

1-5 Products

Objective: To review the rules for multiplying real numbers.

Vocabulary

Rules for multiplication

- The product of two real numbers with *like signs* is a *positive* real number.
Examples: $(3)(8) = 24$ $(-6)(-9) = 54$
- The product of two reals with *opposite signs* is a *negative* real number.
Example: $(5)(-14) = -70$
- A product of nonzero numbers is *positive* if the number of negative factors is *even*.
Example: $(-8)(-3)(-5)(-4) = 480$ (4 negative factors)
- A product of nonzero numbers is *negative* if the number of negative factors is *odd*.
Example: $(-6)(5)(-1)(-9) = -270$ (3 negative factors)
- The absolute value of the product of two or more numbers is the product of their absolute values. Example: $|(3)(-8)(4)| = |3| \cdot |-8| \cdot |4| = 96$

Multiplicative property of 0 The product of any number and zero is zero.

Multiplicative property of -1 The product of any number and negative one is the opposite of that number. Examples: $(5)(-1) = -5$ $(-1)(-18) = 18$

Property of the opposite of a product For all real numbers a and b , $-ab = (-a)(b) = (a)(-b)$.
Example: $-(3)(5) = (-3)(5) = (3)(-5) = -15$

Property of the opposite of a sum For all real numbers a and b , $-(a + b) = (-a) + (-b)$.
Example: $-[3 + (-19)] = -3 + 19 = 16$

Example 1 Simplify.

a. $\left(\frac{1}{2}\right)(-8)(-6)\left(-\frac{1}{6}\right)$ b. $(4x)(-3y)(2)$ c. $(5 - 7)(-8 + 3)$

Solution a. Multiply, beginning with the reciprocals. b. Reorder and regroup factors. c. Simplify expressions in parentheses first.

$$\begin{array}{lll} \left(\frac{1}{2}\right)(-8)(-6)\left(-\frac{1}{6}\right) & (4x)(-3y)(2) & (5 - 7)(-8 + 3) \\ = \left(\frac{1}{2}\right)(-8)(1) & = 4(-3)(2)xy & = (-2)(-5) \\ = (-4)(1) & = -24xy & = 10 \\ = -4 & & \end{array}$$

Simplify.

- $4(-2)(-3)(-5)$
- $(1.4)(-3)(-0.2)$
- $(-0.6)(-4)(-3)(-5.2)$
- $\frac{1}{2}(-6)\left(-\frac{1}{12}\right)(-12)$
- $(4)\left(-\frac{3}{8}\right)(12)$
- $\left(-\frac{1}{2}\right)\left(-\frac{1}{3}\right)(0)(-2)(-3)$
- $5(2x)(-3y)$
- $\left(-\frac{1}{3}\right)(3u)(-v)$
- $(4x)(-2y)(-3z)$
- $(-a)(-b)(-c)$
- $(4 - 5)(3 + 8)$
- $(-12 - 3)(2 + 5)$

1-5 Products (continued)

Example 2 Simplify: **a.** $(-2)^3 \left(-\frac{1}{4}\right)$ **b.** $3(-6) + 3(-2)$

Solution **a.** Write $(-2)^3$ as a product of factors. Then multiply.

$$\begin{aligned} & (-2)^3 \left(-\frac{1}{4}\right) \\ &= (-2)(-2)(-2)\left(-\frac{1}{4}\right) \\ &= (4)(-2)\left(-\frac{1}{4}\right) \\ &= (-8)\left(-\frac{1}{4}\right) = 2 \end{aligned}$$

b. Follow the order of operations.

$$\begin{aligned} 3(-6) + 3(-2) &= -18 + (-6) \\ &= -24 \end{aligned}$$

Or, apply the distributive property.

$$\begin{aligned} 3(-6) + 3(-2) &= 3[-6 + (-2)] \\ &= 3(-8) \\ &= -24 \end{aligned}$$

Simplify.

13. $(14)(-1)^8 (-3)^2$

14. $(-3)^2 \left(-\frac{1}{9}\right)^2$

15. $(-2)^5 (-3)(-1)$

16. $6(-8) + 6(5)$

17. $7(8.5) + 7(-1.5)$

18. $(-4)^3(-1 - 1)(-3)$

Example 3 Simplify $3(x^2 - 4) - 2(5x^2 - x)$.

Solution Distribute and simplify. Remember that a minus sign before a set of parentheses reverses each sign inside the parentheses.

$$\begin{aligned} 3(x^2 - 4) - 2(5x^2 - x) &= 3x^2 - 12 - 10x^2 + 2x \\ &= -7x^2 + 2x - 12 \end{aligned}$$

Simplify.

19. $-2(x^2 - 3x - 2)$

20. $-4(-2x + 3y - z)$

21. $2\left(-6a - \frac{3}{2}\right)$

22. $(-r)(6s) + (3r)(-4s)$

23. $-5r - 4(2 + r)$

24. $5(2a + b) - 3(2a + b)$

25. $2(p^2 + 2) - 3(2p^2 - p)$

26. $4(2x - 3y) - 2(-2y + 3x)$

27. $m(n + 1) - 4(mn + 2)$

Mixed Review Exercises

Evaluate each expression if $a = -2$ and $b = 3$.

1. $2a + b + 1$

2. $-|a| + |b|$

3. $a + b^2$

4. $-|a - b|$

5. $a - 2(b - 5)$

6. $a - 4b$

Name the property illustrated in each statement.

7. $8 \cdot 4 = 4 \cdot 8$

8. $5 \cdot 1 = 5$

9. $\frac{2}{3} \cdot \frac{3}{2} = 1$

10. $-3 + 3 = 0$

11. $3 \cdot 6 + 3 \cdot 9 = 3(6 + 9)$

12. $(6 + 2) + 8 = 6 + (2 + 8)$