

## 1.6 Modeling with Functions

Target 1F: Model real world situations and use regressions with the use of functions

## Review of Prior Concepts

1. Write as a mathematical expression: five less than twice a number

$$2x - 5$$

five less than twice a number  
 $5$  subtract  $2x$

2. A small company has \$1000 to distribute to its employees as a bonus. Write a mathematical expression for how much money each employee will get.

$$\frac{1000}{e}$$

divide 1000 by # of employees

## More Practice

## Writing Mathematical Expressions

<https://www.khanacademy.org/math/algebra-basics/core-algebra-expressions/core-algebra-variables-and-expressions/v/writing-expressions-1>

[http://www.learnnc.org/lp/media/uploads/2008/08/9writing\\_expressions.pdf](http://www.learnnc.org/lp/media/uploads/2008/08/9writing_expressions.pdf)

<https://www.youtube.com/watch?v=CfUvzKZgPJQ>

## SAT Connection

## Heart of Algebra

1. Create, solve, or interpret a linear expression or equation in one variable

Example:

If  $16 + 4x$  is 10 more than 14, what is the value of  $8x$ ?

A) 2

B) 6

C) 16

D) 80

$$10 + 14 = 24$$

$$16 + 4x = 24$$

$$4x = 8$$

$$x = 2$$

$$\text{so, } 8x = 8(2) = 16$$

## Solution

## Change English Statements into Mathematical Expression

- Write a mathematical expression for the quantity described verbally.  
 (An expression has no equal sign, and, therefore, can NOT be solved.)

Example 1:

- a) A number  $x$  decreased by six and then doubled.

$$2(x - 6)$$

- b) A salary after a 4.4% increase, if the original salary is  $x$  dollars.

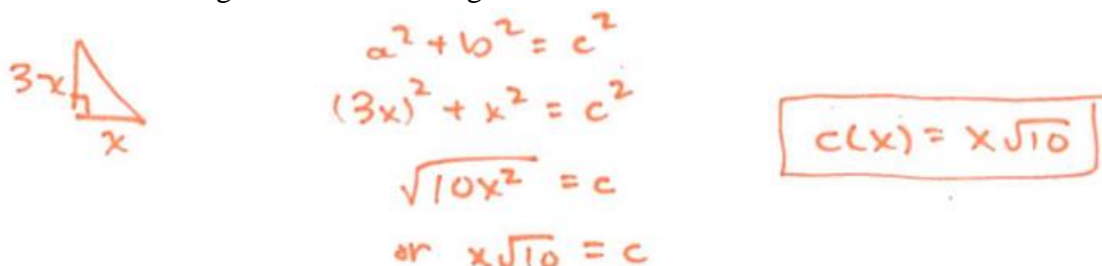
$$x + .044x$$

## Write Equations to Model Given Situations

- Write an equation for each of the following statements.

Example 2:

- a) One leg of a right triangle is three times as long as the other. Write the length of the hypotenuse as a function of the length of the shorter leg.



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

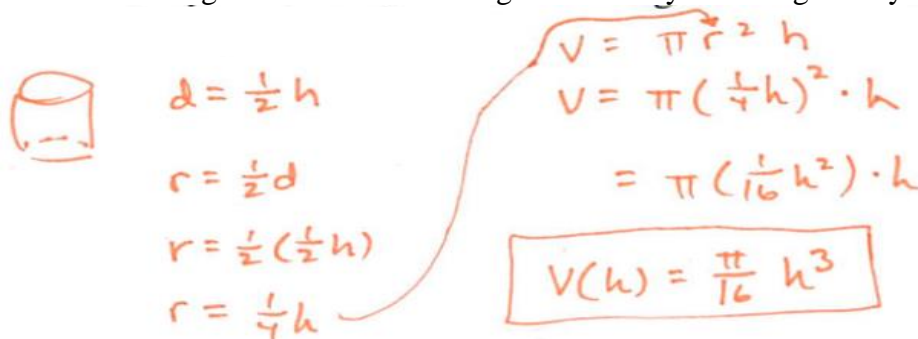
$$(3x)^2 + x^2 = c^2$$

$$\sqrt{10x^2} = c$$

$$\text{or } x\sqrt{10} = c$$

$$c(x) = x\sqrt{10}$$

- b) The diameter of a right circular cylinder equals half its height. Write the volume of the cylinder as a function of its height. The volume of a right circular cylinder is given by  $V = \pi r^2 h$ .



$$d = \frac{1}{2}h$$

$$r = \frac{1}{2}d$$

$$r = \frac{1}{2}\left(\frac{1}{2}h\right)$$

$$r = \frac{1}{4}h$$

$$V = \pi r^2 h$$

$$V = \pi \left(\frac{1}{4}h\right)^2 \cdot h$$

$$= \pi \left(\frac{1}{16}h^2\right) \cdot h$$

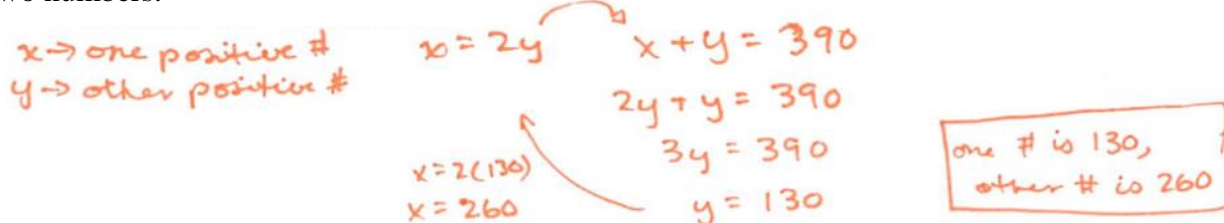
$$V(h) = \frac{\pi}{16}h^3$$

## Use Equations to Solve Percentage and Mixture Problems

- For each statement below, do the following:
  - Write an equation (be sure to define any variables used).
  - Solve the equation, and answer the question.

Example 3:

- a) One positive number is twice another positive number. The sum of the two numbers is 390. Find the two numbers.



$$x \rightarrow \text{one positive \#}$$

$$y \rightarrow \text{other positive \#}$$

$$x = 2y$$

$$x + y = 390$$

$$2y + y = 390$$

$$3y = 390$$

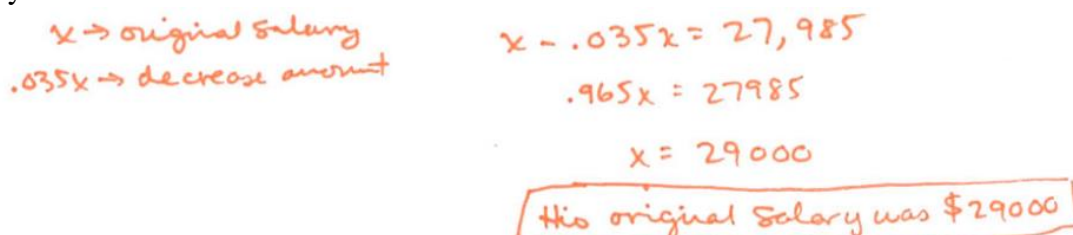
$$y = 130$$

$$x = 2(130)$$

$$x = 260$$

$$\text{one \# is 130, other \# is 260}$$

- b) Joe Pearlman received a 3.5% pay decrease. His salary after the decrease was \$27,985. What was his salary before the decrease?



$$x \rightarrow \text{original salary}$$

$$.035x \rightarrow \text{decrease amount}$$

$$x - .035x = 27,985$$

$$.965x = 27,985$$

$$x = 29,000$$

$$\text{His original salary was \$29,000}$$

- c) Investment returns Jackie invests \$25,000 part at 5.5% annual interest and the balance at 8.3% annual interest. How much is invested at each rate if Jackie receives a 1-year interest payment of \$1571?

$$\begin{aligned}
 x &\rightarrow \text{invested @ 5.5\%} \\
 25000 - x &\rightarrow \text{invested @ 8.3\%} \\
 x(.055) + (25000 - x)(.083) &= 1571 \\
 .055x + 2075 - .083x &= 1571 \\
 -.028x + 2075 &= 1571 \\
 -.028x &= -504 \\
 x &= 18000 \\
 \boxed{\$18000 \text{ invested @ 5.5\%, } \$7000 \text{ invested @ 8.3\%}}
 \end{aligned}$$

- d) The chemistry lab at the University of Ellanoy keeps two acid solutions on hand. One is 20% acid and the other is 35% acid. How much 20% solution and how much 35% acid solution should be used to prepare 25 liters of a 26% acid solution?

$$\begin{aligned}
 \text{one soln} &\rightarrow x \\
 \text{other soln} &\rightarrow y \\
 \text{(g)} \quad .20x + .35y &= .26(25) \rightarrow .20x + .35y = 6.5 \\
 \text{(liters)} \quad x + y &= 25 \\
 y &= 25 - x \\
 .20x + .35(25 - x) &= 6.5 \\
 .20x + 8.75 - .35x &= 6.5 \\
 -.15x + 8.75 &= 6.5 \\
 -.15x &= -2.25 \\
 x &= 15
 \end{aligned}$$

15 liters of 20% acid,  
10 liters of 35% acid

### More Practice

#### Modeling with Functions

[http://cims.nyu.edu/~kiry1/Precalculus/Section\\_1.6-](http://cims.nyu.edu/~kiry1/Precalculus/Section_1.6-)

[Modeling%20with%20Equations/Modeling%20with%20Equations.pdf](http://cims.nyu.edu/~kiry1/Precalculus/Section_1.6-Modeling%20with%20Equations/Modeling%20with%20Equations.pdf)

<https://socratic.org/precalculus/functions-defined-and-notation/modeling-with-functions>

### Homework Assignment

p.152 #5,6,15,16,18,19,33,37

**SAT Connection**  
**Solution**

**Choice C is correct.** The description “ $16 + 4x$  is 10 more than 14” can be written as the equation  $16 + 4x = 10 + 14$ , which is equivalent to  $16 + 4x = 24$ . Subtracting 16 from each side of  $16 + 4x = 24$  gives  $4x = 8$ . Since  $8x$  is 2 times  $4x$ , multiplying both sides of  $4x = 8$  by 2 gives  $8x = 16$ . Therefore, the value of  $8x$  is 16.

Choice A is incorrect because it is the value of  $x$ , not  $8x$ . Choices B and D are incorrect; those choices may be a result of errors in rewriting  $16 + 4x = 10 + 14$ . For example, choice D could be the result of subtracting 16 from the left side of the equation and adding 16 to the right side of  $16 + 4x = 10 + 14$ , giving  $4x = 40$  and  $8x = 80$ .