

Explore Equivalent Expressions

Previously, you worked with equivalent expressions that have positive coefficients. In this lesson, you will work with equivalent expressions that have negative coefficients.

► **Use what you know to try to solve the problem below.**

In a certain video game, players earn bonus points after finishing a level. The number of bonus points is based on how many seconds, t , it takes the player to finish the level. The game uses the expression $-5.5 + 500 + 0.9t + \left(\frac{11}{2} - 1.9t\right)$ to determine the number of bonus points.

Zahara finishes a level in 201 seconds. How many bonus points does she earn?



**TRY
IT**



Math Toolkit grid paper, sticky notes

DISCUSS IT

Ask: What did you do first to determine how many bonus points Zahara earns?

Share: First, I ... because ...



Learning Target SMP 1, SMP 2, SMP 3, SMP 4, SMP 5, SMP 6, SMP 7

Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.

CONNECT IT

- 1 Look Back** How many bonus points does Zahara earn? What is another expression the game could use to determine the number of bonus points she earns?

- 2 Look Ahead** In the **Try It**, you evaluated an expression. Sometimes it can be helpful to find an equivalent expression to evaluate instead. One way to find an equivalent expression is to use the distributive property.
 - a.** Sometimes you can use the distributive property to expand an expression. You can expand $-3(5 - x)$ into the equivalent expression $-15 + 3x$. Show how you can use the distributive property to expand $-4(-a + 2)$ to get an equivalent expression.

 - b.** Sometimes you can use the distributive property to **factor** an expression. You can factor $3z - 6$ to get the equivalent expression $3(z - 2)$. Show how you can use the distributive property to factor $2g - 10$ to get an equivalent expression.

 - c.** Can you factor $-2x + 6$ to get $-2(x - 3)$? Explain.

- 3 Reflect** Explain why the expressions $-6(5 - k)$ and $6k - 30$ are equivalent.

Prepare for Writing Equivalent Expressions Involving Rational Numbers

- 1 Think about what you know about the terms of an expression. Fill in each box. Use words, numbers, and pictures. Show as many ideas as you can.

In My Own Words

My Illustrations

term

Examples

Non-Examples

- 2 Aiden says that equivalent expressions always have the same number of terms. Is Aiden correct? If he is, explain why. If he is not correct, give a counterexample.

- 3 Jake cuts out five-pointed stars. They are different sizes, but they all have the same shape. The side lengths within each star are the same. To find the perimeter of each star, Jake uses the expression $12\ell + \frac{1}{2} - 4\ell - 8.5 + 2\ell + 8$, where ℓ is the side length of the star.
- a. Find the perimeter of a star with side length 6 inches. Show your work.

SOLUTION _____

- b. Check your answer to problem 3a. Show your work.



Develop Expanding Expressions

► Read and try to solve the problem below.

Are $-\frac{1}{3}(-3m + 6 - 12 + 15m)$ and $2(1 - 2m)$ equivalent expressions?

Show why or why not.

**TRY
IT**



Math Toolkit grid paper, sticky notes

DISCUSS IT

Ask: How did you get started figuring out whether the expressions are equivalent?

Share: I started by ...

► Explore different ways to find equivalent expressions.

Are $-\frac{1}{3}(-3m + 6 - 12 + 15m)$ and $2(1 - 2m)$ equivalent expressions?

Show why or why not.

Solve It

You can combine like terms, then expand.

$$\begin{array}{ll}
 -\frac{1}{3}(-3m + 6 - 12 + 15m) & 2(1 - 2m) \\
 -\frac{1}{3}(12m - 6) & 2(1) - 2(2m) \\
 -\frac{1}{3}(12m) - \left(-\frac{1}{3}\right)(6) & 2 - 4m \\
 -4m + 2 & -4m + 2
 \end{array}$$

Solve It

You can expand, then combine like terms.

$$\begin{array}{ll}
 -\frac{1}{3}(-3m + 6 - 12 + 15m) & 2(1 - 2m) \\
 -\frac{1}{3}(-3m) + \left(-\frac{1}{3}\right)(6) - \left(-\frac{1}{3}\right)(12) + \left(-\frac{1}{3}\right)(15m) & 2(1) - 2(2m) \\
 m - 2 + 4 - 5m & 2 - 4m \\
 -4m + 2 & -4m + 2
 \end{array}$$

CONNECT IT

► Use the problem from the previous page to help you understand how to find equivalent expressions.

- 1 How do the **Solve Its** show that the expressions are equivalent?
- 2 How can expanding two expressions help show that the expressions are equivalent?
- 3 Is $-\frac{1}{3}(3 - m)$ equivalent to $-1 + \frac{1}{3}m$ or to $-1 - \frac{1}{3}m$? Explain.
- 4 How is expanding an expression with negative terms like expanding an expression with positive terms? How is it different?
- 5 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to determine whether expressions are equivalent.

Apply It

► Use what you learned to solve these problems.

- 6 Raúl says the expression $-25\left(\frac{1}{5}x - 20\right)$ is equivalent to $-5x - 500$. Do you agree?

Explain why or why not.

- 7 Which expressions are equivalent to $-4(-25y + 4 + 50y - 8)$? Select all that apply.

A $-100y - 4$

B $-2(23y - 5 + 27y - 3)$

C $(100y + 32) - (200y + 16)$

D $-16 - 100y$

E $-(-100y + 16 + 200y - 32)$

F $-300y - 48$

- 8 Are the expressions $2(3x - 6)$ and $2(3x) - 6$ equivalent? Explain your reasoning.

Practice Expanding Expressions

- Study the Example showing how to decide whether two expressions are equivalent. Then solve problems 1–5.

Example

Is $-\frac{3}{4}(-8a - 12)$ equivalent to $6a + 9$?

You can start by expanding $-\frac{3}{4}(-8a - 12)$.

$$-\frac{3}{4}(-8a - 12)$$

$$-\frac{3}{4}[-8a + (-12)]$$

$$\left(-\frac{3}{4}\right)(-8a) + \left(-\frac{3}{4}\right)(-12)$$

$$6a + 9$$

You can rewrite $-\frac{3}{4}(-8a - 12)$ as $6a + 9$. So, the two expressions are equivalent.

- 1 Look at the Example. How do you know that $\left(-\frac{3}{4}\right)(-8a) + \left(-\frac{3}{4}\right)(-12)$ is equivalent to both $-\frac{3}{4}(-8a - 12)$ and $6a + 9$?

- 2 Bianca makes an error when she tries to write an expression equivalent to $12 + 15(3 - y) - 10y$. What is the error? Fix Bianca's error.

$$12 + 15(3 - y) - 10y$$

$$12 + 45 + 15y - 10y$$

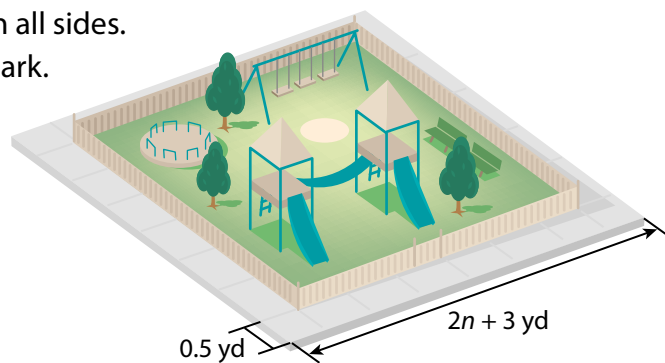
$$57 + 5y$$

Vocabulary

equivalent expressions

two or more different expressions that always name the same value.

- 3 A square playground is surrounded by a sidewalk on all sides. The sidewalk is $2n + 3$ yd long on each side of the park. The sidewalk is 0.5 yd wide. Write two equivalent expressions for the perimeter of the playground. Show your work.



SOLUTION _____

- 4 Is $-\frac{2}{3}(-12b - 6 + 9b - 18)$ equivalent to $2(b + 8)$? Show your work.

SOLUTION _____

- 5 Juanita says that $3.5[4d - (2)(1.5)]$ and $2[7d - (5)(1.05)]$ are equivalent. Is Juanita correct? Explain your reasoning.

Develop Factoring Expressions

► Read and try to solve the problem below.

Are the expressions $24c - 36 + 12 - 12c + 36 - 48c$ and $-2(18c - 6)$ equivalent?
Show why or why not.

**TRY
IT**



Math Toolkit algebra tiles, grid paper

DISCUSS IT

Ask: How did you reach that conclusion?

Share: First, I...

► Explore different ways to determine whether expressions are equivalent.

Are the expressions $24c - 36 + 12 - 12c + 36 - 48c$ and $-2(18c - 6)$ equivalent?
Show why or why not.

Solve It

You can combine like terms and then expand the expression that has parentheses.

$$\begin{array}{rcl} 24c - 36 + 12 - 12c + 36 - 48c & & -2(18c - 6) \\ (24c - 12c - 48c) + (-36 + 12 + 36) & & -36c + 12 \\ -36c + 12 & & \end{array}$$

Solve It

You can combine like terms and then factor.

$$\begin{array}{rcl} 24c - 36 + 12 - 12c + 36 - 48c & & -2(18c - 6) \\ (24c - 12c - 48c) + (-36 + 12 + 36) & & \\ -36c + 12 & & \\ -2(18c - 6) & & \end{array}$$

Solve It

You can factor each expression before combining like terms.

$$\begin{array}{rcl} 24c - 36 + 12 - 12c + 36 - 48c & & -2(18c - 6) \\ 12(2c - 3 + 1 - c + 3 - 4c) & & -2[-6(-3c + 1)] \\ 12(-3c + 1) & & 12(-3c + 1) \end{array}$$

CONNECT IT

► Use the problem from the previous page to help you understand how to use the distributive property to find equivalent expressions.

- 1 How does each of the **Solve Its** show that the expressions are equivalent?
- 2 In the third **Solve It**, the second expression is already in factored form. Why can it be factored again?
- 3 How is factoring an expression with negative terms similar to factoring an expression with positive terms? How is it different?
- 4 Combining like terms, expanding, and factoring are strategies you can use to write equivalent expressions. When might you want to use each of these strategies?
- 5 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to determine whether expressions are equivalent.

Apply It

► Use what you learned to solve these problems.

- 6 A cell phone company is having a sale. The expression $12c + 12\left(\frac{3}{4}c\right) + 12\left(\frac{1}{2}c\right)$ shows the total cost for buying 3 phones that each cost c dollars per month for 12 months.

Which expressions are equivalent to that expression? Select all that apply.

- A $12(2.25c)$
- B $12c + 12\frac{3}{4}c + 12\frac{1}{2}c$
- C $12c + 8c + 6c$
- D $37\frac{1}{4}c$
- E $c(12 + 9 + 6)$
- 7 Are $(9g - 11 + 10g) - (12 - 11g + 13)$ and $-3(-10g + 12)$ equivalent expressions? Explain.

- 8 Is $2(6 - 3x) + x$ equivalent to $2(3x) + x + 12$? Show your work.



SOLUTION _____

Practice Factoring Expressions

- **Study the Example showing how to use factoring to write an equivalent expression. Then solve problems 1–6.**

Example

Consider the expression $(-3t + 3) + (2 - 2t) + (-4t + 4)$. Write an equivalent expression that is the product of two factors.

You can combine like terms. Then find a common factor.

$$(-3t + 3) + (2 - 2t) + (-4t + 4)$$

$$(-3t - 2t - 4t) + (3 + 2 + 4)$$

$$-9t + 9$$

$$-9[t + (-1)]$$

An equivalent expression is $-9(t - 1)$.

- 1 Write $-9t + 9$ as the product of two factors in a way that is not shown in the Example. Explain how you found it.
- 2 Write an expression equivalent to $6 - 4(3 - 6m) + 12m$ that is the product of two factors. Show your work.

SOLUTION

- 3 Is $1 + 4(3x - 10) - 12x$ equivalent to -39 ? Explain.

Vocabulary

equivalent expressions

two or more different expressions that always name the same value.

factor (noun)

a number, or expression within parentheses, that is multiplied.

factor (verb)

to rewrite an expression as a product of factors.



- 4 Olivia and Isabella each earn d dollars for each dog she walks. One day, Olivia walks 6 dogs and gets \$8 in tips. That same day, Isabella walks 9 dogs and gets \$12 in tips.
- a. Olivia writes $6d + 8 + 9d + 12$ to represent the amount they earn together. Isabella writes $5(3d + 4)$. Are their expressions equivalent? Show your work.

Dog Walking	
Olivia	Isabella
6 walks \$8 in tips	9 walks \$12 in tips

SOLUTION

- b. Olivia and Isabella want to find out how much money they earn altogether. Suppose they earn \$12 for each dog walk. Will you get a different amount if you evaluate Isabella's expression instead of Olivia's? Explain.
- 5 Are $\frac{1}{2}x + \frac{3}{4} - \frac{5}{8}x - \frac{7}{8}$ and $\frac{1}{8}(x + 1)$ equivalent expressions? Show your work.

SOLUTION

- 6 Show that $-0.75(-4f + 12)$ and $(5f + 9) - (2f + 18)$ are equivalent expressions.

Refine Writing Equivalent Expressions Involving Rational Numbers

► Complete the Example below. Then solve problems 1–9.

Example

Consider the expression $-\frac{3}{4}(-4f + 3g + 8f - 5g)$. Write an equivalent expression that is the sum of two terms.

Look at how you could rewrite an expression with more than one variable.

$$-\frac{3}{4}(-4f + 3g + 8f - 5g)$$

$$-\frac{3}{4}(-4f + 8f + 3g - 5g)$$

$$-\frac{3}{4}(4f - 2g)$$

SOLUTION _____

CONSIDER THIS . . .

To be like terms, the terms must have the same variables.

PAIR/SHARE

What would happen if you factored 4 out of $(4f - 2g)$?

Apply It

- 1 Are $0.5 - 3(-2x - \frac{1}{3} + 4 + 8x)$ and $-1.5(12x + 7)$ equivalent expressions? Show your work.

CONSIDER THIS . . .

Sometimes it is easier to see common factors after you combine like terms.

SOLUTION _____

PAIR/SHARE

What is another way you could show that your answer is correct?

- 2 Are the expressions $8(9 - 6x + 11)$ and $15 + \frac{3}{2}(-32x + 120) - 35$ both equivalent to $-16(3x - 10)$? Show your work.

CONSIDER THIS ...

You can start by expanding, factoring, or combining like terms.

SOLUTION

- 3 Which expression is equivalent to $-3(10m - 2) + (3 + 6m - 3)$?

- A $-24m + 6$
- B $-24m - 6$
- C $-48m + 6$
- D $-18m$

Evelyn chose A as the correct answer. How might she have gotten that answer?

PAIR/SHARE

Is it possible for both expressions to be equivalent to $-16(3x - 10)$ but not to each other? Why or why not?

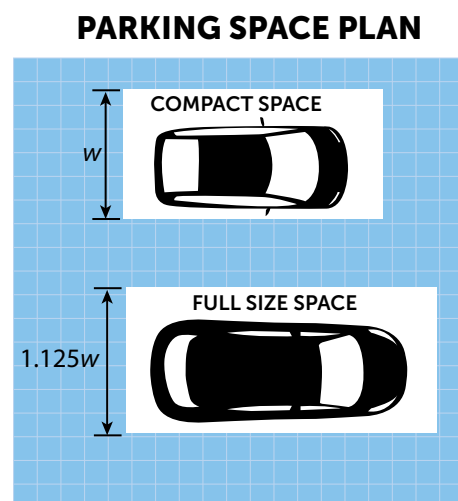
CONSIDER THIS ...

The product of two negative numbers is positive.

PAIR/SHARE

How could you check your answer?

- 4 In front of a store, there is a row of parking spaces. Cars park parallel to one another, with the front of each car facing the store. Currently there are 10 compact spaces and 12 full size spaces. The store owners think they can repaint in the same space to fit 16 compact spaces and 9 full size spaces. The width of each type of space will not change. Are the store owners correct? Explain.



- 5 The variable z represents a positive integer. Does $4 + 3(2z - 5)$ represent a number that is *greater than*, *less than*, or *equal to* $2(3z - 4)$? Show your work.

SOLUTION _____

- 6 Which expressions are equivalent to $\frac{1}{5}x(5y + 60)$? Select all that apply.
- A $\frac{1}{5}(2xy + 20x + 3xy + 40x)$
 - B $xy + 60x$
 - C $y + 12x$
 - D $25xy + 300x$
 - E $13xy$
 - F $x(y + 12)$

- 7 Tell whether each statement is *True* or *False*.

	True	False
a. $6(-5a + 4)$ and $3(-10a + 8)$ are equivalent expressions.	☐	☐
b. $\frac{1}{6}(15a - 36)$ and $\frac{1}{2}a - (3a + 6)$ are equivalent expressions.	☐	☐
c. $-3a + 1.5$ and $-0.5(6a + 1.5)$ are equivalent expressions.	☐	☐
d. $-4(a - 4 + 2a + 8)$ and $-4(a - 4) - 4(2a + 8)$ are equivalent expressions.	☐	☐

- 8 Kazuko says the expressions $5x$ and $6 - x$ are equivalent expressions, because you can substitute 1 for x in both expressions and get the same result. Is Kazuko's reasoning correct? Explain.

- 9 **Math Journal** Start with the expression $12 - \frac{3}{4}(8f - \frac{5}{3} + 4f + \frac{2}{3})$. Write an equivalent expression, and explain why it is equivalent. Then write an expression that is not equivalent and explain why it is not equivalent.

✓ End of Lesson Checklist

- ☐ **INTERACTIVE GLOSSARY** Find the entry for *factor* (verb). Add two things you learned about factoring in this lesson.
- ☐ **SELF CHECK** Go back to the Unit 4 Opener and see what you can check off.

Explore Solving Multi-Step Equations

Previously, you learned how to reason about equations to find unknown values. In this lesson, you will learn about solving equations algebraically.

► **Use what you know to try to solve the problem below.**

Adela, Rachel, and Santo take pictures at a Purim celebration.

- Adela takes 7 more pictures than Rachel.
- Santo takes 4 times as many pictures as Adela.
- Santo takes 48 pictures.

How many pictures does Rachel take?



**TRY
IT**



Math Toolkit algebra tiles, grid paper, number lines, sticky notes

DISCUSS IT

Ask: What did you do first to find the number of pictures Rachel takes? Why?

Share: I started by ... because ...



Learning Targets SMP 1, SMP 2, SMP 3, SMP 4, SMP 5, SMP 6, SMP 7

Use variables to represent quantities and construct simple equations to solve problems.

- 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.

CONNECT IT

- 1 Look Back** How many pictures do Adela and Rachel each take?
How do you know?

- 2 Look Ahead** One way to find the number of photos Adela and Rachel each take is to reason about the quantities arithmetically. Another way is to solve an equation algebraically. Look at two ways you could find the unknown in the statement *the product of 6 and a number, n , plus 4 is 22*.

Arithmetic Approach

Think: What number is 4 less than 22?

Step 1: $22 - 4 = 18$

Think: What number times 6 is 18?

Step 2: $18 \div 6 = 3$

The number is 3.

Algebraic Approach

$$6n + 4 = 22$$

Step 1: $6n + 4 - 4 = 22 - 4$

$$6n = 18$$

Step 2: $6n \div 6 = 18 \div 6$

$$n = 3$$

- How is Step 1 in the arithmetic approach like Step 1 in the algebraic approach?
- How is Step 2 in the arithmetic approach like Step 2 in the algebraic approach?
- Why do both approaches lead to the same solution?

- 3 Reflect** How is the algebraic approach similar to the arithmetic approach?
How is it different?

Prepare for Writing and Solving Multi-Step Equations

- 1 Think about what you know about the like terms in an expression. Fill in each box. Use words, numbers, and pictures. Show as many ideas as you can.

What Is It?

What I Know About It

like terms

Examples

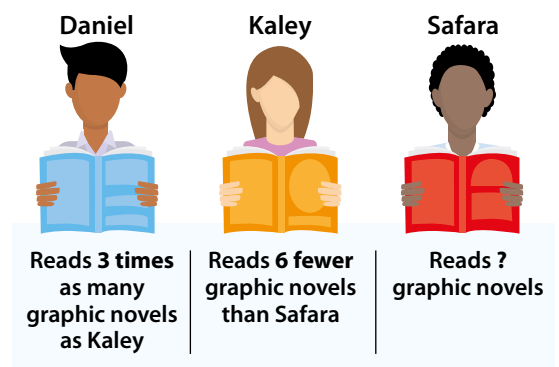
Non-Examples

- 2 Rosa says $4x$ and $-6x$ are like terms, so they can be combined. Tiffany says $5a$ and $5b$ are like terms, so they can be combined. Is Rosa correct? Is Tiffany correct? Why or why not?

3 Kaley, Safara, and Daniel keep track of how many graphic novels they read over the summer.

- Kaley reads 6 graphic novels fewer than Safara.
- Daniel reads 3 times as many as Kaley.
- Daniel reads 30 graphic novels.

a. How many graphic novels does Safara read?
Show your work.



SOLUTION

b. Check your answer to problem 3a. Show your work.

Develop Writing and Solving Equations With Two or More Addends

► Read and try to solve the problem below.

Noah is designing a set for a school theater production. He has 150 cardboard bricks. He needs to use some of the bricks to make a chimney and 4 times as many bricks to make an arch. He also saves 15 bricks in case some get crushed. How many cardboard bricks can he use to make the arch?



TRY
IT



Math Toolkit algebra tiles, grid paper, number lines, sticky notes

DISCUSS IT

Ask: How would you explain what the problem is asking in your own words?

Share: The problem is asking . . .

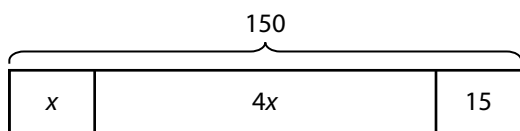
► **Explore different ways to find an unknown value in an equation that has two or more addends.**

Noah is designing a set for a school theater production. He has 150 cardboard bricks. He needs to use some of the bricks to make a chimney and 4 times as many bricks to make an arch. He also saves 15 bricks in case some get crushed. How many cardboard bricks can he use to make the arch?

Model It

You can draw a bar model to make sense of the problem.

Let x represent the number of bricks in the chimney.



Use the model to write an equation.

$$x + 4x + 15 = 150$$

$$5x + 15 = 150$$

Model It

You can start solving the equation by isolating the x -term.

$$5x + 15 = 150$$

$$5x + 15 - 15 = 150 - 15$$

$$5x = 135$$

Model It

You can start solving the equation by dividing both sides by the same value.

$$5x + 15 = 150$$

$$\frac{(5x + 15)}{5} = \frac{150}{5}$$

$$x + 3 = 30$$



CONNECT IT

► Use the problem from the previous page to help you understand how to solve an equation that has two or more addends.

- 1 How many bricks can Noah use to make the arch?
- 2 Look at the first **Model It**. How does the bar model represent the situation?
- 3 Look at the second **Model It**. Why do you subtract 15 from both sides? What do you need to do next to find the value of x ?
- 4 Look at the third **Model It**. Why do you divide all of the terms by 5?
- 5 Look at the second and third **Model Its**. How are the strategies for solving $5x + 15 = 150$ similar? How are they different?
- 6 Describe two ways you could solve the equation $2x + 12 = 8$.
- 7 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to solve the **Try It** problem.

Apply It

► Use what you learned to solve these problems.

- 8 Solve $-21 = -\frac{1}{4}y + 6$. Show your work.

SOLUTION _____

- 9 A rectangular garden sits next to a house. There is fencing on three sides of the garden and the fourth side is the house. There is a total of 21.5 meters of fencing around the garden. The length of the garden along the house is 9 meters. Which equation can be used to find the width, w , of the garden in meters?
- A $2w + 9 = 21.5$
- B $2w + 18 = 21.5$
- C $2w - 21.5 = 9$
- D $2w + 21.5 = 9$
- 10 The total cost of a sketchpad and 6 pencils is \$22.53. The sketchpad costs \$9.99. Each pencil costs the same amount. How much does each pencil cost? Show your work.

SOLUTION _____



Practice Writing and Solving Equations With Two or More Addends

- **Study the Example showing how to solve a problem using an equation. Then solve problems 1–5.**

Example

Chloe is making a mural. She spends 6 hours designing it. She paints it during 3 sessions. Each session is the same number of hours long. In all, Chloe spends 24 hours making the mural. How many hours long, h , is each painting session?

You can represent the situation with an equation.

$$3h + 6 = 24$$

$$\frac{3h + 6}{3} = \frac{24}{3}$$

$$h + 2 = 8$$

$$h + 2 - 2 = 8 - 2$$

$$h = 6$$

Each painting session is 6 hours long.

- 1 Demarco has a piece of fabric 6 yd long. He uses a piece 3 yd long. He cuts the rest into strips that are each $\frac{3}{4}$ yd long. How many $\frac{3}{4}$ yd long strips are there? Show your work.

- 2 Solve $-7 = 12x - 16$. Show your work.

SOLUTION _____

SOLUTION _____



- 3 Liam makes soap sculptures of sea turtles. Each sculpture weighs $\frac{3}{8}$ pound. He ships them in a wooden box that weighs 2 pounds. The total weight of the box filled with the t sea turtles is 5 pounds. How many sea turtles are in the box? Show your work.

SOLUTION _____

- 4 Solve $-0.4k - 6 = 1.2$. Show your work.

SOLUTION _____

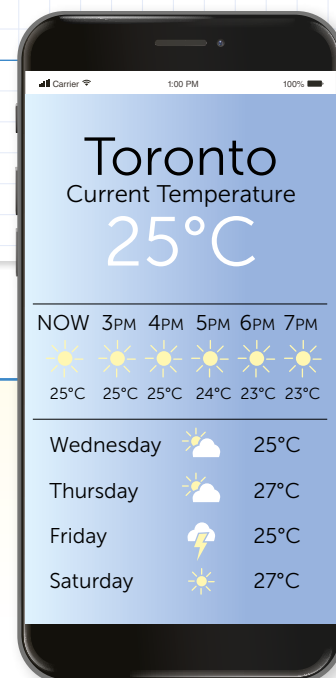
- 5 Claudia buys 12 postcards, 12 stamps, and 1 pen. The postcards cost twice as much as the stamps. The pen costs \$1.50. The total cost is \$14.10. How much does each postcard cost? Show your work.

SOLUTION _____

Develop Writing and Solving Equations with Grouping Symbols

► Read and try to solve the problem below.

Hugo is traveling in Toronto, Canada. His weather app shows the temperature is 25°C . Hugo writes the equation $25 = \frac{5}{9}(F - 32)$ to find the temperature in degrees Fahrenheit, F . What is the temperature in degrees Fahrenheit?



TRY IT



Math Toolkit grid paper, number lines, sticky notes

DISCUSS IT

Ask: Why did you choose that strategy to find the temperature in degrees Fahrenheit?

Share: I knew . . .
so I . . .

- Explore different ways to find an unknown value in an equation with grouping symbols.

Hugo is traveling in Toronto, Canada. His weather app shows the temperature is 25°C . Hugo writes the equation $25 = \frac{5}{9}(F - 32)$ to find the temperature in degrees Fahrenheit, F . What is the temperature in degrees Fahrenheit?

Model It

You can use the distributive property to expand.

$$25 = \frac{5}{9}(F - 32)$$

$$25 = \frac{5}{9}(F) - \frac{5}{9}(32)$$

$$25 = \frac{5}{9}F - \frac{160}{9}$$

$$25 + \frac{160}{9} = \frac{5}{9}F - \frac{160}{9} + \frac{160}{9}$$

$$\frac{385}{9} = \frac{5}{9}F$$

Model It

You can divide each side by the coefficient $\frac{5}{9}$.

$$25 = \frac{5}{9}(F - 32)$$

$$25 \div \frac{5}{9} = \frac{5}{9}(F - 32) \div \frac{5}{9}$$

$$25 \cdot \frac{9}{5} = \frac{5}{9}(F - 32) \cdot \frac{9}{5}$$

$$45 = F - 32$$

CONNECT IT

► Use the problem from the previous page to help you understand how to solve an equation with grouping symbols.

- 1 What is 25°C in degrees Fahrenheit?
- 2 Look at the first **Model It**. Describe the steps shown for solving the equation. What do you still need to do to find the value of F ?
- 3 Look at the second **Model It**. Describe the steps shown for solving the equation. What do you still need to do to find the value of F ?
- 4 Look at the **Model Its**. What was one advantage of distributing first? What was one advantage of dividing first?
- 5 Consider the equation $12 = b(2.5x + 15)$. What values of b might make you want to start solving the equation by distributing b ? What values of b might make you want to start solving the equation by dividing by b ?
- 6 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to write and solve an equation that includes grouping symbols.

Apply It

► Use what you learned to solve these problems.

- 7 Carolina fosters 5 puppies. For each puppy she buys a crate that costs c dollars and a leash that costs \$20. She spends \$475 total. Which equations model the situation? Select all that apply.

A $5c + 20c = 475$

B $5(c + 20) = 475$

C $5c + 100 = 475$

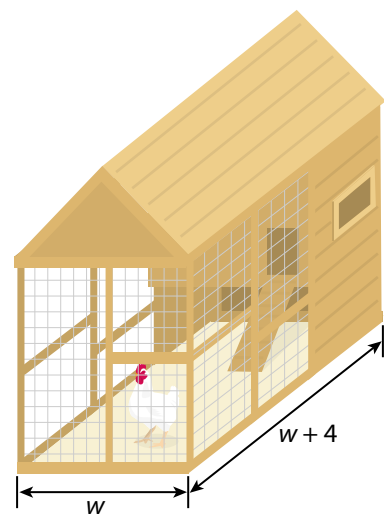
D $5c + 20 = 475$

E $c + 20 = 475$

- 8 Solve $-8 = \frac{k-4}{-6}$. Show your work.

SOLUTION _____

- 9 The perimeter of a rectangular chicken coop is 30 feet. The width is w feet and the length is $w + 4$ feet. What are the length and width of the coop? Show your work.



SOLUTION _____

Practice Writing and Solving Equations with Grouping Symbols

- Study the Example showing how to use an equation with grouping symbols to solve a problem. Then solve problems 1–5.

Example

Lillie and her family donate money to charity at the end of each year. Lillie's brother donates \$3 more than Lillie. Her parents donate 4.5 times as much as Lillie's brother. Lillie's parents donate \$45. How much does Lillie donate?

You can represent the situation with an equation.

d = Lillie's donation in dollars

$$4.5(d + 3) = 45$$

$$\frac{4.5(d + 3)}{4.5} = \frac{45}{4.5}$$

$$d + 3 = 10$$

$$d + 3 - 3 = 10 - 3$$

$$d = 7$$

Lillie donates \$7.

- 1 Look at $4.5(d + 3) = 45$ from the Example.
 - a. What does $(d + 3)$ represent?
 - b. Why is $(d + 3)$ multiplied by 4.5?
 - c. How much does Lillie's brother donate?
- 2 Malik joins a gym. He gets \$2 per month off the regular monthly rate for 3 months. Malik pays \$49.50 for 3 months. What is the gym's regular monthly rate, r ? Show your work.

SOLUTION _____



- 3 Luis is shopping for gifts. Mugs are on sale for \$4 off the regular price, p . Luis buys 6 mugs. He pays a total of \$54. What is the regular price of a mug? Show your work.

SOLUTION _____

- 4 Solve $\frac{3}{4}(5x - 3) + 8 = 17$. Show your work.

SOLUTION _____

- 5 Solve $-72 = 8(y - 3)$. Show your work.

SOLUTION _____

Refine Writing and Solving Multi-Step Equations

► Complete the Example below. Then solve problems 1–8.

Example

Solve $-0.25x + 7.5 = 15$.

Look at how you could show your work using multiplication.

$$-0.25x + 7.5 = 15$$

$$100(-0.25x + 7.5) = (100)15$$

$$-25x + 750 = 1,500$$

$$-25x + 750 - 750 = 1,500 - 750$$

$$-25x = 750$$

SOLUTION _____

CONSIDER THIS . . .

You can multiply both sides by a power of 10 to eliminate the decimals.

PAIR/SHARE

What is another way you could solve this problem?

Apply It

1 Solve $0 = -1.8y + 0.72$. Show your work.

CONSIDER THIS . . .

You can think of $0 = -1.8y + 0.72$ as having two addends.

SOLUTION _____

PAIR/SHARE

How can you check your answer?

- 2 Solve $\frac{2(n+17)}{8} = \frac{3}{8}$. Show your work.

CONSIDER THIS ...

There is more than one way to think about this problem.

SOLUTION

- 3 Three siblings are born on the same date in consecutive years. The sum of their ages is 42. What is the age of the oldest sibling?

- A 13
- B 14
- C 15
- D 16

Victoria chose A as the correct answer. How might she have gotten that answer?

PAIR/SHARE

How did you choose your first step?

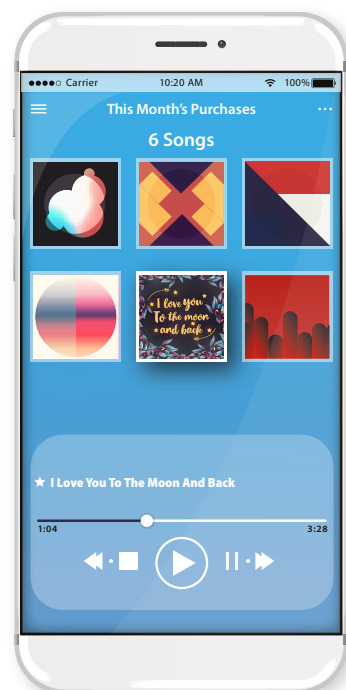
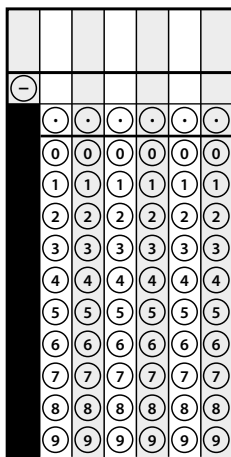
CONSIDER THIS ...

Consecutive integers follow each other, like 4, 5, 6. If the first integer is x , the next is $x + 1$, then $x + 2$, and so on.

PAIR/SHARE

How would the answer change if there were four siblings?

- 4 Leon pays \$12.50 per month for a music subscription service. One month he also buys 6 songs from the service. Each song costs the same. His bill for that month is \$17.84. In dollars, how much does he pay for each song?



- 5 One side of an isosceles triangle is $2x + 1$ ft long. The other two sides are both $3x - 1$ ft long. The perimeter of the triangle is 55 ft. What is the length of each side? Show your work.

SOLUTION

- 6 Khalid is solving the equation $8.5 - 1.2y = 6.7$. He gets to $1.8 = 1.2y$. Explain what he might have done to get to this equation.

- 7 Mora preparing her pack for a hike. Her empty pack weighs $\frac{15}{16}$ pound. She adds some water bottles that each weigh $1\frac{1}{8}$ pound. Now Mora's pack weighs $6\frac{9}{16}$ pounds. How many bottles, b , does Mora add to her pack? Show your work.

SOLUTION _____

- 8 Solve $\frac{1}{2} + \frac{1}{3}w = \frac{1}{6}$. Show your work.

SOLUTION _____

- 9 **Math Journal** Damita says the equations $0.8x - 0.8 = 1.6$ and $\frac{4}{5}(x - 1) = 1\frac{3}{5}$ are the same. How can she show this, without solving the equations?

✓ End of Lesson Checklist

- ☐ **INTERACTIVE GLOSSARY** Write a new entry for *represent*. Write at least one synonym for *represent*.
- ☐ **SELF CHECK** Go back to the Unit 4 Opener and see what you can check off.