You can use properties of operations to write equivalent expressions involving variable terms and rational numbers.

Example 1 Using the Distributive Property

Simplify each expression.

a. $-\frac{1}{3}(3n - 6)$

> **Remember**
>
> The Distributive Property states
>
> $a(b + c) = ab + ac$
>
> and
>
> $a(b - c) = ab - ac.$

$$-\frac{1}{3}(3n - 6) = -\frac{1}{3}(3n) - \left(-\frac{1}{3}\right)(6) \qquad \text{Distributive Property}$$

$$= -n - (-2) \qquad \text{Multiply.}$$

$$= -n + 2 \qquad \text{Add the opposite.}$$

b. $5(-x + 3y)$

$$5(-x + 3y) = 5(-x) + 5(3y) \qquad \text{Distributive Property}$$

$$= -5x + 15y \qquad \text{Multiply.}$$

> **2**
> **MTR** **USE ANOTHER METHOD**
>
> Can you combine like terms in parentheses before using the Distributive Property in part (c)? Explain your reasoning.
> _____
> _____
> _____
> _____
> _____

c. $-3(-1 + 2x + 7)$

$$-3(-1 + 2x + 7) = -3(-1) + (-3)(2x) + (-3)(7) \qquad \text{Distributive Property}$$

$$= 3 + (-6x) + (-21) \qquad \text{Multiply.}$$

$$= -6x + 3 + (-21) \qquad \text{Comm. Prop. of Add.}$$

$$= -6x + [3 + (-21)] \qquad \text{Assoc. Prop. of Add.}$$

$$= -6x + (-18) \qquad \text{Add.}$$

$$= -6x - 18 \qquad \text{Simplify.}$$

Try It Simplify the expression.

1. $-1(x + 9)$

$-x - 9$

2. $12(-7.5 + w)$

$-90 + 12w$

3. $\frac{2}{3}(-3z - 6)$

$-2z - 4$

4. $-1.5(8m - n)$

$-12m + 1.5n$

5. $2(-3s + 1 - 5)$

$-6s + 2 - 10$

$-6s - 8$

6. $-\frac{3}{2}(a - 4 - 2a)$

$-\frac{3}{2}a + 6 + 3a$

$1\frac{1}{2}a + 6$

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equivalent means equal or the same

Example 2 B.E.S.T. Test Prep: Identifying Equivalent Expressions

Which expression is *not* equivalent to $\frac{3}{2}(-2x + 4) + x$?

(A) $2(-x - 3)$

(C) $-3\left(\frac{2}{3}x - 2\right)$

(B) $-x - x + 6$

(D) $-3x + x + 3 + 3$

4 MTR JUSTIFY A RESULT

Show that the expressions in Choices B, C, and D are equivalent to the original expression. Justify each step.

_____
_____
_____
_____
_____

Simplify the original expression.

$$\frac{3}{2}(-2x + 4) + x = -3x + 6 + x \qquad \text{Distributive Property}$$
$$= -3x + x + 6 \qquad \text{Comm. Prop. of Add.}$$
$$= -2x + 6 \qquad \text{Combine like terms.}$$

Simplifying the expression in Choice A results in $-2x - 6$. Simplifying the expressions in Choices B, C, and D results in $-2x + 6$.

▶ Because $-2x - 6$ is *not* equivalent to $-2x + 6$, the correct answer is (A).

Try It

7. Are $2(-x - 3)$ and $\frac{3}{2}(-2x - 4) + x$ equivalent? Explain.

$-2x-6$ $-2x-6$ yes

In-Class Practice   **1** I don't understand yet.   **2** I can do it with help.   **3** I can do it on my own.   **4** I can teach someone else.

8. **WRITING** Explain how to use the Distributive Property when simplifying an expression.

USING THE DISTRIBUTIVE PROPERTY Simplify the expression.

9. $\frac{5}{6}(-2y + 3)$

10. $6(3s - 2.5 - 5s)$

5 MTR 11. **STRUCTURE** Use the terms to complete the expression so that it is equivalent to $9x - 12$. Justify your answer.

8 $3x$ $\frac{3}{2}$ $4x$ ☐ (☐ − ☐) + ☐

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USING THE DISTRIBUTIVE PROPERTY Simplify the expression. (See Example 1.)

13. $3(a - 7)$

$3a - 21$

14. $-6(2 + x)$

$-12 - 6x$

15. $-9(-5 - 4c)$

$45 + 36c$

16. $4.5(3s + 6)$

$13.5s + 27$

17. $-6(-4d - 8.3 + 3d)$

$24d + 49.8 - 18d$

$6d + 49.8$

18. $2.3h(6 - k)$

19. $-\frac{3}{8}(-4y + z)$

$1\frac{1}{2}y - \frac{3}{8}z$

20. $2(-2w - 1.2 + 7x)$

$-4w - 2.4 + 14x$

21. $\frac{5}{3}\left(\frac{4}{3}a + 9b + \frac{2}{3}a\right)$

22. $-6a + 7(-2a - 4)$

$-6a - 14a - 28$

$-20a - 28$

23. $c(4 + 3c) - 0.75(c + 3)$

24. $-\frac{3}{4}(5p - 12) + 2\left(8 - \frac{1}{4}p\right)$

YOU BE THE TEACHER Your friend simplifies the expression. Is your friend correct? Explain your reasoning.

25.

$-2(h + 8k) = -2(h) + 2(8k)$

$= -2h + 16k$

26.

$-3(4 - 5b + 7) = -3(11 - 5b)$

$= -3(11) + (-3)(5b)$

$= -33 - 15b$

EQUIVALENT EXPRESSIONS Determine whether the expressions are equivalent. (See Example 2.)

▶ **27.** $2(7x - 5) + 8$, $14x + 2$

$14x - 10 + 8$

no

$14x - 2$

28. $-8.2 + 3.5(2.2 - 4.1p)$, $-0.5 + 14.35p$

$-8.2 + 7.7 - 14.35p$

$-0.5 - 14.35p$ no

29. $\frac{3}{2}\left(g - \frac{3}{4}\right) + 2$, $2 + \frac{3}{2}g - \frac{9}{8}$

$\frac{3}{2}g - \frac{3}{4} + 2$ no

$\frac{3}{2}g - 1\frac{1}{4}$

30. $-1 + \frac{7}{6}\left(\frac{1}{3} + \frac{3}{7}m\right)$, $\frac{1}{2}\left(\frac{5}{9} + m\right) - \frac{8}{9}$

31. **MODELING REAL LIFE** The cost (in dollars) of a custom-made sweatshirt is represented by $3.5n + 29.99$, where n is the number of different colors in the design. Write and interpret a simplified expression that represents the cost of 15 sweatshirts. (See Example 3.)

$15(3.5n + 29.99)$

$52.5n + 449.85$

32. **MODELING REAL LIFE** A ski resort makes snow using a snow fan that costs \$1200. The fan has an average daily operation cost of \$9.50. Write and interpret a simplified expression that represents the cost to purchase and operate 6 snow fans.

33. **NUMBER SENSE** Predict whether the instructions below will produce equivalent expressions. Then show whether your prediction is correct.

- Subtract 3 from n, add 3 to the result, and then triple that expression.

- Subtract 3 from n, triple the result, and then add 3 to that expression.