

4.3 Multiplication Properties of Exponents

PRODUCT OF POWERS

$$(a)^m (a)^n = a^{m+n}$$

EXAMPLES

Write the expression as a single power of the base.

$$1. \quad 5^3 \cdot 5^6 = \boxed{5^9}$$

$$2. \quad (-2)^1 (-2)^4 = \boxed{(-2)^5}$$

$$3. \quad x^4 \cdot x^3 \cdot x^2 = \boxed{x^9}$$

$$4. \quad (-3)^1 (-3)^5 (-3)^2 = \boxed{(-3)^8}$$

YOU TRY...

Write the expression as a single power of the base.

$$a) \quad 7^8 \cdot 7^1 = \boxed{7^9}$$

$$b) \quad g^2 \cdot g^5 \cdot g^9 = \boxed{g^{16}}$$

$$c) \quad (-9)^4 (-9)^4 = \boxed{(-9)^8}$$

POWER OF A POWER

$$(a^m)^n = a^{mn}$$

EXAMPLES

Write the expression as a single power of the base.

$$5. (4^3)^6 = 4^{18}$$

$$6. (p^8)^4 = p^{32}$$

$$7. [(-6)^4]^2 = (-6)^8$$

$$8. (k^5)^5 = k^{25}$$

YOU TRY...

Write the expression as a single power of the base.

$$a) (5^2)^3 = 5^6$$

$$b) (h^7)^4 = h^{28}$$

$$c) [(-2)^3]^4 = (-2)^{12}$$

POWER OF A PRODUCT

$$(ab)^n = a^n b^n$$

EXAMPLES Simplify the expression.

9. $(-6 \cdot 5)^2$
 $-6^2 \cdot 5^2 = 36 \cdot 25$
 $= 900$

10. $(2xy)^4$
 $2^4 x^4 y^4 = 16x^4 y^4$

11. $-(2w)^2$
 $2^2 w^2$
 $-4w^2$

12. $(7gh)^3$
 $7^3 g^3 h^3$
 $343g^3 h^3$

YOU TRY...

Simplify the expression.

a) $(3 \cdot 4)^2 = 3^2 \cdot 4^2 = 9 \cdot 16 = 144$

b) $(4ef)^6 = 4^6 e^6 f^6 = 4096e^6 f^6$

c) $(-7k)^5 = (-7)^5 k^5 = -16807k^5$

$$\begin{array}{r} 3 \\ 16 \\ \times 16 \\ \hline 96 \\ 160 \\ \hline 256 \end{array}$$

$$\begin{array}{ccccccc} 4 & \cdot & 4 & \cdot & 4 & \cdot & 4 \\ \downarrow & & \downarrow & & \downarrow & & \downarrow \\ 16 & \cdot & 16 & \cdot & 16 & \cdot & 16 \\ \downarrow & & \downarrow & & \downarrow & & \downarrow \\ 256 & \cdot & 16 & & & & \\ \downarrow & & \downarrow & & \downarrow & & \downarrow \\ & & & & 1536 & & \\ & & & & \times 16 & & \\ & & & & \hline & & & & 4096 \end{array}$$

$$\begin{array}{r} (-7) \cdot (-7) \cdot (-7) \cdot (-7) \cdot (-7) \\ 49 \cdot 49 \cdot (-7) \\ 2401 \cdot (-7) \\ \times 7 \\ \hline 16807 \end{array}$$

USING ALL THREE PROPERTIES

EXAMPLES Simplify the expression.

13. $(4x^2y)^3 \cdot x^5$

$$4^3(x^2)^3 y^3 \cdot x^5$$

$$64 \boxed{x^4} y^3 \boxed{x^5} = \boxed{64x^9y^3}$$

14. $(-3a^4)^2 \cdot a^7$

$$(-3)^2(a^4)^2 \cdot a^7$$

$$9 \boxed{a^8} \boxed{a^7} = \boxed{9a^{15}}$$

15. $9 \cdot (9z^5)^2$

$$9^1 \cdot 9^2(z^5)^2$$

$$9^3 z^{10}$$

$$\boxed{729z^{10}}$$

16. $(2mn^6)^3 \cdot 3m^7$

$$2^3 m^3 (n^6)^3 \cdot 3m^7$$

$$\boxed{8} \boxed{m^3} \boxed{n^{18}} \boxed{3} \boxed{m^7}$$

$$\boxed{24m^{10}n^{18}}$$

YOU TRY...

Simplify the expression.

a) $(3mn^2)^4 \cdot 2m^2$

$$3^4 m^4 (n^2)^4 \cdot 2m^2$$

$$\boxed{81} \boxed{m^4} \boxed{n^8} \boxed{2} \boxed{m^2}$$

$$\boxed{162m^6n^8}$$

b) $(-2c^3d^2)^3 \cdot 5cd^6$

$$(-2)^3(c^3)^3(d^2)^3 \cdot 5cd^6$$

$$\boxed{-8} \boxed{c^9} \boxed{d^6} \boxed{5} \boxed{c} \boxed{d^6}$$

$$\boxed{-40c^{10}d^{12}}$$

4.3 Division Properties of Exponents

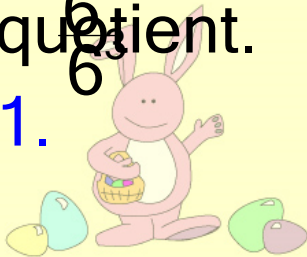
Quotient of Powers

$$\frac{a^m}{a^n} = a^{m-n}$$

Examples: Simplify each

1. $\frac{6^5}{6^3}$

1.



2. $\frac{d^1}{d^9}$

2.

3. $\frac{(-3)^7}{(-3)^4}$

3.

You try some...

Examples: Simplify each

4. $\frac{8^1}{8}$

4.

5. $\frac{k^4}{k}$

5.

6. $\frac{(-4)^9}{(-4)^5}$

6.



Power of a

$$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$$

Examples: Simplify each quotient.

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

8. $\left(\frac{-3}{y}\right)^3$

9. $\left(\frac{g}{-2}\right)^6$



You try some...

Examples: Simplify each quotient.

10. $\left(\frac{2}{x}\right)^5$

11. $\left(\frac{5}{4}\right)^3$

12. $\left(\frac{-}{7}\right)^2$



8.3 Division Properties of Exponents.notebook