Algebra

4-3 Proportions

CONTENT STANDARDS
7.RP.2, 7.RP.2.a

What You'll Learn

To test whether ratios form a proportion by using equivalent ratios and cross products

New Vocabulary proportion, cross products

Why Learn This?

Pollsters conduct surveys. They ask different groups of people the same questions. You can use proportions to compare the answers from the different groups.

Did You See a Movie This Weekend?

Class	Yes	Total Number
A	10	24
B	25	60

A **proportion** is an equation stating that two ratios are equal. One method of testing whether ratios form a proportion is to write both ratios in simplest form. Then see if they are equal.

EXAMPLE Writing Ratios in Simplest Form

Surveys Refer to the table above. For each class, write the ratio of the number of students who saw a movie to the total number of students. Do the ratios form a proportion?

Class A: $\frac{10}{24} = \frac{10 \div 2}{24 \div 2} = \frac{5}{12}$ ← Divide 10 and 24 by their GCF, which is 2.

Class B: $\frac{25}{60} = \frac{25 \div 5}{60 \div 5} = \frac{5}{12}$ ← Divide 25 and 60 by their GCF, which is 5.

Since both ratios are equal to $\frac{5}{12}$, the ratios are proportional.

Example

1 Writing Ratios in Simplest Form Do the ratios $\frac{42}{56}$ and $\frac{56}{64}$ form a proportion?

$\frac{42}{56} = \frac{42 \div \boxed{14}}{56 \div \boxed{14}} = \frac{\boxed{3}}{\boxed{4}}$ ← **Divide the numerator and denominator by the GCF.** → $\frac{56}{64} = \frac{56 \div \boxed{8}}{64 \div \boxed{8}} = \frac{\boxed{7}}{\boxed{8}}$

The ratios in simplest form are not equivalent. They [cannot] form a proportion.

Determine if the ratios 10/12 and 40/56 form a proportion.

A No; 5/6 does not equal 5/7

B Yes; (10)(56) does not equal (12)(40)

C Yes; both ratios equal 5/6

D No; 10/12 equals 40/56

KEY CONCEPTS **Proportion**

Ratios that are equal form a proportion.

Arithmetic	Algebra
$\frac{6}{8} = \frac{9}{12}$	$\frac{a}{b} = \frac{c}{d}, b \neq 0, d \neq 0$

You can use the properties of equality to discover another way to determine whether ratios form a proportion.

$$\frac{6}{8} = \frac{9}{12}$$ ← Use the ratios from the beginning of the lesson.

$$\frac{6}{8}\left(\frac{8}{1} \cdot \frac{12}{1}\right) = \frac{9}{12}\left(\frac{8}{1} \cdot \frac{12}{1}\right)$$ ← Use the Multiplication Property of Equality. Multiply each side by both denominators.

$$\frac{6}{\cancel{8}^{1}}\left(\frac{\cancel{8}^{1}}{1} \cdot \frac{12}{1}\right) = \frac{9}{\cancel{12}^{1}}\left(\frac{8}{1} \cdot \frac{\cancel{12}^{1}}{1}\right)$$ ← Divide numerators and denominators by their GCF.

$$6 \cdot 12 = 9 \cdot 8$$

The products $6 \cdot 12$ and $9 \cdot 8$ are called cross products. For two ratios, the **cross products** are the two products found by multiplying the denominator of each ratio by the numerator of the other ratio.

KEY CONCEPTS Cross-Products Property

If two ratios form a proportion, the cross products are equal. If two ratios have equal cross products, they form a proportion.

Arithmetic	Algebra
$\frac{6}{8} = \frac{9}{12}$	$\frac{a}{b} = \frac{c}{d}$
$6 \cdot 12 = 8 \cdot 9$	$ad = bc$, where $b \neq 0$ and $d \neq 0$

You can use the Cross-Products Property to determine whether ratios form a proportion.

EXAMPLE Using Cross Products

Do the ratios in each pair form a proportion?

a. $\frac{5}{9}, \frac{30}{54}$

$\frac{5}{9} \stackrel{?}{=} \frac{30}{54}$ ← Test each pair of ratios. →

$5 \cdot 54 \stackrel{?}{=} 9 \cdot 30$ ← Write cross products. →

$270 = 270$ ← Simplify. →

Yes, $\frac{5}{9}$ and $\frac{30}{54}$ form a proportion.

b. $\frac{7}{8}, \frac{55}{65}$

$\frac{7}{8} \stackrel{?}{=} \frac{55}{65}$ ← Test each pair of ratios. →

$7 \cdot 65 \stackrel{?}{=} 8 \cdot 55$ ← Write cross products. →

$455 \neq 440$ ← Simplify. →

No, $\frac{7}{8}$ and $\frac{55}{65}$ do *not* form a proportion.

Example

2 Using Cross Products Do the ratios in each pair form a proportion?

a. $\frac{4}{10}, \frac{6}{15}$

$\frac{4}{10} \stackrel{?}{=} \frac{6}{15}$ ← Test each pair of ratios. →

$4 \cdot \boxed{15} \stackrel{?}{=} 10 \cdot \boxed{6}$ ← Write cross products. →

$\boxed{60} \boxed{=} 60$ ← Simplify. →

Yes, $\frac{4}{10}$ and $\frac{6}{15}$ **form** a proportion.

b. $\frac{8}{6}, \frac{9}{7}$

$\frac{8}{6} \stackrel{?}{=} \frac{9}{7}$

$8 \cdot \boxed{7} \stackrel{?}{=} 6 \cdot \boxed{9}$

$\boxed{56} \boxed{\neq} 54$

No, $\frac{8}{6}$ and $\frac{9}{7}$ **do not form** a proportion.

Determine whether the ratios 3/8 and 6/16 form a proportion by using cross products.

A No; 18 does not equal 129

B Yes; 48 = 48

C Yes; 24 doesn't equal 96

D No; 3/8 does not equa 6/16

Determine whether the ratios 6/9 and 4/6 form a proportion by using cross products.

A. No; 24 does not equal 54

B. Yes; 72 does not equal 24

C. Yes; 36 =36

D. No: 6/9 does not equal 4/6

Determine whether the ratios 4/8 and 5/9 form a proportion by using cross products.

A. No; 20 ≠ 72

B. Yes; 4/8 = 5/9

C. No; 36 ≠ 40

D. Yes; 13 = 13

A proportion states that two _____ are equal.

A solutions

B ratios

C operations

D decimals

Without writing 3/5 and 9/15 in simplest form or using the cross-products property, how can you tell whether the ratios form a proportion?

A You can't tell if they form a proportion.

B You can divide the numerators of 9/15 by 9.

C If you multiply both the numerator and denominator of the 1st fraction by 3, you get the 2nd fraction.

D You can multiply 9/15 by 3 and get an equivalent fraction.

Replace the ? so that each pair of ratios forms a proportion: 1/2 and 4/?

Text in your number answer now.

Complete so that each pair of ratios forms a proportion: 3/3 9/?

A 27

B 12

C 3

D 1

E 9

Complete so that each pair of ratios forms a proportion:
3/4 ?/12

A 9

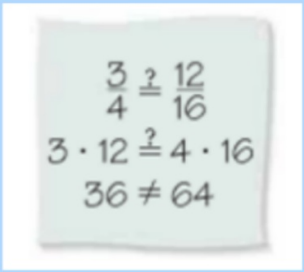
B 2

C 6

D 15

E 36

A student used the cross products property to determine that 3/4 and 12/16 do not form a proportion. Is his work correct?



A No; he needed to multiply the numerator of one fraction by the denominator of the other fraction.

B No; he should have added the numerators and denominators instead of muptiplying.

C No; he multiplied incorrectly.

D Yes; they do not form a proportion.

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