Carpentry (46.0201) T-Chart

Find centerlines of window openings using a tape measure	=	**Apply the properties of rational and irrational numbers to solve real-world or mathematical problems**

Program Task: Find the center line on the top and bottom plates of 4 windows equally spaced on a length of a wall.
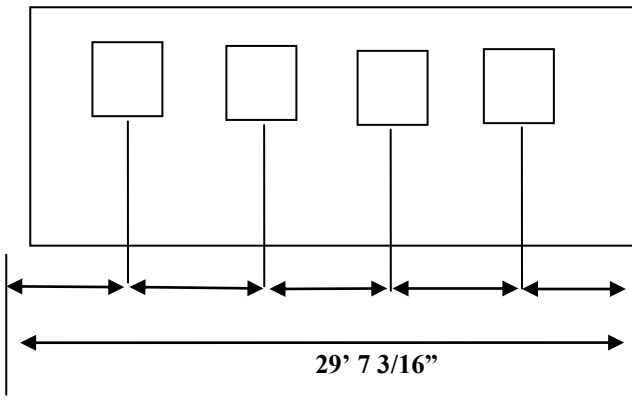
PA Core Standard: CC.2.1.HS.F.2

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

Program Associated Vocabulary:
DIMENSION, FRACTION, INCH, WIDTH

Math Associated Vocabulary:
IRRATIONAL NUMBER, SQUARE ROOT, PI

Program Formulas and Procedures:
Carpenters will be given a length of a wall and will be required to equally space out centerlines of four windows. Each window will need to be an equal distance apart. The length of the wall will be located on the floor plan. With the length of the wall, the carpenter will need to divide the wall length by 5.

Using a tape measure, the carpenter will mark the center dimension of the windows on the top and bottom plates.

Formulas and Procedures:
Irrational Number: a non-repeating & non-terminating decimal number that cannot be written as a fraction.

π: The number π is a mathematical constant, commonly approximated as 3.14159.

Square Root: The square root of a number is a number which, when multiplied by itself, yields that original number.

Example 1: Locate the following numbers on a number line. $\sqrt{2}, \sqrt{5}, \pi$
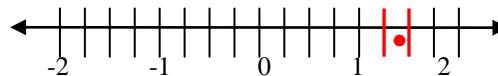
General steps:

1. Rewrite the number as a decimal to the nearest tenth or hundredth digit.
2. Use marks (1/4, 1/2, 3/4,) to approximate the location on the number line.

Example 2: Identify $\sqrt{2}$ on the number line below:

$\sqrt{2} = 1.41421356237\ldots \approx 1.41$

1.41 is between 1.25 and 1.5, but closer to 1.5.

29' 7 3/16"

Example:

Wall Length $= 29'\ 7\ 3/16''$

$7\ 3/16'' = 7.1875'' \rightarrow 7.1875' \div 12 = 0.5989583'$

$29 + 0.5989583' = 29.5989583'$

$29.5989583' \div 5 = 5.9197916'$

Rewrite the number to the nearest hundredth digit

$5.9197916' \longrightarrow 5.920'$

Convert into feet and inches
$5.92'$

$0.92 \times 12 = 11.04''$

$0.04 \times 16 = 0.64 (round)$

$5.92' = 5'11\ 1/16''$

Using a tape measure, start from the end of the wall plates and place centers mark every 5' 11 1/16" apart.

Instructor's Script - Comparing and Contrasting
In Carpentry, you often must compute square roots of measurements. It is not unusual to work with irrational numbers, which are non-repeating and non-terminating decimals; these numbers must be converted into measurable units. In the example provided on page 1 of the Carpentry T-Chart, the measurement (5.9197916) is not an irrational number. But this problem still serves as a great example, because in locating and/or identifying irrational numbers at their approximate location on the number line, one must be able to round the irrational number to locate its position on the number line. The number, 5.9197916, must be rounded and then the decimal equivalent converted to inches and fractions of an inch.

Common Mistakes Made By Students
Taking the square root of a number: This mostly occurs when the student is unfamiliar with a calculator. Some calculators require the student to press the number then the square root button; others require that the square root button is pressed before the number. It may be important to show students to take the square root of 4, using both methods to evaluate which order gives the correct answer of 2.
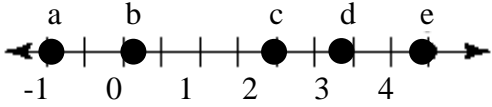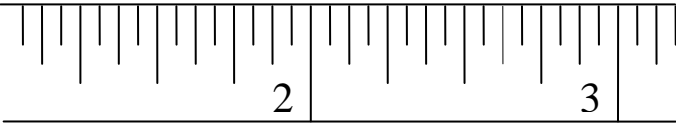
Using the appropriate rounding technique for the given situation: In most cases, it is beneficial to round the number to the nearest hundredth. If the number line is broken into quarters, thirds, or tenths, then rounding the number to the closest hundredth would provide the information necessary to correctly identify the number's location.
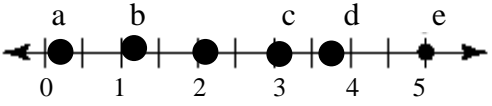
Being able to partition a number line and identify the location of the decimal number: Sometimes the number line uses integer values only (…,-2, -1, 0, 1, 2, 3…). In this case, the student must be able to mentally divide the space between the integers into quarters or thirds to best approximate the location of the irrational number.
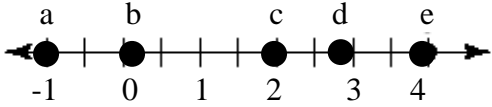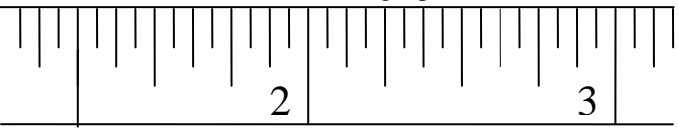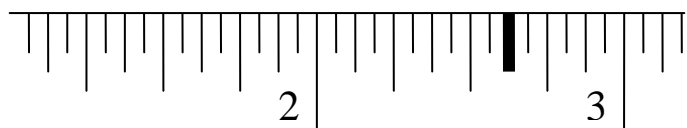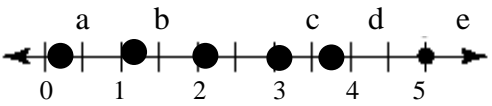
CTE Instructor's Extended Discussion
If carpenters square root or divide a number and the solution is an irrational number, rewrite the number as a decimal to the nearest hundredth digit. Then solve to the closest 1/16" of an inch.

Carpentry (46.0201) T-Chart

	Problems — Career and Technical Math Concepts	Solutions
1.	A 3'x2' kitchen window is to be placed in the center of a wall that measures 18' 5' long. How far will you measure from the corner to place the left side of the window? Convert the answer in feet and inches	
2.	A concrete foundation is 6'x13'. You calculate a diagonal to be $\sqrt{205}$. Convert the value to closet 1/16" of an inch.	
3.	When staking out a building to excavate, a one inch tolerance is acceptable. The diagonal measures 11' 1 ½". The correct diagonal measurement is $= \sqrt{125}$. Is the 11' 1 ½" measurement within the 1" tolerance?	

	Problems — Related, Generic Math Concepts	Solutions
4.	The location of $\sqrt{8}$ is closest to which point on the number line below?	
5.	What can't the square root of Pi be a rational number?	
6.	Using the Pythagorean Theorem, a student finds that she needs $\sqrt{7}$ inches of material. Identify the location of this measurement on the measuring tape below.	

Problem 4 number line:

a   b   c   d   e
-1   0   1   2   3   4

Problem 6 measuring tape:

2   3

	Problems — PA Core Math Look	Solutions
7.	Which of the following numbers would be located between 9 and 10 on the number line? a) 2π b) 3π c) $2\sqrt{5}$ d) $5\sqrt{2}$	
8.	The location of $\sqrt{13}$ is closest to which point on the number line below?	
9.	Which of the following would be closest to the value of $\sqrt{8}$? a) 2 ¾ b) 3 ¼ c) 4 d) 2 ½	

Problem 8 number line:

a   b   c   d   e
0   1   2   3   4   5

Problems	Career and Technical Math Concepts	Solutions
1. A 3'x2' kitchen window is to be placed in the center of a wall that measures 18' 5"long. How far will you measure from the corner to place the left side of the window? Convert the answer in feet and inches.	$18'5'' = 18 \times 12 + 5 = 221'' \rightarrow 221'' \div 2 = 100.5''$ center point of wall $3' \times 12 = 36'' \rightarrow 36'' \div 2 = 18''$ center point of window $100.5'' - 18'' = 82.5''$ $82.5'' \div 12 = 6.875' \rightarrow 0.875 \times 12 = 10.5''$ The left corner of the window should be placed at 6'10 ½"	
2. A concrete foundation is 6'x13'. You calculate a diagonal to be $\sqrt{205}$. Convert the value to closet 1/16" of an inch.	$\sqrt{205} = 14.3178'$ $.3178 \times 12 = 3.814''$ $.814 \times 16 = 13.024 \approx 13$ $\sqrt{205} = 14.3178' = 14' \ 3 \ 13/16''$	
3. When staking out a building to excavate, a one inch tolerance is acceptable. The diagonal measures 11' 1 ½". The correct diagonal measurement is $= \sqrt{125}$. Is the 11' 1 ½" measurement within the 1" tolerance?	$\sqrt{125} = 11.180'$ $.180 \times 12 = 2.16''$ $.16 \times 16 = 2.56 \approx 3$ $\sqrt{125} = 11.180' = 11' \ 2 \ 3/16''$ 11' 2 3/16" minus the 1" tolerance is 11' 1 3/16". The diagonal of 11' 1 ½" is between those two measurements so it is within specifications.	

Problems	Related, Generic Math Concepts	Solutions
4. The location of $\sqrt{8}$ is closest to which point on the number line below?	d. $\sqrt{8} = 2.828$	
5. What can't the square root of Pi be a rational number?	Because Pi is an irrational number, and any rational number squared would produce a rational number.	
6. Using the Pythagorean Theorem, a student finds that she needs $\sqrt{7}$ inches of material. Identify the location of this measurement on the measuring tape below.	Since $\sqrt{7} = 2.645751....$, We round to 2.65 inches. $\frac{6}{10} = \frac{x}{16} \rightarrow 6(16) = 10x \rightarrow 96 = 10x \rightarrow 9.6 = x$, $2^{10}/_{16}$	

Problems	PA Core Math Look	Solutions
7. Which of the following numbers would be located between 9 and 10 on the number line? a) 2π b) 3π c) $2\sqrt{5}$ d) $5\sqrt{2}$	b. 3π	
8. The location of $\sqrt{13}$ is closest to which point on the number line below?	d. $\sqrt{13} \approx 3.61$	
9. Which of the following would be closest to the value of $\sqrt{8}$? a) 2 ¾ b) 3 ¼ c) 4 d) 2 ½	a. 2 ¾ $\sqrt{8} \approx 2.828$	