TOPIC 2

LESSON 2.3b
Tagging Sharks

7.RP.2c
7.RP.3

Objective Solving Proportions Using Means and Extremes

Warm-Up

Solve each equation.

1. $w - 7 = 33$

2. $11x = 990$

3. $\frac{c}{6} = 48$

4. $2.75 + m = 12$

Solving Proportions with Means and Extremes

Nora

$$\frac{8 \text{ defective batteries}}{320 \text{ batteries}} \overset{\div 8}{=} \frac{1 \text{ defective battery}}{40 \text{ batteries}} \overset{\times 80}{=} \frac{80 \text{ defective batteries}}{3200 \text{ batteries}}$$

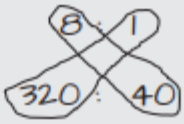
"One out of every 40 batteries is defective. So, out of 3200 batteries, 80 batteries could be defective because $3200 \div 40 = 80$."

2. Describe the strategy Nora used.

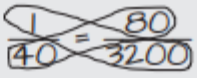
Natalie

When I write Nora's ratios using colons like Parker, I notice something about proportions . . .

$8 : 320 = 1 : 40$



$1 : 40 = 80 : 3200$



. . . the two middle numbers have the same product as the two outside numbers. So, I can solve any proportion by setting these two products equal to each other.

3. Verify that Natalie is correct.

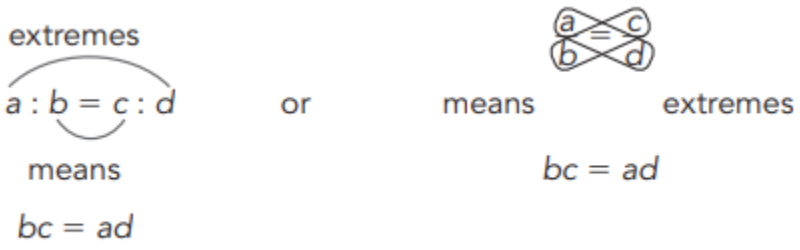
4. Try the various proportion-solving methods on these proportions and determine the unknown value. Explain which method you used.

a. $\frac{\text{3 granola bars}}{\text{420 calories}} = \frac{\text{g granola bars}}{\text{140 calories}}$

b. 8 correct : 15 questions 5 24 correct : q questions

c. $\frac{\text{d dollars}}{\text{5 miles}} = \frac{\$9}{\text{7.5 miles}}$

The relationship that Natalie noticed is between the means and extremes. In a proportion that is written a : b 5 c : d, the product of the two values in the middle (the **means**) equals the product of the two values on the outside (the **extremes**).



when $b \neq 0, d \neq 0$

To solve a proportion using this method, first, identify the means and extremes. Then, set the product of the means equal to the product of the extremes and solve for the unknown quantity. To **solve a proportion** means to determine all the values of the variables that make the proportion true.

WORKED EXAMPLE

You can rewrite a proportion as the product of the means equal to the product of the extremes.

7 books : 14 days = 3 books : 6 days

means

extremes

(14)(3) = (7)(6)

42 = 42

$$\frac{7 \text{ books}}{14 \text{ days}} = \frac{3 \text{ books}}{6 \text{ days}}$$

(14)(3) = (7)(6)

42 = 42

5. You can rewrite the product of the means and extremes from the worked example as four different equations. Analyze each equation.

$3 = \frac{(7)(6)}{14}$ $\quad 14 = \frac{(7)(6)}{3}$ $\quad \frac{(3)(14)}{7} = 6$ $\quad \frac{(3)(14)}{6} = 7$

a. Why are these equations all true? Explain your reasoning.

b. Compare these equations to the equation showing the product of the means equal to the product of the extremes. How was the balance of the equation maintained in each?

6. Why is it important to maintain balance in equations?

WORKED EXAMPLE

In the proportion $\frac{a}{b} = \frac{c}{d}$, you can multiply both sides by b to isolate the variable a.

$$b \cdot \frac{a}{b} = b \cdot \frac{c}{d} \longrightarrow b = \frac{bc}{d}$$

When you **isolate the variable** in an equation, you perform an operation, or operations, to get the variable by itself on one side of the equals sign. Multiplication and division are inverse operations. **Inverse operations** are operations that "undo" each other.

WORKED EXAMPLE

Another strategy to isolate the variable a is to multiply the means and extremes and then isolate the variable by performing inverse operations.

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

Step 1: $ad = bc$

Step 2: $\frac{ad}{d} = \frac{bc}{d}$

Step 3: $a = \frac{bc}{d}$

7. Describe each step shown.

8. Rewrite the proportion $\frac{a}{b} = \frac{c}{d}$ to isolate each of the other variables: b, c, and d. Explain the strategies you used to isolate each variable.

EXPLORE 3

Solving Problems with Proportions

Write and solve proportions to solve each problem.

1. An astronaut who weighs 85 kilograms on Earth weighs 14.2 kilograms on the Moon. How much would a person weigh on the Moon if they weigh 95 kilograms on Earth? Round your answer to the nearest tenth.

2. Water goes over Niagara Falls at a rate of 180 million cubic feet every $\frac{1}{2}$ hour. How much water goes over the Falls in 1 minute?

3. The value of the U.S. dollar in comparison to the value of foreign currency changes daily. Complete the table shown. Round to the nearest hundredth.

Euro	U.S. Dollar
1	1.07
	1.00
	6.00
6	
10	

4. To make 4.5 cups of fruity granola, the recipe calls for 1.5 cups of raisins, 1 cup of granola, and 2 cups of blueberries. If you want to make 18 cups of fruity granola, how much of each of the ingredients do you need?

Show You KNOW

Choose Your Own Proportion Adventure

Write a problem situation for each proportion. Show the solution.

1. $\frac{8}{3} = \frac{2}{n}$

2. $\frac{\frac{1}{2}}{\frac{1}{4}} = \frac{h}{1}$

Name: _____ Date: _____ Class: _____

Homework HW

LESSON 2.3b
Tagging Sharks

Objective Solving Proportions Using Means and Extremes

Answer the following questions.

1. Three tickets to attend an Off-Broadway show cost $81, 4 tickets cost $108, and 5 tickets cost $135.

   a. Show that the relationship between number and the cost is a proportional relationship by making a table of tickets for 1 to 5 tickets.

Number of Tickets					
Total Cost ($)					

   b. The constant of proportionality k is _____.

   c. Write an equation for the relationship: _____

2. On the seventh-grade trip to Washington, D.C., for every 8 students, there were 3 chaperones. Twelve chaperones were needed. How many students went on the trip?

_____

Determine whether the relationship is a proportional relationship. If so, write an equation for the relationship, and tell what each of your variables represents. If the relationship is not proportional, explain.

3. Ty takes 1 hour to read 35 pages, 2 hours to read 70 pages, and 3 hours to read 105 pages.

_____

4. There are 12 grams of protein in 2 ounces of almonds.

_____

5.

Weight (lb)	4	5	6	7
Cost ($)	18	22.5	27	31.5

_____