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Mathematics

Quarter 3 – Week 5 - Module 5:
Proportion

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Mathematics 9
Quarter 3- Week 5 - Module 5: Proportion
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Region I

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Lesson 1	Proportion

Jumpstart

For you to understand the lesson well, let's first recall concepts on ratio.

Let us consider the following problem:

If there are 40 students and 2 wall fans in a classroom. What is the student-wall fan ratio?

The student-wall fan ratio is 40: 2 or 20: 1.

A ***ratio*** is a comparison of two or more quantities. It can be written in the variety of forms or ways: a to b, a: b, or $\frac{a}{b}$.

Given two numbers ***a*** and ***b***, ***b*** $\neq 0$, a ratio is ***a*** divided by ***b***. Ratios, like fraction can be written in lowest terms.

Now, try the following activities:

ACTIVITY 1. Make Me Simple!

Express the following ratio of the first quantity to the second quantity in simplest form.

1. 4 boys : 8 girls
2. 16 dm : 48 dm
3. 5m : 300 cm
4. 400 g : 600 g
5. 5 days : 1 week

ACTIVITY 2. Find my Ratio!

Give the ratio of the following statements.

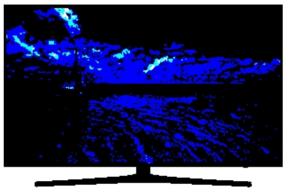
1. The measure of one angle of an equilateral triangle to the sum its interior angles.
2. The side of the square is 4 cm to its perimeter.
3. The sum of the interior angle of a triangle to the sum of the interior angle of a quadrilateral.

Discover

Now, let us discover concepts and skills involving proportion.

Let us consider a problem involving two ratios.

Suppose the length and the width of a flat-screen television screen are 48 inches and 32 inches, respectively. If the image for the advertisement of the television has a length of 12 inches, how wide should the image be?



This situation forms two equivalent ratios expressed as proportion.

A **proportion** states that two ratios are equal.

In the given problem above, the ratio of the dimensions of the television is 48: 32, while the ratio of the dimension of the advertisement is 12: x. Since the new length, 12 inches is one-fourth of 48, the width of the image should also be one-fourth of the width of the original. Hence, the width of the image must be $\frac{1}{4}$ (32) = 8 inches.

By using **proportion**, we will be able to solve the missing dimension of the image.
If the ratios 48: 32 and 12: 8 are expressed in lowest terms, they will be both 3: 2; therefore, 48: 32 and 12: 8 are equal ratios or simply, ***proportional.***

PROPORTION AND ITS PARTS

A **proportion** is a statement of equality between two ratios.

In symbols; $\frac{a}{b} = \frac{c}{d}$ or a : b = c : d, where b ≠ 0, d ≠ 0.

Each number in a proportion is called *term.*

$$\frac{\boldsymbol{a}\ (\boldsymbol{first\ term})}{\boldsymbol{b}\ (\boldsymbol{second\ term})} = \frac{\boldsymbol{c}\ (\boldsymbol{third\ term})}{\boldsymbol{d}\ (\boldsymbol{fourth\ term})}$$

The second and third terms are called the *means* and the first and fourth terms are called the *extremes* of the proportion.

a : b = c : d

means

extremes

FUNDAMENTAL RULE OF PROPORTION

If a : b = c : d, then $\frac{a}{b} = \frac{c}{d}$ provided that b≠0, d≠0.

PROPERTIES OF PROPORTION

1. Cross-Multiplication Property If $\frac{a}{b} = \frac{c}{d}$ then $ad = bc$; $b \neq 0, d \neq 0$

2. Alternation Property If $\frac{a}{b} = \frac{c}{d}$ then $\frac{a}{c} = \frac{b}{d}$; $b \neq 0, c \neq 0, d \neq 0$

3. Inverse Property If $\frac{a}{b} = \frac{c}{d}$ then $\frac{b}{a} = \frac{d}{b}$; $b \neq 0, c \neq 0, d \neq 0$

4. Addition Property If $\frac{a}{b} = \frac{c}{d}$ then $\frac{a+b}{b} = \frac{c+d}{d}$; $b \neq , d \neq 0$

5. Subtraction Property If $\frac{a}{b} = \frac{c}{d}$ then $\frac{a-b}{b} = \frac{c-d}{d}$; $b \neq , d \neq 0$

6. Numerator-Denominator Sum Property If $\frac{a}{b} = \frac{c}{d} = \frac{e}{f} = \ldots$, then $\frac{a+C+e\ldots}{b+d+f} = \frac{a}{b} = \frac{c}{d} \ldots$;

Applying the fundamental rule of proportion and the properties of proportion, study the given examples.

Example 1.

Find the value of x in the proportion $\frac{4}{x} = \frac{6}{9}$.

Solution:

a. Using the Cross-Multiplication Property

$$\frac{4}{x} = \frac{6}{9} \longrightarrow 6(x) = 4(9) \longrightarrow \mathbf{x = 6}$$

b. Using the Alternation Property

$$\frac{4}{x} = \frac{6}{9} \longrightarrow \frac{4}{6} = \frac{x}{9} \longrightarrow 6(x) = 4(9) \longrightarrow \mathbf{x = 6}$$

c. Using the Inverse Property

$$\frac{4}{x} = \frac{6}{9} \longrightarrow \frac{x}{4} = \frac{9}{6} \longrightarrow 6(x) = 4(9) \longrightarrow \mathbf{x = 6}$$

d. Using Addition Property

$$\frac{4}{x} = \frac{6}{9} \longrightarrow \frac{4+x}{x} = \frac{6+9}{9}$$

9(4 + x) = x (6 + 9)

36 + 9x = 6x + 9x

-6x = -36

x = 6

e. Using Subtraction Property

$$\frac{4}{x} = \frac{6}{9} \longrightarrow \frac{4-x}{x} = \frac{6-9}{9}$$

9(4 - x) = x (6 - 9)

36 - 9x = 6x - 9x

-6x = -36

x = 6

Example 2.

If a: b = 4: 3, find 3a – 2b: 3a + b.

Solution:

$\frac{a}{b} = \frac{4}{3} \longrightarrow a = \frac{4b}{3}$

Using a $=\frac{4b}{3}$

$$\frac{3a-2b}{3a+b} = \frac{3(\frac{4b}{3})-2b}{3(\frac{4b}{3})+b} = \frac{4b-2b}{4b+b} = \frac{2b}{5b} = \frac{2}{5}$$

Therefore,

3a – 2b: 3a + b = 2: 5

Example 3.

If a and b represent two non-zero numbers, find the ratio a: b if $2a^2 + ab - 3b^2 = 0$.

Solution:

$2a^2 + ab - 3b^2 = 0$

$(2a + 3b)(a - b) = 0 \longrightarrow$ Factor $2a^2 + ab - 3b^2$

$2a + 3b = 0 \longrightarrow$ Equate each factor to 0

$a - b = 0$

For each factor: $2a + 3b = 0$ $\qquad$ $a - b = 0$

$2a = -3b$ $\qquad$ $a = b$

$\frac{2a}{2b} = \frac{-3b}{2b}$ $\qquad$ $\frac{a}{b} = \frac{b}{b}$

$\frac{a}{b} = \frac{-3}{2}$ $\qquad$ $\frac{a}{b} = \frac{1}{1}$

Hence, $\frac{a}{b} = \frac{-3}{2} = \frac{1}{1}$ or a:b = -3:2 or 1:1

Example 4.

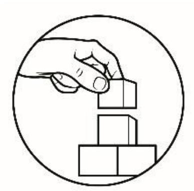
If $\frac{p}{2} = \frac{q}{3} = \frac{r}{4} = \frac{5p-6q-7r}{x}$. Find x.

Solution:

Let $\frac{p}{2} = \frac{q}{3} = \frac{r}{4} = \frac{5p-6q-7r}{x}$ = k. Then,

p= 2k, q = 3k, r = 4k, and $5p - 6q - 7r$ = kx.

$$5(2k) - 6(3k) - 7(4k) = kx$$
$$-36k = kx$$
$$\mathbf{x = -36}$$



Explore

ACTIVITY 3. Find my X!

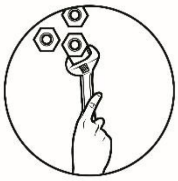
Find the value of x in the proportion.

1. 2 : x = 15 : 30
2. x : 3 = 18 : 2
3. 16 : x = 4 : 8
4. $\frac{5}{6} = \frac{x}{12}$
5. $\frac{12}{x} = \frac{x}{3}$

ACTIVITY 4: Solve Me!

Solve the given problems.

1. Find $\frac{y}{x}$ = 5y – 2x : 10 = 3y – x : 7
2. Solve for the ratio x: y if $x^2 + 3xy - 10y^2 = 0$
3. Solve for the ratio x: y if $x^2 + 3xy - 10y^2 = 0$



Deepen

Apply the concepts and skills learned in the lesson by doing the following activities.

ACTIVITY 5

Using the fundamental rule and the properties proportion, determine what is asked in the following situations:

1. The measures of the three angles of a triangle are in the ratio of 1:2: 3. Find their measures.
2. Two complementary angles are in the ratio of 2: 3. Find the measure of each angle.
3. The angles of a triangle are in the ratio of 2: 3: 5. Find the measure of the smallest angle.

ACTIVITY 6

Solve the following real-life problems involving proportion.

1. The ratio of the female and male in a certain barangay is 7: 5. If there are 3,192 females, what is the total population of the school?
2. A ladder measures 9 feet long leans against a building 7 feet above the ground. At what height would a 15 feet ladder touch the building form the same angle with the ground?

Gauge

Multiple Choice: Choose the letter of the correct answer. Write the chosen letter on a separate answer sheet.

1. What do you call a statement that two ratios are equal?
   A. Fraction B. Proportion C. Ratio D. Similarity

2. It is used to compare two or more quantities.
   A. Fraction B. Proportion C. Ratio D. Similarity

3. In the proportion, a: b = c: d, the second and the third terms are called the ____
   A. Denominator B. Extremes C. Means D. Numerator