7-1 Multiplication Properties of Exponents

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

1. 15
   SOLUTION:
   15 is a monomial. It is a constant and all constants are monomials.

2. 2– 3a
   SOLUTION:
   2– 3a is not a monomial. There is subtraction and more than one term.

3. \(\frac{5c}{d}\)
   SOLUTION:
   \(\frac{5c}{d}\) is not a monomial. There is a variable in the denominator.

4. \(-15g^2\)
   SOLUTION:
   \(-15g^2\) is a monomial. It is the product of a number and variables.

5. \(\frac{r}{2}\)
   SOLUTION:
   \(\frac{r}{2}\) is a monomial. It is the product of a number and a variable.

6. \(7b + 9\)
   SOLUTION:
   No; there is addition and more than one term.

   Simplify each expression.

7. \(k(k^3)\)
   SOLUTION:
   
   \[k \cdot (k^3) = k^1 \cdot (k^3)\]
   
   \[= k^{1+3} \quad \text{Products of Powers}\]
   
   \[= k^4 \quad \text{Simplify}\]
7-1 Multiplication Properties of Exponents

8. \( m^4(m^2) \)

**SOLUTION:**

\[ m^4(m^2) = m^{4+2} \quad \text{Product of Powers} \]

\[ = m^6 \quad \text{Simplify}. \]

9. \( 2q^2(9q^4) \)

**SOLUTION:**

\[ 2q^2(9q^4) = (2 \cdot 9)(q^2 \cdot q^4) \quad \text{Group the coefficients and the variables} \]

\[ = 18q^{2+4} \quad \text{Product of Powers} \]

\[ = 18q^6 \quad \text{Simplify}. \]

10. \( (5u^4v)(7u^4v^3) \)

**SOLUTION:**

\[ (5u^4v)(7u^4v^3) = (5 \cdot 7)(u^4 \cdot u^4)(v \cdot v^3) \quad \text{Group the coefficients and the variables} \]

\[ = 35u^{4+4}(v^{1+3}) \quad \text{Product of Powers} \]

\[ = 35u^8v^4 \quad \text{Simplify}. \]

11. \( [(3^2)^2]^2 \)

**SOLUTION:**

\[ \left[ (3^2)^2 \right]^2 = (3^2)^{2 \cdot 2} \quad \text{Power of a Power} \]

\[ = (3^2)^4 \quad \text{Simplify}. \]

\[ = 3^{2 \cdot 4} \quad \text{Power of a Power} \]

\[ = 3^8 \quad \text{Simplify}. \]

\[ = 6561 \quad \text{Simplify}. \]

12. \( (xy^4)^6 \)

**SOLUTION:**

\[ (xy^4)^6 = \left( x^1y^4 \right)^6 \]

\[ = \left( x^1 \right)^6(y^4)^6 \quad \text{Product of a Power} \]

\[ = x^{1 \cdot 6}y^{4 \cdot 6} \quad \text{Product of a Power} \]

\[ = x^6y^{24} \quad \text{Simplify}. \]
7-1 Multiplication Properties of Exponents

13. \((4a^4b^9c)^2\)

\[
\begin{align*}
\text{SOLUTION:} \\
(4a^4b^9c)^2 &= (4)^2(a^4)^2(b^9)^2(c)^2 & \text{Power of a Power} \\
&= 4^2(a^{4\cdot2})(b^{9\cdot2})(c^2) & \text{Power of a Power} \\
&= 16a^8b^{18}c^2 & \text{Simplify.}
\end{align*}
\]

14. \((-2y^2g^3h^2)^3\)

\[
\begin{align*}
\text{SOLUTION:} \\
(-2y^2g^3h^2)^3 &= (-2)^3(y^2)^3(g^3)^3(h^2)^3 & \text{Power of a Product} \\
&= -8(y^{2\cdot3})(g^{3\cdot3})(h^{2\cdot3}) & \text{Power of a Power} \\
&= -8y^6g^9h^6 & \text{Simplify.}
\end{align*}
\]

15. \((-3p^5t^6)^4\)

\[
\begin{align*}
\text{SOLUTION:} \\
(-3p^5t^6)^4 &= (-3)^4(p^5)^4(t^6)^4 & \text{Power of a Product} \\
&= 81(p^{5\cdot4})(t^{6\cdot4}) & \text{Power of a Power} \\
&= 81p^{20}t^{24} & \text{Simplify.}
\end{align*}
\]
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.

![Cube](image)

a. Express the surface area of the cube as a monomial.

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

**SOLUTION:**

\[
SA = 6s^2 \quad \text{Surface Area formula.}
\]

\[
= 6\left(a^3b\right)^2 \quad \text{Substitution.}
\]

\[
= 6\left(a^3\right)^2\left(b\right)^2 \quad \text{Power of a Power}
\]

\[
= 6\left(a^{3\cdot 2}\right)b^2 \quad \text{Power of a Power}
\]

a. \[= 6a^6b^2 \quad \text{Simplify.}\]

\[
6a^6b^2 = 6(3)^6(4)^2 \quad \text{Substitution}
\]

\[
= 6(729)(16) \quad \text{Simplify.}
\]

b. \[= 69,984 \quad \text{Simplify.}\]

So the surface area is 69,984 square units.
7-1 Multiplication Properties of Exponents

Simplify each expression.

17. \((5x^2y^2)(2xy^3z^3)(4xyz)\)

**SOLUTION:**

\[
\left(5x^2y^2\right)^2 \cdot \left(2xy^3z^3\right)^3 \cdot \left(4xyz\right)^1
\]

\[
= \left[\left(5x^2y^2\right)^2 \cdot \left(2xy^3z^3\right)^3 \cdot \left(4xyz\right)^1\right] \text{ Power of a Power}
\]

\[
= 25x^4 \cdot y^4 \cdot 8x^3y^9z^3 \cdot 4xyz \text{ Power of a Power}
\]

\[
= 25x^4 \cdot y^4 \cdot 8x^3y^9z^3 \cdot 4xyz \text{ Simplify.}
\]

\[
= \left(25 \cdot 8 \cdot 4\right) \cdot \left(x^4 \cdot x^3 \cdot x\right) \cdot \left(y^2 \cdot y^9 \cdot y\right) \cdot \left(z^3 \cdot z\right) \text{ Group the coefficients and the variables}
\]

\[
= 800 \cdot \left(x^{4+3+1}\right) \cdot \left(y^{2+9+1}\right) \cdot \left(z^{3+1}\right) \text{ Product of a Power}
\]

\[
= 800x^8y^{12}z^4 \text{ Simplify.}
\]

18. \((-3d^2f^3g)^2 \cdot \left(-3d^2f\right)^3\)

**SOLUTION:**

\[
\left(-3d^2f^3g\right)^2 \cdot \left(-3d^2f\right)^3
\]

\[
= \left[\left(-3\right)^2 \cdot \left(d^2\right)^2 \cdot \left(f^3\right)^2 \cdot \left(g\right)^2\right] \cdot \left[-\left(3d^2f\right)^3\right] \text{ Power of a Power}
\]

\[
= \left[9 \cdot \left(d^2\right)^2 \cdot \left(f^3\right)^2 \cdot \left(g\right)^2\right] \cdot \left[-\left(3d^2f\right)^3\right] \text{ Power of a Power}
\]

\[
= \left[9d^4f^6g^2\right] \cdot \left(\frac{1}{27} \cdot \left(d^2\right)^6 \cdot \left(f^6\right)\right) \text{ Simplify.}
\]

\[
= \left[9d^4f^6g^2\right] \cdot \left(\frac{1}{27} \cdot \left(d^{12}\right) \cdot \left(f^6\right)\right) \text{ Power of a Power.}
\]

\[
= \left[9d^4f^6g^2\right] \cdot \left(\frac{1}{27} \cdot \left(d^{12}\right) \cdot \left(f^6\right)\right) \text{ Simplify.}
\]

\[
= \left(9 \cdot 729\right) \cdot \left(d^4 \cdot d^{12}\right) \cdot \left(f^6 \cdot f^6\right) \cdot \left(g^2\right) \text{ Group the coefficients and the variables}
\]

\[
= 6561 \cdot \left(d^{4+12}\right) \cdot \left(f^{6+6}\right) \cdot g^2 \text{ Product of a Power}
\]

\[
= 6561 \cdot d^{16} \cdot f^{12} \cdot g^2 \text{ Simplify.}
\]
7-1 Multiplication Properties of Exponents

19. \((-2g^3h)(-3gj^4)^2(-ghj)^2\)

**SOLUTION:**

\[
(-2g^3h)(-3gj^4)^2(-ghj)^2 \\
= \left(-2g^3h\right)\left((-3)^2(g)^2(j^4)^2\right)\left((-g)^2(h)^2(j)^2\right) \quad \text{Power of a Power} \\
= \left(-2g^3h\right)\left(9g^2(j^{4\cdot2})\right)\left(g^2h^2j^2\right) \quad \text{Power of a Power} \\
= \left(-2g^3h\right)\left(9g^2(j^8)\right)\left(g^2h^2j^2\right) \quad \text{Simplify.} \\
= (-2\cdot9)(g^{3+2+2})(j^{8+2})(h\cdot h^2) \quad \text{Group the coefficients and the variables} \\
= -18g^{7}h^{3}j^{10} \quad \text{Product of a Power} \\
= -18g^{7}h^{3}j^{10} \quad \text{Simplify.}
\]

20. \((-7ab^4c)^3[(2a^2c)^2]^3\)

**SOLUTION:**

\[
(-7ab^4c)^3[(2a^2c)^2]^3 \\
= \left(-7ab^4c\right)^3\left(2a^2c\right)^{2\cdot3} \quad \text{Power of a Power} \\
= \left(-7ab^4c\right)^3\left(2a^2c\right)^6 \quad \text{Simplify.} \\
= \left[(-7)^3(a)^3(b^4)^3(c)^3\right]\left[2^6(a^2)^6(c)^6\right] \quad \text{Power of a Power} \\
= \left[-343a^3b^{12}c^3\right]\left[64a^{12}c^6\right] \quad \text{Power of a Power} \\
= \left[-343a^3b^{12}c^3\right]\left[64a^{12}c^6\right] \quad \text{Simplify.} \\
= (-343\cdot64)(a^{3\cdot12})(b^{12})(c^{3\cdot6}) \quad \text{Group the coefficients and the variables} \\
= -21952a^{3+12}b^{12}c^{3+6} \quad \text{Product of a Power} \\
= -21952a^{15}b^{12}c^{9} \quad \text{Simplify.}
\]

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

21. 122

**SOLUTION:**

122 is a monomial. A constant is a monomial.
7-1 Multiplication Properties of Exponents

22. $3a^4$

**SOLUTION:**
$3a^4$ is a monomial. It is the product of a number and variables.

23. $2c + 2$

**SOLUTION:**
$2c + 2$ is not a monomial. It involves addition and has more than one term.

24. $\frac{-2g}{4h}$

**SOLUTION:**
$\frac{-2g}{4h}$ is not a monomial. The expression has a variable in the denominator.

25. $\frac{5k}{10}$

**SOLUTION:**
$\frac{5k}{10}$ is a monomial. It can be written as the product of a number and variable.

26. $6m + 3n$

**SOLUTION:**
$6m + 3n$ is not a monomial. In the expression, there is addition and more than one term.

**Simplify each expression.**

27. $(q^2)(2q^4)$

**SOLUTION:**
\[
\begin{align*}
(q^2)(2q^4) &= 2(q^2 \cdot q^4) \\
&= 2q^{2+4} \\
&= 2q^6
\end{align*}
\]
Group the variables
Product of a Power
Simplify.

28. $(-2t^2)(6t^6)$

**SOLUTION:**
\[
\begin{align*}
(-2t^2)(6t^6) &= (-2 \cdot 6)(t^2 \cdot t^6) \\
&= -12t^{2+6} \\
&= -12t^8
\end{align*}
\]
Group the coefficients and variables
Product of Powers
Simplify.
7-1 Multiplication Properties of Exponents

29. \((9w^2x^8)(w^6x^4)\)

\[\text{SOLUTION:} \]
\[= 9(w^2 \cdot w^6)(x^8 \cdot x^4) \quad \text{Group the variables} \]
\[= 9w^{2+6}x^{8+4} \quad \text{Product of a Power} \]
\[= 9w^8x^{12} \quad \text{Simplify}. \]

30. \((y^6z^9)(6y^4z^2)\)

\[\text{SOLUTION:} \]
\[= 6(y^6 \cdot y^4)(z^9 \cdot z^2) \quad \text{Group the variables} \]
\[= 6y^{6+4}z^{9+2} \quad \text{Product of Powers} \]
\[= 6y^{10}z^{11} \quad \text{Simplify}. \]

31. \((b^8c^6d^5)(7b^6c^2d)\)

\[\text{SOLUTION:} \]
\[= 7(b^8 \cdot b^6)(c^6 \cdot c^2)(d^5 \cdot d) \quad \text{Group the variables} \]
\[= 7b^{8+6}c^{6+2}d^{5+1} \quad \text{Product of Powers} \]
\[= 7b^{14}c^8d^6 \quad \text{Simplify}. \]

32. \((14f^2g^2h^2)(-3f^4g^2h^2)\)

\[\text{SOLUTION:} \]
\[= (14 \cdot -3)(f^1 \cdot f^4)(g^2 \cdot g^2)(h^2 \cdot h^2) \quad \text{Group the coefficients and the variables} \]
\[= -42f^{1+4}g^{2+2}h^{2+2} \quad \text{Product of Powers} \]
\[= -42f^5g^4h^4 \quad \text{Simplify}. \]

33. \((j^5k^7)^4\)

\[\text{SOLUTION:} \]
\[= (j^5)^4(k^7)^4 \quad \text{Power of a Product} \]
\[= j^{5 \cdot 4}k^{7 \cdot 4} \quad \text{Power of a Product} \]
\[= j^{20}k^{28} \quad \text{Simplify}. \]
7-1 Multiplication Properties of Exponents

34. \((n^3p)^4\)

**SOLUTION:**

\[
(n^3p)^4 = (n^3)^4(p)^4 \quad \text{Power of a Product}
\]

\[
= n^{3\cdot4}p^{1\cdot4} \quad \text{Power of a Power}
\]

\[
= n^{12}p^4 \quad \text{Simplify.}
\]

35. \([(2^3)^2]^2\)

**SOLUTION:**

\[
\left(\left(2^3\right)^2\right)^2 = \left(2^3\right)^{2\cdot2} \quad \text{Power of a Product}
\]

\[
= \left(2^3\right)^4 \quad \text{Simplify.}
\]

\[
= 2^{3\cdot4} \quad \text{Power of a Power}
\]

\[
= 2^8 \quad \text{Simplify.}
\]

\[
= 256 \quad \text{Simplify.}
\]

36. \([(3^2)^2]^4\)

**SOLUTION:**

\[
\left(\left(3^2\right)^2\right)^4 = \left(3^2\right)^{2\cdot4} \quad \text{Power of a Power}
\]

\[
= \left(3^2\right)^8 \quad \text{Simplify.}
\]

\[
= 3^{2\cdot8} \quad \text{Power of a Power}
\]

\[
= 3^{16} \quad \text{Simplify.}
\]

\[
= 43,046,721 \quad \text{Simplify.}
\]

37. \([(4r^2\ell)^2]^3\)

**SOLUTION:**

\[
\left(\left(4r^2\ell\right)^2\right)^3 = \left(4r^2\ell\right)^{3\cdot2} \quad \text{Power of a Power}
\]

\[
= \left(4r^2\ell\right)^6 \quad \text{Simplify.}
\]

\[
= (4)^6(r^2)^6(\ell)^6 \quad \text{Power of a Product}
\]

\[
= 4096r^{2\cdot6}\ell^6 \quad \text{Power of a Power}
\]

\[
= 4096r^{12}\ell^6 \quad \text{Simplify.}
\]
7-1 Multiplication Properties of Exponents

38. \( [(-2xy^2)^3]^2 \)

**SOLUTION:**

\[
\left[ (-2xy^2)^3 \right]^2 = (-2xy^2)^{3\cdot2} \quad \text{Power of a Power}
\]

\[
= (-2xy^2)^6 \quad \text{Simplify.}
\]

\[
= (-2)^6(x)^6(y^2)^6 \quad \text{Power of a Product}
\]

\[
= 64x^6y^{2\cdot6} \quad \text{Power of a Power}
\]

\[
= 64x^6y^{12} \quad \text{Simplify.}
\]

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

39.

**SOLUTION:**

\[ A = \frac{1}{2}bh \quad \text{Formula for area of a triangle.} \]

\[
= \frac{1}{2}(5c^2d)(3c^2d^4) \quad \text{Substitution.}
\]

\[
= \left(\frac{1}{2}\cdot5\cdot3\right)(c^2\cdot c^2)(d \cdot d^4) \quad \text{Group the coefficients and the variables}
\]

\[
= 20c^{3+2}d^{1+4} \quad \text{Product of a Power}
\]

\[
= 20c^5d^5 \quad \text{Simplify.}
\]

40.

**SOLUTION:**

\[ A = \frac{1}{2}bh \quad \text{Formula for the area of a triangle} \]

\[
= \frac{1}{2}(3gh)(2g^2h^5) \quad \text{Substitution.}
\]

\[
= \left(\frac{1}{2}\cdot3\cdot2\right)(g \cdot g^2)(h \cdot h^5) \quad \text{Group the coefficients and the variables}
\]

\[
= 3g^{1+2}h^{1+5} \quad \text{Product of a Power}
\]

\[
= 3g^3h^6 \quad \text{Simplify.}
\]
7-1 Multiplication Properties of Exponents

Simplify each expression.

41. \((2a^3)^4(a^3)^3\)

**SOLUTION:**

\[
(2a^3)^4(a^3)^3 = (2)^4(a^3)^4(a^3)^3 \quad \text{Power of a Product}
\]

\[= 16a^{3\cdot4}a^9 \quad \text{Power of a Product}
\]

\[= 16a^{12}a^9 \quad \text{Simplify.}
\]

\[= 16a^{12+9} \quad \text{Product of Powers}
\]

\[= 16a^{21} \quad \text{Simplify.}
\]

42. \((c^3)^2(-3c^5)^2\)

**SOLUTION:**

\[
(c^3)^2(-3c^5)^2 = (c^{3\cdot2})(-3)^2(c^5)^2 \quad \text{Power of a Product}
\]

\[= c^6(-3)^2(c^{5\cdot2}) \quad \text{Power of a Power}
\]

\[= c^6(-3)c^{10} \quad \text{Simplify.}
\]

\[= 9(c^6 \cdot c^{10}) \quad \text{Group the variables.}
\]

\[= 9c^{6+10} \quad \text{Product of Powers}
\]

\[= 9c^{16} \quad \text{Simplify.}
\]
7-1 Multiplication Properties of Exponents

43. \((2g^4h^3)^2((-2g^4h)^3)^2\)

SOLUTION:

\[
(2g^4h^3)^3((-2g^4h)^3)^2
\]

\[
= [2g^4h^3]^3(-2g^4h)^{3 \cdot 2}\quad \text{Power of a Product}
\]

\[
= \left(2^3 \cdot g^4 \cdot h^3\right)^3(-2g^4h)^6\quad \text{Power of a Product}
\]

\[
= \left[8g^3h^{12}\right]^3(-2\cdot 6 \cdot g^4 \cdot h^6)
\]

\[
= \left[8g^3h^{12}\right]64g^4 \cdot h^6\quad \text{Power of a Product}
\]

\[
= 512\left(8 \cdot g^3 \cdot h^{24}\right)(h^{12} \cdot h^6)
\]

\[
= 512\left(8 \cdot g^{3+24}\right)h^{18}\quad \text{Product of Powers}
\]

\[
= 512g^{27}h^{18}\quad \text{Simplify.}
\]

44. \((5k^2m)^3((4km^4)^2)^2\)

SOLUTION:

\[
(5k^2m)^3((4km^4)^2)^2
\]

\[
= (5^3 \cdot k^2 \cdot m^3)(4^4 \cdot (k^4 \cdot m^4)^4) \quad \text{Power of a Product}
\]

\[
= 125k^{2 \cdot 3}m^{3 \cdot 3}(4^4 \cdot (k^4 \cdot m^4)^4) \quad \text{Power of a Product}
\]

\[
= 125k^6m^{12}(256k^4m^{4 \cdot 4}) \quad \text{Power of a Product}
\]

\[
= 125 \cdot 256 \cdot k^6 \cdot k^4 \cdot m^{3 \cdot 16}\quad \text{Group the coefficients and the variables}
\]

\[
= 32,000k^{6+4}m^{3+16}\quad \text{Product of Powers}
\]

\[
= 32,000k^{10}m^{19}\quad \text{Simplify.}
\]
7-1 Multiplication Properties of Exponents

45. \((p^5r^2)^4(-q^3r^4)^2(6pr^3)\)

**SOLUTION:**

\[\left( p^5r^2 \right)^4 \left( -q^3r^4 \right)^2 \left( 6pr^3 \right) \]

\[= \left[ (p^5)^4 (r^2)^4 \right] \left[ (-q^3)^2 (r^4)^2 \right] \left( 6pr^3 \right) \quad \text{Power of a Product} \]

\[= \left[ p^{20}r^8 \right] \left[ 49p^{6}r^8 \right] \left( 6pr^3 \right) \quad \text{Power of a Power} \]

\[= (49 \cdot 6) \left( p^{20+6+1} \right) \left( r^8+r^8+r^3 \right) \quad \text{Group the coefficients and the variables.} \]

\[= 294 \left( p^{27}r^{19} \right) \quad \text{Product of Powers} \]

\[= 294p^{27}r^{19} \quad \text{Simplify.} \]

46. \((5x^2y)^2(2xy^3z)^3(4xyz)\)

**SOLUTION:**

\[\left( 5x^2y \right)^2 \left( 2xy^3z \right)^3 \left( 4xyz \right) \]

\[= \left[ (5)^2 (x^2)^2 (y)^2 \right] \left[ (2)^3 (x)^3 (y)^3 (z)^3 \right] \left( 4xyz \right) \quad \text{Power of a Product} \]

\[= \left( 25x^4y^2 \right) \left( 8x^3y^3z^3 \right) \left( 4xyz \right) \quad \text{Power of a Power} \]

\[= (25 \cdot 8 \cdot 4) \left( x^4 \cdot x^3 \cdot x \right) \left( y^2 \cdot y^9 \cdot y \right) \left( z^3 \cdot z \right) \quad \text{Group the coefficients and the variables.} \]

\[= 800x^{4+3+1}y^{2+9+1}z^{3+1} \quad \text{Product of Powers} \]

\[= 800x^8y^{12}z^4 \quad \text{Simplify.} \]

47. \((5a^2b^3c^4)(6a^3b^4c^2)\)

**SOLUTION:**

\[\left( 5a^2b^3c^4 \right) \left( 6a^3b^4c^2 \right) \]

\[= (5 \cdot 6) \left( a^{2+3} \right) \left( b^{3+4} \right) \left( c^{4+2} \right) \quad \text{Group the coefficients and the variables.} \]

\[= 30a^{5}b^{7}c^{6} \quad \text{Product of Powers} \]

\[= 30a^{5}b^{7}c^{6} \quad \text{Simplify.} \]
7-1 Multiplication Properties of Exponents

48. \((10xy^5z^3)(3x^4y^6z^3)\)

\[
\text{SOLUTION:} \\
\left(10xy^5z^3\right)\left(3x^4y^6z^3\right) = (10 \cdot 3)\left(x \cdot x^4\right)\left(y^5 \cdot y^6\right)\left(z^3 \cdot z^3\right) \\
= 30x^{1+4}y^{5+6}z^{3+3} \quad \text{Group the coefficients and the variables.} \\
= 30x^5y^{11}z^6 \quad \text{Product of Powers} \\
= 30x^5y^{11}z^6 \quad \text{Simplify.}
\]

49. \((0.5x^3)^2\)

\[
\text{SOLUTION:} \\
(0.5x^3)^2 = (0.5)^2(x^3)^2 \quad \text{Power of a Product} \\
= 0.25x^{3 \cdot 2} \quad \text{Power of a Power} \\
= 0.25x^6 \quad \text{Simplify.}
\]

50. \((0.4h^5)^3\)

\[
\text{SOLUTION:} \\
(0.4h^5)^3 = (0.4)^3(h^5)^3 \quad \text{Power of a Product} \\
= 0.064h^{5 \cdot 3} \quad \text{Power of a Power} \\
= 0.064h^{15} \quad \text{Simplify.}
\]

51. \((\frac{-3}{4}c)^3\)

\[
\text{SOLUTION:} \\
\left(\frac{-3}{4}c\right)^3 = \left(\frac{-3}{4}\right)^3(c)^3 \quad \text{Power of a Product} \\
= \frac{(-3)^3}{4^3} (c)^3 \quad \text{Simplify.} \\
= \frac{-27}{64}c^3 \quad \text{Simplify.} \\
= -\frac{27}{64}c^3 \quad \text{Simplify.}
\]
52. \( \left( \frac{4}{5}a^2 \right)^2 \)

**SOLUTION:**

\[
\left( \frac{4}{5}a^2 \right)^2 = \left( \frac{4}{5} \right)^2 (a^2)^2 \quad \text{Power of a Product}
\]

\[
= \frac{(4)^2}{(5)^2} (a^2)^2 \quad \text{Simplify}
\]

\[
= \frac{16}{25}a^4 \quad \text{Power of a Power}
\]

\[
= \frac{16}{25}a^4 \quad \text{Simplify}
\]

53. \((8y^3)(-3x^2y^2)\left(\frac{3}{8}xy^4\right)\)

**SOLUTION:**

\[
(8y^3)(-3x^2y^2)\left(\frac{3}{8}xy^4\right)
\]

\[
= (8 \cdot (-3) \cdot \frac{3}{8}) (x^2 \cdot x) (y^3 \cdot y^2 \cdot y^4) \quad \text{Group the coefficients and the variables}
\]

\[
= -9x^{2+1}y^{3+2+4} \quad \text{Product of Powers}
\]

\[
= -9x^3y^9 \quad \text{Simplify}
\]

54. \(\left( \frac{4}{7}m \right)^2 (49m)(17p)\left(\frac{1}{34} p^5 \right)\)

**SOLUTION:**

\[
\left( \frac{4}{7}m \right)^2 (49m)(17p)\left(\frac{1}{34} p^5 \right)
\]

\[
= \left( \frac{4}{7} \right)^2 m^2 (49m)(17p)\left(\frac{1}{34} p^5 \right) \quad \text{Power of a Product}
\]

\[
= \frac{(4)^2}{(7)^2} m^2 (49 \cdot 17 \cdot \frac{1}{34} p^5) \quad \text{Group coefficients and variables.}
\]

\[
= 8n^{2+1}p^{1+5} \quad \text{Product of Powers}
\]

\[
= 8n^3p^6 \quad \text{Simplify}
\]
7-1 Multiplication Properties of Exponents

55. \((-3r^3w^4)^3(2rw)^2(-3r^2)^3(4r^2)^3(2r^2w^3)^4\)

**SOLUTION:**

\[
\left(-3r^3w^4\right)^3 \left(2rw\right)^2 \left(-3r^2\right)^3 \left(4r^2\right)^3 \left(2r^2w^3\right)^4
\]

\[
= \left[-3\right]^3\left(r^3\right)^3\left(w^4\right)^3\left(2\right)^2\left(r\right)^2\left(w\right)^2\left[-3\right]^3\left(r^2\right)^3\left(4\right)^3\left(r^2\right)^3\left(2\right)^4\left(r^2\right)^4\left(w^3\right)^4
\]

Power of a Prod:

Power of Power:

Simplify.

Group the coeffi

Product of Pow

Simplify.

\[
= \left(-27r^9w^{12}\right)\left(4r^2w^2\right)\left(-27r^6\right)\left(64r^3w^6\right)\left(16r^8w^{12}\right)
\]

\[
= \left(-27 \cdot 4 \cdot (-27) \cdot 64 \cdot 16 \cdot r^9 \cdot r^2 \cdot r^6 \cdot r^3 \cdot r^8 \cdot w^{12} \cdot w^2 \cdot w^6 \cdot w^{12}\right)
\]

\[
= 2,985,984r^9+2+6+3+8w^{12}+2+6+12
\]

\[
= 2,985,984r^{28}w^{32}
\]

56. \((3ab^2c)^2(-2a^4b^4)(a^4c^3)(a^2b^4c^5)^2(2a^3b^2c^4)^3\)

**SOLUTION:**

\[
\left(3ab^2c\right)^2\left(-2a^2b^4\right)^2\left(a^4c^3\right)^3\left(a^2b^4c^5\right)^2\left(2a^3b^2c^4\right)^3
\]

\[
= \left[3^2\left(a\right)^2\left(b^2\right)^2\left(c\right)^2\right]\left[-2\right]^2\left(a^2\right)^2\left(b^4\right)^2\left(a^4\right)^3\left(c^3\right)^3\left(a^2b^4c^5\right)^2\left(2\right)^3\left(a^3\right)^3\left(b^2\right)^3\left(c^4\right)^3
\]

Power

Power

Simplify

Group

Product

Simplify.

\[
= \left[9a^2\left(b^2\right)^2c^2\right]\left[\left(4\right)^2\left(a^2\right)^2\left(b^4\right)^2\left(a^4\right)^3\left(c^3\right)^3\right]\left[\left(2\right)^2\left(b^4\right)^2\left(c^5\right)^2\right]\left[\left(8\right)^2\left(a^3\right)^3\left(b^2\right)^3\left(c^4\right)^3\right]
\]

\[
= \left[9a^2\left(b^4\right)^2\left(c^2\right)^2\right]\left[\left(4\right)^2\left(a^4\right)^2\left(b^8\right)^2\left(a^12\right)^2\left(c^6\right)^2\left(b^8\right)^2\left(c^10\right)^2\right]\left[\left(8\right)^2\left(a^9\right)^2\left(b^6\right)^2\left(c^{12}\right)^2\right]
\]

\[
= \left[9 \cdot 4 \cdot 8\right]\left(a^2\cdot a^4 \cdot a^{12} \cdot a^4 \cdot a^9\right)\left(b^4 \cdot b^8 \cdot b^8 \cdot b^6\right)\left(c^2 \cdot c^6 \cdot c^{10} \cdot c^{12}\right)
\]

\[
= 288\left(a^{2+4+12+4+9}\right)\left(b^{4+8+8+6}\right)\left(c^{2+6+10+12}\right)
\]

\[
= 2,880a^{31}b^{26}c^{30}
\]
7-1 Multiplication Properties of Exponents

57. **FINANCIAL LITERACY** Clevon 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.

a. Clevon makes a deposit of $2c and leaves it for 2 years. Write a monomial that represents the interest earned.

b. If \( c \) represents a birthday gift of $250, how much will Clevon have in this account after 2 years?

**SOLUTION:**

a. \( I = Prt \)

\[ = (2c)(0.03)(2) \]

\[ = 0.12c \]

b. \( 0.12c = 0.12(250) \)

\[ = 30 \]

Clevon will make $30 interest, so he will have \( 250 + 30 = 280 \) in his account.

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

58.

**SOLUTION:**

\[ V = \pi r^2 h \]

\[ = \pi (2x)^2 \left( \frac{3x^2}{2} \right) \]

\[ = \pi \left( \frac{4x^2}{2} \right) \left( \frac{3x^2}{2} \right) \]

\[ = \pi \left( \frac{4x^2}{2} \right) \left( \frac{3x^2}{2} \right) \]

\[ = \pi (4 \cdot 3) \left( x^2 \cdot x^2 \right) \]

\[ = \pi (12) \left( x^{2+2} \right) \]

\[ = 12\pi x^4 \]
7-1 Multiplication Properties of Exponents

59. SOLUTION:
\[ V = \ell \cdot w \cdot h \]
\[ = (5x^3)(3x^2)(x^2) \]
\[ = (5 \cdot 3)(x^3 \cdot x^2 \cdot x^2) \]
\[ = 15x^{3+2+2} \]
\[ = 15x^7 \]

60. SOLUTION:
\[ V = \ell \cdot w \cdot h \]
\[ = (2x^2)(2x^3)(4x^4) \]
\[ = (2 \cdot 2 \cdot 4)(x^2 \cdot x^3 \cdot x^4) \]
\[ = 16x^{2+3+4} \]
\[ = 16x^9 \]

61. PACKAGING For a commercial art class, Aiko must design a new container for individually wrapped pieces of candy. The shape that she chose is a cylinder. The formula for the volume of a cylinder is \( V = \pi r^2 h \).

a. The radius that Aiko would like to use is \( 2p^3 \), and the height is \( 4p^3 \). Write a monomial that represents the volume of her container.

b. Make a table of five possible measures for the radius and height of a cylinder having the same volume.

c. What is the volume of Aiko’s container if the height is doubled?

SOLUTION:
7-1 Multiplication Properties of Exponents

\[ V = \pi r^2 h \quad \text{Volume Formula} \]
\[ = \pi (2p^3)^2 (4p^3) \quad \text{Substitution.} \]
\[ = \pi \left[ (2)^2 (p^3)^2 \right] (4p^3) \quad \text{Power of a Product} \]
\[ = \pi (4p^{3\cdot2}) (4p^3) \quad \text{Power of a Product} \]
\[ = \pi (4p^6) (4p^3) \quad \text{Simplify.} \]
\[ = \pi (4 \cdot 4) (p^6 \cdot p^3) \quad \text{Group the coefficients and the variables} \]
\[ = \pi (16) (p^{6+3}) \quad \text{Product of Powers} \]
\[ = 16\pi p^9 \quad \text{Simplify.} \]

b. The product of the square of the radius’ coefficient and the height’s coefficient must be 16. The exponents of the radius and the height must have a sum of 9. Sample answer:

<table>
<thead>
<tr>
<th>Radius</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>4p</td>
<td>( p^3 )</td>
</tr>
<tr>
<td>4p^2</td>
<td>( p^5 )</td>
</tr>
<tr>
<td>2p^3</td>
<td>( 4p^3 )</td>
</tr>
<tr>
<td>2p^4</td>
<td>4p</td>
</tr>
<tr>
<td>2p</td>
<td>( 4p^7 )</td>
</tr>
</tbody>
</table>

\[ V = \pi r^2 h \quad \text{Volume Formula} \]
\[ = \pi (2p^3)^2 (8p^3) \quad \text{Substitution.} \]
\[ = \pi \left[ (2)^2 (p^3)^2 \right] (8p^3) \quad \text{Power of a Product} \]
\[ = \pi (4p^{3\cdot2}) (8p^3) \quad \text{Power of a Product} \]
\[ = \pi (4p^6) (8p^3) \quad \text{Simplify.} \]
\[ = \pi (4 \cdot 8) (p^6 \cdot p^3) \quad \text{Group the coefficients and the variables} \]
\[ = \pi (32) (p^{6+3}) \quad \text{Product of Powers} \]
\[ = 32\pi p^9 \quad \text{Simplify.} \]

So, the volume of Aiko’s container is \( 32\pi p^9 \) cubic units.
7-1 Multiplication Properties of Exponents

62. ENERGY  Albert Einstein’s formula $E = mc^2$ shows that if mass is accelerated enough, it can be converted into usable energy. Energy $E$ is measured in joules, mass $m$ in kilograms, and the speed of light is about 300 million meters per second.

a. Complete the calculations to convert 3 kilograms of gasoline completely into energy.

b. What is the energy if the amount of gasoline is doubled?

**SOLUTION:**

a. $E = mc^2$

   $= 3(300,000,000)^2$

   $= 3(90,000,000,000,000)$

   $= 270,000,000,000,000$

So, 3 kilograms of gasoline converts to 270,000,000,000,000 joules of energy.

b. If the amount of gasoline is doubled to 6 kilograms, then the energy is also doubled.

   $E = mc^2$

   $= 6(300,000,000)^2$

   $= 6(90,000,000,000,000)$

   $= 540,000,000,000,000$

63. MULTIPLE REPRESENTATIONS  In this problem, you will explore exponents.

a. TABULAR  Copy and use a calculator to complete the table.

<table>
<thead>
<tr>
<th>Power</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$3^0$</td>
<td>1</td>
</tr>
<tr>
<td>$3^1$</td>
<td>3</td>
</tr>
<tr>
<td>$3^2$</td>
<td>9</td>
</tr>
<tr>
<td>$3^3$</td>
<td>27</td>
</tr>
<tr>
<td>$3^4$</td>
<td>81</td>
</tr>
<tr>
<td>$3^{-1}$</td>
<td>$\frac{1}{3}$</td>
</tr>
<tr>
<td>$3^{-2}$</td>
<td>$\frac{1}{9}$</td>
</tr>
<tr>
<td>$3^{-3}$</td>
<td>$\frac{1}{27}$</td>
</tr>
<tr>
<td>$3^{-4}$</td>
<td>$\frac{1}{81}$</td>
</tr>
</tbody>
</table>

b. ANALYTICAL  What do you think the values of $5^0$ and $5^{-1}$ are? Verify your conjecture using a calculator.

c. ANALYTICAL  Complete: For any nonzero number $a$ and any integer $n$, $a^{-n} =$ ______.

d. VERBAL  Describe the value of a nonzero number raised to the zero power.

**SOLUTION:**

a.

<table>
<thead>
<tr>
<th>Power</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$5^0$</td>
<td>1</td>
</tr>
<tr>
<td>$5^1$</td>
<td>5</td>
</tr>
<tr>
<td>$5^2$</td>
<td>25</td>
</tr>
<tr>
<td>$5^3$</td>
<td>125</td>
</tr>
<tr>
<td>$5^4$</td>
<td>625</td>
</tr>
<tr>
<td>$5^{-1}$</td>
<td>$\frac{1}{5}$</td>
</tr>
<tr>
<td>$5^{-2}$</td>
<td>$\frac{1}{25}$</td>
</tr>
<tr>
<td>$5^{-3}$</td>
<td>$\frac{1}{125}$</td>
</tr>
<tr>
<td>$5^{-4}$</td>
<td>$\frac{1}{625}$</td>
</tr>
</tbody>
</table>

b. If $3^0 = 1$, then $5^0$ may also equal 1. If $3^{-1}$ equals one-third, then $5^{-1}$ may equal one-fifth.

c. From the table, it seems that a number raised to a negative power is the same the same as its reciprocal raised to the same power, only positive. So, $a^{-n} = \left(\frac{1}{a}\right)^n = \frac{1}{a^n}$

d. Any nonzero number raised to the zero power is 1.
64. **CCSS PERSEVERANCE**  For any nonzero real numbers $a$ and $b$ and any integers $m$ and $t$, simplify the expression
\[
\left( \frac{a^m}{b^t} \right)^{2t}
\]
and describe each step.

**SOLUTION:**
\[
\left( \frac{a^m}{b^t} \right)^{2t}
\]

Move the negative sign to the numerator. Since raising the fraction to the $2t$ power means multiplying both the numerator and the denominator by themselves $2t$ times, we can rewrite the expression as the power of a power for both the numerator and the denominator.
\[
\frac{(-a)^m}{b^t}\]

To find the power of the power, multiply the exponents.
\[
\frac{(-a)^{m2t}}{b^{t2t}}
\]

Regroup the numerator to isolate the negative base.
\[
\frac{((-a)^{m2t}}{b^{t2t}}
\]

Simplify the numerator and denominator.
\[
\frac{a^{m2t}}{b^{t2t}}
\]

Use the power of a power rule one last time to simplify.
\[
\frac{a^{2tm}}{b^{2t^2}}
\]
7-1 Multiplication Properties of Exponents

65. **REASONING** Copy the table below.

<table>
<thead>
<tr>
<th>Equation</th>
<th>Related Expression</th>
<th>Power of x</th>
<th>Linear or Nonlinear</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y = x )</td>
<td>( x )</td>
<td>1</td>
<td>linear</td>
</tr>
<tr>
<td>( y = x^2 )</td>
<td>( x^2 )</td>
<td>2</td>
<td>nonlinear</td>
</tr>
<tr>
<td>( y = x^3 )</td>
<td>( x^3 )</td>
<td>3</td>
<td>nonlinear</td>
</tr>
</tbody>
</table>

a. For each equation, write the related expression and record the power of \( x \).

b. Graph each equation using a graphing calculator.

c. Classify each graph as **linear** or **nonlinear**.

d. Explain how to determine whether an equation, or its related expression, is linear or nonlinear without graphing.

**SOLUTION:**

a. 

<table>
<thead>
<tr>
<th>Equation</th>
<th>Related Expression</th>
<th>Power of x</th>
<th>Linear or Nonlinear</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y = x )</td>
<td>( x )</td>
<td>1</td>
<td>linear</td>
</tr>
<tr>
<td>( y = x^2 )</td>
<td>( x^2 )</td>
<td>2</td>
<td>nonlinear</td>
</tr>
<tr>
<td>( y = x^3 )</td>
<td>( x^3 )</td>
<td>3</td>
<td>nonlinear</td>
</tr>
</tbody>
</table>

b. [Graph images]

c. [Graph images]

d. If the power of \( x \) is 1, the equation or its related expression is linear.

66. **OPEN ENDED** Write three different expressions that can be simplified to \( x^6 \).

**SOLUTION:**

Sample answer: \( x^4 \cdot x^2 \); \( x^5 \cdot x \); For these, the exponents must have a sum of 6.

\( (x^3)^2 \); For this type, the product of 3 and 2 is 6.
7-1 Multiplication Properties of Exponents

67. **WRITING IN MATH** Write two formulas that have monomial expressions in them. Explain how each is used in a real-world situation.

**SOLUTION:**
Sample answer: The area of a circle or \( A = \pi r^2 \), where \( r \) is the radius, can be used to find the area of any circle. The area of a rectangle or \( A = w \cdot l \), where \( w \) is the width and \( l \) is the length, can be used to find the area of any rectangle.

68. Which of the following is not a monomial?
   A. \(-6xy\)
   B. \(\frac{1}{2}a^2\)
   C. \(\frac{1}{2b^3}\)
   D. \(5gh^4\)

**SOLUTION:**
The only example that has a negative exponent is C. This means that the term has a variable in the denominator. Therefore it is not a monomial and choice C is the correct answer.

69. **GEOMETRY** The accompanying diagram shows the transformation of \( \triangle XYZ \) to \( \triangle XYZ' \).

![Diagram of triangles XYZ and XYZ']

This transformation is an example of a

F. dilation
G. line reflection
H. rotation
J. translation

**SOLUTION:**
Because the original triangle got smaller in the transformation, it is a dilation. None of the other types of transformations involve changing the size of a shape (they only affect location). Therefore, choice F is the correct answer.
7.1 Multiplication Properties of Exponents

70. **Cars** In 2002, the average price of a new domestic car was $19,126. In 2008, the average price was $28,715. Based on a linear model, what is the predicted average price for 2014?

- A $45,495
- B $38,304
- C $35,906
- D $26,317

**SOLUTION:**
Let \( x \) be the year and \( y \) be the average price of a new domestic car. Since all the points are part of a linear model, the slope between any two points will be the same. Find the slope of the line containing the data points (2002, 19,126) and (2008, 28,715).

\[
m = \frac{y_2 - y_1}{x_2 - x_1} \quad \text{Slope formula}
\]

\[
m = \frac{28,715 - 19,126}{2008 - 2002} = \frac{9,589}{6} \quad (x_1, y_1) = (2002, 19,126); (x_2, y_2) = (2008, 28,715)
\]

\[
m = \frac{9589}{6} \quad \text{Simplify.}
\]

\[
m \approx 1598.17 \quad \text{Use a calculator.}
\]

Use this slope and the points (2002, 19,126) and (2014, \( y_2 \)) to determine the average cost of a new domestic car in 2014.

\[
m = \frac{y_2 - y_1}{x_2 - x_1} \quad \text{Slope formula}
\]

\[
1598.17 = \frac{y_2 - 19,126}{2014 - 2002} \quad (x_1, y_1) = (2002, 19,126); (x_2, y_2) = (2014, y_2); m = 1598.17
\]

\[
1598.17 = \frac{y_2 - 19,126}{12} \quad \text{Simplify.}
\]

\[
19,178.04 = y_2 - 19,126 \quad \text{Multiply each side by 12.}
\]

\[
38,304.04 = y_2 \quad \text{Add 19,126 to each side.}
\]

The predicted average price of a new domestic car for 2014 is about $38,304. Therefore, the correct choice is B.
7-1 Multiplication Properties of Exponents

71. SHORT RESPONSE If a line has a positive slope and a negative y–intercept, what happens to the x–intercept if the slope and the y–intercept are doubled?

SOLUTION:
The y–intercept of the graphed equation is −4 and the slope is 2, so the equation would be \( y = 2x - 4 \). From the graph, we see that the x–intercept is 2. Now, double the slope and intercept, and the new equation is \( y = 4x - 8 \). Substitute \( y = 0 \), to find the x–intercept.

\[
\begin{align*}
y &= 4x - 8 \\
0 &= 4x - 8 \\
0 + 8 &= 4x - 8 + 8 \\
8 &= 4x \\
\frac{8}{4} &= \frac{4x}{4} \\
2 &= x
\end{align*}
\]
Notice that the x–intercept does not change.
Solve each system of inequalities by graphing.

72. \( y < 4x \)
\( 2x + 3y \geq -21 \)

**SOLUTION:**
Write equation 2 in slope, intercept form.

\[
\begin{align*}
    y &< 4x & \text{Equation 1} \\
    2x + 3y &\geq -21 & \text{Original equation 2} \\
    2x - 2x + 3y &\geq -2x - 21 & \text{Subtract } 2x \text{ from each side} \\
    3y &\geq -2x - 21 & \text{Simplify.} \\
    \frac{3y}{3} &\geq \frac{-2x - 21}{3} & \text{Divide each side by } 3 \\
    y &\geq -\frac{2}{3}x - 7 & \text{Equation 2}
\end{align*}
\]

Graph each inequality. The graph of \( y < 4x \) is dashed and is not included in the graph of the solution. The graph of \( 2x + 3y \geq -21 \) is solid and is included in the graph of the solution. The solution of the system is the set of ordered pairs in the intersection of the graphs of \( y < 4x \) and \( 2x + 3y \geq -21 \). This region is darkly shaded in the graph below.
7.1 Multiplication Properties of Exponents

73. \( y \geq 2 \)
\[ 2y + 2x \leq 4 \]

**SOLUTION:**
Write equation 2 in slope-intercept form.
\[ 2y + 2x \geq 4 \quad \text{Original equation 2} \]
\[ 2y + 2x - 2x \geq -2x + 4 \quad \text{Subtract 2x from each side.} \]
\[ 2y \geq -2x + 4 \quad \text{Simplify.} \]
\[ \frac{2y}{2} \geq \frac{-2x + 4}{2} \quad \text{Divide each side by 2} \]
\[ y \geq -x + 2 \quad \text{Equation 2} \]
\[ y \geq 2 \quad \text{Equation 1} \]

Graph each inequality. The graph of \( y \geq 2 \) is solid and is not included in the graph of the solution. The graph of \( 2y + 2x \leq 4 \) is also solid and is included in the graph of the solution. The solution of the system is the set of ordered pairs in the intersection of the graphs of \( y \geq 2 \) and \( 2y + 2x \leq 4 \). This region is darkly shaded in the graph below.

![Graph of y ≥ 2 and 2y + 2x ≤ 4](image)

74. \( y > -2x - 1 \)
\[ 2y \leq 3x + 2 \]

**SOLUTION:**
Rewrite equation 2 in slope-intercept form.
\[ 2y \leq 3x + 2 \quad \text{Original equation 2} \]
\[ \frac{2y}{2} \leq \frac{3x + 2}{2} \quad \text{Divide each side by 2} \]
\[ y \leq \frac{3}{2}x + 1 \quad \text{Equation 2} \]
\[ y > -2x - 1 \quad \text{Equation 1} \]

Graph each inequality. The graph of \( y > -2x - 1 \) is dashed and is not included in the graph of the solution. The graph of \( 2y \leq 3x + 2 \) is solid and is included in the graph of the solution. The solution of the system is the set of ordered pairs in the intersection of the graphs of \( y > -2x - 1 \) and \( 2y \leq 3x + 2 \). This region is darkly shaded in the graph below.

![Graph of y > -2x - 1 and 2y ≤ 3x + 2](image)
7-1 Multiplication Properties of Exponents

75. \(3x + 2y < 10\)  
\(2x + 12y < -6\)

**SOLUTION:**

Write each equation in slope-intercept form.

**Equation 1:**

\[
3x + 2y < 10 \\
3x - 3x + 2y < -3x + 10 \\
2y < -3x + 10 \\

\[
\frac{2y}{2} < \frac{-3x + 10}{2} \\
\frac{2y}{2} < -\frac{3}{2}x + 5 \\
\]

**Equation 1**

**Equation 2:**

\[
2x + 12y < -6 \\
2x - 2x + 12y < -2x - 6 \\
12y < -2x - 6 \\

\[
\frac{12y}{12} < \frac{-2x - 6}{12} \\
\frac{12y}{12} < -\frac{1}{6}x - \frac{1}{2} \\
\]

**Equation 2**

Graph each inequality. The graph of \(3x + 2y < 10\) is dashed and is not included in the graph of the solution. The graph of \(2x + 12y < -6\) is also dashed and is not included in the graph of the solution. The solution of the system is the set of ordered pairs in the intersection of the graphs of \(3x + 2y < 10\) and \(2x + 12y < -6\). This region is darkly shaded in the graph below.
76. **SPORTS** In the 2006 Winter Olympic Games, the total number of gold and silver medals won by the U.S. was 18. The total points scored for gold and silver medals was 45. Write and solve a system of equations to find how many gold and silver medals were won by the U.S.

![Gold 3 points Silver 2 points](image)

**SOLUTION:**
Each gold medal is worth 3 points and each silver medal is worth 2 points. So, if the U.S. won \( g \) gold medals and \( s \) silver medals, then they won \( 3g + 2s \) points.

The total number of gold and silver medals, \( g + s \), is 18. So, we have 2 equations:

\[
3g + 2s = 45 \\
g + s = 18
\]

Solve the 2nd equation for \( g \).

\[
g + s = 18 \\
g = 18 - s
\]

Substitute for \( g \) in the other equation.

\[
3g + 2s = 45 \\
3(18 - s) + 2s = 45 \\
54 - 3s + 2s = 45 \\
9 = s
\]

\[
g = 18 - 9 = 9 \\
g = 9; s = 9
\]

77. **DRIVING** Tires should be kept within 2 pounds per square inch (psi) of the manufacturer’s recommended tire pressure. If the recommendation for a tire is 30 psi, what is the range of acceptable pressures?

**SOLUTION:**

\[
30 + 2 = 32 \\
30 - 2 = 28
\]

The pressure will range between 28 and 32 psi, inclusive.
7-1 Multiplication Properties of Exponents

78. **BABYSITTING**  Alexis charges $10 plus $4 per hour to babysit. Alexis needs at least $40 more to buy a television for which she is saving. Write an inequality for this situation. Will she be able to get her television if she babysits for 5 hours?

**SOLUTION:**
Let \( h \) represent the number of hours that Alexis has to babysit.
\[
10 + 4h \geq 40
\]
If she babysits 5 hours, substitute \( h = 5 \) into the inequality.
\[
10 + 4(5) \geq 40
\]
\[
10 + 20 \geq 40
\]
\[
30 \geq 40
\]
This inequality is not true, so she will not be able to afford her television if she babysits for 5 hours.

**Find each quotient.**

79. \(-64 \div (-8)\)

**SOLUTION:**
The quotient of two negative integers is positive.
\[-64 \div (-8) = 8\]

80. \(-78 \div 1.3\)

**SOLUTION:**
The quotient of a negative number and a positive number is negative.
\[-78 \div 1.3 = -60\]

81. \(42.3 \div (-6)\)

**SOLUTION:**
The quotient of a positive number and a negative number is negative.
\[42.3 \div (-6) = -7.05\]

82. \(-23.94 \div 10.5\)

**SOLUTION:**
The quotient of a negative number and a positive number is negative.
\[-23.94 \div 10.5 = -2.28\]

83. \(-32.5 \div (-2.5)\)

**SOLUTION:**
The quotient of two negative numbers is positive.
\[-32.5 \div (-2.5) = 13\]

84. \(-98.44 \div 4.6\)

**SOLUTION:**
The quotient of a negative number and a positive number is negative.
\[-98.44 \div 4.6 = -21.4\]