

4.6 Applying Exponent Laws (Part 1)

Product Rule	$(x^a)(x^b) = x^{a+b}$	ex: $5^2 \cdot 5^4 = 5^{2+4} = 5^6$
Quotient Rule	$\frac{x^a}{x^b} = x^{a-b}$	ex: $\frac{a^8}{a^3} = a^{8-3} = a^5$
Power Rule	$(x^a)^b = x^{a \cdot b}$	ex: $\left[(-2)^3\right]^4 = (-2)^{3 \cdot 4} = (-2)^{12}$
Power of a Product Rule	$(xy)^a = x^a \cdot y^a$	ex: $(3x^2)^3 = (3)^3 \cdot (x^2)^3 = 3^3 \cdot x^6 = 27x^6$
Power of a Quotient Rule	$\left(\frac{x}{y}\right)^a = \frac{x^a}{y^a}$	ex: $\left(\frac{4}{2}\right)^3 = \frac{4^3}{2^3} = \frac{4^3}{8}$
Power of Zero Rule	$x^0 = 1$	ex: $(2x^3y)^0 = 1$
Negative Exponents	$x^{-a} = \frac{1}{x^a}$	ex: $5^{-2} = \frac{1}{5^2} = \frac{1}{25} \quad \left/ \quad \left(\frac{4}{5}\right)^{-8} = \left(\frac{5}{4}\right)^8$

*When simplifying exponential expressions, all answers must be left with **positive exponents** only.

Example 1: Simplify

$$\begin{aligned} \text{a) } & 2^3 \times 2^5 \\ & = 2^{3+5} \\ & = 2^8 \end{aligned}$$

$$\begin{aligned} \text{c) } & \frac{(1.4)^3 (1.4)^4}{(1.4)^{-2}} \quad \left. \begin{array}{l} \text{simplify} \\ \text{numerator} \\ \text{first} \end{array} \right\} \\ & = \frac{(1.4)^{3+4}}{(1.4)^{-2}} \\ & = \frac{(1.4)^7}{(1.4)^{-2}} \end{aligned}$$

$$\begin{aligned} & = (1.4)^{7-(-2)} \\ & = (1.4)^9 \end{aligned}$$

$$\begin{aligned} \text{e) } & (x^3 y^2)(x^2 y^{-4}) \\ & = x^{3+2} y^{2+(-4)} \\ & = x^5 y^{-2} \end{aligned}$$

$$\frac{x^5}{y^2}$$

$$\begin{aligned} \text{g) } & (x^4)^{-3} \\ & = x^{4 \cdot (-3)} \\ & = x^{-12} \\ & = \frac{1}{x^{12}} \end{aligned}$$

$$\begin{aligned} \text{b) } & \left[\left(-\frac{3}{2} \right)^{-4} \right]^2 \times \left[\left(-\frac{3}{2} \right)^2 \right]^3 \\ & \quad \text{simplify first} \\ & = \left(-\frac{3}{2} \right)^{-8} \cdot \left(-\frac{3}{2} \right)^6 \\ & = \left(-\frac{3}{2} \right)^{-8+6} \\ & = \left(-\frac{3}{2} \right)^{-2} \\ & = \left(-\frac{2}{3} \right)^2 = \frac{4}{9} \end{aligned}$$

$$\begin{aligned} \text{d) } & x^3 \cdot x^{-5} \\ & = x^{3+(-5)} \\ & = x^{-2} \\ & = \frac{1}{x^2} \end{aligned}$$

$$\begin{aligned} \text{f) } & \frac{10a^5 b^3}{2a^2 b^{-2}} \\ & = 5a^{5-2} b^{3-(-2)} \\ & = 5a^3 b^5 \end{aligned}$$

$$\begin{aligned} \text{h) } & \frac{100a}{25a^5 b^{-\frac{1}{2}}} \\ & = \frac{4a^{1-5}}{b^{-\frac{1}{2}}} \\ & = \frac{4a^{-4}}{b^{-\frac{1}{2}}} \\ & = \frac{4b^{\frac{1}{2}}}{a^4} \end{aligned}$$