

Solve & Discuss It!

Stefan estimates the income and expenses for renting a phone accessory store in the mall. He enters the amounts in the table below. Should Stefan rent a phone accessory store? Explain.

Estimated Income and Expenses		
Type	Amount	Frequency
Sales	\$950	Each week
Services	\$2,875	Each month
Rent	-\$4,500	Each month
Travel	-\$7.50	Each day
Merchandise	-\$1,650	Each month

Lesson 1-10

Solve Problems with Rational Numbers

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I can...
solve problems with rational numbers.

Focus on math practices

Reasoning How can you assess the reasonableness of your solution using mental math or estimation strategies?

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Essential Question

How do you decide which rational number operations to use to solve problems?

EXAMPLE 1

Decide Which Operations to Use to Solve Problems

Water drains steadily out of a lock to lower a boat from one level to another. What is the boat's change in position each minute?

The boat lowers 3 ft.

4 1/2 minutes to lower the boat

Reasoning Which operation can you use to find the boat's change in position in 1 minute?

STEP 1 Use a bar diagram to represent the time it takes the boat to lower 3 feet in the lock.

4 1/2 min →

-3 ft

Each whole box represents the boat's change in position in 1 minute.

This 1/2 box represents the boat's change in position in 1/2 minute.

STEP 2 Decide which operation to use to find the boat's change in position in 1 minute.

$$\frac{-3}{4\frac{1}{2}}$$

Divide to find the boat's change in position in 1 minute.

$$= -3 \div \frac{9}{2}$$

$$= -3 \cdot \frac{2}{9}$$

$$= -\frac{6}{9} = -\frac{2}{3}$$

So, the boat's change in position each minute is $-\frac{2}{3}$ feet. The boat lowers $\frac{2}{3}$ feet each minute.

Try It!

A weather balloon ascended from an elevation of 18 feet below sea level to an elevation of $19\frac{1}{2}$ feet above sea level. What distance did the weather balloon rise?

The distance between two points is the absolute value of their .

So, $|-18| - 19\frac{1}{2}| = \text{}$.

The weather balloon rose a distance of feet.

Convince Me! How can you decide which operation to use to solve a problem?

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EXAMPLE 2 Use Properties of Operations with Rational Numbers

Kevin played a trivia game. Each correct answer is worth $2\frac{1}{4}$ points, and each incorrect answer is worth $-\frac{1}{2}$ point. What was Kevin's score?

Use Structure How are the two methods of solving the problem alike? How are they different?

ONE WAY


$$\begin{aligned} &(15)2\frac{1}{4} + (15)\left(-\frac{1}{2}\right) \\ &= \frac{2}{4}(15) + \left(-\frac{1}{2}\right)(15) \quad \text{Multiply first. Then add.} \\ &= \frac{135}{4} + \left(-\frac{15}{2}\right) \\ &= \frac{135}{4} + \left(-\frac{30}{4}\right) \\ &= \frac{105}{4} = 26\frac{1}{4} \end{aligned}$$

Kevin's score was $26\frac{1}{4}$ points.

ANOTHER WAY

$$\begin{aligned} &(15)2\frac{1}{4} + (15)\left(-\frac{1}{2}\right) \\ &= 15\left[2\frac{1}{4} + \left(-\frac{1}{2}\right)\right] \quad \text{Since Kevin had the same number of correct and incorrect answers, use the Distributive Property.} \\ &= 15\left(\frac{1}{4}\right) \\ &= 15\left(\frac{1}{4}\right) \\ &= \frac{105}{4} = 26\frac{1}{4} \end{aligned}$$

Kevin's score was $26\frac{1}{4}$ points.



Try It!
Rashida had 18 correct answers and 12 incorrect answers. What was Rashida's score?

EXAMPLE 3 Solve Multi-Step Problems with Rational Numbers

The temperature at 4:00 P.M. was 2.5°F . It dropped 0.75°F each hour for the next 4 hours. What was the temperature at 8:00 P.M.?

STEP 1 Multiply to find the total change in temperature.
 $-0.75 \times 4 = -3$
The total change in temperature was -3 degrees.

STEP 2 Add the total change in temperature to the initial temperature.
 $2.5 + (-3) = -0.5$
The temperature at 8:00 P.M. was -0.5°F .

Reasoning Use multiplication if a value is given per hour and you need to find the value after several hours.

Try It!
The temperature at 10:00 A.M. was -3°F and increased 2.25°F each hour for the next 5 hours. What was the temperature at 3:00 P.M.?

KEY CONCEPT

You can solve a problem with rational numbers by making sense of the problem and deciding which operations to use.

Do You Understand?

- Essential Question** How do you decide which rational number operations to use to solve problems?
- Reasoning** A truck's position relative to a car's position is -60 feet. The car and the truck move in the same direction, but the car moves 5 feet per second faster for 8 seconds. What operations could be used to find the truck's relative position after 8 seconds? Explain.
- Construct Arguments** Emilio used addition of two rational numbers to solve a problem. Jim used subtraction to solve the same problem. Is it possible that they both solved the problem correctly? Use a specific example to explain.

Do You Know How?

- Kara had a savings account balance of $\$153$ on Monday. On Tuesday, she had six withdrawals of $\$15.72$ and a deposit of $\$235.15$. What was her account balance after these transactions?
- A scuba diver is swimming at the depth shown, and then swims 0.5 foot toward the surface every 3 seconds. What is the location of the scuba diver, relative to the surface, after 15 seconds?
- The temperature of a cup of coffee changed by -54°F over $22\frac{1}{2}$ minutes. What was the change in temperature each minute?



Name: _____

Practice & Problem Solving

7. Suppose there is a 1.1°F drop in temperature for every 1000 feet that an airplane climbs into the sky. If the temperature on the ground is 59.7°F , what will be the temperature at an altitude of 11,000 ft?

Temp Drop $(-1.1^\circ) \cdot 11$

$$\begin{array}{r} 59.7 - 12.1 \\ -12.1 \\ \hline 47.6 \end{array}$$

8. A farmer sells an average of $15\frac{3}{5}$ bushels of corn each day. What integer represents the change in bushels of corn in his inventory after 6 days?

$$15\frac{3}{5} \times 6 \text{ see notes}$$

9. A certain plant grows $\frac{1}{6}$ inches every week. How long will it take the plant to grow $\frac{1}{2}$ inches?

$$\begin{array}{r} 1.1 \\ \times 11 \\ \hline -12.1^\circ\text{F} \end{array}$$

10. An object is traveling at a steady speed of $\frac{8}{9}$ miles per hour. How long will it take the object to travel $\frac{1}{3}$ miles?

see notes

11. Brianna works as a customer service representative. She knows that the amount of her yearly bonus is \$155, but $\$2.50$ is taken away for each customer complaint about her during the year. What is her bonus if there are 12 complaints about her in the year?

Brianna would receive \$125 as a bonus.

$$\begin{array}{r} \$2.50 \\ \times 12 \\ \hline \$30.00 \\ \$155 \\ -\$30 \\ \hline \$125 \end{array}$$

12. **Make Sense and Persevere** There are ten birdbaths in a park. On the first day of spring, the birdbaths are filled. Several weeks later, the overall change in the water level is found. The results are shown in the table. What is the range of the data?

Changes in Water Levels (inches)									
2.4	1.4	2.9	2.3	-1.2	-1.4	-1.8	2.5	0.9	

range = largest minus smallest

$$\begin{array}{r} +2.9 \\ +2.3 \\ \hline 5.2 \end{array}$$

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Over the course of several weeks the water levels in birdbaths located in the park changed by 5.2 inches overall.

10) $d = r \cdot t$

distance rate (speed) time

speed = $8\frac{2}{3}$ mph

distance = $5\frac{1}{5}$ mi

$$d = r \cdot t$$

$$5\frac{1}{5} = 8\frac{2}{3} \cdot t \quad 40 = 5 \cdot t$$

$$\frac{5\frac{1}{5}}{8\frac{2}{3}} = \frac{8\frac{2}{3} \cdot t}{8\frac{2}{3}} \quad \frac{40}{5} = \frac{5 \cdot t}{5}$$

$$5\frac{1}{5} \div 8\frac{2}{3}$$

$$\frac{26}{5} \div 8\frac{2}{3}$$

$$\frac{26}{5} \times \frac{3}{26}$$

$$\frac{1 \cdot 3}{5 \cdot 1}$$

$$\frac{3}{5} \text{ hours}$$

It will take $\frac{3}{5}$ hours for the object to travel $5\frac{1}{5}$ miles.

8) $15\frac{3}{5} \times 6$ ~~$90\frac{3}{5}$~~

$15\frac{3}{5} \times \frac{6}{1}$

468

$5 \overline{) 468}$

$93\frac{3}{5}$

The farmer's inventory has gone down by $93\frac{3}{5}$ bushels of corn over 6 weeks.

13. **Model with Math** Marcelo played a carnival game 6 times. He spent 3 tokens to play each game, and he won 7 tokens each game. Write two different expressions that can be used to find the total profit in tokens that Marcelo made.

14. The temperature of a pot of water is shown. The temperature of the water changed -2.5°F per minute.

- a. What was the temperature after 20 minutes?
- b. **Make Sense and Persevere** How many minutes did it take to cool to 100.3°F ?



15. **Higher Order Thinking** The table shows the relationship between a hedgehog's change in weight and the number of days of hibernation.

- a. What number represents the change in weight for each day of hibernation?
- b. What number represents the change in weight in ounces for the hedgehog in 115 days of hibernation?

Days of Hibernation	Change in Weight (oz)
8	-0.24
28	-0.84
75	-2.25
93	-2.79

115×0.03

$8 \overline{) 0.24}$ -0.0302 lost each day

$28 \overline{) -0.84}$

Assessment Practice

- 16. A basketball team played six games. In those games, the team won by 7 points, lost by 20, won by 8, won by 11, lost by 3, and won by 9. Which was the mean amount by which the team won or lost over the six games?
 - A -3 points
 - B 2 points
 - C 3 points
 - D 6 points

17. In digging a hole, the construction crew records the location of the bottom of the hole relative to ground level. After 3 hours the hole is 8.25 feet deep.

PART A

What number represents the change in location in feet after 1 hour?

PART B

If the crew were to continue digging at the same rate, what number would they record for the location in feet after 8 hours?

