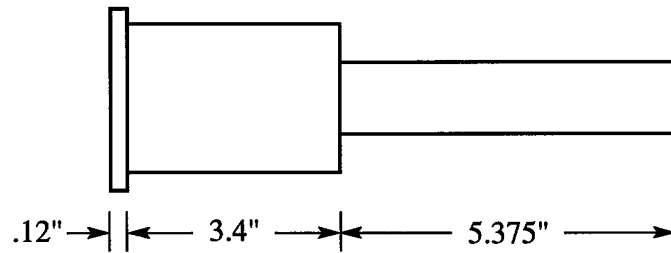
17. Find the perimeter of the triangle:



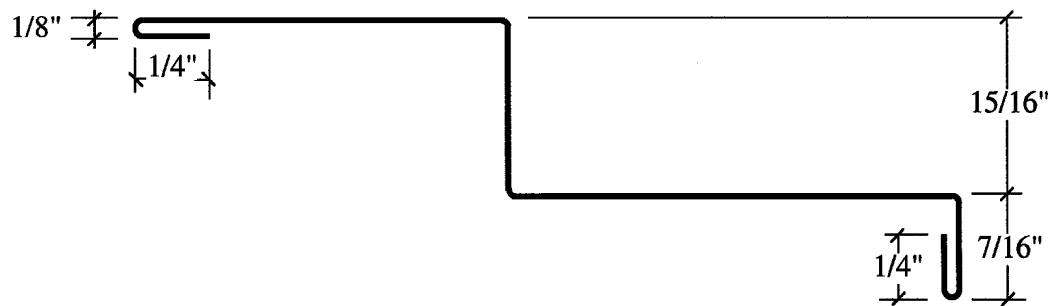
18. How long is the missing dimension in this stairway?



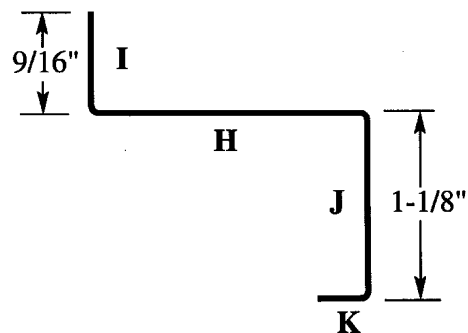
19. What is the total length of the aluminum fabricated component?



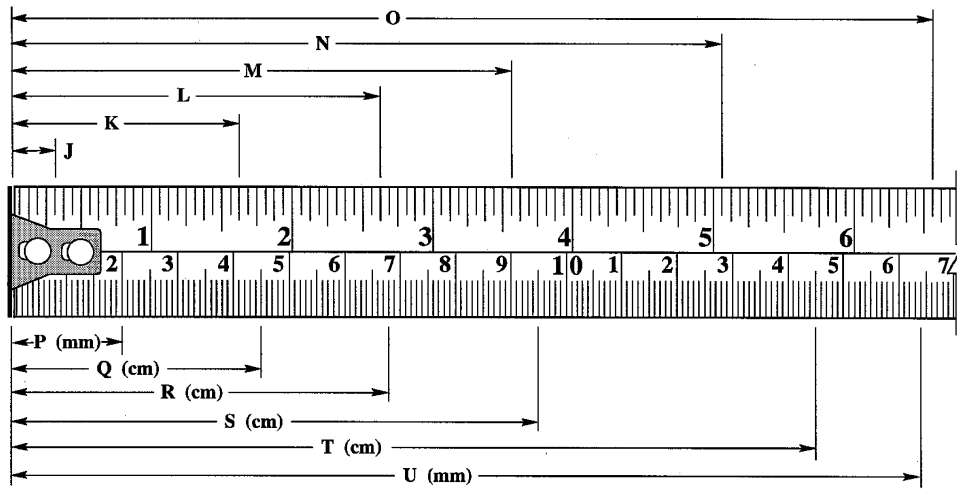
20. The .040 aluminum moulding measures  $7 \frac{1}{4}''$ . Deduct the measurements provided. What is the remaining length of the line?



21. Dimensions are given for both lines I and J. What is the total of these two lines?



22. Give the rule reading for each of the lettered dimensions:



J \_\_\_\_\_ P \_\_\_\_\_

K \_\_\_\_\_ Q \_\_\_\_\_

L \_\_\_\_\_ R \_\_\_\_\_

M \_\_\_\_\_ S \_\_\_\_\_

N \_\_\_\_\_ T \_\_\_\_\_

O \_\_\_\_\_ U \_\_\_\_\_

