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**Estimated length of module: 7-10 school days**

## Equations & Expressions Pre-Assessment

6.EE.A.2.a: Write expressions that record operations with numbers and variables.

Write an algebraic expression from the given sentence.

1. Subtract  $h$  from nine. \_\_\_\_\_

2. Six times  $m$ . \_\_\_\_\_

a. Define expression:

\_\_\_\_\_

b. How is an expression different from an equation? (give an example):

\_\_\_\_\_

\_\_\_\_\_

6.EE.A.2.b: Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity

Fill in the blanks with the appropriate vocabulary word from the following:

variable    coefficient    letter    equation

3. A \_\_\_\_\_ is a \_\_\_\_\_ that stands for an unknown quantity.

4. A \_\_\_\_\_ is a number that is multiplied to a variable.

Identify the following by filling in the variable, coefficient, and constant for each algebraic expression:

5.  $4y - 7$                       variable \_\_\_\_\_ coefficient \_\_\_\_\_ constant \_\_\_\_\_

6.  $6n + 12$                       variable \_\_\_\_\_ coefficient \_\_\_\_\_ constant \_\_\_\_\_

Challenge:

Is there a constant in the following algebraic expression?

7.  $3h$                       variable \_\_\_\_\_ coefficient \_\_\_\_\_

Is there a coefficient in the following algebraic expression?

8.  $s$                       variable \_\_\_\_\_ coefficient \_\_\_\_\_

Select the one that best describes the algebraic expression.

9.  $8 + (4n + 5)$
- a. product of two terms
  - b. difference of two terms
  - c. quotient of two terms
  - d. sum of two terms
10.  $10(3m - 13)$
- a. product of two terms
  - b. difference of two terms
  - c. quotient of two terms
  - d. sum of two terms
11.  $(9d + 12) \div 3$
- a. product of two terms
  - b. difference of two terms
  - c. quotient of two terms
  - d. sum of two terms

Adapted from:

<http://www.rhnet.org/webpages/jfalci/files/variables%20expressions%20and%20equations.pdf>

6.EE.A.2.c: Evaluate expressions given specific values of their variables. Include expressions that arise from formulas used to solve mathematical problems and problems in real-world context. Perform arithmetic operations, including those involving whole number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations).

MusicPalace.com is having a sale:

**Music Palace Sale**

**\$1.20 for the first download**

**\$0.60 for each additional download**

**All prices include tax**

12. Write an algebraic expression that shows how to calculate the cost of buying 10 downloads.

13. What would  $n$  downloads cost? Write as an algebraic expression.  
Adapted from Eureka

**6.EE.3: Apply the properties of operations to generate equivalent expressions.**

14. Does each algebraic expression equal  $3n$  for any numerical value of  $n$ ? Write yes or no.

- a. 3 times  $n$  \_\_\_\_\_
- b.  $n$  plus  $n$  plus  $n$  \_\_\_\_\_
- c.  $n$  to the third power \_\_\_\_\_

Adapted from Illustrative Mathematics

### Answer Key

Write an algebraic expression from the given sentence.

1. Subtract  $h$  from nine.  $\underline{\quad 9 - h \quad}$
2. Six times  $m$ .  $\underline{\quad 6m \quad}$ 
  - a. Define expression: *a mathematical phrase that can contain numbers, symbols (except equal signs), and/or variables*
  - b. How is an expression different from an equation? (give an example): *An expression (i.e.,  $2x + 35$ ) is different from an equation (i.e.,  $2x + 35 = 170$ ) in that an equation represents two expressions that are equivalent.*

Note to instructor: emphasize expressions can be **simplified**, but equations can be **solved**

Fill in the blanks with the appropriate vocabulary word from the following:  
variable   coefficient   letter   equation

3. A variable is a letter that stands for an unknown quantity.
4. A coefficient is a number that is multiplied to a variable.

Identify the following by filling in the variable, coefficient, and constant for each algebraic expression:

5.  $4y - 7$                       variable  $y$  coefficient  $4$  constant  $-7$
6.  $6n + 12$                       variable  $n$  coefficient  $6$  constant  $12$

Challenge:

Is there a constant in the following algebraic expression?

**Yes, the constant is 0**

7.  $3h$                       variable  $h$  coefficient  $3$

Is there a coefficient in the following algebraic expression?

**Yes, the coefficient is 1**

8.  $s$                       variable  $s$  coefficient  $1$

Select the one that best describes the algebraic expression.

9.  $8 + (4n + 5)$ 
  - a. product of two terms
  - b. difference of two terms
  - c. quotient of two terms
  - d. **sum of two terms**

10.  $10(3m - 13)$

- a. product of two terms
- b. difference of two terms
- c. quotient of two terms
- d. sum of two terms

11.  $(9d + 12) \div 3$

- a. product of two terms
- b. difference of two terms
- c. quotient of two terms
- d. sum of two terms

MusicPalace.com is having a sale:

**Music Palace Sale**

**\$1.20 for the first download**

**\$0.60 for each additional download**

**All prices include tax**

12. Write an algebraic expression that shows how to calculate the cost of buying 10 downloads.

**$d = \text{downloads}$**   
 **$1.20 + .60d$**   
 **$1.20 + .60(10 - 1)$  -----> remember that 1.20 is the first song download so we must take 1 from the 10, leaving us 9**  
 **$1.20 + 5.40$**   
 **$\$6.60$  is the cost of 10 downloads**

13. What would  $n$  downloads cost? Write as an algebraic expression.

**$n = \text{number of downloads}$**   
 **$1.20 + .60(n - 1)$**

Adapted from Eureka

14. Does each algebraic expression equal  $3n$  for any numerical value of  $n$ ? Write yes or no.

- a. 3 times  $n$  yes
- b.  $n$  plus  $n$  plus  $n$  yes
- c.  $n$  to the third power no

Adapted from Illustrative Mathematics

6.EE.B Reason about and solve one-variable equations and inequalities.

6.EE.B.6 Use variables to represent numbers and write expressions when solving mathematical problems and problems in real-world context; understand that a variable can represent an unknown number or any number in a specified set.

6.EE.B.7 Solve mathematical problems and problems in real-world context by writing and solving equations of the form  $x + p = q$ ,  $x - p = q$ ,  $px = q$ , and  $x/p = q$  for cases in which  $p$ ,  $q$  and  $x$  are all non-negative rational numbers.

### Implementation

#### Learning Context

Prior to the 7th grade lesson, 6th grade standards must have been met. The above standards will be assessed through the following lesson.

#### Differentiated Instruction

**Reading Rainbow Tip:** Try to keep in mind that children learn in many different ways. By consciously thinking about this, you'll be able to use different teaching techniques to reach as many children as possible in your classroom!

- a. Visual Learners
- b. Auditory Learners
- c. Kinesthetic Learners
- d. ESL Students
- e. At-risk Students
- f. Advanced Learners

#### Materials & Resources

- a. Adapted from: TruMath-  
<http://map.mathshell.org/lessons.php?unit=6215&collection=8>
- b. Created using GoogleDoc template (Reading Rainbow)

### Assessment

#### 1. Activity: **How many students are in our school?**

For the following given information, complete each section below. In our school, there are two types of classes. There are four core content area classes and two elective classes. In the core content area classes, the same number of students are in each class. There are the same number of students in each elective class as well, but this number may be lower or higher than the amount of students in the core classes.

- a. Use a legend to define the variables (unknowns).

#### Legend

Let  $c =$

Let  $e =$

Let  $t =$

- b. Write the algebraic equation represented by this situation, verbally and symbolically.

- c. What is the important information?

- d. Rewrite the problem in your own words.

2. Write a real-world situation that represents this equation:  $2x - 3 = 15$ . Then solve.

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## Answer Key

### 1. Activity: How many students are in our school?

For the following given information, complete each section below. In our school, there are two types of classes. There are four core content area classes and two elective classes. In the core content area classes, the same number of students are in each class. There are the same number of students in each elective class as well, but this number may be lower or higher than the amount of students in the core classes.

a. Use a legend to define the variables (unknowns).

Let  $c$  = the number of students in a core content class

Let  $e$  = the number of students in an elective class

Let  $t$  = the total number of students in the school

b. Write the algebraic equation represented by this situation, verbally and symbolically.

$4c + 2e = t$   $\longrightarrow$  four times the number of students in a core class plus two times the number of students in an elective class is equal to the total number of students in the school

c. What is the important information?

Important information includes:

- There are four content areas with the same number of students in each class.
- There are two elective classes with the same number of students in each class, but different from the number of students in core content classes.

d. Rewrite the problem in your own words.

Answers will vary. How can we determine the number of students in a school which has four core content areas with one amount of students in each class and two elective classes with the same (but different from the previous) number of students in each class.

### 2. Write a real-world situation that represents this equation: $2x - 3 = 15$ . Then solve.

Answers will vary. For instance: Let  $x$  represent the cost of a t-shirt. If you have a \$3 off coupon and you want to buy two shirts, you would pay \$15. How much is the cost of one t-shirt?

Let  $x$  = the cost of one t-shirt

$$\begin{aligned} 2x - 3 &= 15 \\ 2x - 3 (+3) &= 15 (+3) \\ 2x + 0 &= 18 \\ \frac{2x}{2} &= \frac{18}{2} \\ 1x &= 9 \end{aligned}$$

$x = 9$  or the cost of one t-shirt is \$9

**7.EE.B.3** Solve multi-step mathematical problems and problems in real-world context posed with positive and negative rational numbers in any form.

**7.EE.B.4** Use variables to represent quantities in mathematical problems and problems in real-world context, and construct simple equations... to solve problems.

**MP1** Make sense of problems and persevere in solving them

**MP6** Attend to precision

### Streaming Services

It takes  $g$  amount of gigabytes to stream Netflix on a tablet per hour. Let  $g$  represent how many gigabytes it takes to stream Netflix. *\*Note to teacher; an opening discussion reminding of the definition of expression and equation before beginning is necessary.*

### Legend

Let  $g$  = amount of gigabytes to stream Netflix

Hulu streams 4 gigabytes of data more than Netflix streams per hour. *\*Check for understanding: use 2 minute check from teacher toolbox.*

1. Write an expression, in terms of  $g$ , that represents the amount of gigs Hulu streams per hour.

Amazon streams  $\frac{1}{2}$  as many gigabytes of data as Hulu per hour.

2. Write an expression, in terms of  $g$ , that represents the amount of gigabytes that Amazon streams.

The sum of the gigabytes that all three services stream totals 21 gigabytes *\*Check for understanding: find common misconception and discuss here.*

3. Form an equation using the expressions above to solve for how many gigabytes it takes to stream Netflix, Hulu, and Amazon during one hour.
  - a. Netflix uses \_\_\_\_\_ gigabytes of data per hour
  - b. Hulu uses \_\_\_\_\_ gigabytes of data
  - c. Amazon uses \_\_\_\_\_ gigabytes of data
4. Justify or prove that your answers are correct.
5. Let's say an entire school was streaming using all three companies at once for an hour, using a total of 448 gigabytes. If you knew that Hulu used 188 gigabytes in that hour, could you find the amount of gigabytes that Netflix and Amazon used?

(Adopted from <http://map.mathshell.org/download.php?fileid=1094> on 7/16/2017)

### Answer Key

1.  $g + 4$

2.  $\frac{1}{2}(g + 4)$  or  $\frac{1}{2}g + 2$

3.  $n + h + a = 21$

$g + (g + 4) + \frac{1}{2}(g + 4) = 21$

$g + (g + 4) + \frac{1}{2}g + 2 = 21$

$g + g + \frac{1}{2}g + 6 = 21$   
 $-6 \quad -6$

$\frac{5}{2}g = 15$

$(\frac{2}{5})\frac{5}{2}g = 15 (\frac{2}{5})$

$g = 6$

Netflix uses 6 gigabytes of data per hour

Hulu uses 10 gigabytes of data per hour

Amazon uses 5 gigabytes of data per hour

4. Justifications will vary

Students could use the information plugged into the equation created totals 21 gigabytes

$6 + 10 + 5 = 21$

$16 + 5 = 21$

$21 = 21$

Or students could plug  $g = 6$  into the expressions to show that their answer works and then total it to show that the total is 21 gigabytes.

Or students could substitute  $g = 6$  into the expanded or simplified equation to justify their answer.

5.  $1.5g + (188) + \frac{1}{2}g + 2 = 448$

$1.5g + 190 = 448$

$1.5g = 258$

$g = 172$

Netflix is represented by  $g$ , therefore, Netflix streamed 172 gigabytes

Amazon is represented by the expression  $\frac{1}{2}(g + 4)$  so  $\frac{1}{2}(172 + 4)$  becomes  $\frac{1}{2}(176)$ , so Amazon streamed 88 gigabytes.

$188 (\text{Hulu}) + 172 (\text{Netflix}) + 88 = 448$

$448 = 448$

**7.EE.B.4.a** Use variables to represent quantities in mathematical problems and problems in real-world context, and construct simple equations and inequalities to solve problems.

The distance between Phoenix and Orlando is 2,124 miles. Excited to go to Disneyworld, the Flitwick family hopped into their self-driving car and began their journey. The car is traveling at an average speed of 72 mi/hr, and will not stop until it has reached its destination. Provide evidence that supports your solution for each of the following:

a. After 12 hours, Jimmy notes that they had driven 864 miles. How many more miles remain in the trip?

b. Create and solve an equation that to find how long will the remainder of trip will take.

**Legend:** Let \_\_\_\_ = \_\_\_\_\_

c. In total, how long is the drive time for the entire trip?

**7.EE.B.4.a.** Solve word problems leading to equations of the form  $px+q = r$  and  $p(x+q) = r$ , where  $p$ ,  $q$ , and  $r$  are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach.

Jon Orr. *Quick Points!* Tap Into Teen Minds. 17 July 2017.

Video Retrieved from <https://tapintoteenminds.com/3acts-by-common-core/7-ee-4/>>

After watching the video, answer the following questions. Be sure to provide evidence for your claims.

a. How many baskets will it take to get 46 points?

b. Construct an equation to find how many shots the player needs to make to earn 46 points if he begins with 12 points. Assume each shot made is worth 2 points.

**Legend:** Let \_\_\_\_ = \_\_\_\_\_

- c. Let's assume the shooter has to make 90 points. After making 36 shots, he has reached 90 points. Construct an equation to find how many points the shooter had before making the 36 shots?

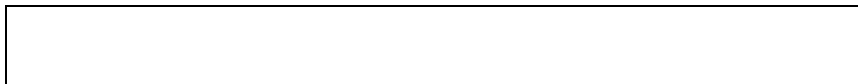
**Legend:** Let \_\_\_\_\_ = \_\_\_\_\_

**7.EE.A.1.** Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.

$\frac{2}{3}$  of Cedric's class plans to participate in the school talent show.

- a. If there are 18 students participating in the talent show, how many students are in Cedric's class? Provide evidence for your claim.

- b. Create a tape diagram that represents the total number of students in the class, as well as the students participating in the talent show.



- c. Using the tape diagram as a reference, construct an equation to find how many students are in Cedric's class.

**7.EE.A.1.** Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.

After the team's big win, Coach Wood decided to take everyone out for ice cream. Each cone costs \$2.50 and coach has \$32.

- a. Assuming coach has enough money to purchase a cone for everyone, how many players are on the team? Be sure to provide evidence for your claim.

- b. Create a tape diagram that accurately represents how many ice cream cones the coach can buy for his players.

|  |
|--|
|  |
|--|

- c. Using the tape diagram as a reference, construct an equation to find how many cones the coach can buy.

**Legend:** Let \_\_\_\_\_ = \_\_\_\_\_

**7.EE.B.4.a** Use variables to represent quantities in mathematical problems and problems in real-world context, and construct simple equations and inequalities to solve problems.

The distance between Phoenix and Orlando is 2,124 miles. Excited to go to Disneyworld, the Flitwick family hopped into their self-driving car and began their journey. The car is traveling at an average speed of 72 mi/hr, and will not stop until it has reached its destination. Provide evidence that supports your solution for each of the following:

- a. After 12 hours, Jimmy notes that they had driven 864 miles. How many more miles remain in the trip?

**2124** ←Distance between Phoenix and Orlando

**-864** ←Distance traveled

**1260** ←Remaining distance

**The Flitwick family still needs to travel 1260 miles.**

- b. Construct and solve an equation that to find how long will the remainder of trip will take. Create a legend for your variables.

**Legend:** Let  $h$  = number of hours for remainder of trip

|                           |          |                              |          |                          |
|---------------------------|----------|------------------------------|----------|--------------------------|
| <b>Total<br/>Distance</b> |          | <b>Distance<br/>traveled</b> |          | <b>Rate of<br/>speed</b> |
| ↓                         |          | ↓                            |          | ↓                        |
| <b>2124</b>               | <b>=</b> | <b>864</b>                   | <b>+</b> | <b><math>72h</math></b>  |
| <b>-864</b>               |          | <b>-864</b>                  |          |                          |
| <b>1260</b>               | <b>=</b> | <b>0</b>                     | <b>+</b> | <b><math>72h</math></b>  |
| <b>1260</b>               | <b>=</b> | <b><math>72h</math></b>      |          |                          |
| <b>72</b>                 | <b>=</b> | <b>72</b>                    |          |                          |
| <b>17.5</b>               | <b>=</b> | <b><math>h</math></b>        |          |                          |

**The remainder of the trip will take 17 hours and 30 minutes.**

- c. In total, how long is the drive time for the entire trip?

|                 |          |                 |          |                       |
|-----------------|----------|-----------------|----------|-----------------------|
|                 |          | <b>Miles</b>    |          |                       |
| <b>Total</b>    |          | <b>traveled</b> |          | <b># of</b>           |
| <b>distance</b> |          | <b>per hour</b> |          | <b>hours</b>          |
| ↓               |          | ↓               |          | ↓                     |
| <b>2124</b>     | <b>÷</b> | <b>72</b>       | <b>=</b> | <b><math>h</math></b> |
| -----           |          |                 |          |                       |
| <b>2124</b>     | <b>÷</b> | <b>72</b>       | <b>=</b> | <b>29.5</b>           |

**The total drive time between Phoenix and Orlando is 29 hours and 30 minutes.**

**7.EE.B.4.a.** Solve word problems leading to equations of the form  $px+q = r$  and  $p(x+q) = r$ , where  $p$ ,  $q$ , and  $r$  are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach.

Jon Orr. *Quick Points!* Tap Into Teen Minds. 17 July 2017.

Video Retrieved from <<https://tapintoteenminds.com/3acts-by-common-core/7-ee-4/>>

After watching the video, answer the following questions. Be sure to provide evidence for your claims.

- a. How many baskets will it take to get 46 points?

|                  |   |                      |   |                       |
|------------------|---|----------------------|---|-----------------------|
| Points<br>Earned |   | Points<br>per basket |   | Total<br>baskets made |
| ↓                |   | ↓                    |   | ↓                     |
| 46               | ÷ | 2                    | = | 23                    |

If each basket is worth two points, then it would take 23 baskets to earn 46 points.

- b. Construct an equation to find how many shots the player needs to make to earn 46 points if he begins with 12 points. Assume each shot made is worth 2 points.

Legend: Let  $b$  = # of shots

|                        |   |                |   |                      |
|------------------------|---|----------------|---|----------------------|
| Total points<br>Earned |   | Points<br>made |   | 2 points<br>per shot |
| ↓                      |   | ↓              |   | ↓                    |
| 46                     | = | 12             | + | $2b$                 |
| <u>-12</u>             |   | <u>-12</u>     |   |                      |
| 34                     | = | 0              | + | $2b$                 |
| <u>34</u>              | = | <u>2b</u>      |   |                      |
| 2                      |   | 2              |   |                      |
| 17                     | = | $b$            |   |                      |

The player needs to make 17 baskets to earn the full 46 points.

- c. Let's assume the player has to make 90 points. After making 36 shots, he has reached 90 points. Construct an equation to find how many points the player had before making the 36 shots?

Legend: Let  $p$  = # of points earned before making 36 shots

|                 |   |                                    |   |                     |
|-----------------|---|------------------------------------|---|---------------------|
| Total<br>Points |   | 2 points<br>per shot<br>(36 shots) |   | Number<br>of Points |
| ↓               |   | ↓                                  |   | ↓                   |
| 90              | = | 2 (36)                             | + | $p$                 |
| 90              | = | 72                                 | + | $p$                 |
| <u>-72</u>      |   | <u>-72</u>                         |   |                     |
| 18              | = | 0                                  | + | $p$                 |
| 18              | = | $p$                                |   |                     |

He had 18 points before he made the additional 36 shots.



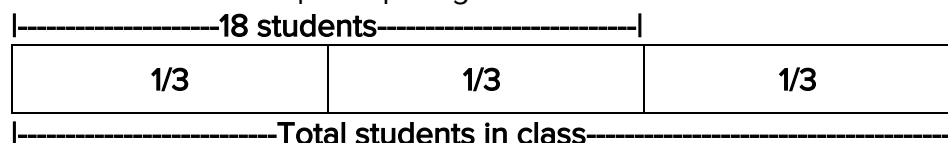
**7.EE.A.1.** Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.

$\frac{2}{3}$  of Cedric's class plans to participate in the school talent show.

a. If there are 18 students participating in the talent show, how many students are in Cedric's class? Provide evidence for your claim.

**If  $\frac{2}{3}$  of the class is represented by 18 students, then  $\frac{1}{3}$  of the class would have to represent 9 students. If there are 3 copies of  $\frac{1}{3}$ , then there are 3 copies of 9, which is 27. Therefore, there are 27 students in the class.**

b. Create a tape diagram that represents the total number of students in the class, as well as the students participating in the talent show.



c. Using the tape diagram as a reference, construct an equation to find how many students are in Cedric's class. Let  $c$  represent the total amount of students in the class.

**Legend: Let  $c$  = total number of students in the class**

|                                             |   |                                                       |
|---------------------------------------------|---|-------------------------------------------------------|
| $\frac{2}{3}$ of<br>the whole<br>class<br>↓ |   | # of Students<br>participating<br>in talent show<br>↓ |
| $\frac{2}{3}c$                              | = | 18                                                    |
| $(\frac{3}{2})(\frac{2}{3})c$               | = | (18)( $\frac{3}{2}$ )                                 |
| $c$                                         | = | $\frac{54}{2}$                                        |
| $c$                                         | = | 27                                                    |

**There are 27 total students in Cedric's class.**

**7.EE.A.1.** Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.

After the team's big win, Coach Wood decided to take everyone out for ice cream. Each cone costs \$2.50 and coach has \$32.

a. Assuming coach has enough money to purchase a cone for everyone, how many players are on the team? Be sure to provide evidence for your claim.

|                     |   |                             |   |                               |
|---------------------|---|-----------------------------|---|-------------------------------|
| Total<br>Money<br>↓ |   | Price per<br>ice cream<br>↓ |   | Total ice cream<br>cones<br>↓ |
| 32                  | ÷ | 2.50                        | = | 12.5                          |

**Since you cannot purchase half of a cone, there are 12 players on the team.**

- b. Create a tape diagram that accurately represents how many ice cream cones the coach can buy for his players.

|                        |        |        |        |        |        |        |        |        |        |        |        |     |
|------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----|
| -----\$32 dollars----- |        |        |        |        |        |        |        |        |        |        |        |     |
| \$2.50                 | \$2.50 | \$2.50 | \$2.50 | \$2.50 | \$2.50 | \$2.50 | \$2.50 | \$2.50 | \$2.50 | \$2.50 | \$2.50 | \$2 |

- c. Using the tape diagram as a reference, construct an equation to find how many cones the coach can buy.

Legend: Let c = # of cones that can be bought

|                            |   |                    |
|----------------------------|---|--------------------|
| Amount of<br>Coach's money |   | \$2.50 per<br>cone |
| ↓                          |   | ↓                  |
| <u>32</u>                  | = | <u>2.50c</u>       |
| 2.50                       |   | 2.50               |
| 12.80                      | = | c                  |

Coach can buy 12 ice cream cones for his team, and have \$2 left over.

**7.EE.A.2** Rewrite an expression in different forms, and understand the relationship between the different forms and their meanings in a problem context.

*Illustration:  $a + 0.05a = 1.05a$  means that "to increase  $a$  by 5%" is the same as "multiply  $a$  by 1.05."*

Note to Instructor: It is extremely important for students to see the connection between the meaning of a verbal phrase and its symbolic representation. For example: Write and simplify an expression to represent adding 5% tax to the cost of an item.

$$\begin{array}{ccccccc}
 a & & + & & .05a & & = & & 1.05a \\
 \downarrow & & & & \downarrow & & & & \downarrow \\
 \text{original cost} & + & 5\% \text{ of original cost} & = & \text{total cost (tax included)}
 \end{array}$$

- 1) What does the  $a$  represent?
- 2) What is the meaning of  $.05$ ?
- 3) What does  $.05a$  mean?
- 4) Write and simplify an expression that would show adding a 7% tax to the cost,  $C$ , of an item?
- 5) Write and simplify expressions for the sales tax for these cities in Maricopa County, given the cost of an item is represented by  $C$ .
 

|                  |       |       |
|------------------|-------|-------|
| Chandler/Gilbert | 7.8%  | _____ |
| Glendale         | 9.2%  | _____ |
| Mesa             | 8.05% | _____ |
| Peoria           | 8.1%  | _____ |
| Phoenix          | 8.6%  | _____ |
| Scottsdale       | 7.95% | _____ |
| Queen Creek      | 8.55% | _____ |
- 6) If you bought a Thirstbuster in Peoria that had a price of \$.89, how much would you spend on your drink with tax included?
- 7) Write an expression that shows the total for a restaurant bill of \$ $R$  that includes an 18% tip.
- 8) Write an expression that represents a 22% discount on an item that costs \$ $M$ .

**7.EE.B.4** Use variables to represent quantities in mathematical problems and problems in real-world context, and construct simple equations and inequalities to solve problems.

a. Solve word problems leading to equations of the form  $px+q=r$  and  $p(x+q)=r$ , where  $p$ ,  $q$ , and  $r$  are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach.

8) You decide to buy a ticket to the Cardinals-Seahawks game. The stadium is in Glendale. If you paid a total of \$491.40 for your ticket, what was the face value (base price) of your ticket? (Note: Base price does not include sales tax)

**Legend**

Let \_\_\_\_\_ = \_\_\_\_\_

9) David bought a 2017 Chevy Silverado at Autonation in Gilbert. The base price was \$36,128. How much did he spend after paying sales tax?

**Legend**

Let \_\_\_\_\_ = \_\_\_\_\_

10) Jim buys a BMW M4 convertible at BMW North Scottsdale. After adding in tax he pays a total of \$108,036.36. What was the base price of his car?

**Legend**

Let \_\_\_\_\_ = \_\_\_\_\_

11) Shana drives to Avondale to buy a Nissan 370z Nismo Tech. It has a list price of \$43,777 and after tax costs \$47,629.38. What was the sales tax rate that she had to pay for her car that she bought in Avondale?

**Legend**

Let \_\_\_\_\_ = \_\_\_\_\_

Adapted from :<http://ime.math.arizona.edu/progressions/>

## ANSWER KEY

**7.EE.A.2** Rewrite an expression in different forms, and understand the relationship between the different forms and their meanings in a problem context.

*Illustration:  $a + 0.05a = 1.05a$  means that "to increase  $a$  by 5%" is the same as "multiply  $a$  by 1.05."*

Note to Instructor: It is extremely important for students to see the connection between the meaning of a verbal phrase and its symbolic representation. For example: Write and simplify an expression to represent adding 5% tax to the cost of an item.

- 1) What does the  $a$  represent? **The original cost of the item**
- 2) What is the meaning of .05? **The sales tax written as a percent**
- 3) What does .05a mean? **The amount of the tax on the original price**
- 4) Write and simplify an expression that would show adding a 7% tax to the cost,  $C$ , of an item?

$$C + .07C = 1.07C$$

5) Write and simplify expressions for the sales tax for these cities in Maricopa County, given the cost of an item is represented by  $C$ .

|                  |       |                                          |
|------------------|-------|------------------------------------------|
| Chandler/Gilbert | 7.8%  | <u><math>C + .078C = 1.078C</math></u>   |
| Glendale         | 9.2%  | <u><math>C + .092C = 1.092C</math></u>   |
| Mesa             | 8.05% | <u><math>C + .0805C = 1.0805C</math></u> |
| Peoria           | 8.1%  | <u><math>C + .081C = 1.081C</math></u>   |
| Phoenix          | 8.6%  | <u><math>C + .086C = 1.086C</math></u>   |
| Scottsdale       | 7.95% | <u><math>C + .0795C = 1.0795C</math></u> |

6) If you bought a Thirstbuster in Peoria that had a price of \$.89, how much would you spend on your drink with tax included?

**$1.081(.89) = \$ .97$  (answer is \$.96209 but must be rounded because of money)**

7) Write an expression that shows the total for a restaurant bill of  $\$R$  that includes an 18% tip.

$$R + .18R = 1.18R$$

8) Write an expression that represents a 22% discount on an item that costs  $\$M$ .

$$M - .22M = .78M$$

**7.EE.B.4** Use variables to represent quantities in mathematical problems and problems in real-world context, and construct simple equations and inequalities to solve problems.

a. Solve word problems leading to equations of the form  $px+q=r$  and  $p(x+q)=r$ , where  $p$ ,  $q$ , and  $r$  are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach.

8) You decide to buy a ticket to the Cardinals-Seahawks game. The stadium is in Glendale. If you paid a total of \$491.40 for your ticket, what was the face value (base price) of your ticket? (Note: Base price does not include sales tax)

**Legend**

**Let  $t$  = face value of ticket**

**$1.092a = \$491.40$     The face value of the ticket is \$450.**

9 David bought a 2017 Chevy Silverado at Autonation in Gilbert. The base price was \$36,128. How much did he spend after paying sales tax?

**Legend**

**Let  $p$  = cost after tax**

**$36,128(1.078) = 38,945.99$     The total cost of the car is \$38,945.99 (need to round up to the nearest cent)**

10) Jim buys a BMW M4 convertible at BMW North Scottsdale. After adding in tax he pays a total of \$108,036.36. What was the base price of his car?

**Legend**

**Let  $p$  = base price**

**$1.0795a = 108,306$      $a = \$100,080$     The base price was \$100,080**

11) Shana drives to Avondale to buy a Nissan 370z Nismo Tech. It has a list price of \$43,777 and after tax costs \$47,629.38. What was the sales tax rate that she had to pay for her car that she bought in Avondale?

**Legend**

**Let  $t$  = sales tax percentage**

**$47629.38 - 43777 = 3852.38$     \$3852.38 is the amount of the sales tax**

**$47629.38t = 3852.38$**

**$t = 3852.38/47629.38$**

**$t = 0.088$                        $.088 = 8.8\%$     The tax rate is 8.8%**

**SAMPLE ASSESSMENT QUESTION WITH SCORING RUBRIC**

Luna received \$60 for her birthday. She has decided to use that money and start saving to purchase a new smartphone. For babysitting, her rate per hour is \$12.50.

1. Complete a legend that will define variables needed to create an expression.

**Legend:** Let \_\_\_\_\_ = \_\_\_\_\_

2. Write an algebraic expression to represent the sum of Luna received for her birthday and the money she will earn from babysitting.

The phone that she wants to purchase costs \$820.

3. Using the expression from number 2, create an algebraic equation to find how many hours Luna needs to work to be able to purchase her smartphone.
4. Solve the equation from #3 to find how many hours Luna needs to babysit in order to purchase a smartphone. Write your solution in terms of hours and minutes. Verify your response.

## Grading Rubric

|                 | Neatness and Organization                                                                   | Mathematical concepts                                                                                                                                                                                                                                                                                        | Mathematical errors |
|-----------------|---------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>4 points</b> | The work is presented in a neat, clear, and organized fashion that is easy to read.         | Student demonstrates <b>complete</b> ability to apply properties of operations, solves multi-step problems in real-world context posed with both positive and negative rational numbers and use variables to represent quantities in mathematical problems and construct simple equations to solve problems. | Zero errors         |
| <b>3 points</b> | The work is presented in a neat and organized fashion that is usually easy to read.         | Student demonstrates <b>some</b> ability to apply properties of operations, solves multi-step problems in real-world context posed with both positive and negative rational numbers and use variables to represent quantities in mathematical problems and construct simple equations to solve problems.     | 1-2 errors          |
| <b>2 points</b> | The work presented in an organized fashion but may be hard to read at times.                | Student demonstrates <b>little</b> ability to apply properties of operations, solves multi-step problems in real-world context posed with both positive and negative rational numbers and use variables to represent quantities in mathematical problems and construct simple equations to solve problems.   | 3-4 errors          |
| <b>1 point</b>  | The work appears sloppy and unorganized. It is hard to know what information goes together. | <b>Lacks evidence</b> of the ability to apply properties of operations, solve multi-step problems in real-world context posed with both positive and negative rational numbers and use variables to represent quantities in mathematical problems and construct simple equations to solve problems.          | 5+ errors           |

|           |                      |
|-----------|----------------------|
| 12        | Highly proficient    |
| 8-11      | Proficient           |
| 4-7       | Partially proficient |
| 3 or less | Minimally proficient |



## UNIVERSAL RUBRIC

|                 | Neatness and Organization                                                                   | Mathematical concepts                                                                   | Mathematical errors |
|-----------------|---------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|---------------------|
| <b>4 points</b> | The work is presented in a neat, clear, and organized fashion that is easy to read.         | Student demonstrates <b>complete</b> ability to apply relevant concepts and procedures. | Zero errors         |
| <b>3 points</b> | The work is presented in a neat and organized fashion that is usually easy to read.         | Student demonstrates <b>some</b> ability to apply relevant concepts and procedures.     | 1-2 errors          |
| <b>2 points</b> | The work presented in an organized fashion but may be hard to read at times.                | Student demonstrates <b>little</b> ability to apply relevant concepts and procedures.   | 3-4 errors          |
| <b>1 point</b>  | The work appears sloppy and unorganized. It is hard to know what information goes together. | <b>Lacks evidence</b> of the ability to apply relevant concepts and procedures.         | 5+ errors           |

12            Highly proficient  
 8-11        Proficient  
 4-7         Partially proficient  
 3 or less    Minimally proficient

## SAMPLE ASSESSMENT ANSWER KEY

Luna received \$60 for her birthday. She has decided to use that money and start saving to purchase a new smartphone. For babysitting, her rate per hour is \$12.50.

1. Create a legend that will define variables needed to create an expression.

**$h$  = hours she will babysit**

2. Write an algebraic expression to represent the sum of Luna received for her birthday and the money she will earn from babysitting.

$$\begin{array}{ccc} \text{Initial} & & \$12.50 \text{ per} \\ \text{amount} & & \text{hour} \\ \downarrow & & \downarrow \\ 60 & + & 12.50h \end{array}$$

The phone that she wants to purchase costs \$820.

3. Using the expression from number 2, create an algebraic equation to find how many hours Luna needs to work to be able to purchase her smartphone.

$$\begin{array}{ccccc} \text{Initial} & & \$12.50 \text{ per} & & \text{Cost of} \\ \text{Amount} & & \text{hour} & & \text{phone} \\ \downarrow & & \downarrow & & \downarrow \\ 60 & + & 12.50h & = & 820 \end{array}$$

4. Solve the equation from #3 to find how many hours Luna needs to babysit in order to purchase a smartphone. Write your solution in terms of hours and minutes. Verify your response.

$$\begin{array}{ccccccc} \text{Initial} & & \$12.50 \text{ per} & & \text{Cost of} & & \\ \text{Amount} & & \text{hour} & & \text{phone} & & \\ \downarrow & & \downarrow & & \downarrow & & \\ 60 & + & 12.50h & = & 820 & & \\ \underline{-60} & & & & \underline{-60} & & \\ 0 & + & 12.50h & = & 760 & & \\ & & \underline{12.50h} & = & \underline{760} & & \\ & & 12.50 & & 12.50 & & \\ & & h & = & 60.8 & & \end{array}$$

---

60.8 hours means that Luna needs to work for 60 hours and 8/10 of an hour. Therefore, she needs to work for 60 hours and 48 minutes.

**\*\*There should be evidence of the 0.8 of an hour converted to minutes\*\***

---

$$\begin{array}{rclcl} 60 & + & 12.50(60.8) & = & 820 \\ 60 & + & 760 & = & 820 \\ & & 860 & = & 860 \end{array}$$

**SAMPLE ASSESSMENT QUESTION WITH SCORING RUBRIC**

Luna received \$60 for her birthday. She has decided to use that money and start saving to purchase a new smartphone. Her rate per hour is \$12.50.

1. Create a legend that will define variables needed to create an expression.

60 → initial amount    \$12.50 → hourly rate     $h$  → hours needed to babysit  
for babysitting

2. Write an algebraic expression to represent the sum of Luna received for her birthday and the money she will earn from babysitting.

$$\$12.50h + 60$$

The phone that she wants to purchase costs \$820.

3. Using the expression from number 2, create an algebraic equation to find how many hours Luna needs to work to be able to purchase her smart phone.

$$\$12.50h + 60 = \$820$$

4. Solve the equation from #3 to find how many hours Luna needs to babysit in order to purchase a smartphone. Write your solution in terms of hours and minutes. Verify your response.

$$\begin{array}{r} 12.50h + 60 = \$820 \\ - 60 \quad - 60 \\ \hline 12.50h = 760 \\ \hline 12.50 \end{array}$$

$$h = 60.8 \text{ or } 60 \text{ hour } 48 \text{ minutes}$$

SAMPLE ASSESSMENT QUESTION WITH SCORING RUBRIC

Luna received \$60 for her birthday. She has decided to use that money and start saving to purchase a new smartphone. Her rate per hour is \$12.50.

1. Create a legend that will define variables needed to create an expression.

Let  $n$  = the amount of hours

2. Write an algebraic expression to represent the sum of Luna received for her birthday and the money she will earn from babysitting.

$$60n + 12.50$$

The phone that she wants to purchase costs \$820.

3. Using the expression from number 2, create an algebraic equation to find how many hours Luna needs to work to be able to purchase her smart phone.

$$60n + 12.50 = 820$$

4. Solve the equation from #3 to find how many hours Luna needs to babysit in order to purchase a smartphone. Write your solution in terms of hours and minutes. Verify your response.

$$\begin{array}{r} 60n + 12.50 = 820 \\ -12.50 \quad -12.50 \end{array}$$

$$\begin{array}{r} 60n + 0 = 807.50 \\ \hline 60 \quad \quad 60 \end{array}$$

$$n = 13.46$$

= 13 hours and 28 min

SAMPLE ASSESSMENT QUESTION WITH SCORING RUBRIC

Luna received \$60 for her birthday. She has decided to use that money and start saving to purchase a new smartphone. Her rate per hour is \$12.50.

1. Create a legend that will define variables needed to create an expression.

$$h = \text{hrs.}$$

2. Write an algebraic expression to represent the sum of Luna received for her birthday and the money she will earn from babysitting.

$$12.50h + 60$$

The phone that she wants to purchase costs \$820.

3. Using the expression from number 2, create an algebraic equation to find how many hours Luna needs to work to be able to purchase her smart phone.

$$60 + 12.50h = 820$$

4. Solve the equation from #3 to find how many hours Luna needs to babysit in order to purchase a smartphone. Write your solution in terms of hours and minutes. Verify your response.

$$60 + 12.50h = 820$$

$$\begin{array}{r} \cancel{60} \\ 72.50h = 820 \\ \div 72.50 \end{array}$$

$$h = \sim 11.31 \text{ hrs.}$$

### 8th Grade Extension Task

Kimi and Jordan are each working during the summer to earn money in addition to their weekly allowance, and they are saving all their money. Kimi earns \$9 an hour at her job, and her allowance is \$8 per week. Jordan earns \$7.50 an hour, and his allowance is \$16 per week.

A. Complete the two tables shown below:

|                                       |   |   |   |   |   |   |   |   |
|---------------------------------------|---|---|---|---|---|---|---|---|
| Number of hours worked in a week, $h$ | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Kimi's weekly total savings, $K$      |   |   |   |   |   |   |   |   |

|                                       |   |   |   |   |   |   |   |   |
|---------------------------------------|---|---|---|---|---|---|---|---|
| Number of hours worked in a week, $h$ | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Jordan's weekly total savings, $J$    |   |   |   |   |   |   |   |   |

- B. Write an equation that can be used to calculate the total of Kimi's allowance and job earnings at the end of one week given the number of hours she works.
- C. Write an equation that can be used to calculate the total of Jordan's allowance and job earnings at the end of one week given the number of hours worked.
- D. Sketch the graphs of your two equations on one pair of axes.
- E. Jordan wonders who will save more money in a week if they both work the same number of hours. Write an answer for him.

## IM Commentary

The purpose of the table in (a) is to help students complete (b) by noticing regularity in the repeated reasoning required to complete the table (Standard for Mathematical Practice 8).

## Solutions

Solution: 1

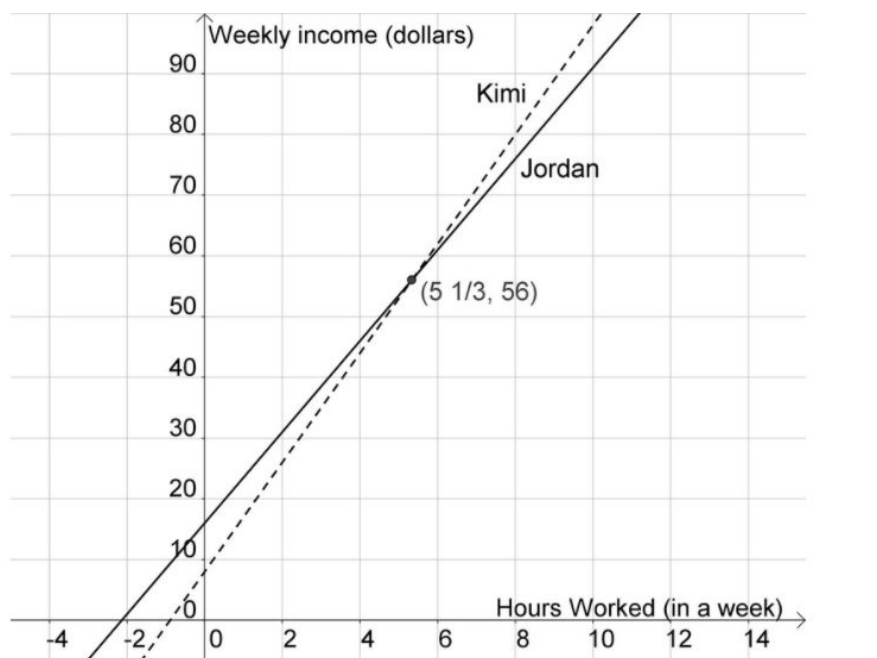
a.

|                                       |   |    |    |    |    |    |    |    |
|---------------------------------------|---|----|----|----|----|----|----|----|
| Number of hours worked in a week, $h$ | 0 | 1  | 2  | 3  | 4  | 5  | 6  | 7  |
| Kimi's weekly total earnings, $K$     | 8 | 17 | 26 | 35 | 44 | 53 | 62 | 71 |

|                                       |    |      |    |      |    |      |    |      |
|---------------------------------------|----|------|----|------|----|------|----|------|
| Number of hours worked in a week, $h$ | 0  | 1    | 2  | 3    | 4  | 5    | 6  | 7    |
| Jordan's weekly total earnings, $J$   | 16 | 23.5 | 31 | 38.5 | 46 | 53.5 | 61 | 68.5 |

b. Kimi's total savings,  $K$ , is the sum of her \$8 dollar allowance and (\$9 per hour  $\times$  the number of hours she works,  $h$ ). In other words,  $K=8+9h$ .

c. Similarly, Jordan's total savings,  $J$ , is given by  $J=16+7.5h$ .



d. The two graphs are shown above.

e. We can see from the graph that if Kimi and Jordan only work a few hours per week, Jordan will save more money. But at some point between 4 and 6 hours of work per week, Kimi's savings overtake Jordan's savings and from that point on, she will save more money. We can find out for what number of hours of work Kimi and Jordan will make the same amount of money. We do this by setting the expressions for Kimi's total and Jordan's total equal to each other,  $9h+8=7.5h+16$ , and solving for  $h$ . This yields  $h=5\frac{1}{3}$ . This tells us that if they both work the same number of hours per week, Jordan will make more money than Kimi if they work less than 513 hours. If, however, they work more than 513 hours, then Kimi will make more money.

### **Solution: Alternate (e) solution**

e. Kimi's allowance is \$8 less than Jordan's, but her hourly rate is \$1.50 higher. So for only a few hours worked, she will earn less per week than Jordan, but if she works a lot of hours, her higher hourly rate will make up for the lower allowance. We can find the number of hours at which this change occurs by calculating how many hours, at \$1.50 more per hour, it will take to make \$8:

$$\frac{\$8}{\$1.50 \text{ per hour}} = 5\frac{1}{3} \text{ hours,}$$

or 5 hours and 20 minutes.

Source: <https://www.illustrativemathematics.org/content-standards/8/EE/C/8/tasks/73>

For additional Resources

<http://math.openupresources.org/index.html>



## SENTENCE STARTERS

I know my answer is right because...

I got “stuck” when...

So what you’re saying is...

My first step was...

I understand what you’re saying, but...

I respectfully disagree because...

I knew \_\_\_\_\_ because \_\_\_\_\_

I agree with \_\_\_\_\_ because...

I’d like to go back to what \_\_\_\_\_ said about...

I’d like to add...

I noticed that...

Another example is...

Another way to solve it is...

Do you think that...

Couldn’t it also be that...

Why do you think that?

Can you explain what you mean?

Can you tell me more?

What’s your evidence?

Can you use a picture to solve it?

The first thing I did was....

I figured out \_\_\_\_\_ by ....

Something I noticed....

Something that is important to remember is.....

I thought.....

I can show this idea by.....

I learned.....

I compared.....

The strategy that helped me to understand this idea was.....

This reminds me of ....

Can you explain that to me?

What do you mean by

What would happen if.....

How did you.....

## Teacher Toolbox

### Types of Checking for Understanding

Checking for understanding should be used daily throughout this module

- Grouping based on pre-assessment score (by gaps- homogeneous)
- Tiered assignments
- Thumbs-up, thumbs down
- Rapid whiteboards (individual)
- 2 minutes checks discussing guided questions (explain the next step to your partner)
- Find common misconceptions