Name _____   Date _____

Deciding When to Use Cross Products

KEY CONCEPT

Rewrite Equations in order to Solve Using Cross Products

A proportion is a special type of equation where one ratio is equal to a second ratio. Proportions can be solved using cross products. Other equations containing ratios can be solved using cross products if you first rewrite them as proportions.

EXAMPLE 1 ## Determine whether an equation is written as a proportion

Determine whether each equation is written as a proportion.

a. $\dfrac{y}{9} - \dfrac{5}{12} = \dfrac{1}{6}$ **b.** $\dfrac{3}{b+4} = \dfrac{7}{b}$

Solution:

a. The equation $\dfrac{y}{9} - \dfrac{5}{12} = \dfrac{1}{6}$ is not a written as a proportion because the expression to the left of the equal sign is not in the form of a single ratio.

b. The equation $\dfrac{3}{b+4} = \dfrac{7}{b}$ is written as a proportion because the expressions on both sides of the equal sign are single ratios. ■

Some equations can be rewritten as proportions as shown in the next example.

EXAMPLE 2 ## Rewrite an equation as a proportion

Rewrite each equation as a proportion.

a. $\dfrac{x+2}{3} - \dfrac{x+1}{4} = 0$ **b.** $\dfrac{8}{p} = \dfrac{7}{10} + \dfrac{1}{5}$ **c.** $\dfrac{m}{2} = 6$

Solution:

a. The equation $\dfrac{x+2}{3} - \dfrac{x+1}{4} = 0$ can be written as a proportion by adding $\dfrac{x+1}{4}$ to each side.

$$\dfrac{x+2}{3} - \dfrac{x+1}{4} = 0$$

$$\dfrac{x+2}{3} - \dfrac{x+1}{4} + \dfrac{x+1}{4} = 0 + \dfrac{x+1}{4}$$

$$\dfrac{x+2}{3} = \dfrac{x+1}{4}$$

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b. The equation $\frac{8}{p} = \frac{7}{10} + \frac{1}{5}$ can be written as a proportion by expressing the sum of the fractions on the right side of the equal sign as a single fraction.

$$\frac{8}{p} = \frac{7}{10} + \frac{1}{5}$$

$$\frac{8}{p} = \frac{7}{10} + \frac{2}{10}$$

$$\frac{8}{p} = \frac{9}{10}$$

c. The equation $\frac{m}{2} = 6$ can be written as a proportion by expressing 6 as the ratio $\frac{6}{1}$.

$$\frac{m}{2} = \frac{6}{1} \quad \blacksquare$$

After an equation is rewritten as a proportion, we can use cross products to solve the equation.

EXAMPLE 3 ## Solve an equation using cross products

Solve the equation $\frac{x+2}{3} - \frac{x+1}{4} = 0$ using cross products.

Solution:

We first need to rewrite the equation as a proportion. This was done in Example 2. Then we use cross products to eliminate the fractions from the equation.

$$\frac{x+2}{3} = \frac{x+1}{4}$$
$$4(x+2) = 3(x+1)$$
$$4x + 8 = 3x + 3$$
$$x + 8 = 3$$
$$x = -5$$

The solution is -5. Check the solution by substituting -5 into the original equation. $\blacksquare$

Practice

Determine whether each equation is written as a proportion.

1. $\frac{x}{4} - \frac{3}{5} = 0$ **2.** $\frac{5}{y} - \frac{6}{11} = 0$ **3.** $\frac{s}{8} - \frac{1}{2} = \frac{s}{4}$ **4.** $\frac{1}{t} - \frac{3}{8} = \frac{5}{8}$

5. $\frac{x+9}{7} = \frac{x}{6}$ **6.** $\frac{1}{h-2} = \frac{2}{h}$ **7.** $\frac{4}{b+2} - \frac{1}{b} = 0$ **8.** $\frac{3+g}{2} - \frac{g}{3} = 0$

Deciding When to Use Cross Products *continued*

Rewrite each equation as a proportion. Then solve the equation using cross products.

9. $\dfrac{x}{8} - \dfrac{3}{4} = 0$ **10.** $\dfrac{c}{14} + \dfrac{5}{7} = 0$ **11.** $\dfrac{3}{5} + \dfrac{d}{25} = 0$ **12.** $\dfrac{1}{6} - \dfrac{w}{24} = 0$

13. $\dfrac{10}{y} + \dfrac{5}{16} = 0$ **14.** $\dfrac{9}{v} - \dfrac{3}{7} = 0$ **15.** $\dfrac{6}{11} - \dfrac{12}{b} = 0$ **16.** $\dfrac{7}{13} + \dfrac{63}{g} = 0$

17. $\dfrac{z}{4} = 3 - \dfrac{1}{2}$ **18.** $\dfrac{m}{6} = 2 - \dfrac{1}{3}$ **19.** $\dfrac{1}{y} = \dfrac{1}{7} - \dfrac{1}{8}$ **20.** $\dfrac{1}{d} = \dfrac{1}{8} - \dfrac{1}{9}$

21. $\dfrac{x+1}{2} = 8$ **22.** $\dfrac{x+2}{5} = 3$ **23.** $\dfrac{10}{h+2} = 2$ **24.** $\dfrac{25}{n-9} = 5$

25. $\dfrac{y}{3} = y$ **26.** $\dfrac{m}{5} = m$ **27.** $\dfrac{k+2}{3} = k$ **28.** $\dfrac{\ell-3}{4} = \ell$

29. $\dfrac{z-1}{3} - \dfrac{z+1}{2} = 0$ **30.** $\dfrac{r+1}{5} - \dfrac{r-1}{4} = 0$

31. $\dfrac{m+2}{3} + \dfrac{m-5}{2} = 0$ **32.** $\dfrac{b-5}{2} + \dfrac{b+1}{5} = 0$

33. $\dfrac{p-5}{p-6} - \dfrac{1}{2} = 0$ **34.** $\dfrac{x+1}{x+2} + \dfrac{2}{3} = 0$

35. $\dfrac{1}{y-5} - \dfrac{1}{2y-4} = 0$ **36.** $\dfrac{1}{t-4} - \dfrac{1}{2t+5} = 0$

Write an equation for each sentence. Then rewrite the equation as a proportion, if necessary. Solve the proportion using cross products.

37. The sum of the quotient of x and 4 and the quotient of 2 and 3 is 0.

38. The sum of the quotient of y and 5 and the quotient of 3 and 4 is 0.

39. The difference between the quotient of a and 2 and the quotient of 4 and 5 is 0.

40. The difference between the quotient of b and 6 and the quotient of 1 and 7 is 0.

41. When the quantity $x + 5$ is divided by 8, the result equals $\dfrac{1}{2}$.

42. When the quantity $y - 1$ is divided by 10, the result equals $\dfrac{2}{5}$.

43. The quotient of 4 and the quantity $d + 2$ equals $-\dfrac{1}{3}$.

44. The quotient of 5 and the quantity $n + 1$ equals $-\dfrac{1}{4}$.