Lesson 4-7 Subtract Expressions

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

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

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?

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Essential Question How can properties of operations be used to subtract expressions?

EXAMPLE 1 Subtract Expressions by Using Properties

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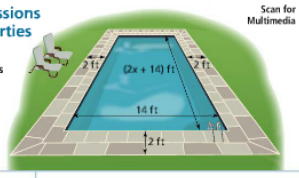
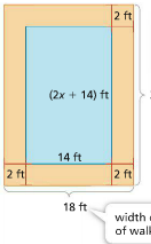
Lita's family wants to put a tiled border around their swimming pool. What expression represents the total area of the border?

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: $2 + 14 + 2$

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

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

Use properties of operations to subtract the expressions.

(area of pool + tiles) − (area of pool)

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

$= 36x + 324 - 28x - 196$ — First, use the Distributive Property.

$= 36x - 28x + 324 - 196$ — Then, use the Commutative Property.

$= 8x + 128$

The area of the tiled border is $8x + 128$ ft^2.

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 ☐ in^2.

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

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)

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

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

$= 24.99m - 10 + (-1)(19.95m) + (-1)(49.95)$ — Use the Distributive Property.

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

$= (24.99m - 19.95m) - 10 - 49.95$ — Use the Commutative and Associative Properties to reorder and group like terms.

$= 5.04m - 59.95$

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

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

Try It!

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

EXAMPLE 3 Subtract More Complex Expressions

Subtract the expressions.

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

$= \left(5j - 2q + \frac{2}{5}\right) + \left(-4 + 3j + \frac{1}{2}q\right)$ — Distribute the minus sign, or −1, to all terms in the second expression.

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

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

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

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

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.

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

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

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

Do You Understand?

1. **Essential Question** How can properties of operations be used to subtract expressions?

2. **Use Structure** How is subtracting $-4x$ from $9x$ similar to subtracting -4 from 9?

3. 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?

4. Subtract.
   a. $(21x) - (-16 + 7x)$
   b. $(-13n) - (17 - 5n)$
   c. $(4y - 7) - (y - 7)$
   d. $(-w + 0.4) - (-w - 0.4)$

5. 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.

$5p + 1.49$ original

$-(2p + 6.49)$ updated cost

6. Subtract and simplify.
   $\frac{1}{6}m - \left(-\frac{5}{8}m + \frac{1}{3}\right)$

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

14m + (5 - 8m)
14m + -5 + -8m
14m + -8m + -5
6m + -5

Practice & Problem Solving

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Leveled ... 7–9 fill in the missing signs or numbers.

7. Rewrite the expression 14m − (5 + 8m) without parentheses.
14m + 5 + 8m
6m + -5

8. Rewrite the expression 13d − (−9d − 4) without parentheses.
13d + 9d + 4
13d + (+9d + 4)
13d + (+9d + +4)
22d + 4

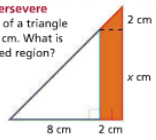
9. Write an equivalent expression to 8k − (5 + 2k) without parentheses. Then simplify.
8k − (5 + 2k) = 8k + -5 + -2k
8k + (5 + 2k)
8k + -5 + -2k
(8k + -2k) + -5
6k + -5

10. A company has two manufacturing plants with daily production levels of 5x + 11 items and 2x − 3 items, respectively, where x represents a minimum quantity. The first plant produces how many more items daily than the second plant?

11. Two communications companies offer calling plans. With Company X, it costs 35¢ to connect and then 5¢ for each minute. With Company Y, it costs 15¢ to connect and then 4¢ for each minute.

Write and simplify an expression that represents how much more Company X charges than Company Y, in cents, for n minutes.

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?



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.

Jackson
$7.65 + 5p
Tim
+($2.45 + 4p)

14. Yu's family wants to rent a car to go on vacation. EnvoCar charges $50.50 and 8¢ per mile. Freedomride charges $70.50 and 12¢ per mile. How much more does Freedomride charge for driving d miles than EnvoCar?

A large − A small □
A = l × w
ft × ft = ft²

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

A large = 6.5(8x + 5)
A small = 6(6.5x + 3.5)
large area
52x + 32.5
small
+(39x + 21.0)
(13x + 11.5) ft²

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

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

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 $\frac{1}{4}p - \left(1 - \frac{1}{3}p\right)$.

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

$\frac{1}{4}p + \left(1 + -\frac{1}{3}p\right)$
$\frac{1}{4}p + -1 + +\frac{1}{3}p$
$\left(\frac{1 \cdot 3}{4 \cdot 3}p + \frac{1 \cdot 4}{3 \cdot 4}p\right) + -1$
$\frac{3}{12}p + \frac{4}{12}p + -1$
$\frac{7}{12}p + -1$

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

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

4 3
2·2 3·1
2·1
1 4 3
·4·3
LCD = 12

Assessment Practice

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

Ⓐ −0.55n + 0.55
Ⓑ −0.55n − 0.05
Ⓒ 0.55n + 0.55
Ⓓ 0.55n − 0.05

17) $(7x + {}^{-}6\frac{2}{3}) + (+3x + {}^{-}4\frac{3}{4})$

$+7x + {}^{-}6\frac{2}{3}$

$+ {}^{+}3x + {}^{-}4\frac{3}{4}$

$10x + {}^{-}11\frac{5}{12}$

LCD: $3 \cdot 4 = 12$

$-6\frac{2}{3} = -6\frac{8}{12}$

$+{}^{-}4\frac{3}{4} = +{}^{-}4\frac{9}{12}$

$10\frac{17}{12}$

$12\overline{)17}$ R 5, so $\frac{17}{12} = 1\frac{5}{12}$

$10 + 1\frac{5}{12}$

$11\frac{5}{12}$