

### 4-3 Multiplying Monomials

**Objective:** To multiply monomials.

Rule of Exponents for Products of Powers	Example
For all positive integers $m$ and $n$ : $a^m \cdot a^n = a^{m+n}$	$x^3 \cdot x^5 = x^3 + 5 = x^8$
This means that when you multiply two powers having the same base, you add the exponents.	

**CAUTION** Use the rule of exponents for products of powers only when the two powers to be multiplied have the *same base*. For example,

$$m^2 \cdot n^3 = m^2n^3, \text{ not } mn^5$$

**Example 1** Simplify: a.  $x^2 \cdot x^5$  b.  $c^6 \cdot c^3$  c.  $a \cdot a^5$

**Solution** a.  $x^2 \cdot x^5 = x^2 + 5 = x^7$   
 b.  $c^6 \cdot c^3 = c^6 + 3 = c^9$   
 c.  $a \cdot a^5 = a^1 \cdot a^5 = a^1 + 5 = a^6$

**Simplify.**

- |  |   |   |
|--|---|---|
| 1. $x^3 \cdot x^6$ $x^9$               | 2. $c^7 \cdot c^8$ $c^{15}$             | 3. $a^9 \cdot a^{10}$ $a^{19}$          |
| 4. $x^2 \cdot x^3 \cdot x$ $x^6$       | 5. $n^2 \cdot n^2 \cdot n^3$ $n^7$      | 6. $c \cdot c^5 \cdot c^2$ $c^8$        |
| 7. $a^2 \cdot a^3 \cdot a^5$ $a^{10}$  | 8. $x^5 \cdot x^6 \cdot x^7$ $x^{18}$   | 9. $c^3 \cdot c^6 \cdot c^7$ $c^{16}$   |
| 10. $m^2 \cdot m^6 \cdot m^8$ $m^{16}$ | 11. $n^{10} \cdot n \cdot n^3$ $n^{14}$ | 12. $x \cdot x^9 \cdot x^{10}$ $x^{20}$ |

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

**Solution**  $(2x^3)(4x^4) = (2 \cdot 4)(x^3 \cdot x^4)$  { Use the commutative and associative properties of multiplication.  
 $= 8(x^3 \cdot x^4)$   
 $= 8x^7$  Use the rule of exponents for products of powers.

**Simplify.**

- |   |  |
|---|--|
| 13. $(2a^4)(5a^3)$ $10a^7$                | 14. $(4x^3)(3x^4)$ $12x^7$                   |
| 15. $(7m^5)(2m^6)$ $14m^{11}$             | 16. $(5x^4)(3x^2)$ $15x^6$                   |
| 17. $(-2xy^2)(-3x^2y)$ $6x^3y^3$          | 18. $(4a^2b)(-3ab^3)$ $-12a^3b^4$            |
| 19. $(3ab)(a^2b)(5b^2)$ $15a^3b^4$        | 20. $(6x^2y)(2xy^2)(3x)$ $36x^4y^3$          |
| 21. $(3cd^4)(-2c^2)(4cd^2)$ $-24c^4d^6$   | 22. $(5a^3b^2)(-4a^2b^2)(-2ab^3)$ $40a^8b^7$ |
| 23. $(-x^2y^2)(3x^2y)(-4xy^3)$ $12x^5y^6$ | 24. $(-a^2b)(-5ab^3)(-b^2)$ $-5a^3b^6$       |

### 4-3 Multiplying Monomials (continued)

**Example 3** Simplify  $(\frac{10x^2y}{3})(\frac{6x^3y^2}{5})$ .

**Solution**  $(\frac{10x^2y}{3})(\frac{6x^3y^2}{5}) = (\frac{10}{3} \cdot \frac{6}{5})(x^2 \cdot x^3)(y \cdot y^2) = 4x^5y^3$

**Simplify.**

- |  |  |
|--|--|
| 25. $(\frac{3}{4}r^2)(\frac{4}{3}r^2)$ $r^2t^2$          | 26. $(\frac{6h^2k^3}{5})(\frac{20hk^2}{3})$ $8h^3k^5$          |
| 27. $(8a)(\frac{3}{4}a^2)$ $6a^3$                        | 28. $(12c^2)(-\frac{5}{6}cd^2)$ $-10c^3d^2$                    |
| 29. $(\frac{3a^2}{7})(35a^5)$ $15a^7$                    | 30. $(\frac{8x^2y}{5})(\frac{15xy^2}{16})$ $\frac{3}{2}x^3y^3$ |
| 31. $(-\frac{5}{6}x^3)(3xy^2)(-y^2)$ $\frac{5}{2}x^4y^4$ | 32. $(3y^2)(\frac{2}{3}y^2)(\frac{1}{2}y)$ $y^5$               |

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

**Solution**  $(2x^3)(-4x^2) + (5x^2)(3x^3) = \underbrace{(2)(-4)}_{-8} \underbrace{(x^3 \cdot x^2)}_{x^5} + \underbrace{(5 \cdot 3)}_{15} \underbrace{(x^2 \cdot x^3)}_{x^5}$   
 $= -8x^5 + 15x^5$   
 $= 7x^5$

**Simplify.**

- |   |  |
|---|--|
| 33. $(2x)(3x^3) + (5x^2)(4x^2)$ $26x^4$   | 34. $(3x^5)(4x) - (5x^3)(2x^3)$ $2x^6$ |
| 35. $(6x^2)(2x^3) + (3x)(5x^4)$ $27x^5$   | 36. $(6x^5)(4x^2) - (2x^3)(12x^4)$ $0$ |
| 37. $(3a^4)(-2a^3) + (2a^2)(a^5)$ $-4a^7$ | 38. $(4y^2)(4y) - (5y^2)(3y)$ $y^3$    |

### Mixed Review Exercises

**Simplify.**

- |   |  |
|---|--|
| 1. $3 + 4^2$ $19$                           | 2. $(3 + 4)^2$ $49$                            |
| 3. $3a^2 + 5b^2 - a^2 - 2b^2$ $2a^2 + 3b^2$ | 4. $2 \cdot 5^2$ $50$                          |
| 5. $(2 \cdot 5)^2$ $100$                    | 6. $2x^2 - 3x + 4 + 5x + 3x^2$ $5x^2 + 2x + 4$ |

**Solve.**

- |                                |                        |                               |
|--------------------------------|------------------------|-------------------------------|
| 7. $3(y + 2) = 24$ {6}         | 8. $10z = 20 + 5z$ {4} | 9. $6n - 12 = 2n$ {3}         |
| 10. $\frac{n}{4} + 2 = 5$ {12} | 11. $3(x - 2) = 9$ {5} | 12. $\frac{x}{3} - 1 = 2$ {9} |