

Explore It!

The East Side Bulldogs and the West Side Bears are playing a football game. A fan is keeping score using T for a touchdown plus extra point, worth 7 points total, and F for a field goal, worth 3 points.

	East Side Bulldogs	West Side Bears
1st quarter	TT F	FFF
2nd quarter	TT F	T FF
3rd quarter	T FF	TTT
4th quarter	TT FF	T

Lesson 5-7

Subtract Expressions

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I can...
subtract expressions using properties of operations.

A. How can you represent the score of each team using expressions?

B. How can you represent the difference of the teams' scores using an expression?

C. How can you determine how many more points the winning team had than the losing team?

Focus on math practices

Look for Relationships How can looking at the coefficients help you determine which team scored the greater number of points?

309

Essential Question

How can properties of operations be used to subtract expressions?

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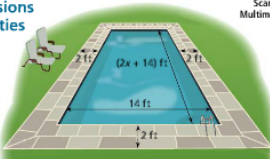
EXAMPLE 1

Subtract Expressions by Using Properties

Lita's family wants to put a tiled border around their swimming pool. What expression represents the total area of the border?

Make Sense and Persevere
How can you use subtraction to find the area of the tiled border?

Write an expression for the area of the pool only. Then write an expression for the area of the pool plus the tiled border.



length of tiled border:
 $2 + (2x + 14) + 2$

$2x + 18$

width of outer edge of walkway: $2 + 14 + 2$

18 ft

Area of pool:
width · length
 $14 \times (2x + 14)$ ft²

Area of pool and tiled border:
 $18 \times (2x + 18)$ ft²

Use properties of operations to subtract the expressions.

(area of pool + tiles) – (area of pool)

$$= 18(2x + 18) - 14(2x + 14)$$

$$= 36x + 324 - 28x - 196$$

$$= 36x - 28x + 324 - 196$$

$$= 8x + 128$$

First, use the Distributive Property.
Then, use the Commutative Property.

The area of the tiled border is $8x + 128$ ft².

Try It!

A frame holds a picture that is 15 inches long and x inches wide. The frame border is 3 inches wide around the picture. What expression represents the area of the frame border?

Area of frame border = Area of entire frame – Area of photo = –

The area of the frame is in².

Convince Me! Why can you choose to add or subtract when subtracting an expression?

310 5-7 Subtract Expressions

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EXAMPLE 2 Subtract Expressions with Rational Coefficients

Jada is comparing membership costs for two gyms. What is the difference in membership costs after m months if she joins Be Strong instead of Zippy Health Club?

Write an expression for each membership cost for m months and subtract them.

(Be Strong) - (Zippy's Health Club)

$$(24.99m - 10) - (19.95m + 49.95)$$

$$= 24.99m - 10 + (-1)(19.95m + 49.95)$$

$$= 24.99m - 10 + (-1)(19.95m) + (-1)(49.95)$$

$$= 24.99m - 10 - 19.95m - 49.95$$

$$= (24.99m - 19.95m) - 10 - 49.95$$

$$= 5.04m - 59.95$$

Jada will pay \$5.04 more each month at Be Strong, but will start with an initial savings of \$59.95.

Use Structure How did the signs of the terms in the second expression change after distributing -1 ?

Use the Distributive Property.

Use the Commutative and Associative Properties to reorder and group like terms.

Try It!

Subtract $(0.95x - 0.04) - (0.99x - 0.13)$.

EXAMPLE 3 Subtract More Complex Expressions

Subtract the expressions.

$$(5j - 2q + \frac{2}{5}) - (4 - 3j - \frac{1}{2}q)$$

$$= (5j - 2q + \frac{2}{5}) + (-4 + 3j + \frac{1}{2}q)$$

$$= 5j - 2q + \frac{2}{5} - 4 + 3j + \frac{1}{2}q$$

$$= 5j + 3j - 2q + \frac{1}{2}q + \frac{2}{5} - 4$$

$$= 8j - \frac{1}{2}q - 3\frac{3}{5}$$

The simplified expression is $8j - \frac{1}{2}q - 3\frac{3}{5}$.

Distribute the minus sign, or -1 , to all terms in the second expression.

Try It!

Subtract $(17 + 4.5m + 8k) - (7.5m - 9 + 4k)$.

KEY CONCEPT

To subtract expressions, you can use properties of operations.

Write the subtraction as addition and use the Distributive Property to multiply -1 to the terms in the expression being subtracted.

$$5 - (-2x - 7)$$

$$= 5 + (-1)(-2x - 7)$$

$$= 5 + (-1)(-2x) + (-1)(-7)$$

$$= 5 + 2x + 7$$

You can use the Distributive Property to distribute the minus sign to the second expression, which changes the signs of the terms.

$$5 - (-2x - 7)$$

$$= 5 + 2x + 7$$

Do You Understand?

- Essential Question** How can properties of operations be used to subtract expressions?
- Use Structure** How is subtracting $-4r$ from $9r$ similar to subtracting -4 from 9 ?
- Is adding the quantity $-12 + 8r$ to an expression the same as subtracting $-8r + 12$ from the same expression? Explain your reasoning.

Do You Know How?

- Subtract.
 - $(21x) - (-16 + 7x)$
 - $(-13n) - (17 - 5n)$
 - $(4y - 7) - (y - 7)$
 - $(-w + 0.4) - (-w - 0.4)$
- Jude has 5 pairs of sunglasses that cost the same in his online shopping cart, but then decides to get only 2. Each pair of sunglasses is the same price. Let p represent the cost of each pair. Write an expression for the original cost, the updated cost, and the difference in cost.

$$\begin{array}{r} 6.49 \\ -1.49 \\ \hline -5.00 \end{array}$$

Handwritten work for Question 5:

Original cost: $5p + 1.49$

Updated cost: $-(2p + 6.49)$

Difference: $(5p + 1.49) + (-2p + 6.49)$

$(5p - 2p) + (1.49 + 6.49)$

$3p + 7.98$

Handwritten work for Question 6:

$\frac{2}{3}m - (-\frac{2}{3}m + \frac{1}{3})$

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

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

Name: _____

Practice & Problem Solving

Leveled Practice In 7-9, fill in the missing signs or numbers.

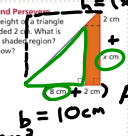
7. Rewrite the expression $14m - (5 + 8m)$ without parentheses.
 $14m \quad \ominus \quad 5 \quad \ominus \quad 8m$

8. Rewrite the expression $13d - (-9d - 4)$ without parentheses.
 $13d \quad \ominus \quad 9d \quad \ominus \quad 4$

9. Write an equivalent expression to $8k - (5 + 2k)$ without parentheses. Then simplify.
 $8k - (5 + 2k) = 8k - 5 - 2k$
 $= 6k - 5$

10. A company has two manufacturing plants with daily production levels of $5x - 11$ items and $2x - 3$ items, respectively. The first plant produces a certain quantity. The first plant produces how many more items daily than the second plant?
 2nd plant
 $3x + 8$
 14
 1st plant
 see notes

11. Two communications companies offer calling plans. With Company X, it costs \$9 to connect and then \$x for each minute. With Company Y, it costs \$5 to connect and then \$m for each minute. Write and simplify an expression that represents how much more Company X charges than Company Y, in cents, for n minutes.
 $(9 + 5n) + (7 + 4m)$
 see notes

12. Make Sense and Persevere
 The base and height of a triangle are each extended 2 cm. What is the area of the shaded region? How do you know?

 $A_{\square} = \frac{1}{2} b \cdot h$
 $A_{\square} = \frac{1}{2} (b + 2) \cdot (h + 2)$
 $A_{\square} = \frac{1}{2} (b \cdot h + 2b + 2h + 4)$
 $A_{\square} = \frac{1}{2} b \cdot h + b + h + 2$
 Total shaded and not shaded
 $A_{\square} = \frac{1}{2} (8 \cdot x)$
 $A_{\square} = (4x) \text{ cm}^2$
 $A_{\text{shaded}} = 5x + 10 + 4x$
 $A_{\text{shaded}} = 9x + 10$

13. Two friends shop for fresh fruit. Jackson buys a watermelon for \$7.65 and 5 pounds of cherries. Tim buys a pineapple for \$2.45 and 4 pounds of cherries. Use the variable p to represent the price, in dollars, per pound of cherries. Write and simplify an expression to represent how much more Jackson spent.
 $A_{\square} = \frac{1}{2} b \cdot w$
 $A_{\square} = \frac{1}{2} b \cdot h$
 see notes

14. Yo's family wants to rent a car to go on vacation. EvoCar charges \$50.50 and \$6 per mile. Freedomride charges \$70.50 and \$2x per mile. How much more does Freedomride charge for driving d miles than EvoCar?
 see notes

10) $(5x + 11) + (2x + 3)$

$(5x + 11) + (-2x + 3)$

$5x + -2x$

$3x$

$+ 11 + +3$

$+ 14$

13)
$$\begin{array}{r} \text{Tim} \\ (\$2.45 + 4p) \end{array} \quad \begin{array}{l} \text{price} \\ \text{cost of cherries} = p \\ \text{per lb} \\ \$14 \end{array}$$

$$\begin{array}{r} \text{Jackson} \\ (\$7.65 + 5p) \end{array} \quad \begin{array}{l} \$20 \end{array}$$

↑ subtract

$$(\$7.65 + 5p) + (-2.45 - 4p)$$

$$(5p + -4p) + (7.65 + -2.45)$$

$$1p + \begin{array}{r} 7.65 \\ -2.45 \\ \hline \$5.20 \end{array}$$

$$(1p + \$5.20)$$

Jackson spent $(1p + \$5.20)$ more than Tim on fruit.

14)
$$\begin{array}{r} \text{Envoy Car} \\ (\$50.50 + \$0.08d) \end{array} \quad \begin{array}{r} \text{Freedom Ride} \\ (\$70.50 + \$0.12d) \end{array}$$

$$(70.50 + \$0.12d) + (-50.50 - 0.08d)$$

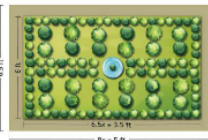
$$70.50 + 0.12d + -50.50 + -0.08d$$

$$(0.12d + -0.08d) + 70.50 + -50.50$$

$$+0.04d + 20$$

Freedom Ride charges an extra \$20 and 4¢ per mile.

15. A rectangular garden has a walkway around it. Find the area of the walkway.



$$\frac{1}{2}p + \left(\frac{1}{4}p + 4\right)$$

16. **Critique Reasoning** Tim incorrectly rewrote the expression $\frac{1}{2}p - (\frac{1}{4}p + 4)$ as $\frac{1}{2}p + \frac{1}{4}p - 4$. Rewrite the expression without parentheses. What was Tim's error?

17. **Higher Order Thinking** Find the difference.
 $(7x - 6\frac{2}{3}) - (-3x + 4\frac{2}{3})$

18. Each month, a shopkeeper spends $(5x + 11)$ dollars on rent and electricity. If he spends $(2x - 3)$ dollars on rent, how much does he spend on electricity?

19. Use the expression $\frac{1}{4}p - (1 - \frac{1}{3}p)$.

Total

$$(5x + 11) + (2x - 3)$$

a. Rewrite the expression without parentheses. Simplify. Show your work.

b. Use a different method to write the expression without parentheses. Do not simplify.

Assessment Practice

20. Which is equivalent to $(0.25n - 0.3) - (0.8n - 0.25)$?

- A $-0.55n + 0.55$
- B $-0.55n - 0.05$
- C $0.55n + 0.55$
- D $0.55n - 0.05$

