

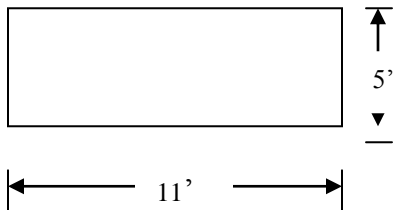
<b>Estimate material and labor cost including overhead and profit</b>	<b>Write functions or sequences that model relationships between two quantities</b>
---	---

**Program Task:** Estimate the material and labor cost for the installation of a hardwood floor. The cost estimate will include a 15% markup on the material and labor cost for overhead and profit.

**Program Associated Vocabulary:**  
ESTIMATE, PERCENTAGE, SQUARE FEET, UNIT PRICE

**Program Formulas and Procedures:**  
If a carpenter is hired to do a job, one of their duties is to estimate material and labor cost. The carpenter will add a percentage after the cost of the labor and material are added together for overhead and profit.

**Example:**  
A carpenter knows he can install 10 sq. ft. of flooring in 2 hours. The job is for 55 sq. ft. of flooring. How many hours will it take him to install the flooring?



$$\frac{10 \text{ sq.ft.}}{2 \text{ hr.}} = \frac{55 \text{ sq.ft.}}{x \text{ hr.}}$$

$$10x = 55 \times 2$$

$$10x = 110$$

$$\frac{10x}{10} = \frac{110}{10}$$

$$x = 11 \text{ hours}$$

The carpenter will charge \$35.50 per hour to install the flooring, what is the labor cost?

$$11 \text{ hours} \times \$35.50 \text{ per hour} = \$390.50.$$

The material cost for the flooring is \$4.57 per sq. ft., how much will the flooring material cost?

$$55 \text{ sq. ft.} \times \$4.57 = \$251.35$$

The total cost for the job will include the labor cost plus the material cost and 15 % for overhead and profit. What is the total cost for the hardwood floor?

$$(\text{Labor cost} + \text{material cost}) \times 15\% = \text{total cost}$$

$$(\$390.50 + \$251.35) \times 15\% = \text{total cost}$$

$$\$641.85 \times .15 = \$96.27$$

$$\$641.85 + \$96.27 = \$738.12$$

$$\text{Total cost} = \$738.12$$

**PA Core Standard:** CC.2.2.HS.C.3

**Description:** Write functions or sequences that model relationships between two quantities.

**Math Associated Vocabulary:**  
RATIO, PROPORTION, CROSS MULTIPLY, SCALE, COEFFICIENT

**Formulas and Procedures:**  
**A proportion states that two ratios are equal.**

$$\frac{a}{b} = \frac{c}{d}$$

**Example:**  
Girls outnumber boys 5 to 3. If there were 21 boys in the class, how many girls would one expect to find?

**Steps:**  
1. Identify the proportional relationship and label the units:

$$5 \text{ girls to } 3 \text{ boys} : \frac{5 \text{ girls}}{3 \text{ boys}}$$

2. Set up the proportional relationship, using a variable for the missing value.

$$\frac{5 \text{ girls}}{3 \text{ boys}} = \frac{x \text{ girls}}{21 \text{ boys}}$$

3. Cross multiply.  
 $(5)(21) = 3x \rightarrow 105 = 3x$

4. Divide by the coefficient.

$$\frac{105}{3} = x \quad x = 35$$

One would expect to find 35 girls.

### **Instructor's Script - Comparing and Contrasting**

The example provided on the carpentry side of the T-chart shows a complex problem where multiple rates are used. First, the rate describing the amount of flooring a carpenter can install in a given time must be used to calculate the total number of hours needed for labor. Second, the hourly rate of the carpenter is used to calculate total labor costs. Then the cost per square foot of material is used to calculate the cost of materials. Lastly, the total cost of the job must be marked up 15% so that the carpenter can see a profit.

### **Common Mistakes Made By Students**

**Students do not write each ratio consistently.** For example, students may write hours/minutes = minutes/hours.

**Conversions of units:** In many cases, the student must convert between units before setting up the proportion. For example, if one ratio is money per hour and the student must use that ratio to set up a proportion to solve for money in a given number of days, the student must convert the number of days to hours before proceeding

### **CTE Instructor's Extended Discussion**

Carpenters who are self employed use multi-step and multiple procedure operations when estimating jobs for cost.

# Carpentry (46.0201) T-Chart

<b>Problems</b>	<b>Career and Technical Math Concepts</b>	<b>Solutions</b>
1. If the flooring area to be covered equals 144 sq. ft., and the material cost equals \$5.00 per sq. ft., how much does the flooring material cost? Add 17% for profit on the materials.		
2. Each box of flooring will cover 20 sq. ft.; each box costs \$65.00. If the flooring area to be covered equals 168 sq. ft., how many boxes of flooring are needed and how much will the material cost? Add 6% for sales tax.		
3. A worker can install 2 windows every 45 minutes and is paid \$15 per window. How much money does he make in a 9 hour shift?		
<b>Problems</b>	<b>Related, Generic Math Concepts</b>	<b>Solutions</b>
4. One oil change takes $\frac{1}{4}$ hr. How many changes can be done in an hour?		
5. Luke can print five posters in 15 minutes. How many can he print in one hour?		
6. Mark works 35 hours and makes \$420. How much does he make if he works 25 hours at the same rate?		
<b>Problems</b>	<b>PA Core Math Look</b>	<b>Solutions</b>
7. Vincent buys four burgers for \$ 20. What is the cost of 10 burgers?		
8. There are 27 pairs of shoes in a case. How many pairs are there in 12 cases?		
9. Margie can buy seven shirts for \$94.50. What would it cost if she only bought four?		

# Carpentry (46.0201) T-Chart

Problems	Career and Technical Math Concepts	Solutions
1. If the flooring area to be covered equals 144 sq. ft., and the material cost equals \$5.00 per sq. ft., how much does the flooring material cost? Add 17% for profit on the materials.	$\frac{\$5.00}{1 \text{ sq.ft.}} = \frac{x \text{ dollars}}{144 \text{ sq.ft.}} \rightarrow x = \$720$	Profit = $0.15 \times \$720 = \$108 \rightarrow \$720 + \$108 = \$828$
2. Three boxes of flooring will cover 45 sq. ft.; each box costs \$65.00. If the flooring area to be covered equals 168 sq. ft., how many boxes of flooring are needed and how much will the material cost? Add 6% for sales tax.	$\frac{45 \text{ sq.ft.}}{3 \text{ boxes}} = \frac{168 \text{ sq.ft.}}{x \text{ boxes}} \rightarrow 45x = 504 \rightarrow \frac{45x}{45} = \frac{504}{45}$	$x = 11.2 \rightarrow 12 \text{ boxes} \rightarrow 12 \text{ boxes} \times \$65.00 = \$780$ Sales Tax = $0.06 \times \$780 = \$46.80 \rightarrow \text{Total} = \$780 + \$46.80 = \$826.80$
3. A worker can install 2 windows every 45 minutes and is paid \$15 per window. How much money does he make in a 9 hour shift?	$\frac{\$15 \text{ dollars}}{45 \text{ min.}} = \frac{x \text{ dollars}}{540 \text{ min.}} \rightarrow 45x = 16200$	$\$15 \text{ dollars} \times 2 \text{ windows} = \$30 \text{ every } 45 \text{ minutes}$ $9 \text{ hours} \times 60 \text{ min.} / \text{hr.} = 540 \text{ min.}$ $\frac{45x}{45} = \frac{16200}{45} \rightarrow x = \$360$
Problems	Related, Generic Math Concepts	Solutions
4. One oil change takes $\frac{1}{4}$ hr. How many changes can be done in an hour?	$\frac{\frac{1}{4} \text{ hr.}}{1 \text{ oil change}} = \frac{1 \text{ hr.}}{x \text{ oil changes}} \rightarrow \frac{1}{4}x = 1$	$(4)\frac{1}{4}x = 1(4) \rightarrow x = 4$
5. Luke can print five posters in 15 minutes. How many can he print in one hour?	$\frac{5 \text{ posters}}{15 \text{ minutes}} = \frac{x \text{ posters}}{60 \text{ minutes}}$	$15x = 5(60)$ $15x = 300$ $x = 20 \text{ posters}$
6. Mark works 35 hours and makes \$420. How much does he make if he works 25 hours at the same rate?	$\frac{35 \text{ hrs.}}{\$420} = \frac{25 \text{ hrs.}}{\$x}$	$35x = 425(25)$ $35x = 10,500$ $x = \$300.00$
Problems	PA Core Math Look	Solutions
7. Vincent buys four burgers for \$ 20. What is the cost of 10 burgers?	$\frac{4}{\$20} = \frac{10}{\$x}$	$20(10) = 4x$ $200 = 4x$ $x = \$50$
8. There are 27 pairs of shoes in a case. How many pairs are there in 12 cases?	$\frac{27 \text{ pairs}}{1 \text{ case}} = \frac{x \text{ pairs}}{12 \text{ cases}}$	$1x = 27(12)$ $x = 324 \text{ pairs}$
9. Margie can buy seven shirts for \$94.50. What would it cost if she only bought four?	$\frac{7 \text{ shirts}}{\$94.50} = \frac{4 \text{ shirts}}{\$x}$	$7x = 94.50(4)$ $7x = 378.00$ $x = \$54$