Plan for Unit Grade 7 Unit 6: Expressions, Equations, and Inequalities

Relevant Unit(s) to review: Grade 6 Unit 6: Expressions and Equations

Essential prior concepts to engage with this unit	• linear equations with variables • tape diagrams • exponential equations
Brief narrative of approach	Begin by reviewing solving equations in the form of $x+p=q$ or $px=q$ (6.6.4), then refresh skills by reviewing the distributive property where one of the quantities is represented by a variable (6.6.10) and representing relationships between two quantities (6.6.17). This leads to a deeper understanding of expressions and equations. Next, introduce tape diagrams as a tool for solving equations which will lead to solving equations using the forms $px+q=r$ and $p(x+q)=r$. Finally, students will work with inequalities and equivalent linear expressions. The modified unit plan relies on lessons created for the IM 6–8 Math Accelerated course to provide combinations of lessons to provide background material as well as make room for the additional lessons.

Lessons to Add	Lessons to Remove or Modify
1. Practice Solving Equations and Representing Situations with Equations (6.6.4) 2. The Distributive Property, Part 2 (6.6.10) 3. Combine Two Related Quantities, Part 1 & 2 (6.6.16 and 6.6.17)	1. Combine 7.6.4 and 7.6.5: Parts 1 and 2 of Reasoning about Equations and Tape Diagrams 2. Combine 7.6.7 and 7.6.8: Parts 1 and 2 of Reasoning about Solving Equations 3. Combine 7.6.20, 7.6.21, 7.6.22: Combining Like Terms Parts 1–3 into 2 days 4. Move 7.6.23 to outside of class: In this culminating lesson students investigate several real-world

	situations that can be represented by an expression with a variable. A discussion could take place in class.
Lessons added: 3	Lessons removed: 4

Modified Plan for Grade 7 Unit 5

Day	IM lesson	Notes
	assessment	7.6 Check Your Readiness assessment Note that the Check Your Readiness assessment includes item-by-item guidance to inform just-in-time adjustments to instruction within the lessons in 7.6.
1	7.6.1	
2	6.6.4	If the initial assessment shows that students are not familiar with solving equations in the form of $x+p=q$ and $px=q$, include this lesson before continuing with grade-level content.
3	7.6.2	
4	7.6.3	
5	6.6.10	If the initial assessment shows that students are not familiar with the distributive property, include this lesson and focus on examples where one of the quantities is represented by a **variable**.
6	7.6.4 7.6.5	A combination of 7.6.4 and 7.6.5. Focus on drawing and finding solutions to an equation by reasoning about tape diagrams.
7	7.6.6	
8	7.6.7 7.6.8	A combination of 7.6.7 and 7.6.8. Focus on writing and solving equations that describe the weights on a balanced hanger.

9	7.6.9	
10	7.6.10	
11	6.6.16 6.6.17	If the initial assessment shows that students need additional familiarity representing relationships between two quantities, include a combination of these activities before continuing with grade-level content.
12	7.6.11	
13	7.6.12	
14	7.6.13	
15	7.6.14	
16	7.6.15	
17	7.6.16	
18	7.6.17	
19	7.6.18	
20	7.6.19	
21	7.6.20 7.6.21	A combination of 7.6.20 and 7.6.21. Focus on writing an equivalent expression that has the fewest terms.
22	7.6.21 7.6.22	A combination of 7.6.21 and 7.6.22. Focus on combining like terms and applying the distributive property in more sophisticated ways.
23	7.6 End Assessment	

Priority and Category List for Lessons

High priority (+), Medium priority (0), Low priority (-)

E: Explore, Play, and Discuss, D: Deep Dive, A: Synthesize and Apply

Lesson	Priority (+, 0, -)	Category (E, D, A)	Notes
7.6.1	0	E	In this introductory lesson, students encounter some engaging contexts characterized by relationships that are not proportional. The goal is simply to see that we need some new strategies—it is the work of the upcoming unit to develop strategies for efficiently solving problems about contexts like some of the ones in this lesson.
7.6.2	0	E	In this lesson, students represent and reason about contexts using tape diagrams.
7.6.3	+	E	The purpose of this lesson is to make connections between a tape diagram and an equation of the form $px+q=r$ or $p(x+q)=r$.
7.6.4	+	D	The focus of this lesson is situations that lead to equations of the form $px+q=r$. Tape diagrams are used to help students understand why these situations can be represented with equations of this form, and to help them reason about solving equations of this form.
7.6.5	0	D	This lesson parallels the previous one, except the focus is on situations that lead to equations of the form $p(x+q)=r$. Tape diagrams are used to help students understand why these situations can be represented with equations of this form, and to help them reason about solving equations of this form.
7.6.6	+	A	The purpose of this lesson is to distinguish equations of the form $px+q=r$ and $p(x+q)=r$. Corresponding tape diagrams are used as tools in this work, along with situations that these equations can represent.
7.6.7	0	E	The goal of this lesson is for students to understand that we can generally approach equations of the form $px+q=r$ by subtracting q from each side and dividing each side by p (or multiplying by $\frac{1}{p}$). Students only work with examples where p, q, and r are specific

			numbers, not represented by letters.
7.6.8	+	E	This lesson continues the work of developing efficient equation-solving strategies, justified by working with hanger diagrams. The goal of this lesson is for students to understand two different ways to solve an equation of the form $p(x+q)=r$ efficiently.
7.6.9	0	D	In the previous lessons, students used hangers to reason about ways to approach equations of the form $px+q=r$ or $p(x+q)=r$ (which can be summed up as "do the same thing to each side until the unknown equals a number"). In this lesson, students see that this method of solving equations also works when there are negative numbers.
7.6.10	0	D	The purpose of this lesson is to practice solving equations of the form $p(x+q)=r$, and to notice that one of the two ways of solving may be more efficient depending on the numbers in the equation.
7.6.11	+	A	This lesson brings together the skills and concepts that have been studied in the unit so far. Students solve problems that can be represented by equations of the form $px+q=r$ and $p(x+q)=r$.
7.6.12	0	A	This lesson is an opportunity for students to revisit percentages of and percentage change to solve word problems.
7.6.13	0	E	In this lesson, students begin to investigate inequalities of the form $px<q$ and $x+p<q$.
7.6.14	+	E	In this lesson, students see more examples of inequalities in a context. This time, many inequalities involve negative coefficients. This illustrates the idea that **solving an inequality** is not as simple as solving the corresponding equation.
7.6.15	+	D	In this lesson, students see more examples of inequalities. This time, many inequalities involve negative coefficients. This reinforces the point that **solving an inequality** is not as simple as solving the corresponding equation. After students find the boundary point, they must do some extra work to figure out the direction of **inequality**.
7.6.16	+	D	In this lesson and the next, students move on to applying inequalities to solve problems.

			The warm-up is a review of the work in the previous lesson about solving inequalities when no context is given. Then students interpret and solve inequalities that represent real-life situations, making sense of quantities and their relationships in the problem.
7.6.17	0	A	This lesson focuses on the modeling process, in which students start with a question they want to answer and decide on their own how they will represent the situation mathematically.
7.6.18	0	E	Previously in this unit, students solved equations of the form $px+q=r$ and $p(x+q)=r$. Sometimes, work has to be done on a more complicated expression to get an equation into one of these forms. And sometimes, it is desirable to rewrite an expression in an equivalent form to understand how the quantities it represents are related.
7.6.19	0	E	In the previous lesson, students learned to rewrite subtraction as "adding the opposite" to avoid common pitfalls. In this lesson, students practice using the distributive property to write **equivalent expressions** when there are rational coefficients. Some of the expressions they will work with are in preparation for understanding combining like **terms** in terms of the distributive property, coming up in the next lesson.
7.6.20	+	D	In this lesson, students have a chance to recall one way of understanding **equivalent expressions**, that is, the expressions have the same value for any number substituted for a **variable**. Then they use properties they have studied over the past several lessons to understand how to properly write an **equivalent expression** using fewer **terms**.
7.6.21	+	D	In this lesson, students are still working toward gaining fluency in writing **equivalent expressions**. The goal of this lesson is to highlight a particular common error: mishandling the subtraction in an expression like $8-3(4+9x)$. To this end, students first analyze and explain the error in several incorrect ways of rewriting this expression. Then, they consider the effect of inserting parentheses in different places in an expression with four **terms**.
7.6.22	+	A	In this lesson, students have an opportunity to demonstrate fluency in combining like **terms** and look for and make use of structure to apply the distributive property in more sophisticated ways.
7.6.23	0	A	In this culminating lesson, students look at several real-world situations that can be

			represented by an expression with a variable.

Lesson 4: Practice Solving Equations and Representing Situations with Equations

4.1: Number Talk: Subtracting From Five

Find the value of each expression mentally.

$5 - 2$

$5 - 2.1$

$5 - 2.17$

$5 - 2\frac{7}{8}$

4.2: Row Game: Solving Equations Practice

Solve the equations in one column. Your partner will work on the other column.

Check in with your partner after you finish each row. Your answers in each row should be the same. If your answers aren't the same, work together to find the error and correct it.

column A	column B
$18 = 2x$	$36 = 4x$
$17 = x + 9$	$13 = x + 5$
$8x = 56$	$3x = 21$
$21 = \frac{1}{4}x$	$28 = \frac{1}{3}x$
$6x = 45$	$8x = 60$
$x + 4\frac{5}{6} = 9$	$x + 3\frac{5}{6} = 8$
$\frac{5}{7}x = 55$	$\frac{3}{7}x = 33$
$\frac{1}{5} = 6x$	$\frac{1}{3} = 10x$
$2.17 + x = 5$	$6.17 + x = 9$
$\frac{20}{3} = \frac{10}{9}x$	$\frac{14}{5} = \frac{7}{15}x$
$14.88 + x = 17.05$	$3.91 + x = 6.08$
$3\frac{3}{4}x = 1\frac{1}{4}$	$\frac{7}{5}x = \frac{7}{15}$

4.3: Choosing Equations to Match Situations

Circle **all** of the equations that describe each situation. If you get stuck, consider drawing a diagram. Then find the solution for each situation.

1. Clare has 8 fewer books than Mai. If Mai has 26 books, how many books does Clare have?
    - $26 - x = 8$
    - $x = 26 + 8$
    - $x + 8 = 26$
    - $26 - 8 = x$

    $x =$ _______

2. A coach formed teams of 8 from all the players in a soccer league. There are 14 teams. How many players are in the league?
    - $y = 14 \div 8$
    - $\frac{y}{8} = 14$
    - $\frac{1}{8}y = 14$
    - $y = 14 \cdot 8$

    $y =$ _______

3. Kiran scored 223 more points in a computer game than Tyler. If Kiran scored 409 points, how many points did Tyler score?
    - $223 = 409 - z$
    - $409 - 223 = z$
    - $409 + 223 = z$
    - $409 = 223 + z$

    $z =$ _______

4. Mai ran 27 miles last week, which was three times as far as Jada ran. How far did Jada run?
    - $3w = 27$
    - $w = \frac{1}{3} \cdot 27$
    - $w = 27 \div 3$
    - $w = 3 \cdot 27$

    $w =$ _______

Are you ready for more?

Mai's mother was 28 when Mai was born. Mai is now 12 years old. In how many years will Mai's mother be twice Mai's age? How old will they be then?

Lesson 4 Summary

Writing and solving equations can help us answer questions about situations.

Suppose a scientist has 13.68 liters of acid and needs 16.05 liters for an experiment. How many more liters of acid does she need for the experiment?

- We can represent this situation with the equation: $13.68 + x = 16.05$
- When working with hangers, we saw that the solution can be found by subtracting 13.68 from each side. This gives us some new equations that also represent the situation:

$$x = 16.05 - 13.68$$

$$x = 2.37$$

- Finding a solution in this way leads to a variable on one side of the equal sign and a number on the other. We can easily read the solution—in this case, 2.37—from an equation with a letter on one side and a number on the other. We often write solutions in this way.

Let's say a food pantry takes a 54-pound bag of rice and splits it into portions that each weigh $\frac{3}{4}$ of a pound. How many portions can they make from this bag?

- We can represent this situation with the equation: $\frac{3}{4}x = 54$
- We can find the value of x by dividing each side by $\frac{3}{4}$. This gives us some new equations that represent the same situation:

$$x = 54 \div \frac{3}{4}$$

$$x = 72$$

- The solution is 72 portions.

Lesson 4: Practice Solving Equations and Representing Situations with Equations

Cool Down: More Storytime

1. Write a story to match the equation $x + 2\frac{1}{2} = 10$.

2. Explain what x represents in your story.

3. Solve the equation. Explain or show your reasoning.

Unit 6 Lesson 4 Cumulative Practice Problems

1. Select **all** the equations that describe each situation and then find the solution.

   a. Kiran's backpack weighs 3 pounds less than Clare's backpack. Clare's backpack weighs 14 pounds. How much does Kiran's backpack weigh?

   - ■ $x + 3 = 14$
   - ■ $3x = 14$
   - ■ $x = 14 - 3$
   - ■ $x = 14 \div 3$

   b. Each notebook contains 60 sheets of paper. Andre has 5 notebooks. How many sheets of paper do Andre's notebooks contain?

   - ■ $y = 60 \div 5$
   - ■ $y = 5 \cdot 60$
   - ■ $\frac{y}{5} = 60$
   - ■ $5y = 60$

2. Solve each equation.

   a. $2x = 5$

   b. $y + 1.8 = 14.7$

   c. $6 = \frac{1}{2}z$

   d. $3\frac{1}{4} = \frac{1}{2} + w$

   e. $2.5t = 10$

3. For each equation, draw a tape diagram that represents the equation.

   a. $3 \cdot x = 18$

   b. $3 + x = 18$

   c. $17 - 6 = x$

   (From Unit 6, Lesson 1.)

4. Find each product.

   $(21.2) \cdot (0.02)$

   $(2.05) \cdot (0.004)$

   (From Unit 5, Lesson 8.)

5. For a science experiment, students need to find 25% of 60 grams.

   - Jada says, "I can find this by calculating $\frac{1}{4}$ of 60."
   - Andre says, "25% of 60 means $\frac{25}{100} \cdot 60$."

   Do you agree with either of them? Explain your reasoning.

   (From Unit 3, Lesson 13.)

Lesson 10: The Distributive Property, Part 2

10.1: Possible Areas

1. A rectangle has a width of 4 units and a length of m units. Write an expression for the area of this rectangle.

2. What is the area of the rectangle if m is:

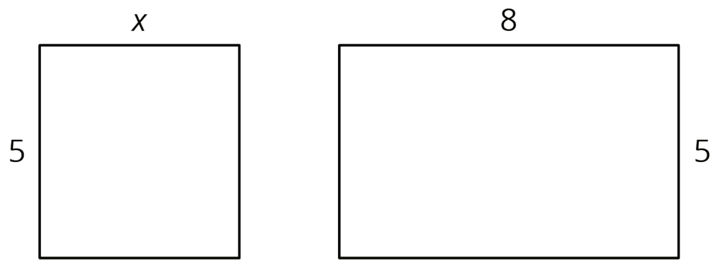
   3 units? 2.2 units? $\frac{1}{5}$ unit?

3. Could the area of this rectangle be 11 square units? Why or why not?

10.2: Partitioned Rectangles When Lengths are Unknown

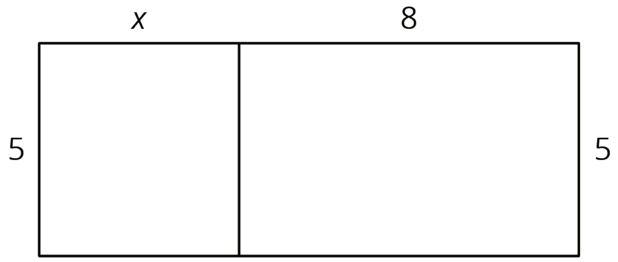
1. Here are two rectangles. The length and width of one rectangle are 8 and 5. The width of the other rectangle is 5, but its length is unknown so we labeled it x.

   Write an expression for the sum of the areas of the two rectangles.



2. The two rectangles can be composed into one larger rectangle as shown.

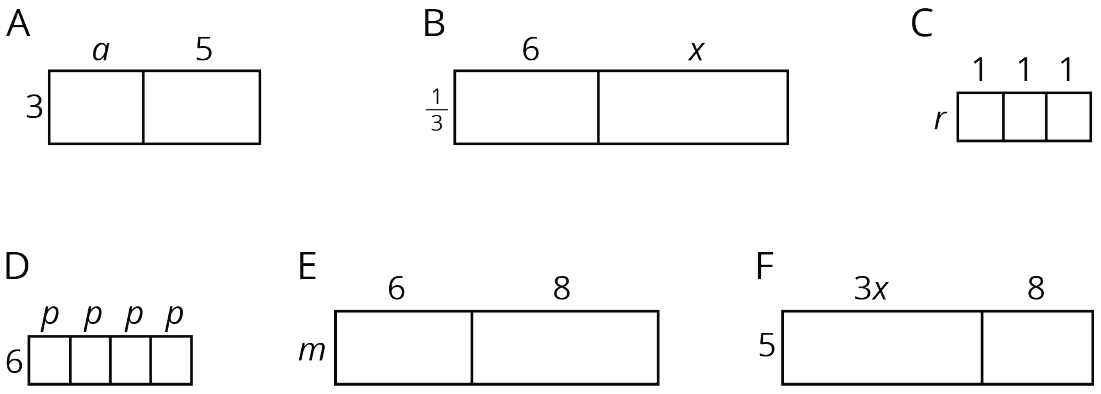
   What are the width and length of the new, large rectangle?



3. Write an expression for the total area of the large rectangle as the product of its width and its length.

10.3: Areas of Partitioned Rectangles

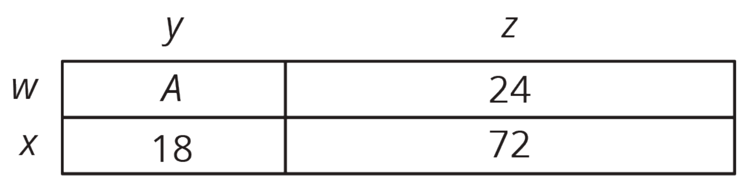
For each rectangle, write expressions for the length and width and two expressions for the total area. Record them in the table. Check your expressions in each row with your group and discuss any disagreements.



rectangle	width	length	area as a product of width times length	area as a sum of the areas of the smaller rectangles
A				
B				
C				
D				
E				
F				

Are you ready for more?

Here is an area diagram of a rectangle.

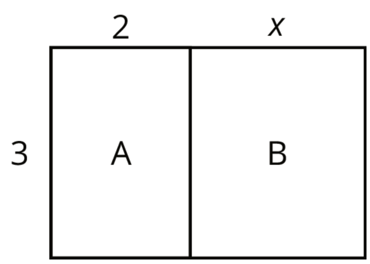


1. Find the lengths w, x, y, and z, and the area A. All values are whole numbers.

2. Can you find another set of lengths that will work? How many possibilities are there?

Lesson 10 Summary

Here is a rectangle composed of two smaller rectangles A and B.



Based on the drawing, we can make several observations about the area of the rectangle:

- One side length of the large rectangle is 3 and the other is $2 + x$, so its area is $3(2 + x)$.
- Since the large rectangle can be decomposed into two smaller rectangles, A and B, with no overlap, the area of the large rectangle is also the sum of the areas of rectangles A and B: $3(2) + 3(x)$ or $6 + 3x$.
- Since both expressions represent the area of the large rectangle, they are equivalent to each other. $3(2 + x)$ is equivalent to $6 + 3x$.

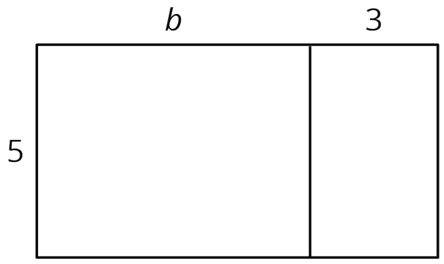
We can see that multiplying 3 by the sum $2 + x$ is equivalent to multiplying 3 by 2 and then 3 by x and adding the two products. This relationship is an example of the *distributive property*.

$$3(2 + x) = 3 \cdot 2 + 3 \cdot x$$

Lesson 10: The Distributive Property, Part 2

Cool Down: Which Expressions Represent Area?

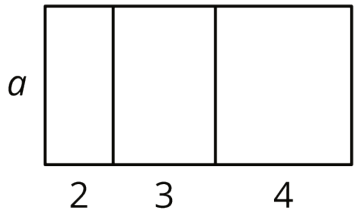
Select **all** the expressions that represent the large rectangle's total area.



- $3(5 + b)$
- $5(b + 3)$
- $5b + 15$
- $15 + 5b$
- $3 \cdot 5 + 3b$

Unit 6 Lesson 10 Cumulative Practice Problems

1. Here is a rectangle.

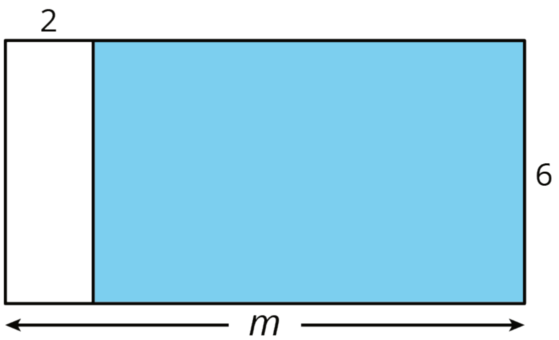


   a. Explain why the area of the large rectangle is $2a + 3a + 4a$.

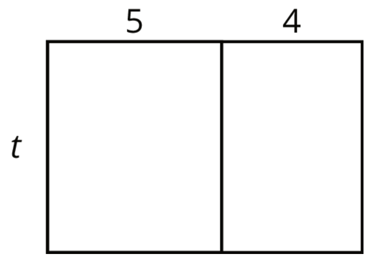
   b. Explain why the area of the large rectangle is $(2 + 3 + 4)a$.

2. Is the area of the shaded rectangle $6(2 - m)$ or $6(m - 2)$?

   Explain how you know.



3. Choose the expressions that do *not* represent the total area of the rectangle. Select **all** that apply.



A. $5t + 4t$

B. $t + 5 + 4$

C. $9t$

D. $4 \cdot 5 \cdot t$

E. $t(5 + 4)$

4. Evaluate each expression mentally.

a. $35 \cdot 91 - 35 \cdot 89$

b. $22 \cdot 87 + 22 \cdot 13$

c. $\frac{9}{11} \cdot \frac{7}{10} - \frac{9}{11} \cdot \frac{3}{10}$

(From Unit 6, Lesson 9.)

5. Select **all** the expressions that are equivalent to $4b$.

A. $b + b + b + b$

B. $b + 4$

C. $2b + 2b$

D. $b \cdot b \cdot b \cdot b$

E. $b \div \frac{1}{4}$

(From Unit 6, Lesson 8.)

6. Solve each equation. Show your reasoning.

$111 = 14a$ $\qquad 13.65 = b + 4.88$ $\qquad c + \frac{1}{3} = 5\frac{1}{8}$

$\frac{2}{5}d = \frac{17}{4}$ $\qquad 5.16 = 4e$

(From Unit 6, Lesson 4.)

7. Andre ran $5\frac{1}{2}$ laps of a track in 8 minutes at a constant speed. It took Andre x minutes to run each lap. Select **all** the equations that represent this situation.

A. $\left(5\frac{1}{2}\right) x = 8$

B. $5\frac{1}{2} + x = 8$

C. $5\frac{1}{2} - x = 8$

D. $5\frac{1}{2} \div x = 8$

E. $x = 8 \div \left(5\frac{1}{2}\right)$

F. $x = \left(5\frac{1}{2}\right) \div 8$

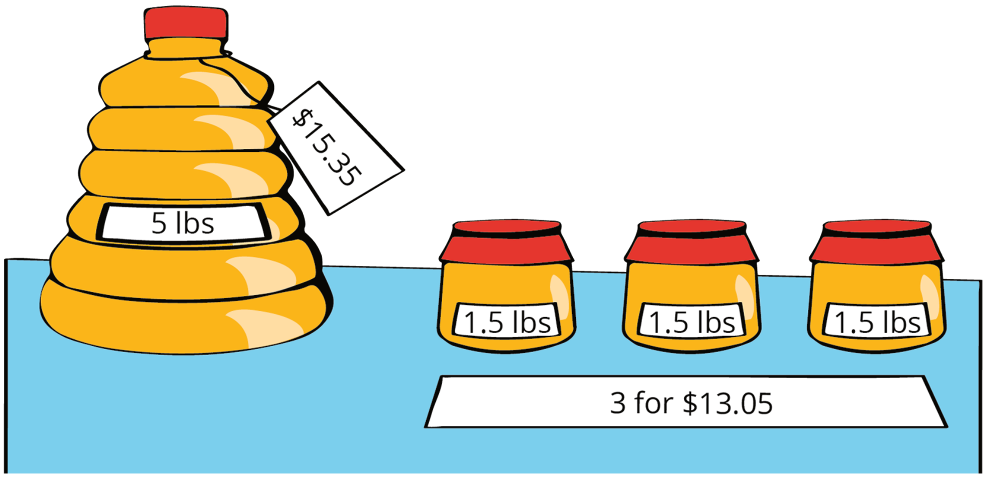
(From Unit 6, Lesson 2.)

Lesson 16: Two Related Quantities, Part 1

16.1: Which One Would You Choose?

Which one would you choose? Be prepared to explain your reasoning.

- A 5-pound jug of honey for $15.35
- Three 1.5-pound jars of honey for $13.05



16.2: Painting the Set

Lin needs to mix a specific shade of orange paint for the set of the school play. The color uses 3 parts yellow for every 2 parts red.

1. Complete the table to show different combinations of red and yellow paint that will make the shade of orange Lin needs.

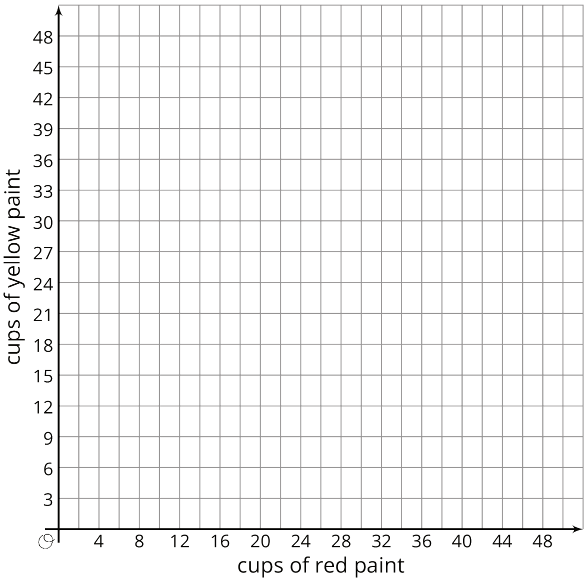
cups of red paint (r)	cups of yellow paint (y)	total cups of paint (t)
2	3	
6		
		20
	18	
14		
16		
		50
	42	

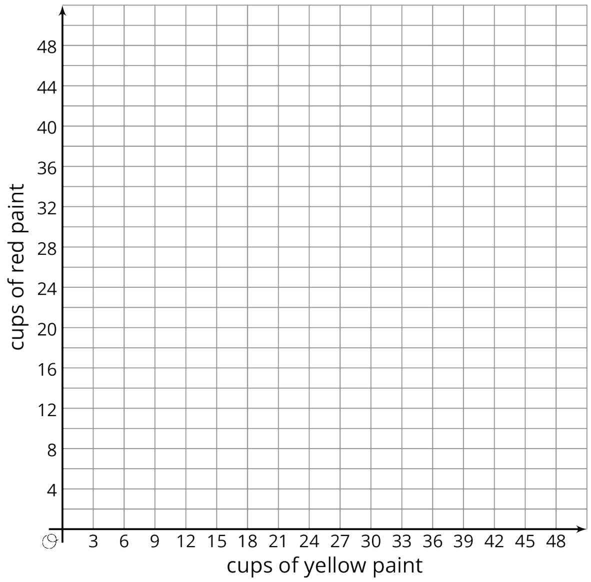
2. Lin notices that the number of cups of red paint is always $\frac{2}{5}$ of the total number of cups. She writes the equation $r = \frac{2}{5}t$ to describe the relationship. Which is the **independent variable**? Which is the **dependent variable**? Explain how you know.

3. Write an equation that describes the relationship between r and y where y is the independent variable.

4. Write an equation that describes the relationship between y and r where r is the independent variable.

5. Use the points in the table to create two graphs that show the relationship between r and y. Match each relationship to one of the equations you wrote.





Are you ready for more?

A fruit stand sells apples, peaches, and tomatoes. Today, they sold 4 apples for every 5 peaches. They sold 2 peaches for every 3 tomatoes. They sold 132 pieces of fruit in total. How many of each fruit did they sell?

Lesson 16 Summary

Equations are very useful for describing sets of equivalent ratios. Here is an example.

A pie recipe calls for 3 green apples for every 5 red apples. We can create a table to show some equivalent ratios.

We can see from the table that r is always $\frac{5}{3}$ as large as g and that g is always $\frac{3}{5}$ as large as r.

green apples (g)	red apples (r)
3	5
6	10
9	15
12	20

We can write equations to describe the relationship between g and r.

- When we know the number of green apples and want to find the number of red apples, we can write:

  $$r = \frac{5}{3}g$$

  In this equation, if g changes, r is affected by the change, so we refer to g as the **independent variable** and r as the **dependent variable**.

  We can use this equation with any value of g to find r. If 270 green apples are used, then $\frac{5}{3} \cdot (270)$ or 450 red apples are used.

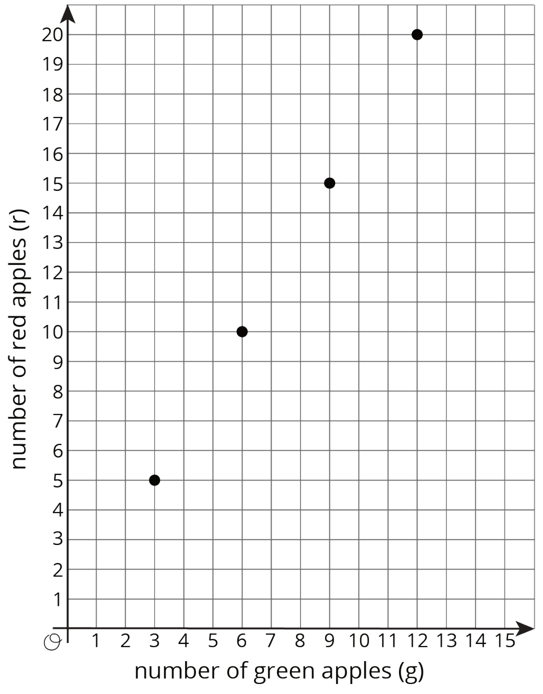
- When we know the number of red apples and want to find the number of green apples, we can write:

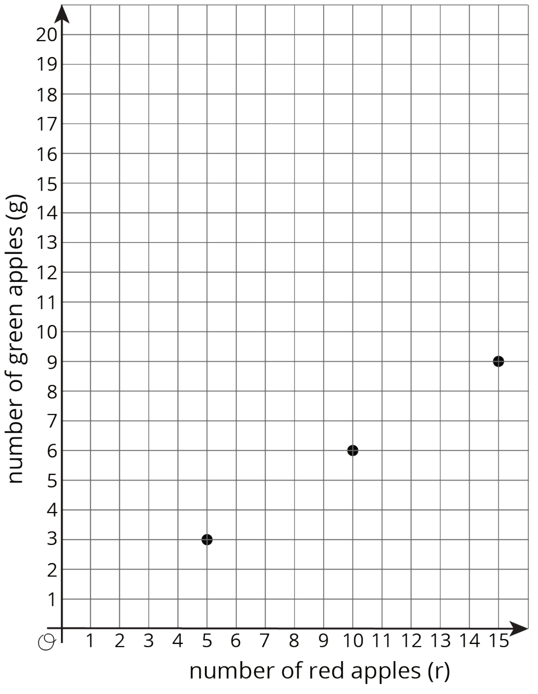
  $$g = \frac{3}{5}r$$

  In this equation, if r changes, g is affected by the change, so we refer to r as the independent variable and g as the dependent variable.

  We can use this equation with any value of r to find g. If 275 red apples are used, then $\frac{3}{5} \cdot (275)$ or 165 green apples are used.

We can also graph the two equations we wrote to get a visual picture of the relationship between the two quantities.

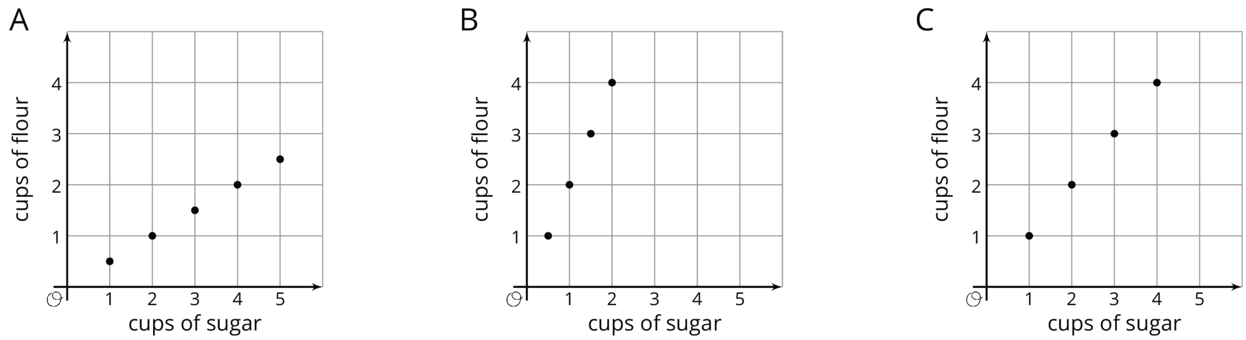




Lesson 16: Two Related Quantities, Part 1

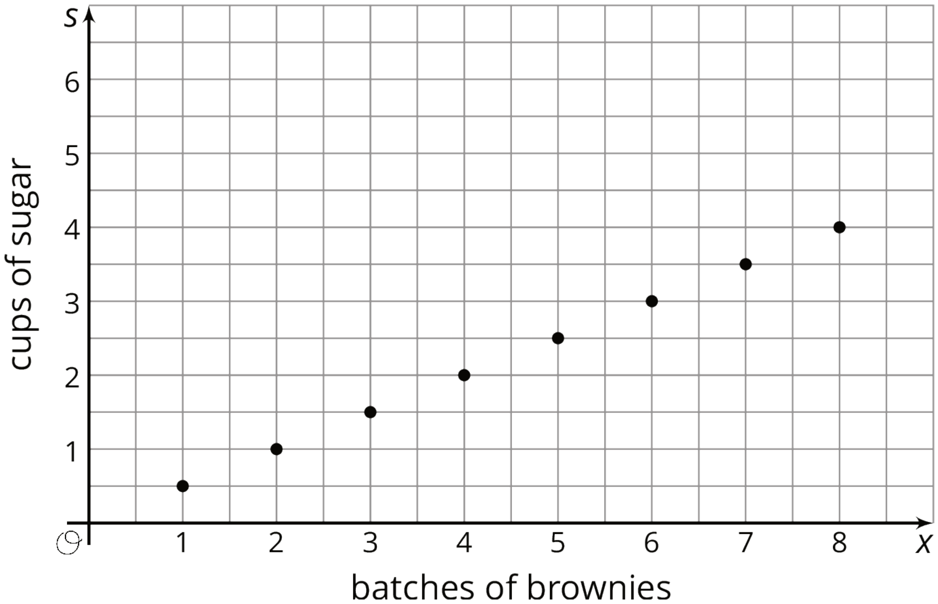
Cool Down: Baking Brownies

A brownie recipe calls for 1 cup of sugar and $\frac{1}{2}$ cup of flour to make one batch of brownies. To make multiple batches, the equation $f = \frac{1}{2}s$ where f is the number of cups of flour and s is the number of cups of sugar represents the relationship. Which graph also represents the relationship? Explain how you know.



Unit 6 Lesson 16 Cumulative Practice Problems

1. Here is a graph that shows some values for the number of cups of sugar, s, required to make x batches of brownies.



   a. Complete the table so that the pair of numbers in each column represents the coordinates of a point on the graph.

x	1	2	3	4	5	6	7
s							

   b. What does the point $(8, 4)$ mean in terms of the amount of sugar and number of batches of brownies?

   c. Write an equation that shows the amount of sugar in terms of the number of batches.

2. Each serving of a certain fruit snack contains 90 calories.

   a. Han wants to know how many calories he gets from the fruit snacks. Write an equation that shows the number of calories, c, in terms of the number of servings, n.

   b. Tyler needs some extra calories each day during his sports season. He wants to know how many servings he can have each day if all the extra calories come from the fruit snack. Write an equation that shows the number of servings, n, in terms of the number of calories, c.

3. Kiran shops for books during a 20% off sale.

   a. What percent of the original price of a book does Kiran pay during the sale?

   b. Complete the table to show how much Kiran pays for books during the sale.

   c. Write an equation that relates the sale price, s, to the original price p.

   d. On graph paper, create a graph showing the relationship between the sale price and the original price by plotting the points from the table.

original price in dollars (p)	sale price in dollars (s)
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

4. Evaluate each expression when x is 4 and y is 6.

   a. $(6 - x)^3 + y$

   b. $2 + x^3$

   c. $2^x - 2y$

   d. $\left(\frac{1}{2}\right)^x$

   e. $1^x + 2^x$

   f. $\frac{2^x}{x^2}$

(From Unit 6, Lesson 15.)

5. Find $(12.34) \cdot (0.7)$. Show your reasoning.

(From Unit 5, Lesson 8.)

6. For each expression, write another division expression that has the same value and that can be used to help find the quotient. Then, find each quotient.

   a. $302.1 \div 0.5$

   b. $12.15 \div 0.02$

   c. $1.375 \div 0.11$

(From Unit 5, Lesson 13.)

Lesson 17: Two Related Quantities, Part 2

17.1: Walking to the Library

Lin and Jada each walk at a steady rate from school to the library. Lin can walk 13 miles in 5 hours, and Jada can walk 25 miles in 10 hours. They each leave school at 3:00 and walk $3\frac{1}{4}$ miles to the library. What time do they each arrive?

17.2: The Walk-a-thon

Diego, Elena, and Andre participated in a walk-a-thon to raise money for cancer research. They each walked at a constant rate, but their rates were different.

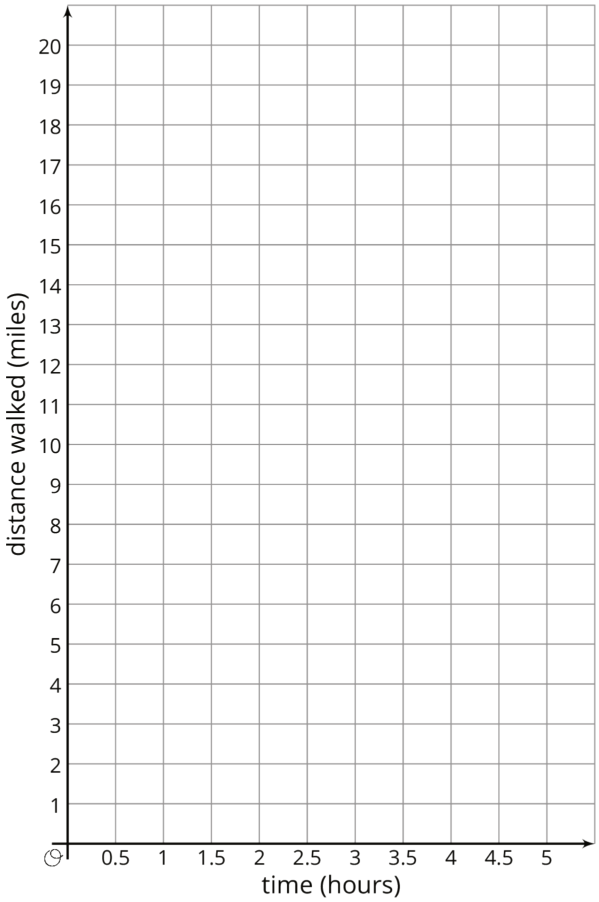
1. Complete the table to show how far each participant walked during the walk-a-thon.

time in hours	miles walked by Diego	miles walked by Elena	miles walked by Andre
1			
2	6		
	12	11	
5			17.5

2. How fast was each participant walking in miles per hour?

3. How long did it take each participant to walk one mile?

4. Graph the progress of each person in the **coordinate plane**. Use a different color for each participant.



5. Diego says that $d = 3t$ represents his walk, where d is the distance walked in miles and t is the time in hours.

    a. Explain why $d = 3t$ relates the distance Diego walked to the time it took.

    b. Write two equations that relate distance and time: one for Elena and one for Andre.

6. Use the equations you wrote to predict how far each participant would walk, at their same rate, in 8 hours.

7. For Diego's equation and the equations you wrote, which is the dependent variable and which is the independent variable?

Are you ready for more?

1. Two trains are traveling toward each other, on parallel tracks. Train A is moving at a constant speed of 70 miles per hour. Train B is moving at a constant speed of 50 miles per hour. The trains are initially 320 miles apart. How long will it take them to meet? One way to start thinking about this problem is to make a table. Add as many rows as you like.

	train A	train B
starting position	0 miles	320 miles
after 1 hour	70 miles	270 miles
after 2 hours		

2. How long will it take a train traveling at 120 miles per hour to go 320 miles?

3. Explain the connection between these two problems.

Lesson 17 Summary

Equations are very useful for solving problems with constant speeds. Here is an example.

A boat is traveling at a constant speed of 25 miles per hour.

1. How far can the boat travel in 3.25 hours?
2. How long does it take for the boat to travel 60 miles?

We can write equations to help us answer questions like these.

Let's use t to represent the time in hours and d to represent the distance in miles that the boat travels.

When we know the time and want to find the distance, we can write:

$$d = 25t$$

In this equation, if t changes, d is affected by the change, so we t is the independent variable and d is the dependent variable.

This equation can help us find d when we have any value of t. In 3.25 hours, the boat can travel $25(3.25)$ or 81.25 miles.

When we know the distance and want to find the time, we can write:

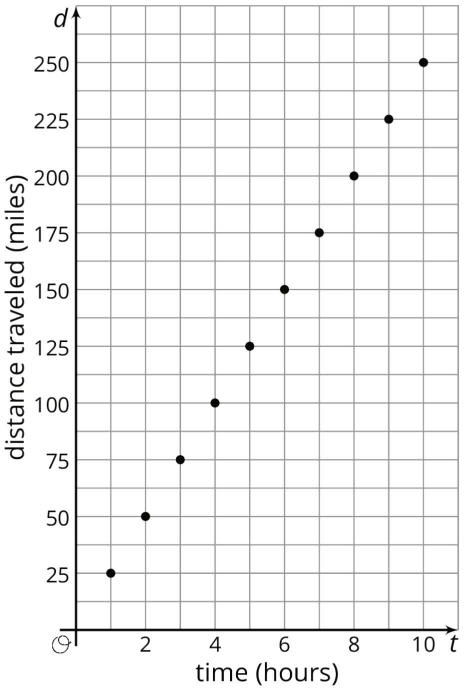
$$t = \frac{d}{25}$$

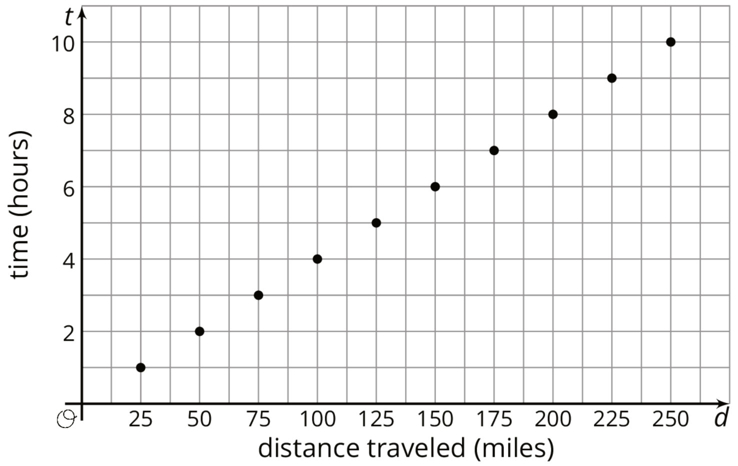
In this equation, if d changes, t is affected by the change, so we d is the independent variable and t is the dependent variable.

This equation can help us find t when for any value of d. To travel 60 miles, it will take $\frac{60}{25}$ or $2\frac{2}{5}$ hours.

These problems can also be solved using important ratio techniques such as a table of equivalent ratios. The equations are particularly valuable in this case because the answers are not round numbers or easy to quickly evaluate.

We can also graph the two equations we wrote to get a visual picture of the relationship between the two quantities:





Lesson 17: Two Related Quantities, Part 2

Cool Down: Interpret the Point

During a walk-a-thon, Noah's time in hours, t, and distance in miles, d, are related by the equation $\frac{1}{3}d = t$. A graph of the equation includes the point $(12, 4)$.

1. Identify the independent variable.

2. What does the point $(12, 4)$ represent in this situation?

3. What point would represent the time it took to walk $7\frac{1}{2}$ miles?

Unit 6 Lesson 17 Cumulative Practice Problems

1. A car is traveling down a road at a constant speed of 50 miles per hour.

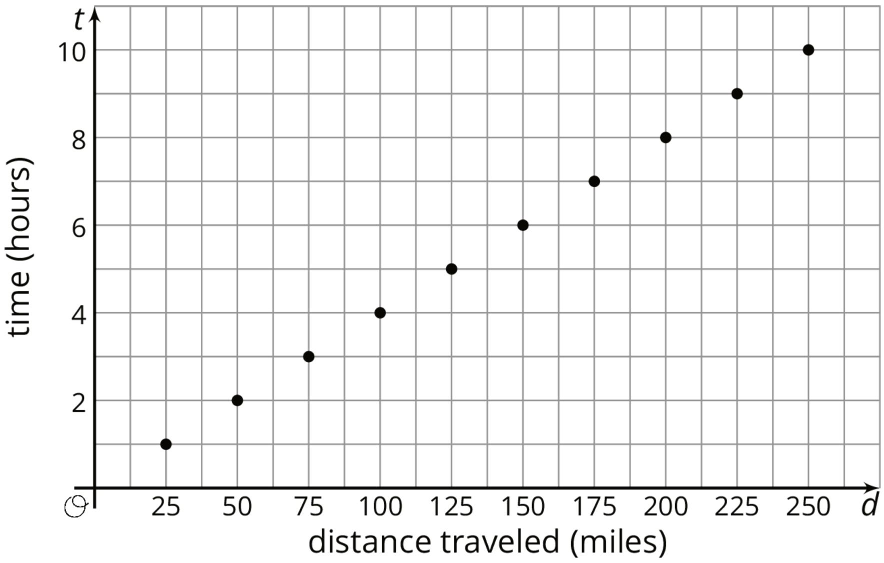
   a. Complete the table with the amounts of time it takes the car to travel certain distances, or the distances traveled for certain amounts of time.

   b. Write an equation that represents the distance traveled by the car, d, for an amount of time, t.

   c. In your equation, which is the dependent variable and which is the independent variable?

time (hours)	distance (miles)
2	
1.5	
t	
	50
	300
	d

2. The graph represents the amount of time in hours it takes a ship to travel various distances in miles.



a. Write the coordinates of one of point on the graph. What does the point represent?

b. What is the speed of the ship in miles per hour?

c. Write an equation that relates the time, t, it takes to travel a given distance, d.

3. Find a solution to each equation in the list that follows (not all numbers will be used):

a. $2^x = 8$

b. $2^x = 2$

c. $x^2 = 100$

d. $x^2 = \frac{1}{100}$

e. $x^1 = 7$

f. $2^x \cdot 2^3 = 2^7$

g. $\frac{2^x}{2^3} = 2^5$

List: $\frac{1}{10}$ $\frac{1}{3}$ 1 2 3 4 5 7 8 10 16

(From Unit 6, Lesson 15.)

4. Select **all** the expressions that are equivalent to $5x + 30x - 15x$.

A. $5(x + 6x - 3x)$

B. $(5 + 30 - 15) \cdot x$

C. $x(5 + 30x - 15x)$

D. $5x(1 + 6 - 3)$

E. $5(x + 30x - 15x)$

(From Unit 6, Lesson 11.)

5. Evaluate each expression if x is 1, y is 2, and z is 3.

a. $7x^2 - z$

b. $(x + 4)^3 - y$

c. $y(x + 3^3)$

d. $(7 - y + z)^2$

e. $0.241x + x^3$

(From Unit 6, Lesson 15.)