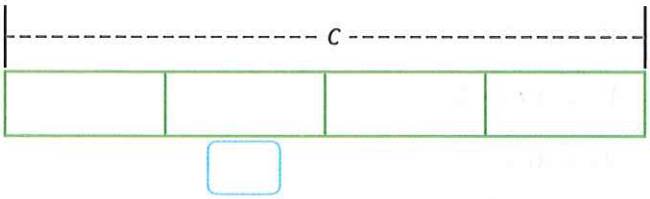
Lesson 3

Solve Equations with Rational Coefficients

Real-World Link

Social Networks Three-fourths of the students in Aaliyah's class belong to a social network. There are 15 students in her class that belong to a social network.

1. Create a bar diagram and shade $\frac{3}{4}$, or 0.75, of it.



Label 15 along the bottom to show the amount of the bar that represents 15 students.

2. Based on the diagram, circle the equation that can be used to find c, the number of students in Aaliyah's class.

$15c = \frac{3}{4}$ $\quad 0.75c = 15$ $\quad 4c = 15$

3. Based on what you know about solving equations, explain how you could solve the equation you circled in Exercise 2.

_____

4. How many students are in Aaliyah's class?

_____

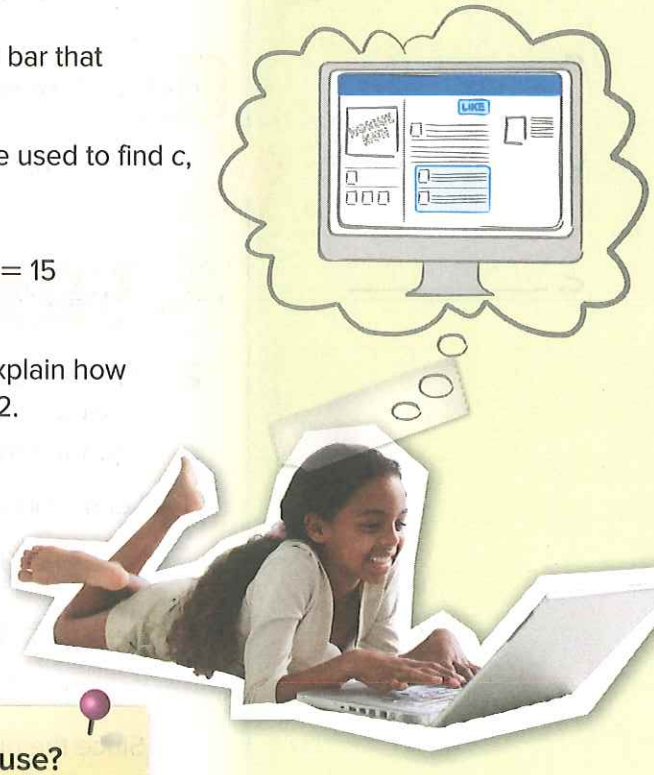
Essential Question

WHAT does it mean to say two quantities are equal?

Common Core State Standards

Content Standards
7.EE.4, 7.EE.4a

MP Mathematical Practices
1, 2, 3, 4



Which MP Mathematical Practices did you use? Shade the circle(s) that applies.

① Persevere with Problems	⑤ Use Math Tools
② Reason Abstractly	⑥ Attend to Precision
③ Construct an Argument	⑦ Make Use of Structure
④ Model with Mathematics	⑧ Use Repeated Reasoning

Work Zone

Decimal Coefficients

If the coefficient is a decimal, divide each side by the coefficient.

Example

Tutor

1. **Solve $16 = 0.25n$. Check your solution.**

$16 = 0.25n$ Write the equation.

$\frac{16}{0.25} = \frac{0.25n}{0.25}$ Division Property of Equality

$64 = n$ Simplify.

Check $16 = 0.25n$ Write the original equation.

$16 \stackrel{?}{=} 0.25 \cdot 64$ Replace n with 64.

$16 = 16$ ✓ This sentence is true.

The solution is 64.

Division with Decimals

$$0.25\overline{)16.00} = 64$$

-150

100

-100

0

Show your work.

a. _____

b. _____

c. _____

Got it? **Do these problems to find out.**

a. $6.4 = 0.8m$ **b.** $-2.8p = 4.2$ **c.** $-4.7k = -10.81$

Real World Example

Tutor

2. **Jaya's coach agreed to buy ice cream for all of the team members. Ice cream cones are $2.40 each. Write and solve an equation to find how many cones the coach can buy with $30.**

Let n represent the number of cones the coach can buy.

$2.4n = 30$ Write the equation; $2.40 = 2.4$.

$\frac{2.4n}{2.4} = \frac{30}{2.4}$ Division Property of Equality

$n = 12.5$ Simplify.

Since the number of ice cream cones must be a whole number, there is enough money for 12 ice cream cones.

Got it? **Do this problem to find out.**

d. Suppose the ice cream cones cost $2.80 each. How many ice cream cones could the coach buy with $42?

d. _____

Fraction Coefficients

Recall that two numbers with a product of 1 are called multiplicative inverses, or reciprocals. If the coefficient in a multiplication equation is a fraction, multiply each side by the reciprocal of the coefficient.

Examples

Tutor

3. Solve $\frac{3}{4}x = \frac{12}{20}$.

$\frac{3}{4}x = \frac{12}{20}$ Write the equation.

$\left(\frac{4}{3}\right) \cdot \frac{3}{4}x = \left(\frac{4}{3}\right) \cdot \frac{12}{20}$ Multiply each side by the reciprocal of $\frac{3}{4}$, $\frac{4}{3}$.

$\frac{\overset{1}{\cancel{4}}}{\underset{1}{3}} \cdot \frac{\overset{1}{\cancel{3}}}{\underset{1}{\cancel{4}}}x = \frac{\overset{1}{\cancel{4}}}{\underset{1}{3}} \cdot \frac{\overset{4}{\cancel{12}}}{\underset{5}{20}}$ Divide by common factors.

$x = \frac{4}{5}$ Simplify. Check the solution.

4. Solve $-\frac{7}{9}d = 5$. Check your solution.

$-\frac{7}{9}d = 5$ Write the equation.

$\left(-\frac{9}{7}\right) \cdot \left(-\frac{7}{9}\right)d = \left(-\frac{9}{7}\right) \cdot 5$ Multiply each side by the reciprocal of $-\frac{7}{9}$, $-\frac{9}{7}$.

$\left(-\frac{9}{7}\right) \cdot \left(-\frac{7}{9}\right)d = \left(-\frac{9}{7}\right) \cdot \frac{5}{1}$ Write 5 as $\frac{5}{1}$.

$\left(-\frac{\overset{1}{\cancel{9}}}{\underset{1}{7}}\right) \cdot \left(-\frac{\overset{1}{\cancel{7}}}{\underset{1}{\cancel{9}}}\right)d = \left(-\frac{9}{7}\right) \cdot \frac{5}{1}$ Divide by common factors.

$d = -\frac{45}{7}$ or $-6\frac{3}{7}$ Simplify.

Check $-\frac{7}{9}d = 5$ Write the original equation.

$-\frac{7}{9}\left(-\frac{45}{7}\right) \stackrel{?}{=} 5$ Replace d with $-\frac{45}{7}$.

$\frac{315}{63} \stackrel{?}{=} 5$ Simplify.

$5 = 5$ ✓ This sentence is true.

Got it? Do these problems to find out.

e. $\frac{1}{2}x = 8$ **f.** $-\frac{3}{4}x = 9$ **g.** $-\frac{7}{8}x = -\frac{21}{64}$

Fractions as Coefficients

The expression $\frac{3}{4}x$ can be read as $\frac{3}{4}$ of x, $\frac{3}{4}$ multiplied by x, $3x$ divided by 4, or $\frac{x}{4}$ multiplied by 3.

Show your work.

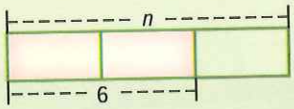
e. _____

f. _____

g. _____

Bar Diagrams

A bar diagram can be used to represent this situation.



$n = 6 \div \frac{2}{3} = \frac{6}{1} \times \frac{3}{2} = 9$

Real World

Example

Watch Tutor

5. Valerie needs $\frac{2}{3}$ yard of fabric to make each hat for the school play. Write and solve an equation to find how many hats she can make with 6 yards of fabric.

Write and solve a multiplication equation. Let n represent the number of hats.

$\frac{2}{3}n = 6$ Write the equation.

$\left(\frac{3}{2}\right) \cdot \frac{2}{3}n = \left(\frac{3}{2}\right) \cdot 6$ Multiply each side by $\frac{3}{2}$.

$n = 9$ Simplify.

So, Valerie can make 9 hats.

Guided Practice

Check

Solve each equation. Check your solution. (Examples 1, 3, and 4)

1. $1.6k = 3.2$

Show your work.

2. $-2.5b = 20.5$

3. $-\frac{1}{2} = -\frac{5}{18}h$

Write and solve an equation. (Examples 2 and 5)

4. The average growth of human hair is 0.5 inch per month. Find how long it takes a human to grow 3 inches of hair.

Equation: _____ Solution: _____

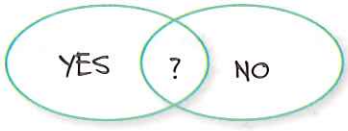
5. Three fourths of the fruit in a refrigerator are apples. There are 24 apples in the refrigerator. How many pieces of fruit are in the refrigerator?

Equation: _____ Solution: _____

6. **Building on the Essential Question** What is the process for solving a multiplication equation with a rational coefficient? _____

Rate Yourself!

Are you ready to move on? Shade the section that applies.



For more help, go online to access a Personal Tutor.

Tutor

Name _____ My Homework _____

Independent Practice

Go online for Step-by-Step Solutions eHelp

Solve each equation. Check your solution. (Examples 1, 3, and 4)

1. $1.2x = 6$

Show your work.

2. $14.4 = -2.4b$

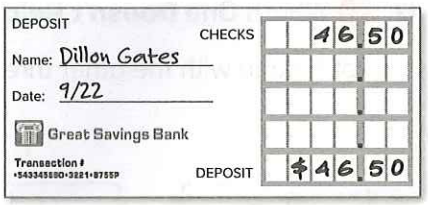
3 $-3.6h = -10.8$

4. $\frac{2}{5}t = \frac{12}{25}$

5. $-3\frac{1}{3} = -\frac{1}{2}g$

6. $-\frac{7}{9}m = \frac{11}{6}$

7 **Financial Literacy** Dillon deposited $\frac{3}{4}$ of his paycheck into the bank. The deposit slip shows how much he deposited. Write and solve an equation to find the amount of his paycheck. (Example 2)


DEPOSIT
CHECKS 46.50
Name: Dillon Gates
Date: 9/22
Great Savings Bank
Transaction # •543345880•3221•8755P
DEPOSIT $46.50

Equation: _____ Solution: _____

8. Twenty-four students brought their permission slips to attend the class field trip to the local art museum. If this represented eight tenths of the class, how many students are in the class? Use a bar diagram to solve arithmetically. Then use an equation to solve algebraically. (Example 5)

Equation: _____ Solution: _____

9. MP **Justify Conclusions** Seventy-five percent, or 15, of the students in Emily's homeroom class are going on a field trip. Two thirds, or 12, of the students in Santiago's homeroom class are going on the field trip. Which class has more students? Justify your answer. _____

10. **Reason Abstractly** Nora and Ryan are making stuffed animals for a toy drive. The table shows the fabric purchases they made. Who purchased the more expensive fabric?

Explain your reasoning. _____

Purchaser	Amount Purchased (yd)	Amount Paid ($)
Nora	$\frac{2}{3}$	4
Ryan	0.8	6

H.O.T. Problems Higher Order Thinking

11. **Reason Inductively** Complete the statement: If $8 = \frac{m}{4}$, then $m - 12 =$ ■. Explain. _____

12. **Which One Doesn't Belong?** Identify the pair of numbers that does not belong with the other three. Explain. _____

$\frac{9}{6}, \frac{6}{9}$ $4, \frac{1}{4}$ $\frac{3}{5}, 5$ $\frac{2}{7}, \frac{7}{2}$

13. **Persevere with Problems** The formula for the area of a trapezoid is $A = \frac{1}{2}h(b_1 + b_2)$, where b_1 and b_2 are both bases and h is the height. Find the value of h in terms of A, b_1, and b_2. Justify your answer.

14. **Model with Mathematics** Write a real-world problem that can be represented by the equation $224 = 3.5r$. Then solve the problem and explain the solution.

Name _____ My Homework _____

Extra Practice

Solve each equation. Check your solution.

15. $0.4d = 2.8$

Homework Help

$0.4d = 2.8$

$\frac{0.4d}{0.4} = \frac{2.8d}{0.4}$

$d = 7$

16. $-5w = -24.5$

17. $-22.8 = 6n$

18. $\frac{7}{8}k = \frac{5}{6}$

$\frac{7}{8}k = \frac{5}{6}$

$\left(\frac{8}{7}\right) \cdot \frac{7}{8}k = \left(\frac{8}{7}\right) \cdot \frac{5}{6}$

$k = \frac{40}{42}$ or $\frac{20}{21}$

19. $-6\frac{1}{4} = \frac{3}{5}c$

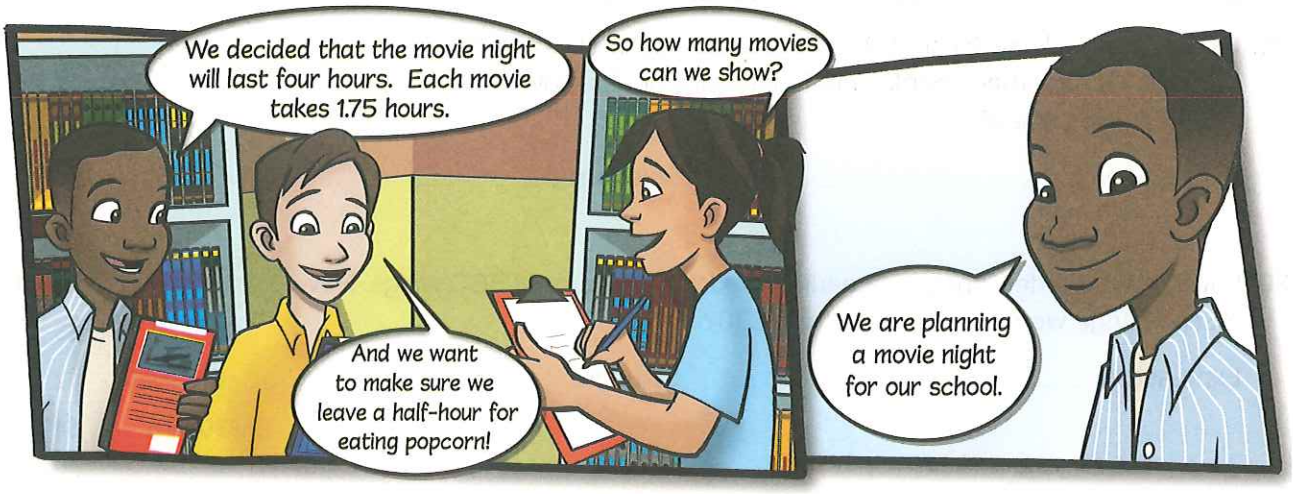
20. $-\frac{4}{7}v = -8\frac{2}{3}$

21. The Mammoth Cave Discovery Tour includes an elevation change of 140 feet. This is $\frac{7}{15}$ of the elevation change on the Wild Cave Tour. What is the elevation change on the Wild Cave Tour? Use a bar diagram to solve arithmetically. Then use an equation to solve algebraically.

Equation: _____ Solution: _____

22. MP **Model with Mathematics** Refer to the graphic novel frame below. Write and solve an equation to find how many movies they have time to show.

Equation: _____ Solution: _____



Power Up! Common Core Test Practice

23. Which of the following high speed trains are traveling at a rate of 150 miles per hour? Select all that apply.

- ☐ a train that travels 100 miles in $\frac{2}{3}$ hour
- ☐ a train that travels 160 miles in $\frac{5}{6}$ hour
- ☐ a train that travels 125 miles in $\frac{4}{5}$ hour
- ☐ a train that travels 90 miles in $\frac{3}{5}$ hour

24. The table shows the results of a survey. Of those surveyed, 275 students said they prefer pop music.

Music Preference	
Type	**Fraction of Students**
Jazz	$\frac{1}{8}$
Pop	$\frac{5}{8}$
Rap	$\frac{1}{4}$

Write an equation that could be used to find the total number of students s who were surveyed. _____

How many students were surveyed? _____

Common Core Spiral Review

Use the order of operations to evaluate each expression. 6.EE.2c

25. $6 \times 4 - 2 =$ _____

26. $70 - 5 \times 4 =$ _____

27. $18 \div 2 - 7 =$ _____

28. Write *add, divide, multiply,* and *subtract* in the correct order to complete the following sentence. 6.EE.2c

When using the order of operations to evaluate an expression,

always _____ and _____ before you _____

and _____.

Write and evaluate an expression for each situation. 6.EE.1

29. Used paperback books are $0.25, and hardback books are $0.50. If you buy 3 paperback books and 5 hardback books, how much money do you spend?

Expression: _____ Solution: _____

30. Suppose you order 2 pizzas, 2 garlic breads, and 1 order of BBQ wings. How much change would you receive from $30?

Expression: _____ Solution: _____

Item	Cost
14" pizza	$8
garlic bread	$2
BBQ wings	$4