

2 Simplify Expressions

We can combine and use these properties to simplify expressions involving monomials.

KeyConcept Simplify Monomial Expressions

To simplify a monomial expression, write an equivalent expression in which:

- each variable base appears exactly once,
- there are no powers of powers, and
- all fractions are in simplest form.

StudyTip

Simplify When simplifying expressions with multiple grouping symbols, begin at the innermost expression and work outward.

Example 5 Simplify Expressions

Simplify $(3xy^4)^2[(-2y)^2]^3$.

$$\begin{aligned} (3xy^4)^2[(-2y)^2]^3 &= (3xy^4)^2(-2y)^6 && \text{Power of a Power} \\ &= (3)^2x^2(y^4)^2(-2)^6y^6 && \text{Power of a Product} \\ &= 9x^2y^8(64)y^6 && \text{Power of a Power} \\ &= 9(64)x^2 \cdot y^8 \cdot y^6 && \text{Commutative} \\ &= 576x^2y^{14} && \text{Product of Powers} \end{aligned}$$

Guided Practice

5. Simplify $(\frac{1}{2}a^2b^2)^3[(-4b)^2]^2$.

Check Your Understanding

= Step-by-Step Solutions begin on page R13.

Example 1 Determine whether each expression is a monomial. Write *yes* or *no*. Explain your reasoning.

- | | | |
|-------------|------------------|-------------------|
| 1. 15 | 2. $2 - 3a$ | 3. $\frac{5c}{d}$ |
| 4. $-15g^2$ | 5. $\frac{r}{2}$ | 6. $7b + 9$ |

Examples 2–3 Simplify each expression.

- | | | |
|------------------------|-----------------------|--------------------|
| 7. $k(k^3)$ | 8. $m^4(m^2)$ | 9. $2q^2(9q^4)$ |
| 10. $(5u^4v)(7u^4v^3)$ | 11. $[(3^2)^2]^2$ | 12. $(xy^4)^6$ |
| 13. $(4a^4b^9c)^2$ | 14. $(-2f^2g^3h^2)^3$ | 15. $(-3p^5t^6)^4$ |

Example 4 16. **GEOMETRY** The formula for the surface area of a cube is $SA = 6s^2$, where SA is the surface area and s is the length of any side.

- Express the surface area of the cube as a monomial.
- What is the surface area of the cube if $a = 3$ and $b = 4$?



Example 5 Simplify each expression.

- | | |
|----------------------------------|-----------------------------------|
| 17. $(5x^2y)^2(2xy^3z)^3(4xyz)$ | 18. $(-3d^2f^3g)^2[(-3d^2f)^3]^2$ |
| 19. $(-2g^3h)(-3gj^4)^2(-ghj)^2$ | 20. $(-7ab^4c)^3[(2a^2c)^2]^3$ |

Practice and Problem Solving

Extra Practice is on page R7.

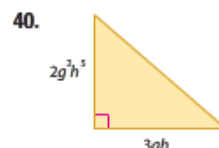
Example 1 Determine whether each expression is a monomial. Write *yes* or *no*. Explain your reasoning.

- | | | |
|----------------------|---------------------|---------------|
| 21. 122 | 22. $3a^4$ | 23. $2c + 2$ |
| 24. $\frac{-2g}{4h}$ | 25. $\frac{5k}{10}$ | 26. $6m + 3n$ |

Examples 2–3 Simplify each expression.

- | | | |
|-------------------------|-----------------------------|--------------------------------|
| 27. $(q^2)(2q^4)$ | 28. $(-2u^2)(6u^6)$ | 29. $(9w^2x^8)(w^6x^4)$ |
| 30. $(y^6z^9)(6y^4z^2)$ | 31. $(b^8c^6d^5)(7b^6c^2d)$ | 32. $(14fg^2h^2)(-3f^4g^2h^2)$ |
| 33. $(j^5k^7)^4$ | 34. $(r^3p)^4$ | 35. $[(2^2)^2]^2$ |
| 36. $[(3^2)^2]^4$ | 37. $[(4r^2t)^3]^2$ | 38. $[(-2xy^2)^3]^2$ |

Example 4 **GEOMETRY** Express the area of each triangle as a monomial.



Example 5 Simplify each expression.

- | | |
|---|---|
| 41. $(2a^3)^4(a^3)^3$ | 42. $(c^3)^2(-3c^5)^2$ |
| 43. $(2gh^4)^3[(-2g^4h)^3]^2$ | 44. $(5k^2m)^3[(4km^4)^2]^2$ |
| 45. $(p^5r^2)^4(-7p^3r^4)^2(6pr^3)$ | 46. $(5x^2y)^2(2xy^3z)^3(4xyz)$ |
| 47. $(5a^2b^3c^4)(6a^3b^4c^2)$ | 48. $(10xy^5z^3)(3x^4y^6z^3)$ |
| 49. $(0.5x^3)^2$ | 50. $(0.4h^5)^3$ |
| 51. $(-\frac{3}{4}c)^3$ | 52. $(\frac{4}{5}a^2)^2$ |
| 53. $(8y^3)(-3x^2y^2)(\frac{3}{8}xy^4)$ | 54. $(\frac{4}{7}m)^2(49m)(17p)(\frac{1}{34}p^5)$ |
| 55. $(-3r^3w^4)^3(2rw)^2(-3r^2)^3(4rw^2)^3(2r^2w^3)^4$ | |
| 56. $(3ab^2c)^2(-2a^2b^4)^2(a^4c^2)^3(a^2b^4c^5)^2(2a^3b^2c^4)^3$ | |

57. FINANCIAL LITERACY Cleavon has money in an account that earns 3% simple interest. The formula for computing simple interest is $I = Prt$, where I is the interest earned, P represents the principal that he put into the account, r is the interest rate (in decimal form), and t represents time in years.

- Cleavon makes a deposit of $\$2c$ and leaves it for 2 years. Write a monomial that represents the interest earned.
- If c represents a birthday gift of $\$250$, how much will Cleavon have in this account after 2 years?

CCSS TOOLS Express the volume of each solid as a monomial.

