

Exponents

Rules for Exponents

Multiplying Exponents: $x^m \cdot x^n = x^{m+n}$

Dividing Exponents: $\frac{x^m}{x^n} = x^{m-n}$

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

Zero Exponent Rule: $x^0 = 1$

Negative Exponent Rule: $x^{-m} = \frac{1}{x^m}$, $\frac{1}{x^{-m}} = x^m$, $\left(\frac{x}{y}\right)^{-m} = \left(\frac{y}{x}\right)^m$

Directions: Simplify and express your answer with positive exponents.

1. $x^{-9} \cdot x^{12} = \boxed{x^3}$

2. $4^2 \cdot 4^1 = 4^3 = \boxed{64}$

3. $3x^{-8} \cdot 4x^{-7} = \frac{12x^{-15}}{1} = \boxed{\frac{12}{x^{15}}}$

4. $\frac{48x^{-12}}{560x^3} = \boxed{\frac{4}{5x^{15}}}$

$3 - -12 = 15$

5. $(x^{-6})^{-2} = \boxed{x^{12}}$

6. $(-4)^{-2} = \left(\frac{-4}{1}\right)^{-2} = \left(\frac{1}{-4}\right)^2$

$\frac{(1)^2}{(-4)^2} = \boxed{\frac{1}{16}}$

$$7. (3x^3)^0 = \boxed{1}$$

$$8. -3^{-2} = -1 \cdot \frac{1}{3^2} = -1 \cdot \frac{1}{9} \\ = \boxed{-\frac{1}{9}}$$

$$9. (6x^3)^{-3} = \left(\frac{6x^3}{1}\right)^{-3} = \left(\frac{1}{6x^3}\right)^3 \\ = \frac{(1)^3}{(6x^3)^3} = \frac{1}{6^3 x^9} = \boxed{\frac{1}{216x^9}}$$

$$10. (3x^{10}y^{-4})^5 \\ = \frac{3^5 x^{50} y^{-20}}{y^{20}} \\ = \boxed{\frac{243x^{50}}{y^{20}}}$$

$$11. (-x^7y^8)^4 = (-1^4 x^{28} y^{32}) = \boxed{1x^{28}y^{32}} \\ \begin{array}{ccccccc} - & 1 & \cdot & - & 1 & \cdot & - & 1 & \cdot & - & 1 \\ & \swarrow & & \swarrow & & \swarrow & & \swarrow & & \swarrow & \\ & 1 & & 1 & & 1 & & 1 & & 1 & \\ & & & & & & & & & & \end{array} = 1$$

$$12. \left(\frac{2a^2b^3c^{-4}}{8a^4b^{-4}c} \right)^{-2} = \left(\frac{1b^7}{4a^2c^5} \right)^{-2} = \left(\frac{4a^2c^5}{b^7} \right)^2$$

$$\frac{a^2}{a^4} = \frac{1}{a^2} = \left(\frac{4^2 a^4 c^{10}}{b^{14}} \right)$$

$$\frac{b^3}{b^{-4}} = b^7 = \boxed{\frac{16a^4c^{10}}{b^{14}}}$$

$$\frac{c^{-4}}{c^1} = \frac{1}{c^5}$$

$$13. (5y^2)(4y^{-3}z^4)^2$$

$$(4^2 y^{-6} z^8)$$

$$\boxed{(5y^2)(16y^{-6}z^8)} = \frac{80y^{-4}z^8}{1} = \boxed{\frac{80z^8}{y^4}}$$

$$14. \left(\frac{x^{12}y^3}{y^{-2}z} \right)^{-4} = \left(\frac{x^{12}y^5}{z^1} \right)^{-4} = \left(\frac{z^1}{x^{12}y^5} \right)^4 = \boxed{\frac{z^4}{x^{48}y^{20}}}$$

$$\frac{y^3}{y^{-2}} = y^5$$

$$15. \left(\frac{x^{-2}}{y^{-2}} \right) \left(\frac{y}{x} \right)^3$$

$$\frac{(y)^3}{(x)^3}$$

$$\frac{x^{-2}}{y^{-2}} \cdot \frac{y^3}{x^3}$$

$$\frac{y^2}{x^2} \cdot \frac{y^3}{x^3} = \boxed{\frac{y^5}{x^5}}$$