

4.6 Applying the Exponent Laws – Part 1

Recall the exponent laws:

Product of powers: $a^m \cdot a^n = a^{m+n}$

$$\text{a) } x^2 \cdot x^4 = x^{2+4} = x^6$$

$$\text{b) } (3^2)(3^3) = 3^5 = 243$$

Quotients of powers: $a^m \div a^n = a^{m-n}$

$$\text{a) } x^5 \div x^2 = x^{5-2} = x^3$$

$$\text{b) } \frac{4^7}{4^3} = 4^{7-3} = 4^4 = 256$$

Power of a power: $(a^m)^n = a^{mn}$

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

$$\text{b) } (2^2)^3 = 2^6 = 64$$

Power of a product: $(ab)^n = a^n b^n$

$$\text{a) } (2 \cdot 3)^2 = 2^2 \cdot 3^2 = 4 \cdot 9 = 36$$

$$(6)^2 = 36$$

$$\text{b) } (x^2 y^3)^2 = x^4 y^6$$

Power of a quotient: $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$

$$\text{a) } \left(\frac{6}{2}\right)^3 = \frac{6^3}{2^3} = \frac{216}{8} = 27$$

$$27 = 3^3 \quad \swarrow$$

$$\text{b) } \left(\frac{x^2}{y^3}\right)^3 = \frac{x^6}{y^9}$$

* Zero exponent law: $a^0 = 1$

Simplify.

Practice: *Simplify the following.*

a) $b^3 \cdot b^5 = b^8$

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

b) $(0.5^2)(0.5^4) = (0.5)^6$

f) $\left(\frac{n^2}{m}\right)^2 = \frac{n^4}{m^2}$

c) $(2y^2)(y^3)(3y^4) = 6y^9$

g) $\frac{x^2 y^3}{xy^2} = xy$

d) $\frac{4x^7}{2x^3} = 2x^4$

h) $\left(\frac{2b}{5c}\right)^2 = \frac{4b^2}{25c^2} = \frac{2^2 b^2}{5^2 c^2}$

What about negative exponents??

Follow the integer laws. Final answer must have a positive exponent:

$a^{-n} = \frac{1}{a^n} \quad 7\left(\frac{1}{x^7}\right)$

Examples: *Simplify.*

a) $b^{-3} \cdot b^5 = b^{-3+5} = b^2$

e) $\frac{14x^{-4}}{2x^3} = 7x^{-4-3} = 7x^{-7} = \frac{7}{x^7}$

b) $(0.5^2)(0.5^{-3}) = 0.5^{2+(-3)} = 0.5^{-1} = \frac{1}{0.5}$

f) $\frac{6x^4 y^{-3}}{14xy^2} = \frac{6 \div 2}{14 \div 2} \frac{x^4 y^{-3}}{xy^2} = \frac{3}{7} \frac{3x^3 y^{-5}}{1y^5} = \frac{3x^3}{7y^5}$

c) $m^4 n^{-2} \cdot m^2 n^3 = m^6 n^{-2+3} = m^6 n$

g) $\left(\frac{x^2}{y^3}\right)^{-2} = \frac{x^{-4}}{y^{-6}} = \frac{y^6}{x^4} \left\{ \left(\frac{y^3}{x^2}\right)^2 = \frac{y^6}{x^4} \right\}$

d) $\frac{(1.4^3)(1.4^4)}{1.4^{-2}} = \frac{(1.4)^7}{(1.4)^{-2}} = 1.4^{7-(-2)} = 1.4^9$

h) $\left[\left(\frac{3}{4}\right)^{-3}\right]^{-2} = \left(\frac{3}{4}\right)^6 = \frac{3^6}{4^6}$