

## 4-4 Powers of Monomials

**Objective:** To find powers of monomials.

Rules of Exponents	Examples
<p><b>Rule of Exponents for a Power of a Power</b></p> <p>For all positive integers <math>m</math> and <math>n</math>:</p> $(a^m)^n = a^{mn}.$ <p>To find a power of a power, you multiply the exponents.</p>	$(2^3)^4 = 2^{3 \cdot 4}$ $= 2^{12}$
<p><b>Rule of Exponents for a Power of a Product</b></p> <p>For every positive integer <math>m</math>:</p> $(ab)^m = a^m b^m.$ <p>To find a power of a product, you find the power of each factor and then multiply.</p>	$(-2x)^5 = (-2)^5(x)^5$ $= -32x^5$

**CAUTION**  $(x^7)^6 = x^{7 \cdot 6} = x^{42}$  but  $x^7 \cdot x^6 = x^{7+6} = x^{13}$

**Example 1** Simplify: a.  $(x^2)^4$  b.  $(u^3)^5$

**Solution** Use the rule for a power of a power.

$$\begin{array}{ll} \text{a. } (x^2)^4 = x^{2 \cdot 4} & \text{b. } (u^3)^5 = u^{3 \cdot 5} \\ = x^8 & = u^{15} \end{array}$$

**Simplify.**

- |              |              |                 |              |
|--------------|--------------|-----------------|--------------|
| 1. $(a^2)^3$ | 2. $(x^4)^3$ | 3. $(t^5)^3$    | 4. $(c^3)^3$ |
| 5. $(t^2)^3$ | 6. $(x^5)^2$ | 7. $(y^{10})^3$ | 8. $(a^7)^8$ |

**Example 2** Simplify: a.  $(2x)^4$  b.  $(-6k)^3$

**Solution** Use the rule for a power of a product.

$$\begin{array}{ll} \text{a. } (2x)^4 = 2^4 \cdot x^4 & \text{b. } (-6k)^3 = (-6)^3 \cdot k^3 \\ = 16x^4 & = -216k^3 \end{array}$$

**Simplify.**

- |               |               |                        |                         |
|---------------|---------------|------------------------|-------------------------|
| 9. $(5a)^2$   | 10. $(-6x)^2$ | 11. $(-3t)^3$          | 12. $(-4c)^2$           |
| 13. $(-5x)^3$ | 14. $(-4t)^3$ | 15. $(-2t)^4$          | 16. $(6x)^3$            |
| 17. $(5x)^4$  | 18. $(7n)^2$  | 19. $(\frac{1}{2}a)^2$ | 20. $(-\frac{1}{3}a)^3$ |

**4-4 Powers of Monomials** (continued)**Example 3** Evaluate if  $x = 3$ : a.  $2x^3$  b.  $(2x)^3$  c.  $2^3 \cdot x^3$ 

**Solution**

$\begin{aligned} \text{a. } 2x^3 &= 2(3)^3 \\ &= 2(27) \\ &= 54 \end{aligned}$	$\begin{aligned} \text{b. } (2x)^3 &= (2 \cdot 3)^3 \\ &= 6^3 \\ &= 216 \end{aligned}$	$\begin{aligned} \text{c. } 2^3 \cdot x^3 &= 2^3 \cdot 3^3 \\ &= 8 \cdot 27 \\ &= 216 \end{aligned}$
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Evaluate if  $x = 2$  and  $y = 4$ .

21. a.  $2x^3$   
 b.  $(2x)^3$   
 c.  $2^3 \cdot x^3$

22. a.  $4y^2$   
 b.  $(4y)^2$   
 c.  $4^2 \cdot y^2$

23. a.  $x^2y^3$   
 b.  $x^2y^2$   
 c.  $(xy)^2$

24. a.  $xy^3$   
 b.  $(xy)^3$   
 c.  $x^3 \cdot y^3$

25. a.  $3x^2$   
 b.  $(3x)^2$   
 c.  $3^2 \cdot x^2$

26. a.  $5x^2$   
 b.  $(5x)^2$   
 c.  $5^2 \cdot x^2$

27. a.  $xy^2$   
 b.  $(x^2y)^2$   
 c.  $x^3y$

28. a.  $2xy$   
 b.  $2x^2y$   
 c.  $2xy^2$

29. a.  $6x^2 \div x$   
 b.  $(6x)^2 \div x$   
 c.  $6(x^2 \div x)$

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

**Solution**  $(-2x^2y^3)^4 = (-2)^4(x^2)^4(y^3)^4 = 16x^8y^{12}$  { First use the rule for a power of a product and then use the rule for a power of a power.

Simplify.

30.  $(3n^2)^3$

31.  $(6b^4)^2$

32.  $\left(\frac{1}{3}x^{10}\right)^3$

33.  $\left(\frac{1}{2}x^2\right)^4$

34.  $(2ab^2)^3$

35.  $(-3x^2y^3)^3$

36.  $(4x^3y^2)^3$

37.  $(-2xy^2)^4$

38.  $(5m^2n^4)^2$

**Mixed Review Exercises**

Simplify.

1.  $(2a^2b)(3ab)(5ab^2)$

2.  $(-xy^2)(2xy)(-3y)$

3.  $(3x^2y^3)^4$

4.  $\left(\frac{1}{3}t^2\right)\left(\frac{3}{4}t^3\right)$

5.  $5c - 2a - 3c + a$

6.  $(2x + 3y + 1) + (3x + 2y)$

7.  $3 \cdot 5^2 + 3 \cdot 5$

8.  $-3^2 \cdot 4$

9.  $(3^3 + 5^2) \div 2^2$

10.  $7 \cdot 3^2 + 6 \cdot 3 + 2$

11.  $\left(\frac{5}{2}t^2\right)\left(\frac{1}{5}t^3\right)$

12.  $(15mn^2)\left(\frac{1}{3}m^2\right)(4n)$