

Find square root for construction formulas

Apply the properties of rational and irrational numbers to solve real-world or mathematical problems

Program Task: Determine unknown variables using the Pythagorean Theorem.

PA Core Standard: CC.2.1.HS.F.2

Program Associated Vocabulary:
SQUARE ROOT, HYPOTENUSE

Description: Apply the properties of rational and irrational numbers to solve real-world or mathematical problems.

Math Associated Vocabulary:
SQUARE ROOT

Program Formulas and Procedure:

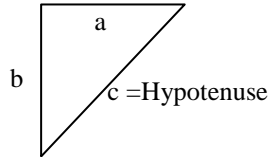
Electricians must be able to use the Pythagorean Theorem to find missing variables. These missing variables must be known to help expedite a job. The last step of the Pythagorean Theorem requires that the student be able to take the square root of a number.

Formulas and Procedures:

Find Square Root:

Example:

If the two known supports (a and b) of a transformer bracket measure 4.5 feet each, what is the measurement for the side needed for the hypotenuse (c)?



$$a^2 + b^2 = c^2$$

$$4.5^2 + 4.5^2 = c^2$$

$$20.25 + 20.25 = c^2$$

$$40.5 = c^2$$

$$\sqrt{40.5} = \sqrt{c^2}$$

$$\sqrt{40.5} = c$$

$$c = 6.36 \text{ feet}$$

Example:

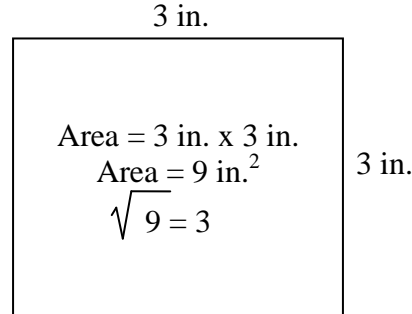
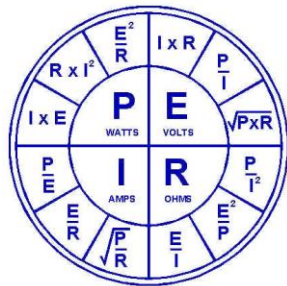
Calculate the amps if a circuit is producing 120 watts and 4 ohms of resistance.

$$I = \sqrt{\frac{P}{R}}$$

$$I = \sqrt{\frac{120}{4}}$$

$$I = \sqrt{30}$$

$$I = 5.478 \text{ amps}$$



Nearest Estimation Method to find Square Root:

1. Pick two perfect squares which are close (in value) to the 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.

Instructor's Script – Comparing and Contrasting

Any career area that uses the Pythagorean Theorem must also consider this eligible content item because taking the square root of a number is the last step in the process.

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 know how to take the square root of 4. Some calculators require the student to press the number 4 then the square root button, and others require the square root button before the number 4.

Confusing the \sqrt{x} Button and the $\sqrt{\quad}$ Button – Scientific calculators will have a \sqrt{x} Button and the $\sqrt{\quad}$ Button. The \sqrt{x} Button is used for calculating other roots like a cubed root. Square roots must be found using the $\sqrt{\quad}$ Button.

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.

Confusing Square Root and Dividing by Two - Students often think that finding the square root means dividing by two.

CTE Instructor's Extended Discussion

Although it seems to be a simple math problem, being able to solve for a square root is an important part of an electricians' job.

Electrical (46.0399) T-Chart

Problems	Career and Technical Math Concepts	Solutions
1. An extension ladder is raised to the roof of a building that measures 27 feet. The ladder extends past the roof line by 3 feet. OSHA Standards require the base of the ladder should be away from the building 7.5 feet. What is the exact measurement of the ladder as it is extended?		
2. Given the formula $P = R \times I^2$ calculate the current of a circuit producing 120 watts and 4 ohms of resistance.		
3. A lineman in a bucket truck is working on an electrical cut-out that is positioned on top of a 50 foot pole. The bucket truck is positioned 31 feet from the base of the pole. How far must the bucket be extended to enable the lineman to reach his work?		
Problems	Related, Generic Math Concepts	Solutions
4. You want to draw a square box and fill it with 144 one-inch squares, how many inches must each side of your square measure?		
5. A square garden box has an area of 8 square units. What is the length of a side of the square to the nearest tenth?		
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 in the bigger picture. They tell you that you will have 140 square feet of "canvas" on which to paint. What is the maximum height that your image can be 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. $Z = \sqrt{31.25}$ Solve for Z. a) 31.25 b) 5.6 c) 6.6 d) 5.1		

Problems	Career and Technical Math Concepts	Solutions
1. An extension ladder is raised to the roof of a building that measures 27 feet. The ladder extends past the roof line by 3 feet. OSHA Standards require the base of the ladder should be away from the building 7.5 feet. What is the exact measurement of the ladder as it is extended?	$A^2 + B^2 = C^2$ $27^2 + 7.5^2 = C^2$ $729 + 56.25 = 785.25^2$ $\sqrt{785.25} = 28$ ft. Answer = 28 + 3' (ladder extension) = 31'	
2. Given the formula $P = R \times I^2$ calculate the current of a circuit producing 120 watts and 4 ohms of resistance.	$P = R \times I^2 \rightarrow 120 = 4 \times I^2$ $\frac{120}{4} = \frac{4 \times I^2}{4} \rightarrow 30 = I^2$ $\sqrt{30} = \sqrt{I^2} \rightarrow 5.478$ amps = I	
3. A lineman in a bucket truck is working on an electrical cut-out that is positioned on top of a 50 foot pole. The bucket truck is positioned 31 feet from the base of the pole. How far must the bucket be extended to enable the lineman to reach his work?	$A^2 + B^2 = C^2$ $50^2 + 31^2 = C^2$ $2500 + 961 = 3461^2$ $\sqrt{3461} = 58.8$ ft. Answer = 60 ft.	
Problems	Related, Generic Math Concepts	Solutions
4. You want to draw a square box and fill it with 144 one-inch squares, how many inches must each side of your square measure?		Find the square root of 144 inches. The box should be 12 inches on all sides.
5. A square garden box has an area of 8 square units. What is the length of a side of the square to the nearest tenth?		A square has 4 equal sides so $s^2 = 8$. A side = $\sqrt{8}$ 8 is between 4 and 9, and much closer to 9. So $\sqrt{8}$ is between 2 and 3, much closer to 3.
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 in the bigger picture. They tell you that you will have 140 square feet of "canvas" on which to paint. What is the maximum height that your image can be assuming the founder is not shown leaning diagonally?		Find the square root of 140. The painting can be 11.83 feet tall, or just under 11' 10" tall. .83' = 9.96"
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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. $Z = \sqrt{31.25}$ Solve for Z. a) 31.25 b) 5.6 c) 6.6 d) 5.1		b) 5.6