

Sec. 8.2 Laws of Exponents: Powers and Products

Power-of-a-Power Property

$$(x^m)^n = x^{m \cdot n}$$

$$\begin{aligned} \text{Ex: } (a^2)^3 &= a^2 \cdot a^2 \cdot a^2 = a^{2+2+2} = a^6 \\ &= (a \cdot a) \cdot (a \cdot a) \cdot (a \cdot a) \\ &= a^6 \end{aligned}$$

Simplify and find the value of each expression when possible.

$$\text{a. } (3^2)^4 = 3^8 = 6,561 \quad \begin{array}{c} 3^2 \cdot 3^2 \cdot 3^2 \cdot 3^2 \\ 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \end{array}$$

$$\text{b. } (10^4)^3 = 10^{12} = 1,000,000,000,000$$

$$\text{c. } (x^2)^5 = x^{10}$$

$$\text{d. } (a^1)^3 = a^{3n}$$

$$\text{e. } (2^6)^2 = 2^{12} = 4,096$$

$$\text{f. } (10^5)^2 = 10^{10} = 10,000,000,000$$

$$\text{g. } (y^3)^5 = y^{15}$$

$$\text{h. } (m^3)^x = m^{3x}$$

Simplify $(x^2y)^3$ using the definition of exponents.

$$\begin{aligned} & \overbrace{x^2y \cdot x^2y \cdot x^2y} \\ & \underbrace{x^2 \cdot x^2 \cdot x^2}_{x^6} \cdot \underbrace{y \cdot y \cdot y}_{y^3} \\ & x^6 y^3 \end{aligned}$$

$$a. (xy)^2 = xy \cdot xy = xxyy = x^2y^2$$

$$b. (xy^2)^2 = xy^2 \cdot xy^2 = xxy^2y^2 = x^2y^4$$

$$c. (\pi r^2)^4 = \pi r^2 \cdot \pi r^2 \cdot \pi r^2 \cdot \pi r^2 = \pi^4 r^8$$

Power-of-a-Product Property

$$(xy)^n = x^n y^n$$

$$\left[(x^m y^p)^n \right] = (x^m)^n (y^p)^n = x^{mn} y^{pn}$$

$$\text{Ex: } (x^2 y^1 z^2)^3 = x^6 y^3 z^6$$