

1.7 Modeling with Functions

Target 1E: 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

$$2x - 5$$

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

<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.

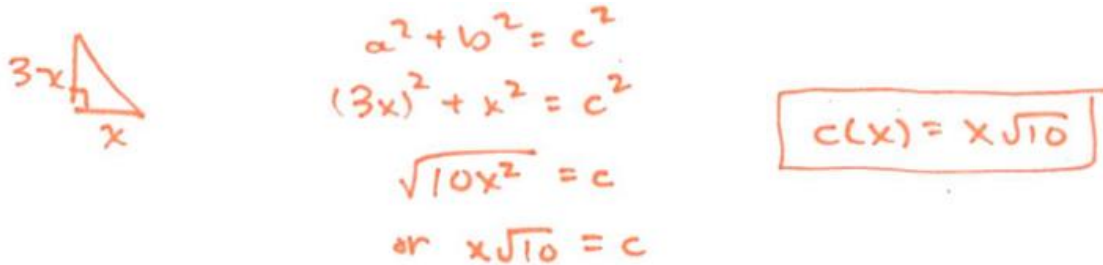
$$x + .044x$$

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.



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

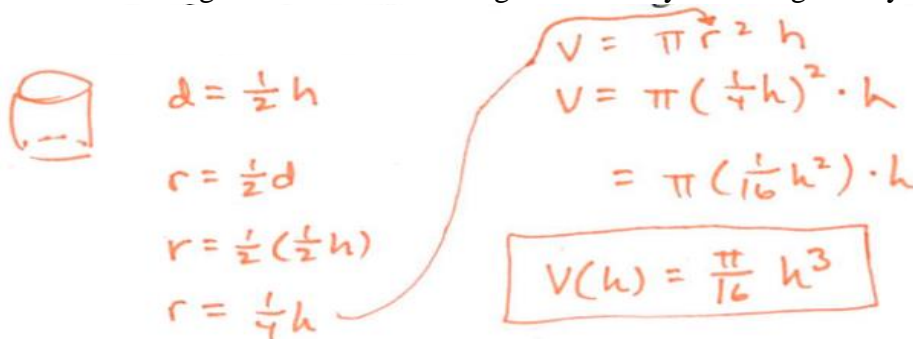
$$(3x)^2 + x^2 = c^2$$

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

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

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

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



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

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

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

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

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

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

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

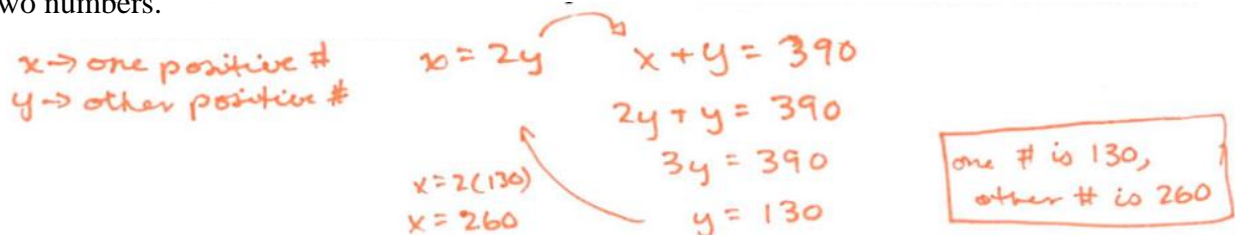
$$V(h) = \frac{\pi}{16}h^3$$

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.



$$x = 2y$$

$$x + y = 390$$

$$2y + y = 390$$

$$3y = 390$$

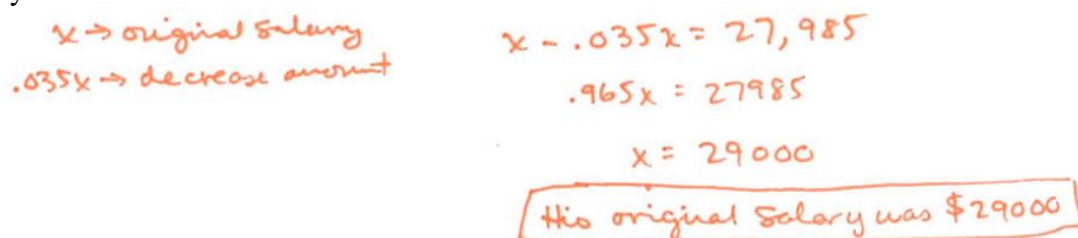
$$y = 130$$

$$x = 2(130)$$

$$x = 260$$

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

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



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

$$.965x = 27,985$$

$$x = 29,000$$

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

- c) Jackie invests \$25,000. She invests part of the money 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?

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

\$18000 invested @ 5.5%, \$7000 invested @ 8.3%

- 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% acid solution and how much 35% acid solution should be used to prepare 25 liters of a 26% acid solution?

one soln $\rightarrow x$
other soln $\rightarrow y$

$$\begin{aligned}
 &\text{(\%)} \quad .20x + .35y = .26(25) \rightarrow .20x + .35y = 6.5 \\
 &\text{(liters)} \quad x + y = 25 \\
 &y = 25 - x
 \end{aligned}$$

$$\text{(liters)} \quad x + y = 25$$

$$y = 25 - x$$

$$.20x + .35(25 - x) = 6.5$$

$$.20x + 8.75 - .35x = 6.5$$

$$-.15x + 8.75 = 6.5$$

$$-.15x = -2.25$$

$$x = 15$$

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

More Practice

Modeling with Functions

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.148 #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 $8x = 80$.