

# Section 4: Solving Real World Equations

In this section, we are going to learn skills for:

## *NGSS Standards*

- ☀ **MA.912.A.3.3** Solve literal equations for a specified variable.  
NOTE: Items must contain more than two variables and require two or more procedural steps to complete.
- ☀ **MA.912.A.3.5** Symbolically represent and solve multi-step and real-world applications that involve linear equations and inequalities.
- ☀ **MA.912.A.5.4** Solve algebraic proportions. NOTE: Products of the means and extremes of proportions cannot exceed degree 1.

## *CCS Standards*

- ☉ **MACC.912.A-CED.1.4** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law  $V = IR$  to highlight resistance  $R$ .*
- ☉ **MACC.912.A-CED.1.1** Create equations and inequalities in one variable and use them to solve problems.
- ☉ **MACC.912.A-CED.1.2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- ☉ **MACC.912.F-BF.1.1** Write a function that describes a relationship between two quantities.

## Section 4 – Video 1

### Literal Equations

- An equation with lots of variables... You just have to solve for one!
  - The answer will be in terms of DIFFERENT variables.

Solve:  $y = mx + b$  for  $x$

Solve  $P = 2a + 2b + 2c$  for  $b$

*Try it!*

Solve  $y = mx + b$  for  $b$

Solve  $C = 2\pi r$  for  $r$

## BEAT THE TEST!

1. A line can be modeled by the equation  $y = mx + b$ .

Solve  $y = mx + b$  for  $m$ .

A.  $m = y + \frac{b}{x}$

B.  $m = \frac{y-b}{x}$

C.  $m = \frac{y+b}{x}$

D.  $m = y - \frac{b}{x}$

2. The price of a taco,  $P$ , depends on the price of beef,  $B$ , and the demand for Mexican food,  $M$ .

Solve  $P = 2B + 2M$  for  $B$

A.  $B = P + M$

B.  $B = P - M$

C.  $B = \frac{P+2M}{2}$

D.  $B = \frac{P}{2} - M$

## Section 4 – Video 2

### Algebraic Proportions

- One way to solve proportions is to cross multiply.

Let's do this one together:

$$\frac{3}{7} = \frac{x + 9}{x - 6}$$

*Try it!*

$$\frac{x + 1}{7} = \frac{x + 5}{9}$$

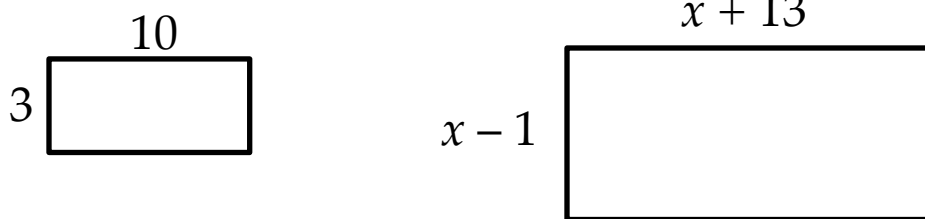
## BEAT THE TEST!

1. Given the following equation, what is  $x$ ?

$$\frac{x + 7}{x - 4} = \frac{10}{7}$$

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2. An engineer is designing a plot of land for the construction of a new factory. The following image comes from the design. For the design to work, the rectangles have to be similar.



A proportion that relates the dimensions is:

$$\frac{10}{x + 13} = \frac{3}{x - 1}$$

What is the length of longest side of the larger rectangle?

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## Section 4 – Video 3

### Attacking Word Problems

- Solving word problems with the equation given:
  - Make sure you're solving for the correct variable.

Mario needs to cut three bookshelves from a board that is 1.8 meters long. The second shelf is twice the length and 15 more centimeters than the first. The third is 5 centimeters longer than the first shelf. The equation below represents this situation, where  $x$  is the length of the first shelf in meters.

$$x + (2x + 0.15) + (x + 0.05) = 1.8$$

Which of the following is the length, in meters, of the first shelf?

- A. 0.40
- B. 0.45
- C. 0.53
- D. 0.96

- Writing equations:
- Use the words as clues.
  - Focus on the answers.

Martha has \$180. She needs a total of \$20,000 to start an account. She earns \$60 per day working, of which she saves \$50. Which equation can she use to determine the number of days,  $d$ , she needs to work to reach her goal of \$20,000?

- A.  $180 + 60d = 20000$
- B.  $180 - 60d = 20000$
- C.  $180 + 50d = 20000$
- D.  $180 - 50d = 20000$



## BEAT THE TEST!

1. Bill is planning to drive from his house to a baseball stadium and arrive in time for the beginning of the championship game. His arrival time depends on the traffic. If traffic is light, he will travel at an average speed of 50 miles per hour and arrive 1 hour early. If traffic is heavy, he will travel at an average speed of 30 miles per hour and arrive on time. The equation below can be used to model this situation, where  $t$  represents Bill's driving time, in hours.

$$50(t - 1) = 30t$$

What is the distance, **in miles**, from Bill's house to the baseball stadium?

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2. The out-of-pocket costs to an employee for health insurance and medical expenses for one year are shown in the table below.

### EMPLOYEE'S ANNUAL HEALTH CARE COSTS

Type of Cost	Definition	Cost to Employee
Premium	Total amount employee pays insurance company for the policy	\$3,626
Deductible	Amount of medical expenses employee pays before insurance company pays for anything	\$500
Co-payment	Percentage of medical expenses after the first \$500 that employee has to pay	20%

According to the plan outlined in the table, total annual health care costs,  $C$ , depend on the employee's medical expenses for that year. If  $x$  represents the total medical expenses of an employee on this plan and  $x \geq 500$ , which of the following equations can be used to determine this employee's total health care costs for that year?

- A.  $C = 3,626 - 500 + 0.20(x - 500)$
- B.  $C = 3,626 - 500 + 0.20x$
- C.  $C = 3,626 + 500 + 0.20(x - 500)$
- D.  $C = 3,626 + 500 + 0.20x$

## Section 4: Solving Real World Equations

### Practice Problems

1. Solve each of the literal equations below for the indicated variable:

a.  $3g + 4h = 18$ ; solve for  $g$

b.  $9g - s + 6a = 8g - 2a + 3$ ; solve for  $a$

2. Marcus wants to go to the Macklemore concert, but it costs \$165 per ticket. Unfortunately, he only has \$20 in his pocket. However, Marcus is an entrepreneur and he is going to sell his clothes at his local thrift shop. If the thrift shop pays him \$2.50 for each piece of clothing, how many pieces of clothing does Marcus have to sell in order to make it to the Macklemore concert?

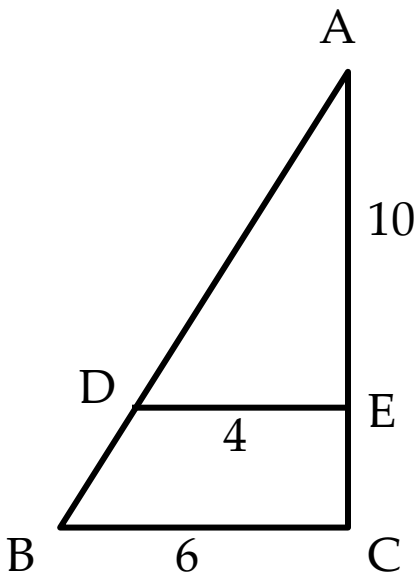
3. The Discovery Channel has a certain number of documentaries on each of the following: birds (B), mammals (M), and reptiles (R). The sum of twice the number of mammal documentaries and three times the number of bird documentaries is equal to half the number of reptile documentaries.

Write the equation representing the given scenario and then solve the equation for B, the number of bird documentaries.

4. There are two plots of land that Barack Obama is considering buying so that his dogs can run around. The two plots of land are similar rectangles. The larger rectangle has a length of  $4x - 2$  and a width of 7. The smaller rectangle has a length of 9 and a width of 2. What is the measure of the longest side of the larger rectangle? (Hint: draw a picture of the situation)

5. Abbotsville and Broken Branch are two cities that are actually 175 miles apart. On a map, the distance between the two towns is 2.5 inches. If there are two other cities on the same map that are shown as being 3.5 inches apart, how far apart are they in real life?

6. Consider the diagram below:



What is the length of line segment  $EC$ ?

7. Johnny Depp spent too much money on pirate costumes and now his Pirates of the Caribbean fund is empty. He started with \$5000.00 to spend, and each dirty, smelly costume he wears costs \$250.00. He bought 14 costumes, and he spent any remaining money he had on fake parrots.

Write an equation that represents the amount Johnny Depp spent on fake parrots and then solve for the amount.

8. You have a coin bank that only has dimes and quarters and in total has a value of \$51.50. It has 115 dimes and an unknown number of quarters. How many quarters must there be in your coin bank?

9. A new football field under construction will have a length that is 50 feet more than twice its width. The length, the width, and the area of the football field must be calculated in order to determine the amount of grass seed necessary to cover the field. Find the length and width of the field if the perimeter will be 1,300 feet. (Hint: draw a picture of the situation)

After you've calculated the length and width, find the area of the field.

