

WORDS TO KNOW

additive inverse

Lesson 11

SOLVE PROBLEMS WITH RATIONAL NUMBERS 7.NR.1.8, 7.NR.1.11

INTRODUCTION

Real-World Connection

Three seventh-grade science classes at Barker Middle School sold the most raffle tickets for a school fundraiser, so they won a \$500 prize to share. Class A sold 1,350 tickets. Class B sold 3,525 tickets. Class C sold 2,625 tickets. Venus is the Student Council treasurer. She needs to divide the prize money so that each class will get the same fraction of the prize money as the fraction of tickets that they sold. Venus can find the amount for each class by solving the problem with rational numbers. Let's practice the skills in the **Guided Instruction** and **Independent Practice** and see how much money each class gets at the end of the lesson!



What I Am Going to Learn

- How to use a variety of strategies to solve real-world multi-step problems involving the four operations with rational numbers in any form
- How to assess the reasonableness of answers using mental strategies

What I May Already Know

- I know how to solve simple word problems.
- I know how to add, subtract, multiply, and divide with decimals and fractions.
- I know how to convert rational numbers between forms to include fractions, decimals, and percentages.

Vocabulary in Action

You can solve problems involving the four operations with rational numbers.

- Apply the properties of operations and use the order of operations.
- Convert between forms (decimals, fractions, and percents) when needed.
- Check your answer for reasonableness using computation and estimation strategies.

Properties of Operations and Order of Operations
Associative Property: When you add or multiply, you can group numbers together in any combination.
Commutative Property: You can add numbers in any order and multiply numbers in any order.
Distributive Property: Multiplying a sum by a number is the same as multiplying each addend by the number and then adding the products.
Identity Property: The sum of 0 and any number is the number. The product of 1 and any number is the number.
Inverse Property of Addition: The sum of a number and its additive inverse is 0.
Order of Operations: Perform operations in the following order: parentheses, exponents, multiply and divide left to right, add and subtract left to right.

EXAMPLE

In a game, Edna earned 6 points for advancing to Level 2 and 3 points for each novelty she found. She is going to take a break when she reaches 330 points. How many novelties does Edna want to find before she takes a break?

Step One Estimate.

Before you start to solve the problem, estimate the expected answer so you know about what to expect.

Since $3 \times 100 = 300$, Edna will need about 100 novelties to reach 330 points.

$$3n + 6 - 6 = 330 - 6$$

$$3n = 324$$

Step Two Write an expression.

$$(330 - 6) \div 3$$

330 represents the total points Edna needs.

6 represents the points Edna received by advancing to Level 2.

3 represents the points Edna will receive for each novelty she finds.

Step Three Using the Order of Operations, solve within the parentheses first.

$$(330 - 6) \div 3$$

$$224 \div 3 = 108$$

Edna will have to find 108 novelties before she takes a break.

TIPS AND HINTS

Always check your work.

TIPS AND HINTS

Estimate before you solve so you have an idea of what the answer will be. In this problem, $\$8 \times 50$ hours = \$400, so from the start you know Harry needs to work around 50 hours to earn the money.

Step Three Check your work. Multiply 3 by 108 and add 6.

$$3 \times 108 = 324$$

$$324 + 6 = 3305$$

Is it reasonable that Edna has to find 108 novelties?

Yes, it is reasonable since 108 is close to the original estimate of 100.

You can model many real-world situations with equations.

EXAMPLE

Harry wants to buy a new game console that costs \$429. If he earns \$8.25 an hour, how many hours must he work to earn enough money to buy the game console?

Step One Estimate a reasonable answer.

Since $8 \times 10 = 80$ and $8 \times 100 = 800$, the hours Harry needs to work will fall between 10 and 100.

Step Two Write an equation.

Let h be the number of hours Harry works.

Harry earns \$8.25 each hour and needs \$429.

$$8.25h = 429$$

Step Three Solve.

Use the Division Property of Equality.

Divide both sides of the equation by 8.25.

$$\frac{8.25h}{8.25} = \frac{429}{8.25}$$

$$h = 52$$

Harry must work 52 hrs.

Step Four Check your work.

Substitute 52 into the equation.

$$8.25 \times 52 = 429$$

Step Five Think whether or not your answer sounds reasonable.

Since \$429 is a lot of money, it seems reasonable that it would take Harry 52 hours to earn it. And, as estimated, 52 hours falls between 10 and 100.

GUIDED INSTRUCTION

1. It took a diver 30 seconds to descend 150 feet below sea level. What was the rate of the diver's descent?

Step One Write a ratio to show the relationship between feet and time.

Use a negative number to represent the number of feet below sea level.

$$\frac{-150 \text{ ft}}{30 \text{ s}}$$

Step Two Simplify to find the unit rate.

$$\frac{-5 \text{ ft}}{1 \text{ s}}$$

Step Three Solve the problem.

The diver descends at a rate of -5 ft/s .

2. Simplify the expression: $(-10)(-0.9) + (-10)(-0.11)$

Step One Using the order of operations, multiply first.

Think about the rules for multiplying integers.

$$(-10)(-0.9) + (-10)(-0.11) = 9 + \boxed{}$$

Step Two Add.

$$9 + 1.1 = \boxed{}$$

3. Clyde has a box of baseball cards. He is keeping 13 of them and dividing the rest amongst five friends. Each friend will get 17 cards. How many cards are in Clyde's box?

Step One Estimate

Clyde must have slightly under 100 cards since $\frac{100}{5} = 20$ and 20 is close to 17.

Step Two Write an expression to represent the situation.

$$(5 \times 17) + 13$$

5 represents the 5 friends. 17 represents the cards Clyde will give each friend. 13 represents the cards Clyde will keep.



THINK ABOUT IT

You can think of the distance the diver goes in terms of absolute value. The diver is 150 from the surface: $|-150|$ feet.

TIPS AND HINTS

Although it may be tempting to do the work in your head, get in the habit of showing the steps. The problems will get more difficult, and it makes it easier to check your work.

Step Three Use Order of Operations to perform the operation within the parentheses first.

$$(5 \times 17) + 13$$

$$\boxed{} + 13 = \boxed{}$$

There are $\boxed{}$ cards in Clyde's box.

Step Four Check your work.

$$85 \div 5 = 17$$

$$85 + 13 = 98$$

Step Five Think whether or not your answer sounds reasonable.

As estimated, 98 is a little less than 100, so that sounds reasonable.

TIPS AND HINTS

5% is half of 10%. You can find 10% by moving the decimal one place to the left.

4. Hania makes \$19.00 an hour working as a delivery driver. She gets a 5% raise. Which of the following statements are true about Hania's new rate of pay? Select the **THREE** correct answers.

- (A) Hania will make an additional $\frac{1}{20}$ of her salary an hour.
- (B) Hania will make an additional \$0.95 an hour.
- (C) Hania's new hourly rate is \$19.50 an hour.
- (D) After working 10 hours at the new rate, Hania will make \$195.00.
- (E) After working 15 hours at the new rate, Hania will make \$299.25.

How Am I Doing?

What questions do you have?

How could you use a number line to model 3×-4 ?

Describe a situation that could be modeled with an equation that involves multiplication and/or division.

TURN AND TALK

Work with a partner to write three equations in the same family of equations as $4 \times 6 = 24$. Remember to include equations with negative numbers.

Color in the traffic signal that shows how you are doing with the skill.



INDEPENDENT PRACTICE

Answer the questions.

1. What is $1.46 \times \left(-\frac{1}{2}\right)$?

- (A) -7.3
- (B) -2.19
- (C) -1.752
- (D) -0.73

► TIPS AND HINTS

Dividing a negative number by a negative number results in a positive number.

2. Which expressions have values less than 1? Select the **THREE** correct answers.

- (A) $-24 \div (-8)$
- (B) $24 \div (-8)$
- (C) $-24 \div 8$
- (D) $8 \div 24$
- (E) $24 \div 8$

3. Roger has 3.2 spools of wire. A spool has $1\frac{7}{8}$ yards of wire. How many yards of wire does Roger have? Write your answer in the box.

yards

4. Which of the following expressions result in negative numbers? Select the **TWO** correct answers.

- (A) $-5 + (-12)$
- (B) $18 - \left(-\frac{1}{3}\right)$
- (C) $2.25 \times (-1.4)$
- (D) $15 \div 30$
- (E) $-\frac{1}{2} \div -3$

5. Circle the option in the drop-down menu to complete the statement.

Reba has $6\frac{1}{3}$ quarts of blueberries. She has several $\frac{4}{9}$ -quart containers.

Reba can fill _____ containers.

11.5

13.25

14.25

17.5

6. To rent a golf cart for the day, it costs \$25.00 plus \$0.30 per mile traveled. What is the total cost for renting the golf cart for 3 days and traveling 50 miles?

- (A) \$90.00
 (B) \$76.50
 (C) \$75.00
 (D) \$41.50

7. The photography club has 54 members. Of these members, 20 are in seventh grade. How many photography club members are in seventh grade? Select the THREE correct answers.

- (A) $0.\overline{370}$ (B) $\frac{10}{27}$
 (C) 0.20 (D) about 37%
 (E) $\frac{1}{5}$ (F) about 50%

8. This weekend, Duane spent $\frac{1}{3}$ of his time playing basketball, $\frac{1}{5}$ of his time sleeping, and 0.25 of his time eating. What portion of his time did Dean spend on all of these activities combined?

Use numbers in the box to write your answer as a fraction in simplest form. The numbers cannot be used more than once. Write each number in the appropriate box.

1 12 15 20 45 47 60

TIPS AND HINTS

Is the ratio of 7th grade members to all members greater than $\frac{1}{2}$ or less than $\frac{1}{2}$? How close is it to $\frac{1}{2}$? Compare this to the choices.

TIPS AND HINTS

Convert 0.25 to a fraction. What is a common denominator for the three fractions?

WORK SPACE

9. Davon has a $10\frac{1}{4}$ -pound package of hamburger meat and an 11.5-pound package of hamburger meat. Which shows the number of hamburger patties Davon can make? Select the THREE correct answers.

(A) 87 hamburger patties that are $\frac{1}{4}$ pound each

(B) 45 hamburger patties that are $\frac{1}{2}$ pound each

(C) 30 hamburger patties that are $\frac{1}{2}$ pound each and
27 hamburger patties that are $\frac{1}{4}$ pound each

(D) 29 hamburger patties that are $\frac{3}{4}$ pound each

(E) 100 hamburger patties that are $\frac{1}{4}$ pound each

10. During a week in February in Nome, Alaska, the daily high temperatures were -3°F , -1°F , -11°F , 4°F , 7°F , 10°F , and 16°F . What expression can you write to find the difference between the highest temperature of the week and the lowest temperature of the week? What is the difference?

11. Part A

What is the value of this expression?

$$6.4 \times 3.2 - 15.96 \div 4.2$$

Write your answer in the box.

Part B

Explain how you found your answer. How can you check that your answer is reasonable?

EXIT TICKET

7.NR.1.8, 7.NR.1.11

Now that you have mastered solving problems with rational numbers, let's solve the problem in the **Real-World Connection**.

Three seventh-grade science classes at Barker Middle School sold the most raffle tickets for a school fundraiser, so they won a \$500 prize to share. Class A sold 1,350 tickets. Class B sold 3,525 tickets. Class C sold 2,625 tickets. Venus is the Student Council treasurer. She needs to divide the prize money so that each class will get the same fraction of the prize money as the fraction of tickets that they sold.

How much money will each class get?

Class A:

Class B:

Class C: