

FIND UNKNOWN MEASUREMENT = FIND MISSING LENGTH

Program Duty: 800 Dimensioning

POS: 801 Apply measurement notes and symbols to a technical drawing

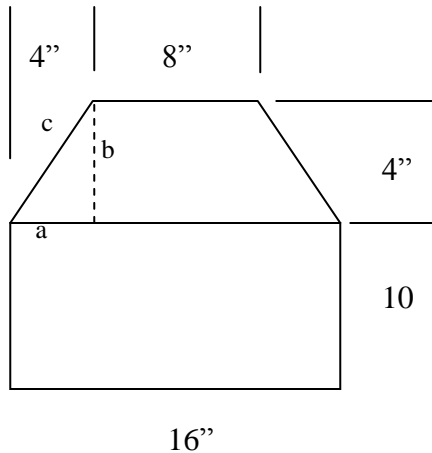
Program Associated Vocabulary:
SQUARE ROOT

Program Formulas and Procedures:

Drafters must be able to calculate square roots in order to determine the length of a line on angle for which there are no dimensions given. In many cases, drafters must use the Pythagorean Theorem to find this missing dimension. Calculating square roots is the last step in the Pythagorean Theorem.

$a^2 + b^2 = c^2$ where "C" (the *HYPOTENUSE*) is the longest side

Example:



In the figure above, we do not know the length of the 45° angled sides of this plate to be machined.

Solution:

$$a^2 + b^2 = c^2 \text{ where } a = 4", b = 4"$$

$$4^2 + 4^2 = c^2 \rightarrow 16 + 16 = 32$$

$$c = 5.6569"$$

The number of decimal places is determined by the allowable tolerances selected for the design.

PA Core Standard: CC.2.3.HS.A.6

Description: Verify and apply theorems involving similarity as they relate to plane figures

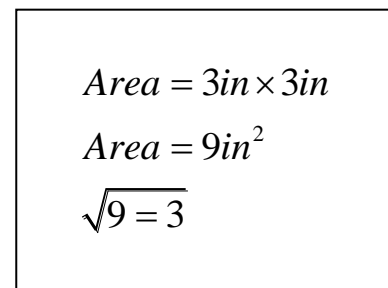
Math Associated Vocabulary:

PERIMETER, CIRCUMFERENCE, AREA, VOLUME, OPPOSITE OPERATIONS, POWERS, ROOTS (SQUARE ROOTS), HYPOTENUSE, VARIABLE

Formulas and Procedures:

Find Square Roots:

3in.



3in.

Nearest Estimation Method to find Square Root:

1. Pick two perfect squares around number to be square rooted, one below and one above (Two perfect squares below and above 7 are 4 and 9)
2. Since 7 is closer to 9 than it is to 4, then $\sqrt{7}$ must be between $\sqrt{4} = 2$ and $\sqrt{9} = 3$, but closer to $\sqrt{9} = 3$.
3. An estimate around 2.6 to 2.7 would be fine.

Teacher's Script - Comparing and Contrasting

Although the eligible content descriptor requires the student find the square root of an integer, such as 2, 3, 44, etc., many real life examples include non-integer numbers. In the drafting examples on page 3, the student must find the square root of numbers in decimal form.

When taking the square root of a number, the answer can actually be + or -. So the square root of 4 is actually ± 2 because square root answers the question "What number do I multiply by itself to get the number under the root?" In this case "2 times 2 = 4 AND -2 times -2 = 4. In most real life applications of square root, the value needed is a measurement so we only concern ourselves with the positive value.

Common Mistakes Made By Students

- Unfamiliar with the calculator – students who borrow calculators or keep switching between styles and models have to continually determine how to enter the square root of a number. Suggestion: Try computing the square root of 4 on a calculator. You know the answer is 2. If you do not get the answer of 2, you have input the entered the information into the calculator incorrectly.
- Estimation – most errors from estimation without a calculator will come from not knowing perfect squares or not being able to find the middle between other values quickly and easily.
- Students often think that finding the square root means dividing by two.

Lab Teacher's Extended Discussion

Machine design often requires tolerances up to four decimal places or more. In order to calculate dimensions of angled areas, students must be able to calculate square roots. Remember, if the information on the drawing is complete and accurate, the resultant product will be correct assuming the machinist manufactures the item as designed.

In addition, it is not the job of the machinist to calculate missing dimensions. This should be done by the individual doing the drafting to prevent errors and save time.

Problems	Occupational (Contextual) Math Concepts	Solutions
1. You are designing an above ground planter box 12' wide by 16" long. To check for square, how many feet must the "corner to corner" measurement equal?		
2. The diagonal measurement of a room (c) is 17' and one wall (a) is 24' long, how long is the other wall (b)?		
3. To determine property setback, you need to calculate the height of the berm that is 12" from the property line and has a hypotenuse of 15". How high is the berm?		
Problems	Related, Generic Math Concepts	Solutions
4. You want to draw a square box and fill it with 144 1-inch squares, how many inches must each side of your square box measure?		
5. You want to build a square garden box for growing tomatoes. If each tomato plant needs 2 square feet and you want 4 plants, what is the dimension of each side of the box?		
6. In celebration of your town's 200th birthday, you are given permission to paint a large image of the town's founder on the side of Town Hall. The town council stipulates that the mural must be square so that it fits in with other artists' work. They tell you that you will have 140 square feet of "canvas" on which to paint. How tall can your image of the founder be drawn (assuming the founder is not shown leaning diagonally)?		

Drafting (15.1301) T-Chart

Problems	PA Core Math Look	Solutions
7. Find $\sqrt{324}$ A. 16 B. 17 C.18 D.19		
8. Which of the following is the approximate value of $\sqrt{5}$ A. 3.4 B. 2.5 C. 2.2 D. 1.8		
9. Find $\sqrt{1144900}$ A. 1060 B. 1070 C.1080 D.1090		

Problems	Occupational (Contextual) Math Concepts	Solutions
1. You are designing an above ground planter box 12' wide by 16" long. To check for square, how many feet must the "corner to corner" measurement equal?		$a^2 + b^2 = c^2$ where $a=16'$ & $b=12'$ $16^2 + 12^2 = c^2 \rightarrow 256 + 144 = 400$ $c^2 = 400 \rightarrow c = \sqrt{400} \rightarrow c = 20'$
2. The diagonal measurement of a room (c) is 17' and one wall (a) is 24' long, how long is the other wall (b)?		$a^2 + b^2 = c^2$ where $a = 17'$ & $c = 24'$ $a^2 + b^2 = c^2 \rightarrow 17^2 + b^2 = 24^2$ $289 + b^2 = 576 \rightarrow = 576 - 289$ $b = \sqrt{287}$ (rounded) the room is 17'X17'
3. To determine property setback, you need to calculate the height of the berm that is 12" from the property line and has a hypotenuse of 15". How high is the berm?		$a^2 + b^2 = c^2$ where $b = 12'$ & $c = 15'$ $a^2 + b^2 = c^2 \rightarrow a^2 + 12^2 = 15^2$ $a^2 + 144 = 225 \rightarrow a^2 = 225 - 144$ $a^2 = 81 \rightarrow \sqrt{81}$ $a = 9'$ The berm is 9" high

Problems	Related, Generic Math Concepts	Solutions
4. You want to draw a square box and fill it with 144 1-inch squares, how many inches must each side of your square measure?		Find the square root of 144 (inches). Ans: The box should be 12 inches on all sides.
5. You want to build a square garden box for growing tomatoes. If each tomato plant needs 2 square feet and you want 4 plants, what is the dimension of each side of the box?		4 plants at 2 ft. by 2 ft. per plant = 4 plants at 4 square ft. per plant or 16 square ft. Your box dimensions are the square root of 16, or 4 ft. per side.
6. In celebration of your town's 200th birthday, you are given permission to paint a large image of the town's founder on the side of Town Hall. The town council stipulates that the mural must be square so that it fits in with other artists' work. They tell you that you will have 140 square feet of "canvas" on which to paint. How tall can your image of the founder be drawn (assuming the founder is not shown leaning diagonally)?		Find the square root of 140. Answer: about 11.83 feet tall, or about 11' 10" tall.

Problems	PA Core Math Look	Solutions
7. Find $\sqrt{324}$ A. 16 B. 17 C.18 D.19		C. 18
8. Which of the following is the approximate value of $\sqrt{5}$ A. 3.4 B. 2.5 C. 2.2 D. 1.8		C. 2.2
9. Find $\sqrt{1144900}$ A. 1060 B. 1070 C.1080 D.1090		B. 1070