

# Eureka Math™ Homework Helper

2015–2016

## Grade 7 Module 2 *Lessons 1–23*

*Eureka Math, A Story of Ratios®*

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## G7-M2-Lesson 1: Opposite Quantities Combine to Make Zero

### Positions on the Number Line

1. Refer to the integer game when answering the following questions.

- a. When playing the Integer Game, what two cards could have a score of  $-14$ ?

***There are many possible answers. Some of the pairs that make  $-14$  include  $-10$  and  $-4$ ,  $-12$  and  $-2$ , or  $-15$  and  $1$ .***

I need to start at zero and find two moves so that the second move ends on  $-14$ . I can begin my moves with many different numbers.

- b. If the two cards played in a round are the same distance from zero but are on opposite sides of zero, what is the score for the round?

***The two given cards would be opposites, and the score for the round would be zero.***

Positive cards move to the right of zero, and negative cards move to the left. So if I start at zero and move 5 to the right and then 5 to the left, I will end up back at zero.

2. Hector was given \$20 as a gift. He spent \$12 at the store and then planned to spend \$14 more on a second item. How much more would he need in order to buy the second item? Be sure to show your work using addition of integers.

***Hector would need \$6 more.***

$$20 + (-12) + (-14) + 6 = 0$$

Hector doesn't have enough money. To have enough money, he needs to end on 0 on the number line. If Hector adds  $20 + (-12) + (-14)$ , he ends on  $-6$ .

The money he is given can be positive, and the amount he spends will be negative.

3. Use the 8 card and its additive inverse to write a real-world story problem about their sum.

An additive inverse is the same distance from zero, but on the opposite side of zero on the number line.

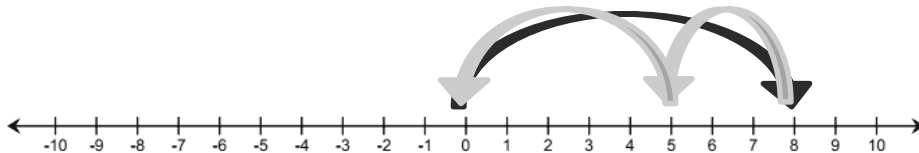
*The temperature in the morning was  $-8^{\circ}\text{F}$ .*

*If the temperatures rises 8 degrees, what is the new temperature?*

**Answer:**  $(-8) + 8 = 0$ ;  $0^{\circ}\text{F}$

Real-world problems with integers could include money, temperatures, elevations, or even sports.

4. Write an addition number sentence that corresponds to the arrows below.



$$8 + (-3) + (-5) = 0$$

I start from 0 and can see arrows moving to the right and then to the left. An arrow moving to the right shows a positive addend, and an arrow moving to the left shows a negative addend.

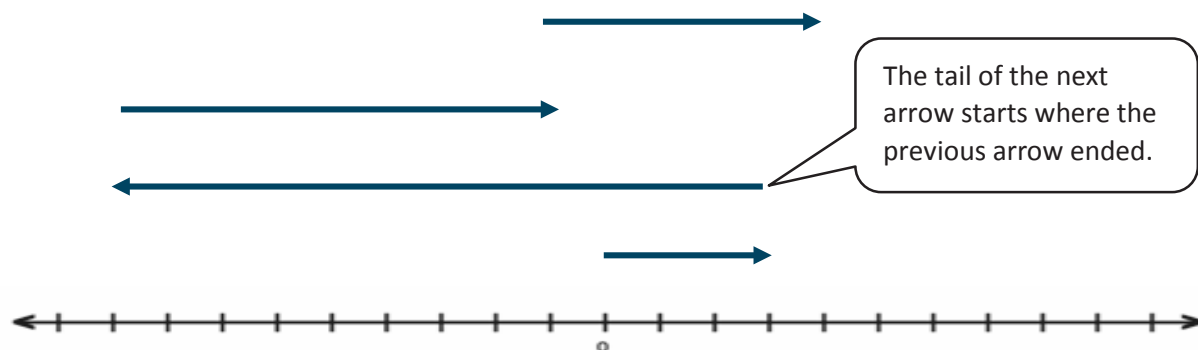
## G7-M2-Lesson 2: Using the Number Line to Model the Addition of Integers

### Adding Integers on a Number Line

1. When playing the Integer Game, Sally drew three cards, 3,  $-12$ , and 8. Then Sally's partner gave Sally a 5 from his hand.

- a. What is Sally's total? Model the answer on the number line and using an equation.

I use arrows to represent each number. Negative numbers will face left, and positive numbers will face right.



$$3 + (-12) + 8 + 5 = 4$$

I also need to show my work using an equation. I can show all of the numbers being added together. The answer is where the last arrow ends.

- b. What card(s) would you need to get your score back to zero? Explain.

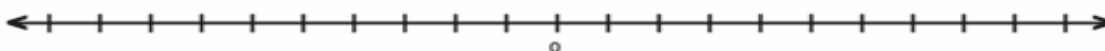
***A  $-4$  card would bring the score back to 0. The number  $-4$  is the additive inverse of 4. It is the same distance from 0 on the number line but in the opposite direction. So when I add 4 and  $-4$ , the answer would be 0.***

I could also choose more than one card, but the sum must be  $-4$ .

2. Write a story problem and an equation that would model the sum of the numbers represented by the arrows in the number diagram below.



The bottom arrow is 8 units and faces left. So it shows  $-8$ . The second arrow is 11 units and faces to the right. So that arrow represents 11.



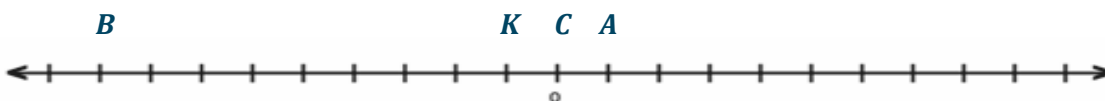
*In the morning, I lost \$8. Later in the day, I got paid \$11. How much money do I have at the end of the day?*

$$-8 + 11 = 3$$

*I had \$3 at the end of the day.*

An equation requires that I also state the answer when the sum is calculated.

3. Mark an integer between  $-2$  and  $4$  on a number line, and label it point  $K$ . Then, locate and label each of the following points by finding the sums.



My answer will depend on what I pick for  $K$ . For this example, I pick  $-1$  for  $K$ .

a. Point  $A$ :  $K + 2$

**Point  $A$ :  $-1 + 2 = 1$**

b. Point  $B$ :  $K + (-8)$

**Point  $B$ :  $-1 + (-8) = -9$**

c. Point  $C$ :  $(-4) + 5 + K$

**Point  $C$ :  $(-4) + 5 + (-1) = 0$**

I can use  $K$  to help me when adding the other numbers. I will always start at  $K$  to determine where each point should be located on the number line.

## G7-M2-Lesson 3: Understanding Addition of Integers

1. Refer to the diagram to the right.

a. What integers do the arrows represent?

**6 and -14**

b. Write an equation for the diagram to the right.

**$6 + (-14) = -8$**

The second arrow is pointing to the sum. So I can write an equation showing the sum of the two integers being equal to the sum.



The length and direction of the arrows will tell me what integers they represent. If the arrow points up, it is positive, and if it points down, it is negative.

c. Describe the sum in terms of the distance from the first addend. Explain.

***The sum is 14 units below 6 because  $|-14| = 14$ . I counted down from 6 fourteen units and stopped at -8.***

d. Describe the arrows you would use on a vertical number line in order to solve  $-3 + -9$ .

***The first arrow would start at 0 and be three units long, pointing downward because the addend is negative. The second arrow would start at -3 and be nine units long, also pointing downward. The second arrow would end at -12.***

The absolute value of the numbers will give me the length of the arrow, and the sign will tell me what direction the arrow should face.

2. Given the expression  $84 + (-29)$ , can you determine, without finding the sum, the distance between 84 and the sum? Is the sum to the right or left of 84 on the number line?

**The distance would be 29 units from 84. The sum is to the left of 84 on the number line.**

If I draw a sketch of the sum, I start at 0 and move 84 units to the right. I would then have to move 29 units to the left, which means the sum will be 29 units to the left of 84.

3. Refer back to the Integer Game to answer this question. Juno selected two cards. The sum of her cards is 16.

If needed, I can draw a number line to see what would happen if both of Juno's cards are negative.

- a. Can both cards be negative? Explain why or why not.

**No. In order for the sum to be 16, at least one of the addends would have to be positive. If both cards are negative, then Juno would count twice going to the left/down, which would result in a negative sum.**

- b. Can one of the cards be positive and the other be negative? Explain why or why not.

**Yes. She could have  $-4$  and  $20$  or  $-2$  and  $18$ . The card with the greatest absolute value would have to be positive.**

I can create a number line to determine if this is possible. This visual will also help me see that the longer arrow (larger absolute value) must be positive to get a positive sum.

4. Determine the afternoon temperatures for each day. Write an equation that represents each situation.
- a. The morning temperature was  $8^{\circ}\text{F}$  and then fell 11 degrees in the afternoon.

$$8 + (-11) = -3$$

**The afternoon temperature will be  $-3^{\circ}\text{F}$ .**

I can show the temperature falling as adding a negative because it would show a move down on a vertical number line.

- b. The morning temperature was  $-5^{\circ}\text{F}$  and then rose 9 degrees in the afternoon.

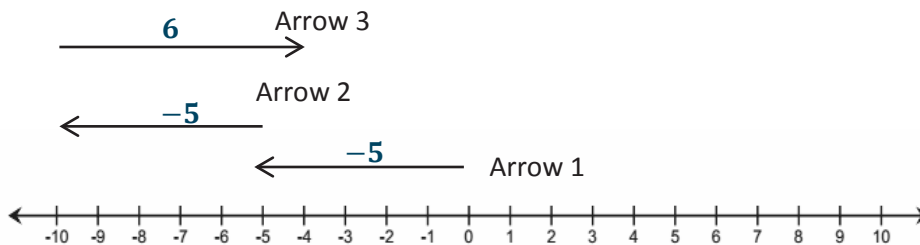
$$-5 + 9 = 4$$

**The afternoon temperature will be  $4^{\circ}\text{F}$ .**

I can show the temperature rising as adding a positive because it would show a move up on a vertical number line.

## G7-M2-Lesson 4: Efficiently Adding Integers and Other Rational Numbers

1. Use the diagram below to complete each part.



- a. How long is each arrow? What direction does each arrow point?

Arrow	Length	Direction
1	5	<i>left</i>
2	5	<i>left</i>
3	6	<i>right</i>

- b. Label each arrow with the number the arrow represents.

I can use the length and direction of each arrow to help me determine what number it represents. If it is facing left, it represents a negative number. If it is facing right, it represents a positive number.

- c. Write an equation that represents the sum of the numbers. Find the sum.

$$(-5) + (-5) + 6 = -4$$

These three arrows represent a sum. The third arrow ends on the answer, or the sum, of all three numbers being represented by the three arrows.



2. Which of these story problems describes the sum  $24 + (-17)$ ? Check all that apply.

Morgan planted 24 tomato plants at the beginning of spring. She sold 17 of the plants at the farmer's market. How many plants does she have now?

Selling some of the plants would be represented as negative numbers when trying to figure out how many plants Morgan has left.

Morgan started with 24 tomato plants. Then her mother took 8 of the plants, and her aunt took 9 of the plants. How many plants does Morgan have now?

If I combine the amounts taken by each family member, I get  $(-8) + (-9) = -17$ . So this would also show  $-17$  plants being added to the total.

Morgan owes her mother 24 tomato plants but only has 17 to give her. How many tomato plants short of the total needed is Morgan?

The amount of plants Morgan owes her mom would be represented by a negative value, while the 17 plants she has would be represented by a positive number. Therefore, the signs of the two addends are opposites of the addends in the given expression.

3. Ezekiel is playing the Integer Game. He has the cards  $-7$  and  $4$ .
- a. What card would Ezekiel need to draw next to win with a score of zero?

I need to calculate the sum of his two cards.

$$-7 + 4 = -3$$

$$-3 + 3 = 0$$

If I add a number and its opposite, I will get zero. So I know that the next card drawn has to be the opposite of  $-3$ .

***Ezekiel would need to draw a 3.***

- b. Ezekiel drew two more cards, and his new score is the opposite of his original score. What two cards might he have drawn?

**His cards must have a sum of 3.**

**The cards could be 1 and 5.**

$$-7 + 4 + 1 + 5 = -7 + 10 = 3$$

I know that the new sum is the opposite of  $-3$ . That means that all four cards together must have a sum of 3. On a number line, I see that  $-3$  and 3 are 6 units apart. So the two new cards must have a sum of 6.

4.  $\frac{1}{5} + \left(-3\frac{7}{10}\right)$

To add fractions, I need common denominators. I will use the least common multiple of 5 and 10.

$$\frac{2}{10} + \left(-3\frac{7}{10}\right)$$

$$\frac{2}{10} + \left(-\frac{37}{10}\right)$$

$$-\frac{35}{10}$$

$$-3\frac{5}{10}$$

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

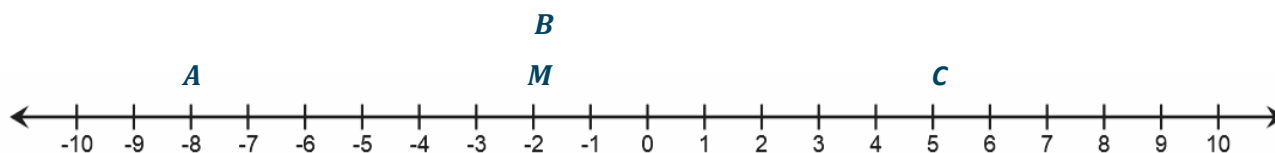
I can write a mixed number as a fraction greater than 1 to help me add the numerators correctly.

## G7-M2-Lesson 5: Understanding Subtraction of Integers and Other Rational Numbers

### Adding the Opposite

1. Choose an integer between 3 and  $-3$  on the number line, and label it point  $M$ . Locate and label the following points on the number line. Show your work.

I can choose any number I want between 3 and  $-3$ . For this example, I choose  $-2$ .



a. Point  $A$ :  $M - 6$

**Point A:**  $-2 - 6$

$$-2 + (-6)$$

$$-8$$

To subtract, I add the opposite. Therefore, I move to the left, just like I would if I subtract a positive.

b. Point  $B$ :  $(M - 5) + 5$

**Point B:**  $(-2 - 5) + 5$

$$(-2 + (-5)) + 5$$

$$-2 \text{ (same value as } M)$$

If I subtract a number and then add the same number, the original value will remain the same. I can see this on the number line, moving left and then moving right the same number of units.

c. Point  $C$ :  $-M - (-3)$

**Point C:**  $-(-2) - (-3)$

$$2 + 3$$

$$5$$

When I see a negative in front of a number, I can read that as "the opposite of." So  $-(-2)$  would mean the opposite of  $-2$ , which would be 2.

2. You and your partner were playing the Integer Game in class. Here are the cards in both hands.



- a. Find the value of each hand. Who would win based on the current scores? (The score closest to 0 wins.)

**My hand:**  $-6 + 5 + 3 + (-4) = -2$

**Partner's hand:**  $7 + (-8) + 6 + (-3) = 2$

I find that both numbers are 2 units from 0, one is to the right, and the other is to the left. Neither player is closer to 0.

**My partner and I would tie because  $-2$  and  $2$  are both 2 units from 0.**

- b. Find the value of each hand if you discarded the  $-4$  and selected a 4 and your partner discarded the  $-3$  and selected a 3. Show your work to support your answer. Then decide who would now win the game.

**My hand: Discard the  $-4$ ,**

$$\begin{aligned} -2 - (-4) \\ -2 + 4 \\ 2 \end{aligned}$$

**Select a 4,**

$$\begin{aligned} 2 + 4 \\ 6 \end{aligned}$$

**Partner's hand: Discard the  $-3$ ,**

$$\begin{aligned} 2 - (-3) \\ 2 + 3 \\ 5 \end{aligned}$$

**Select a 3,**

$$\begin{aligned} 5 + 3 \\ 8 \end{aligned}$$

Discarded means that it was thrown out or taken away. So I need to subtract those values from the scores I found in part (a).

**My hand would win because 6 is the value that is closer to 0.**

3. Explain what is meant by the following, and illustrate with an example:

“For any real number,  $g$ ,  $4 - g = 4 + (-g)$ .”

For this question, I need to explain why  $4 - g$  is equivalent to  $4 + (-g)$ , and I have to give an example where I pick the value of  $g$  and show this is true.

***Subtracting a number is the same as adding its additive inverse. Here is an example.***

***$g = 10$ ,  $4 - (10)$  is the same as  $4 + (-10)$  because  $-10$  is the opposite of  $10$ .***

$$4 - 10 = -6$$

$$4 + (-10) = -6$$

***So,  $4 - 10 = 4 + (-10)$  because they both equal  $-6$ .***

I can substitute 10 for  $g$  in both expressions. Both expressions will give me the same answer ( $-6$ ), showing the statement is true.

4. Write two equivalent expressions that represent the situation. What is the difference in their elevations?

A mountain climber hikes to an altitude of 8,400 feet. A diver reaches a depth of 180 feet below sea level.

A distance above sea level would be represented as a positive integer, and the distance below sea level would be a negative integer.

$$8,400 - (-180)$$

$$8,400 + 180$$

$$8,580$$

I can also show this as addition. I need to add the distance above sea level with the distance below sea level to determine the total difference in their elevations.

***The difference in their elevations is 8,580 ft.***

## G7-M2-Lesson 6: The Distance Between Two Rational Numbers

1. Find the distance between the two rational numbers.

a.  $|-6 - 15|$

$$\begin{aligned} &|-6 - 15| \\ &|-6 + (-15)| \\ &|-21| \\ &21 \end{aligned}$$

The bars on either side indicate absolute value. After I calculate the difference, I determine the absolute value. I can determine this by finding the distance the answer is from 0. Distances are always positive.

b.  $|6 - (-15)|$

$$\begin{aligned} &|6 - (-15)| \\ &|6 + 15| \\ &|21| \\ &21 \end{aligned}$$

c.  $|-7 - 5.4|$

$$\begin{aligned} &|-7 - 5.4| \\ &|-7 + (-5.4)| \\ &|-12.4| \\ &12.4 \end{aligned}$$

I can work with signed decimals the same as I work with integers. I will still subtract by adding the opposite.

d.  $|7 - (-5.4)|$

$$\begin{aligned} &|7 - (-5.4)| \\ &|7 + 5.4| \\ &|12.4| \\ &12.4 \end{aligned}$$

2. Do you notice any special relationships between parts (a) and (b) or between parts (c) and (d)? Explain.

The distance between two sets of opposites is the same.

*The answers in parts (a) and (b) were the same because I was working with opposites. I found the distance between  $-6$  to  $15$  and then found the distance between  $6$  and  $-15$ . The same relationship occurred in parts (c) and (d).*

## G7-M2-Lesson 7: Addition and Subtraction of Rational Numbers

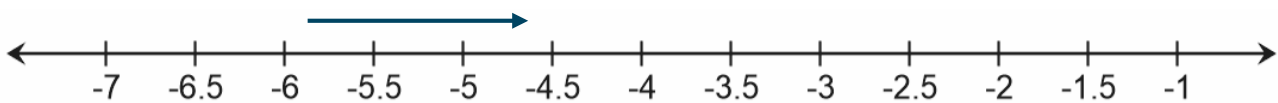
Represent each of the following problems using both a number line diagram and an equation.

1. Mannah went diving to check out different sea creatures. The total dive was 5.8 meters below sea level, and Mannah stops at 1.2 meters from the deepest part of the dive to look at a fish. How far from sea level will he be when he stops?

$$\begin{aligned} -5.8 - (-1.2) \\ -5.8 + 1.2 \\ -4.6 \end{aligned}$$

***Mannah will be 4.6 meters below sea level when he stops to look at the fish.***

Because Mannah is below sea level, the depth of the dive will be negative. Then I will take away  $-1.2$  meters because he already made this part of the journey back up to sea level (0 meters) before he stops to see the fish.



I can check my work using the number line. I know that Mannah is heading towards sea level, or 0, so an arrow that is 1.2 units long facing right matches my equation and shows my work is correct.

2. A sturgeon was swimming  $1\frac{1}{2}$  feet below sea level when it jumped up 4 feet before returning back to the water. How far above sea level was the fish at its highest point?

$$-1\frac{1}{2} + 4 = 2\frac{1}{2}$$

***The sturgeon reached  $2\frac{1}{2}$  feet above sea level.***

The initial location of the sturgeon is negative because it is below sea level. The sturgeon is jumping up, adding to its elevation.



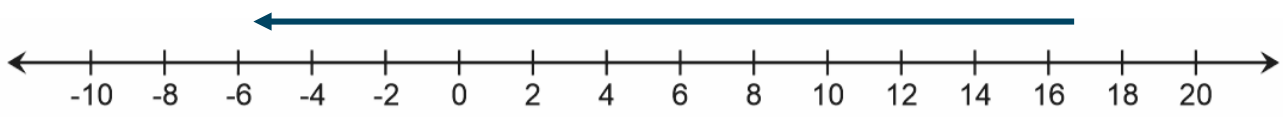


3. Marissa earned \$16.75 babysitting and placed the money on a debit card. While shopping, she wanted to spend \$22.40 on a new skirt. What would her new balance be on the debit card if she makes the purchase?

$16.75 + (-22.40) = -5.65$

The account balance would be  $-\$5.65$ .

The skirt Marissa wants to buy costs more than she earned. So she would have a negative balance on her debit card.



This time my arrow will start at a positive number and go left to show that she is adding a negative when spending the money she earned.

## G7-M2-Lesson 8: Applying the Properties of Operations to Add and Subtract Rational Numbers

1. Jerod dropped his wallet at the grocery store. The wallet contained \$40. When he got home, his grandfather felt sorry for him and gave him \$28.35. Represent this situation with an expression involving rational numbers. What is the overall change in the amount of money Jerod has?

$$-40 + 28.35 = -11.65$$

*The overall change in the amount of money Jerod has is  $-11.65$  dollars.*

The sum of losing the money and then gaining money should be closer to zero but still negative because Jerod was given less money than he lost.

Losing the wallet would be a negative because now he doesn't have the money anymore. But then we need to add a positive on to the total when the grandfather gives him money.

2. Zoe is completing some math problems. What are the answers? Show your work.

a.  $-9 + -\frac{2}{3}$   
 $-9\frac{2}{3}$

In the lesson, I practiced writing a mixed number as the sum of two signed numbers. I can do the reverse of that here and write the sum of two signed numbers as a mixed number.

b.  $16 - 19\frac{4}{5}$

$$16 + \left(-19\frac{4}{5}\right)$$

$$16 + \left(-19 + \left(-\frac{4}{5}\right)\right)$$

$$16 + (-19) + \left(-\frac{4}{5}\right)$$

$$-3 + \left(-\frac{4}{5}\right)$$

$$-3\frac{4}{5}$$

I write the mixed number as the sum of two signed numbers, and then I can combine the integers together. Finally, the two signed numbers will combine to form a mixed number.

c.  $\left(\frac{1}{8} + \frac{3}{4}\right) + \left(\left(-\frac{1}{8}\right) + \left(-\frac{3}{4}\right)\right)$

$\left(\frac{1}{8} + \frac{6}{8}\right) + \left(\left(-\frac{1}{8}\right) + \left(-\frac{6}{8}\right)\right)$

$\left(\frac{7}{8}\right) + \left(-\frac{7}{8}\right)$   
**0**

I rewrite the fractions with common denominators before adding.

I am adding a sum and its opposite. I know this because the second sum in parentheses has the opposite sign but the same absolute value.

## G7-M2-Lesson 9: Applying the Properties of Operations to Add and Subtract Rational Numbers

1. Show all steps needed to rewrite each of the following expressions as a single rational number.

a.  $14 - \left(-8\frac{4}{9}\right)$

$$14 + 8\frac{4}{9}$$

$$14 + 8 + \frac{4}{9}$$

$$22 + \frac{4}{9}$$

$$22\frac{4}{9}$$

I can separate the mixed number so that I can work with the whole number and the fraction separately.

b.  $-2\frac{2}{5} + 4.1 - 8\frac{1}{5}$

$$-2\frac{2}{5} - 8\frac{1}{5} + 4.1$$

$$-2\frac{2}{5} + \left(-8\frac{1}{5}\right) + 4.1$$

$$-2 + \left(-\frac{2}{5}\right) + (-8) + \left(-\frac{1}{5}\right) + 4.1$$

$$-2 + (-8) + \left(-\frac{2}{5}\right) + \left(-\frac{1}{5}\right) + 4.1$$

$$-10 + -\frac{3}{5} + 4.1$$

$$-10\frac{3}{5} + 4.1$$

$$-10\frac{3}{5} + 4\frac{1}{10}$$

$$-10\frac{6}{10} + 4\frac{1}{10}$$

$$-6\frac{5}{10}$$

I apply the commutative property because the two mixed numbers have common denominators already.

I can rewrite the decimal as a fraction,  $4\frac{1}{10}$ . And I can write  $\frac{3}{5}$  as  $\frac{6}{10}$  so that I have common denominators to add.

2. Explain, step by step, how to arrive at a single rational number to represent the following expression. Show both a written explanation and the related math work for each step.

$$4 - \left(-3\frac{2}{9}\right) + 2\frac{1}{3}$$

*Rewrite the subtraction as adding the inverse.*

$$4 + 3\frac{2}{9} + 2\frac{1}{3}$$

*Get common denominators.*

$$4 + 3\frac{2}{9} + 2\frac{3}{9}$$

*Separate each mixed number into the sum of its parts.*

$$4 + 3 + \frac{2}{9} + 2 + \frac{3}{9}$$

*Reorder the addends so that I can add the whole number addends and add the fractional addends.*

$$4 + 3 + 2 + \frac{2}{9} + \frac{3}{9}$$

*Add the whole number addends and then the fractional addends.*

$$9 + \frac{5}{9}$$

*Add the whole number addend and fractional addend together.*

$$9\frac{5}{9}$$

## G7-M2-Lesson 10: Understanding Multiplication of Integers

### Integer Game

Describe sets of two or more matching integer cards that satisfy the criteria in each problem below.

1. Cards increase the score by six points.

**Picking up:** six 1's, three 2's, or two 3's

**OR**

**Removing:** six (-1)'s, three (-2)'s, or two (-3)'s

I can increase my score two ways: picking up positive value cards (pos.  $\times$  pos.) or removing negative value cards from my hand (neg.  $\times$  neg.)

2. Cards decrease the score by 4 points.

**Picking up:** four (-1)'s or two (-2)'s

**OR**

**Removing:** four 1's or two 2's

I can decrease my score two ways: picking up negative value cards (pos.  $\times$  neg.) or removing positive value cards from my hand (neg.  $\times$  pos.).

3. Removing cards that increase the score by 8 points.

**Eight (-1)'s, four (-2)'s, or two (-4)'s**

If I want to remove cards to increase my score, I must remove negative value cards.

4. Bruce is playing the Integer Game and is given the opportunity to discard a set of matching cards. Bruce determines that if he discards one set of cards, his score will increase by 8. If he discards another set, then his score will decrease by 15. If his matching cards make up all seven cards in his hand, what cards are in Bruce's hand?

**There are two possibilities:**

**-4, -4, 3, 3, 3, 3, 3 or -2, -2, -2, -2, 5, 5, 5**

Removing negative cards increases Bruce's score and removing positive cards decreases Bruce's score.

## G7-M2-Lesson 11: Develop Rules for Multiplying Signed Numbers

### Multiplying Integers

1. Explain why  $(-3) \times (-2) = 6$ . Use patterns, an example from the Integer Game, or the properties of operations to support your reasoning.

Instead of using the Integer Game to explain why the product is positive, I could have also used the patterns I saw in the four quadrants during class today.

*If I think about the Integer Game, removing negative cards from my hand, increases my score. Therefore, the problem presented indicates that I removed three cards  $(-3)$  each with a value of  $-2$ . This change would increase my score by 6 points.*

2. Emilia receives allergy shots in order to decrease her allergy symptoms. Emilia must pay \$20 each time she receives a shot, which is twice a week. Write an integer that represents the change in Emilia's money from receiving shots for 8 weeks. Explain your reasoning.

Each time Emilia pays for a shot, her money decreases by \$20, which is indicated with  $-20$  in my equation.

$$2(8) = 16$$

*Emilia receives 16 shots in 8 weeks.*

$$-20(16) = -320$$

*The change in Emilia's money after 8 weeks of receiving shots twice a week is  $-\$320$ .*

3. Write a real-world problem that can be modeled by  $3 \times (-2)$ .

I could have picked a different real-world example, but it would still require that  $-2$  is repeated three times.

*The temperature has decreased two degrees each hour for the last three hours. What is the change in temperature after the three hours?*

A decrease of 2 degrees describes the  $-2$  in the original expression.

## G7-M2-Lesson 12: Division of Integers

1. Find the missing value in each column.

Column A

$$-16 \div 8 = -2$$

$$16 \div -8 = -2$$

$$-16 \div -8 = 2$$

$$16 \div 8 = 2$$

Column B

$$-32 \div 8 = -4$$

$$32 \div -8 = -4$$

$$-32 \div -8 = 4$$

$$32 \div 8 = 4$$

I know that when the dividend and divisor have the same sign, the quotient will be positive. I also know that when the dividend and divisor have opposite signs, the quotient will be negative.

2. Describe the pattern you see in each column's answers in Problem 1, relating it to the divisors and dividends. Why is this so?

*The first two quotients in each column are negative because the dividend and divisor have opposite signs but the same absolute values, which means the answers will have a negative value. The last two quotients in each column are positive because the dividend and divisor have the same signs and absolute values, which means the answer will be a positive value.*

3. Describe the pattern you see between the answers in Column A and Column B in Problem 1. Why is this so?

*The quotients in Column B are each double the corresponding quotients in Column A. This is true because the divisors in each column are the same, but the dividends in Column B are double the corresponding dividends in Column A. Since 32 is double 16 and the divisors remain the same, the quotients will also be double.*

If the divisor's value doubled and the dividend remained constant, the value of the new quotient would be half of the value of the original quotient.



## G7-M2-Lesson 13: Converting Between Fractions and Decimals

### Using Equivalent Fractions

#### Converting Terminating Decimals to Fractions

Convert each terminating decimal to a fraction in its simplest form.

1. 0.8

The decimal place farthest to the right is the tenths place. Therefore, my denominator will be 10, and my numerator will be 8.

$$0.8 = \frac{8}{10} = \frac{4}{5}$$

The numerator and denominator have a greatest common factor of 2. I can divide this common factor out to write the fraction in simplest form.

2. 0.375

The decimal place farthest to the right is the thousandths place. Therefore, my denominator will be 1,000, and my numerator will be 375.

$$0.375 = \frac{375}{1,000} = \frac{75}{200} = \frac{15}{40} = \frac{3}{8}$$

Instead of finding the greatest common factor, I kept dividing by a smaller common factor until the only common factor between the numerator and denominator was 1.

3. 0.05

The extra 0 does not change anything, I still look at the decimal place farthest to the right to determine the denominator.

$$0.05 = \frac{5}{100} = \frac{1}{20}$$

### Converting Fractions to Decimals

Convert each fraction or mixed number to a decimal using an equivalent fraction.

I need to write each fraction with a denominator that is a power of 10.

In order to make my denominator a power of 10, I need to multiply both the numerator and denominator by 2.

$$4. \quad \frac{2}{5} = \frac{2 \times 2}{5 \times 2} = \frac{4}{10} = 0.4$$

In order to make my denominator a power of 10, I need the same number of 2's and 5's in the denominator. Therefore, I need another factor of 5.

$$5. \quad \frac{7}{20} = \frac{7}{2^2 \times 5} = \frac{7 \times 5}{2^2 \times 5^2} = \frac{35}{100} = 0.35$$

If the denominator is 100, then the decimal farthest to the right should be in the hundredths place.

This time I need two more factors of 2 to have the same number of 2's and 5's, which will make my denominator a power of 10.

$$6. \quad \frac{13}{250} = \frac{13}{2 \times 5^3} = \frac{13 \times 2^2}{2^3 \times 5^3} = \frac{52}{1000} = 0.052$$

I need the decimal farthest to the right to be in the thousandths place, so I need to use a 0 for a place holder.

I have to divide out the factor of 7 from the numerator and denominator before I can change the denominator to a power of 10.

$$7. \quad \frac{21}{175} = \frac{7 \times 3}{7 \times 5^2} = \frac{3}{5^2} = \frac{3 \times 2^2}{5^2 \times 2^2} = \frac{12}{100} = 0.12$$

## G7-M2-Lesson 14: Converting Rational Numbers to Decimals

### Using Long Division

1. Convert each rational number into its decimal form.

a.  $\frac{3}{12}$

$$\frac{3}{12} = \frac{3}{2^2 \times 3} = \frac{1}{2^2} = \frac{1 \times 5^2}{2^2 \times 5^2} = \frac{25}{100} = 0.25$$

$$\frac{3}{12} = 0.25$$

I know the decimal will terminate because the fraction can be rewritten with a denominator that is a power of 10.

b.  $\frac{1}{12}$

I notice the remainder continues to repeat, which means the digits in the quotient will also repeat.

$$\begin{array}{r} 0.08\overline{3} \\ 12 \overline{) 1.0000} \\ \underline{-96} \phantom{0} \\ 40 \\ \underline{-36} \phantom{0} \\ 40 \\ \underline{-36} \phantom{0} \\ 40 \\ \underline{-36} \phantom{0} \\ 40 \end{array}$$

I cannot rewrite this denominator as a power of 10, so the decimal will repeat.

$$\frac{1}{12} = 0.08\overline{3}$$

2. Josephine thinks  $-\frac{5}{15}$  is a terminating decimal. Is Josephine correct? Why or why not?

$$-\frac{5}{15} = -\frac{1}{3}$$

**Josephine is not correct because the denominator cannot be written as a power of 10, which must be true if the fraction represents a terminating decimal.**

## G7-M2-Lesson 15: Multiplication and Division of Rational Numbers

1. Charlotte owes her parents \$135. If Charlotte pays her parents \$15 every week for 7 weeks, how much money will she still owe her parents?

To determine how much Charlotte pays her parents, I can multiply the size of the payment by the number of payments.

$$135 + 7(-15) = 135 + (-105) = 30$$

**Charlotte will still owe her parents \$30 after making 7 equal payments of \$15.**

2. Find at least two sets of values that will make each equation true.
- a. Fill in the blanks with two rational numbers that will make the equation true.

$$\underline{\hspace{1cm}} \times \left(-\frac{1}{5}\right) \times \underline{\hspace{1cm}} = 10$$

What must be true about the relationship between the two numbers you choose?

**Two possible answers:  $-10$  and  $5$  or  $10$  and  $-5$**

**The two numbers must be factors of 50 and have opposite signs.**

I can use my knowledge of solving equations to determine the product of the two missing values.

To get a positive quotient, I need an even number of negative factors. The factor  $\left(-\frac{1}{5}\right)$  is already negative, so one of the other two factors needs to be negative.

This part of the equation has a value of 5, which means the missing two factors should have a product of  $-12$ .

- b. Fill in the blanks with two rational numbers that will make the equation true.

$$(-2.5) \times 50 \div (-25) \times \underline{\quad} \times \underline{\quad} = -60$$

What must be true about the relationship between the two numbers you choose?

**Two possible answers: 2 and  $-6$  or  $-3$  and 4**

**The two numbers must be factors of 12 and have opposite signs.**

To have a negative answer, I must have an odd number of negative factors. Two of the factors are already negative, which means one additional factor needs to be negative.

3. Create a word problem that can be represented by the expression, and then represent the quotient as a single rational number.

$$-10 \div 2\frac{1}{2}$$

**The temperature dropped 10 degrees in  $2\frac{1}{2}$  hours. If the temperature dropped at a constant rate, how much did the temperature drop each hour?**

$$-10 \div 2\frac{1}{2}$$

$$-10 \div \frac{5}{2}$$

$$-\frac{10}{1} \times \frac{2}{5}$$

$$-\frac{20}{5}$$

$$-4$$

I could have used a different example of a real-world problem, but the answer will still be  $-4$ .

**The temperature dropped four degrees each hour.**

## G7-M2-Lesson 16: Applying the Properties of Operations to Multiply and Divide Rational Numbers

1. Evaluate the expression  $\left(-\frac{1}{5}\right) \times (-8) \div \left(-\frac{1}{3}\right) \times 15$

a. Using order of operations only.

Using the order of operations to evaluate this expression, I complete the operations from left to right.

$$\begin{aligned} &\left(-\frac{1}{5}\right) \times (-8) \div \left(-\frac{1}{3}\right) \times 15 \\ &\frac{8}{5} \div \left(-\frac{1}{3}\right) \times 15 \\ &\frac{8}{5} \times (-3) \times 15 \\ &\left(-\frac{24}{5}\right) \times 15 \\ &-72 \end{aligned}$$

b. Using the properties and methods used in Lesson 16.

I use the commutative property to change the order of the factors. This allows me to eliminate the fractions.

$$\begin{aligned} &\left(-\frac{1}{5}\right) \times (-8) \div \left(-\frac{1}{3}\right) \times 15 \\ &\left(-\frac{1}{5}\right) \times 15 \times (-8) \times (-3) \\ &(-3) \times (-8) \times (-3) \\ &-72 \end{aligned}$$

2. Evaluate each expression using the distributive property.

a.  $3\frac{1}{3} \times (-12)$

$$\left(3 + \frac{1}{3}\right) \times (-12)$$

$3\frac{1}{3}$  is equivalent to  $3 + \frac{1}{3}$ .

$$3 \times (-12) + \frac{1}{3} \times (-12)$$

$$-36 + (-4)$$

$$-40$$

I distribute the  $-12$  to both values in the parentheses.

$$b. \frac{3}{4}(-3) + \frac{3}{4}(11)$$

$$\frac{3}{4}(-3 + 11)$$

$$\frac{3}{4}(8)$$

$$6$$

I use the distributive property to factor out the common factor  $\left(\frac{3}{4}\right)$ . This allows me to combine the integers before multiplying by the fractional value.

3. Examine the problem and work below. Find and explain the errors, and then find the correct value of the expression.

$$(-3) \times 0.4 \times 2 \div \left(-\frac{1}{5}\right) \div 3$$

$$(-3) \times 0.4 \times 2 \times (-5) \times 3$$

$$(-3) \times 0.4 \times (-5) \times 2 \times 3$$

$$(-3) \times (-2) \times 2 \times 3$$

$$-36$$

When division is changed to multiplication, the divisor needs to be inverted.

Two negative factors result in a positive product.

**There are two mistakes in the work. First, when changing  $\div 3$  to multiplication, it should be changed to  $\times \frac{1}{3}$  because we need to invert and multiply. Second, there is an error with the negative signs in the final step. An even number of negative factors will result in a positive product, not a negative product. The correct work is shown below.**

$$(-3) \times 0.4 \times 2 \times (-5) \times \frac{1}{3}$$

$$(-3) \times \frac{1}{3} \times 0.4 \times (-5) \times 2$$

$$-1 \times 0.4 \times (-5) \times 2$$

$$-1 \times (-2) \times 2$$

$$4$$

I can use the commutative property like I did with an earlier problem.

## G7-M2-Lesson 17: Comparing Tape Diagram Solutions to Algebraic Solutions

Solve each problem by writing an equation and constructing a tape diagram.

- Liam always eats 2 servings of fruit every day. He also eats some vegetables every day. He eats 35 servings of fruits and vegetables every week. If Liam eats the same number of vegetables every day, how many servings of vegetables does he eat each day?

### Algebraic Equation

Let  $v$  represent the number of servings of vegetables Liam eats each day.

I add the number of servings of fruits and vegetables together and then multiply by 7 because there are 7 days in a week, and I know how many servings Liam eats in a week, 35.

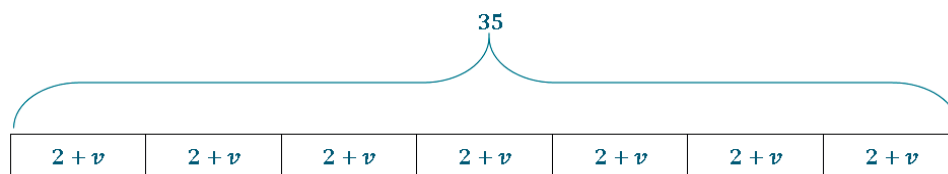
$$\begin{aligned} 7(2 + v) &= 35 \\ 14 + 7v &= 35 \\ 14 - 14 + 7v &= 35 - 14 \\ 7v &= 21 \\ \left(\frac{1}{7}\right)(7v) &= \left(\frac{1}{7}\right)(21) \\ v &= 3 \end{aligned}$$

Here, I apply the distributive property. I could multiply by the multiplicative inverse instead.

I can collect like terms and then multiply by the multiplicative inverse to determine the value of the variable.

**Liam eats 3 servings of vegetables each day.**

### Tape Diagram



$$\begin{aligned} 7v & & 35 - 14 = 21 \\ 7(2) = 14 & & 21 \div 7 = 3 \end{aligned}$$

**Liam eats 3 servings of vegetables each day.**

I have 7 equal sections, one for each day of the week. Each section shows the number of servings Liam eats each day.



2. Ava bought her first cell phone for \$95 and now has a monthly bill. If Ava paid \$815 during the first year of having a cell phone, what is the amount of Ava's monthly bill?

**Algebraic Equation**

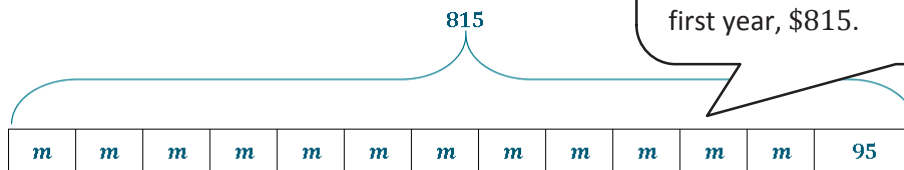
Let  $m$  represent the amount of Ava's monthly bill.

$$\begin{aligned} 12m + 95 &= 815 \\ 12m + 95 - 95 &= 815 - 95 \\ 12m &= 720 \\ \left(\frac{1}{12}\right)(12m) &= \left(\frac{1}{12}\right)(720) \\ m &= 60 \end{aligned}$$

I know Ava makes 12 equal monthly payments over the course of the year. The sum of her monthly bill and her cell phone will be the amount she paid during the first year.

Ava's monthly bill is \$60.

**Tape Diagram**



I create a tape diagram that shows 12 equal payments of  $m$  plus the cost of the cell phone, \$95. The total length of the tape diagram represents the amount Ava paid during the first year, \$815.

$$\begin{aligned} 12m & \qquad \qquad 815 - 95 = 720 \\ 720 \div 12 &= 60 \end{aligned}$$

Ava's monthly bill is \$60.

## G7-M2-Lesson 18: Writing, Evaluating, and Finding Equivalent Expressions with Rational Numbers

1. Geraldine receives a weekly allowance. Every week she spends \$2 on snacks at lunch time and saves the rest of her money.
- a. Write an expression that represents the amount Geraldine will save in 8 weeks if she receives  $a$  dollars each week for her allowance.

*Let  $a$  represent Geraldine's weekly allowance, in dollars.*

I can apply the distributive property to write an equivalent expression.

$$8(a - 2)$$

$$8a - 16$$

I know that Geraldine saves her allowance minus the \$2 she spends on snacks for 8 weeks.

- b. If Geraldine receives \$10 each week for her allowance, how much money will she save in 8 weeks?

$8(a - 2)$	<b>OR</b>	$8a - 16$
$8(10 - 2)$		$8(10) - 16$
$8(8)$		$80 - 16$
<b>64</b>		<b>64</b>

**Geraldine would save \$64.**

I now know the value of  $a$  and can substitute this value into either of the equivalent expressions.

2. During Nero's last basketball game, he made 6 field goals, 2 three-pointers, and 5 free throws.
- a. Write an expression to represent the total points Nero scored during the game.

*Let  $f$  represent the number of points for a field goal,  $p$  represent the number of points for a three-pointer, and  $t$  represent the number of points for a free throw.*

$$6f + 2p + 5t$$

I multiply the number of each type of shot Nero made by the number of points earned for each shot.

- b. Write another expression that is equivalent to the one written above.

$$3f + 3f + 2p + 5t$$

There are many options for an equivalent expression. I could have just changed the order of the terms.

- c. If each field goal is worth 2 points, each three-pointer is worth 3 points, and each free throw is worth 1 point, how many total points did Nero score?

$$6f + 2p + 5t$$

$$6(2) + 2(3) + 5(1)$$

$$12 + 6 + 5$$

$$23$$

I substitute each value in for the corresponding variable and use order of operations to evaluate the expression.

**Nero scored 23 points.**

3. The seventh grade student council is completing a fundraiser at a track meet. They are selling water bottles for \$1.75 but paid \$0.50 for each bottle of water. In order to keep the water cold, the student council also purchased a large cooler for \$75. The table below shows the earnings, expenses, and profit earned when 80, 90, and 100 water bottles are sold.

Amount of Water Bottles Sold	Earnings (in dollars)	Expenses (in dollars)	Profit (in dollars)
80	$80(1.75) = 140$	$80(0.50) + 75 = 115$	$140 - 115 = 25$
90	$90(1.75) = 157.5$	$90(0.50) + 75 = 120$	$157.5 - 120 = 37.5$
100	$100(1.75) = 175$	$100(0.50) + 75 = 125$	$175 - 125 = 50$

- a. Write an expression that represents the profit (in dollars) the student council earned by selling water bottles at the track meet.

**Let  $w$  represent the number of water bottles sold.**

$$1.75w - 0.5w - 75$$

$$1.25w - 75$$

I can collect like terms to write an equivalent expression.

The first term shows the earnings. The last two terms are the expenses, so they must be subtracted from the earnings.

- b. How much profit did the student council make if it sold 50 water bottles? What does this mean? Explain why this might be the case.

$$1.25w - 75$$

$$1.25(50) - 75$$

$$62.5 - 75$$

$$-12.5$$

The negative value means that the expenses were more than the earnings, which means no profit was made.

*The student council did not make any money; in fact, they lost \$12.50. Possible reasons could be that it was not too hot and most people brought their own water to the track meet.*

- c. How much profit did the student council make if it sold 125 water bottles? What does this mean? Explain why this might be the case.

$$1.25w - 75$$

$$1.25(125) - 75$$

$$156.25 - 75$$

$$81.25$$

The positive value means that the expenses were less than the earnings, which means a profit was made.

*The student council would make a profit of \$81.25. The high number of water bottles sold could be explained by extremely hot weather or that most people did not bring enough water to the track meet.*

## G7-M2-Lesson 19: Writing, Evaluating, and Finding Equivalent Expressions with Rational Numbers

Solve the following problems. If necessary, round to the nearest penny.

1. Viviana is having her birthday party at the movie theater. Eight total people attended the party, and Viviana's parents bought each person a ticket. Viviana's parents also bought all of the drinks and snacks; four people chose a soda, two people chose a slushie, and six people chose a large popcorn.
  - a. Write an expression that can be used to figure out the cost of the birthday party. Include the definitions for the variables Viviana's mom may have used.

**Let  $t$  represent the cost of a movie ticket,  $s$  represent the cost of a soda,  $d$  represent the cost of a slushie, and  $p$  represent the cost of a large popcorn.**

$$8t + 4s + 2d + 6p$$

I know that 8 movie tickets were bought, so I multiply 8 by the price of a movie ticket. I follow this same process for the other terms in the expression.

- b. Viviana's dad wrote down  $2(4t + 2s + 3p)$  to determine the total cost of the party. Was he correct? Explain why or why not?

**The expression Viviana's dad wrote is not correct. Although it is possible to apply the distributive property and factor out a 2, he did not complete the process correctly because he dropped a term. There is no longer a term to represent the cost of the slushies. Instead the expression should be  $2(4t + 2s + d + 3p)$ .**

- c. What is the cost of the party if a movie ticket costs \$9.25, a soda costs \$3.25, a slushie costs \$2.50, and a large popcorn costs \$5.50?

I can substitute the known values into the expression from part (a) or the corrected expression in part (b).

$$8t + 4s + 2d + 6p$$

$$8(9.25) + 4(3.25) + 2(2.50) + 6(5.50)$$

$$74 + 13 + 5 + 33$$

$$125$$

**The cost of the birthday party is \$125.**

2. Benson started a resume business. He helps clients create great resumes when they are looking for new jobs. Benson charges each client \$50 to create a resume but paid \$110 for new computer software to help create fancy resumes.
- a. Write an expression to determine Benson's take-home pay after expenses.

*Let  $r$  represent the number of resumes Benson creates.*

$$50r - 110$$

Benson's only expense is the computer software program.

- b. If Benson help 8 clients create resumes, what was his take-home pay after expenses?

$$50r - 110$$

$$50(8) - 110$$

$$290$$

*Benson's take-home pay would be \$290 after paying his expenses.*

3. Mr. and Mrs. Slater bought some new pillows and used a 10% off coupon that allowed them to save some money. Mr. Slater added the 8% sales tax to the original cost first, and then deducted the coupon savings. Mrs. Slater thought they would save more money if the final cost of the pillows was calculated by deducting the savings from the coupon and then adding the 8% sales tax to the reduced cost.
- a. Write an expression to represent each person's scenario if the original price of the pillows was  $p$  dollars.

The sales tax increases the cost of the pillows by 8% of the original cost of the pillows. The coupon decreases the cost of the pillows by 10% of the price of the pillows, including sales tax.

*Mr. Slater*

$$(p + 0.08p) - 0.10(p + 0.08p)$$

$$0.90(p + 0.08p)$$

$$0.90(1.08p)$$

*Mrs. Slater*

$$(p - 0.10p) + 0.08(p - 0.10p)$$

$$1.08(p - 0.10p)$$

$$1.08(0.90p)$$

The coupon decreases the cost of the pillows by 10% of the original cost of the pillows. The sales tax increases the cost of the pillows by 8% of the reduced price of the pillows.

- b. Explain how both of the expressions are equivalent.

*The three factors in the expression are the same, which means the two expressions are equivalent because multiplication is commutative. Both expressions will evaluate to the same value when any number is substituted in for  $p$ .*

## G7-M2-Lesson 20: Investments—Performing Operations with Rational Numbers

A high school basketball team is hosting a family night at one of their games to raise money for new uniforms.

- a. The game will be played on January 12, and the cost of admission is \$4. Write an expression to represent the total amount of money collected for admission. Evaluate the expression if 476 people attend the basketball game.

*Let  $p$  represent the number of people who attended the basketball game.*

$$4p$$

$$4(476)$$

$$1,904$$

This amount represents the deposit in the transaction log in part (c).

*If 476 people attend the basketball game, \$1,904 would be collected from admission.*

- b. The following expenses were necessary for the basketball game, and checks were written to pay each company.
- Referees for the game: *High School Referees Inc.* costs \$104 and is paid for on January 8.
  - T-Shirts from *T-Shirt World* for the first 50 fans: Cost of the t-shirts was \$5.75 each plus 6% sales tax, and the t-shirts were bought on January 5.

Write a numerical expression to determine the cost of the t-shirts.

This value represents one of the payments in the transaction log in part (c).

$$50(5.75 + 5.75(0.06))$$

$$50(5.75 + 0.345)$$

$$50(6.095)$$

$$304.75$$

I add the sales tax to the original cost of each t-shirt to determine the total cost of each t-shirt and then multiply by the number of shirts needed.

*The cost for the t-shirts is \$304.75.*

- c. Complete the transaction log below based on the information presented in parts (a) and (b).

I subtract the payments from the balance, and I add the deposit to the balance.

Date	Description of Transaction	Payment	Deposit	Balance
	Beginning Balance			876.54
January 5	T-Shirt World	304.75		571.79
January 8	High School Referees Inc.	104.00		467.79
January 12	Game Admission		1,904	2,371.79

Analyze the results.

- d. Write an expression to represent the profit earned from the family night. Use the expression to determine the profit if 476 people attend the basketball game.

Let  $p$  represent the number of people who attended the basketball game.

$$4p - 104 - 304.75$$

$$4p - 408.75$$

The profit is the amount of money collected in admissions minus all the expenses (cost of the t-shirts and the referees).

$$4(476) - 408.75$$

$$1,495.25$$

The profit if 476 people attend the basketball game is \$1,495.25.

The profit matches the transaction log if I calculate the difference between the ending balance and the beginning balance.

$$2,371.49 - 876.54 = 1,495.25$$



## G7-M2-Lesson 21: If-Then Moves with Integer Number Cards

1. Evaluate each expression.

- a.  $2 + (-5) + (-8)$      **-11**
- b.  $125 \div (-5) \times 4$      **-100**
- c.  $-10 + 45 \times (-2)$      **-100**

I must follow the order of operations when evaluating expressions.

2. Which expressions from Problem 1 are equivalent?

*Expressions (b) and (c) are equivalent expressions because they both evaluate to the same value.*

3. If the two equivalent expressions from Problem 1 are multiplied by 6, write an if-then statement using the properties of equality.

**If  $125 \div (-5) \times 4 = -100$  and  $-10 + 45 \times (-2) = -100$ , then  $6(125 \div (-5) \times 4) = 6(-10 + 45 \times (-2))$ .**

If I make the same changes to equivalent expressions, then the resulting expressions will still be equivalent.

4. Simplify the expression.

$$3 + (-14) \times 2 \div (-7) - 21$$

$$3 + (-28) \div (-7) - 21$$

$$3 + 4 - 21$$

$$-14$$

Using the expression, write an equation.

$$3 + (-14) \times 2 \div (-7) - 21 = -14$$

Rewrite the expression if 4 is subtracted from both expressions.

$$3 + (-14) \times 2 \div (-7) - 21 - 4 = -14 - 4$$

Write an if-then statement using the properties of equality.

**If  $3 + (-14) \times 2 \div (-7) - 21 = -14$ , then  $3 + (-14) \times 2 \div (-7) - 21 - 4 = -14 - 4$ .**

## G7-M2-Lesson 22: Solving Equations Using Algebra

For each equation below, explain the steps in determining the value of the variable. Then find the value of the variable, showing each step. Write if-then statements to justify each step in solving the equation.

1.  $3(y - 2) = -15$

*Multiply both sides of the equation by  $\frac{1}{3}$ , and then add 2 to both sides of the equation,  $y = -3$ .*

If:  $3(y - 2) = -15$

Then:  $\frac{1}{3}(3(y - 2)) = \frac{1}{3}(-15)$

I use the multiplication property of equality using the multiplicative inverse of 3.

If:  $1(y - 2) = -5$

Then:  $y - 2 = -5$

I recognize the multiplicative identity.

If:  $y - 2 = -5$

Then:  $y - 2 + 2 = -5 + 2$

I use the addition property of equality by using the additive inverse of  $-2$ .

If:  $y + 0 = -3$

Then:  $y = -3$

I recognize the additive identity.

2.  $2 = \frac{3}{4}a + 8$

*Subtract 8 from both sides of the equation, and then multiply both sides of the equation by  $\frac{4}{3}$ ,  $a = -8$ .*

If:  $2 = \frac{3}{4}a + 8$

Then:  $2 - 8 = \frac{3}{4}a + 8 - 8$

The variable is on the right side of the equation, so I need to look at the right side of the equation to determine how to solve.

If:  $-6 = \frac{3}{4}a + 0$

Then:  $-6 = \frac{3}{4}a$

If:  $-6 = \frac{3}{4}a$

Then:  $\frac{4}{3}(-6) = \frac{4}{3}\left(\frac{3}{4}a\right)$

The multiplicative inverse of  $\frac{3}{4}$  is  $\frac{4}{3}$ .

If:  $-8 = 1a$

Then:  $-8 = a$

## G7-M2-Lesson 23: Solving Equations Using Algebra

1. Solve the equation algebraically using if-then statements to justify your steps.

$$5 = \frac{-5+d}{3}$$

$$\text{If: } 5 = \frac{-5+d}{3}$$

$$\text{Then: } 3(5) = 3\left(\frac{-5+d}{3}\right)$$

$$\text{If: } 15 = 1(-5 + d)$$

$$\text{Then: } 15 = -5 + d$$

$$\text{If: } 15 = -5 + d$$

$$\text{Then: } 15 + 5 = -5 + 5 + d$$

$$\text{If: } 20 = 0 + d$$

$$\text{Then: } 20 = d$$

Dividing by 3 is the same as multiplying by  $\frac{1}{3}$ .  
The multiplicative inverse of  $\frac{1}{3}$  is 3.

For Problems 2-3, write an equation to represent each word problem. Solve the equation showing the steps, and then state the value of the variable in the context of the situation.

2. Julianne works two part-time jobs. She waters her neighbor's plants every day for 1 hour. Julianne also babysits every day. She continues the same schedule for 8 days and works a total of 32 hours. How many hours does Julianne babysit each day?

*Let  $b$  represent the number of hours Julianne babysits each day.*

$$8(b + 1) = 32$$

$$\text{If: } 8(b + 1) = 32$$

$$\text{Then: } \frac{1}{8}(8(b + 1)) = \frac{1}{8}(32)$$

$$\text{If: } 1(b + 1) = 4$$

$$\text{Then: } b + 1 = 4$$

$$\text{If: } b + 1 = 4$$

$$\text{Then: } b + 1 - 1 = 4 - 1$$

$$\text{If: } b + 0 = 3$$

$$\text{Then: } b = 3$$

*Julianne babysits for 3 hours each day.*

I could have applied the distributive property and then used properties of equality to solve for the missing variable.

If more explanation on solving equations is needed, I can refer back to Lesson 22.

3. Vince is thinking of joining a new gym and would have to pay a \$55 sign-up fee plus monthly payments of \$35. If Vince can only afford to pay \$265 for a gym membership, for how many months can he be a member?

*Let  $m$  represent the number of months Vince can afford to be a member of the gym.*

$$55 + 35m = 265$$

$$\text{If: } 55 + 35m = 265$$

$$\text{Then: } 55 - 55 + 35m = 265 - 55$$

$$\text{If: } 0 + 35m = 210$$

$$\text{Then: } 35m = 210$$

$$\text{If: } 35m = 210$$

$$\text{Then: } \frac{1}{35}(35m) = \frac{1}{35}(210)$$

$$\text{If: } 1m = 6$$

$$\text{Then: } m = 6$$

*Vince can be a member of the gym for 6 months.*

I know the sign-up fee is a one-time payment, and then Vince has to pay \$35 every month.