

**FIND UNKNOWN MEASUREMENT = FIND MISSING LENGTH**

**Program Duty:** 500 Site Preparation And Layout

**POS:** 505 Stake out a building foundation using the Pythagorean Theorem

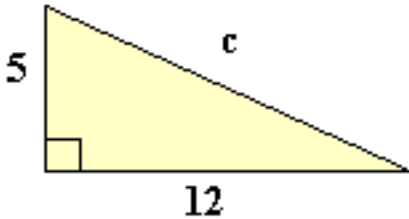
**Program Associated Vocabulary:**  
 PYTHAGOREAN THEOREM, PERIMETER, OPPOSITE OPERATIONS, POWERS, ROOTS (SQUARE ROOTS), VARIABLE, 3-4-5

**Program Formulas and Procedures:**

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

(the Hypotenuse) is the longest side

**Example 1:**

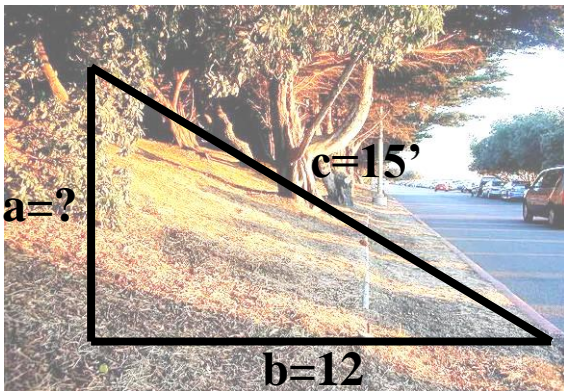


$$a^2 + b^2 = c^2 \text{ where } a = 3, b = 4$$

$$3^2 + 4^2 = 5^2 \quad 9 + 16 = 25$$

**Example 2:**

To determine setback, you need to calculate the height of the berm (a) pictured below:



$$a^2 + b^2 = c^2 \text{ where } b = 12' \text{ \& } c = 15'$$

$$a^2 + b^2 = c^2 \rightarrow a^2 + 12^2 = 15^2$$

$$a^2 + 144 = 225 \rightarrow a^2 = 225 - 144$$

$$a^2 = 81$$

$a = 9'$  The berm is 9' high

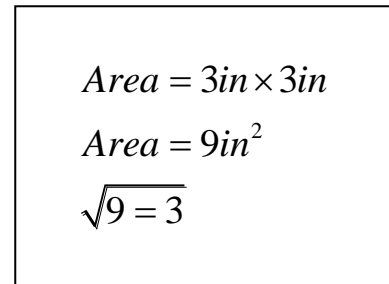
**Common Core Standards:** CC.2.3.HS.A.6

**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), VARIABLE, HYPOTENUSE

**Find Square Roots:**

3in.



3in.

**Formulas and Procedures**

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.

## Carpentry (46.0201) T-Chart

### Teacher's Script - Comparing and Contrasting

Finding square roots of numbers is not an isolated skill for carpenters. Carpenters must be able to use the Pythagorean Theorem, find the square root of the measurement (which often is not an integer), and then must be able to convert that measurement to feet, inches, and fractional inches. For example, sample problem #1, on page 3, yields an answer of 18.601 feet. In math class, we might round that to 18.6 feet. A carpenter must be able to convert the decimal part of the answer to inches and fractions of an inch, such as 18' 7 3/16".

### Common Mistakes Made By Students

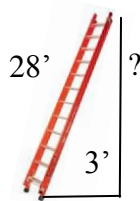
- Unfamiliar with the calculator – students who borrow calculators or keep switching between styles and models have to continually determine how to enter the square root of a number. Suggestion: try calculating a simple square root using the calculator. For example, you know that the square root of 4 is 2. If your answer is not 2, then you have input the information incorrectly into the calculator.
- 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

The reason that carpenters use Square Root and need to solve the answer to the closest 1/16 of an inch is because the building needs to be built square. Using the Pythagorean Theorem when laying out the foundation plan or floor plan will produce an accurate and square building.

# Carpentry (46.0201) T-Chart

Problems	Occupational (Contextual) Math Concepts	Solutions
1. You are building an above ground planter box 6' wide by 8' 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 12' long, how long is the other wall (b)?		
3. The bottom of a 28' ladder (c) is placed 3' (b) from the base of a wall. If the top of the ladder is touching the top of the building (not protruding above the wall) how high is the wall?		
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)?		
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 building an above ground planter box 6' wide by 8' long. To check for square, how many feet must the "corner to corner" measurement equal?	$a^2 + b^2 = c^2$ where $a=6'$ & $b=8'$ $6^2 + 8^2 = c^2 \rightarrow 36 + 64 = 100$ $c^2 = 100 \rightarrow c = \sqrt{100}$ $c = 10'$	
2. The diagonal measurement of a room (c) is 17' and one wall (a) is 12' long, how long is the other wall (b)?	$a^2 + b^2 = c^2$ where $a = 12'$ & $c = 17'$ $a^2 + b^2 = c^2 \rightarrow 12^2 + b^2 = 17^2$ $144 + b^2 = 289 \rightarrow b^2 = 289 - 144$ $b = 145 \rightarrow \sqrt{145} = (\text{rounded})$ the room is 12'X12'	
3. The bottom of a 28' ladder (c) is placed 3' (b) from the base of a wall. If the top of the ladder is touching the top of the building (not protruding above the wall) how high is the wall?	 $a^2 + b^2 = c^2 \rightarrow 3^2 + b^2 = 28^2$ $b^2 = 784 - 9 \rightarrow b^2 = 775$ $b = \sqrt{775} \rightarrow b = 27.838'$	

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). Answer: 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. <b>Answer:</b> 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	