

## AM: WP: Variation Problems

2. The price per person of renting a bus varies inversely with the number of people renting the bus. It costs \$13 per person if 66 people rent the bus. How much will it cost per person if 94 people rent the bus?

[A] \$18.52

[B] \$9.13

[C] \$6.04

[D] \$477.23

$P$  price per person      output \$13      ?  
 $n$  number of people      input 66      94  
 $k$  constant of variation      858

$$P = \frac{k}{n}$$

$$66 \cdot 13 = \frac{k}{66}$$

$$k = 858$$

$$P = \frac{858}{n}$$

$$P = \frac{858}{94}$$

$$P = 9.13$$

28

Slide 2-39

## AM: WP: Variation Problems

4. According to Ohm's Law, the electric current  $I$ , in amperes, in a circuit varies directly as the voltage  $V$ . When 35 volts are applied, the current is 5 amperes. What is the current when 49 volts are applied?

$I$	electric current (amp)	5	?
$V$	voltage (volts)	35	49
$k$	<u>constant of variation</u>	$\frac{1}{7}$	$\frac{1}{7}$

$$V = k \cdot I$$

$$35 = k \cdot 5$$

$$7 = k$$

$$I = k \cdot V$$

$$\frac{5}{35} = k \cdot \frac{35}{35} \quad \frac{1}{7} = k$$

$$I = \frac{1}{7} \cdot 49$$

$$I = 7 \text{ amps}$$



## AM: Solve direct- and indirect- variation problems

2. If  $a$  varies inversely as the square of  $b$ , and  $a$  is  $\frac{3}{64}$  when  $b$  is 8, find  $a$  when  $b$  is 4.

[A]  $\frac{3}{256}$

[B]  $-\frac{253}{64}$

[C]  $\frac{3}{128}$

[D]  $\frac{3}{16}$

$a$  output  
 $b$  input  
 $k$  constant  
 $a = \frac{k}{b^2}$

$8^2 \cdot \frac{3}{64} = \frac{k}{8^2}$   
 $3 = k$

$a = \frac{3}{b^2}$   
 $a = \frac{3}{4^2} = \frac{3}{16}$

## AM: Solve direct- and indirect- variation problems

3. On planet X, an object falls 24 feet in 2 seconds. Knowing the distance it falls varies directly with the square of the time of the fall, how long does it take an object to fall 96 feet? Round your answer to three decimal places.
- [A] 4.000 sec      [B] 1.000 sec      [C] 19.596 sec      [D] 27.713 sec

$d$  distance an object falls (feet) output 24 ft  
 $t$  time (seconds) input 2?  
 $k$  constant

$$d = k \cdot t^2$$

$$\frac{24}{2^2} = k \cdot \frac{2^2}{2^2} \Rightarrow b = k$$

$$d = b \cdot t^2$$

$$96 = b \cdot t^2$$

$$|b = t^2$$

29

Slide 2- 44

## AM: Solve joint & combined variation problems

1. Crystal Glass Co. found that the number of their windows sold,  $M$ , varies directly with their advertising budget,  $A$ , and inversely with the price of each window,  $P$ . When \$40,000 is spent on advertising and the price of a window is \$50, then 7200 units are sold. Determine the number of windows sold if the amount of the advertising budget is increased to \$55,000.
- [A] 9540                      [B] 1296                      [C] 1100                      [D] none of these

LO: From the word problem we know that \_\_\_\_\_ varies directly with \_\_\_\_\_ and inversely with \_\_\_\_\_. Therefore the general variation equation is \_\_\_\_\_, because the word \_\_\_\_\_ implies multiplication and \_\_\_\_\_ implies division. To determine the constant of variation substitute  $M =$  \_\_\_\_\_,  $P =$  \_\_\_\_\_, and  $A =$  \_\_\_\_\_ and solve for  $k$ . Finally, if the Crystal Glass Co. increase its advertising to \_\_\_\_\_ and keeps the price fixed at \_\_\_\_\_ per window they can expect to sell \_\_\_\_\_ windows compared with 7200 windows if they spend \_\_\_\_\_.

30

Slide 2- 46



## AM: Solve joint & combined variation problems

4. Crystal Glass Co. found that the number of their windows sold,  $N$ , varies directly with their advertising budget,  $A$ , and inversely with the price of each window,  $P$ . When \$16,000 is spent on advertising and the price of a window is \$80, then 1600 units are sold.
- Write an equation of variation that models this situation.
  - Determine the number of windows sold if the amount of the advertising budget is increased to \$48,000.

$$1600 = k \cdot \frac{16000}{80}$$

$$k = 8$$

$$N = k \cdot \frac{A}{P}$$

LO: From the word problem we know that  $N$  varies directly with  $A$  and inversely with  $P$ . Therefore the general variation equation is \_\_\_\_\_, because the word *direct* implies multiplication and *inverse* implies division. To determine the constant of variation substitute  $N = 1600$ ,  $P = 80$ , and  $A = 16000$  and solve for  $k$ . Finally, if the Crystal Glass Co. increase its advertising to \_\_\_\_\_ and keeps the price fixed at \_\_\_\_\_ per window they can expect to sell \_\_\_\_\_ windows compared with 7200 windows if they spend \_\_\_\_\_.

30

Slide 2- 48

The number of barrels of oil the ship uses to travel \_\_\_\_\_ at \_\_\_\_\_  
is \_\_\_\_\_ barrels. I found this by plugging \_\_\_\_\_ for \_\_\_\_\_ and  
\_\_\_\_\_ for \_\_\_\_\_ into my specific equation \_\_\_\_\_.

$$P=128$$

$$x+y=64$$



$$y=(64-x)$$

$$A=x(y)$$

$$A(x)(64-x)$$

Direct  
 $y = k \cdot x$

$$\frac{y}{x} = k$$

Inverse  
 $y = \frac{k}{x}$

$$x \cdot y = k$$

x						
y						



## Quiz Practice Problem

3. The amount of oil used by a ship traveling at a uniform speed varies jointly with the distance and the square of the speed. If the ship uses 450 barrels of oil in traveling 200 miles at 36 miles per hour, determine how many barrels of oil are used when the ship travels 360 miles at 18 miles per hour.

a. Define the variables.

$A =$  amount of oil (barrels)  
 $d =$  distance (miles)

$q =$  speed (mph)

b. State the completed equation of the situation using your defined variable and  $k$ .

$$A = k \cdot d \cdot q^2$$

c. Find the constant of variation (constant proportion) for the situation.

$$A = 450$$

$$d = 200$$

$$q = 36$$

$$450 = k \cdot 200 \cdot 36^2$$

$$\frac{450}{259200} = \frac{k \cdot 259200}{259200}$$

$$k = \frac{1}{576}$$

$$d) A = \frac{1}{576} \cdot d \cdot q^2$$

$$e) \left. \begin{array}{l} A = ? \\ d = 360 \\ q = 18 \end{array} \right\}$$

$$A = \frac{1}{576} \cdot 360 \cdot 18^2$$

$$A = 202.5 \text{ barrels}$$

The number of barrels of oil the ship uses to travel 360 miles at 18 mph is 202.5 barrels. I found this by plugging 360 for d and 18 for q into my specific equation  $A = \frac{1}{576} \cdot d \cdot q^2$