

Product of Powers: When multiplying bases, add exponents.

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

Simplify each expression.

1) $(3y^4)(7y^5)$

$$21y^{4+5}$$

$$\boxed{21y^9}$$

2) $(-4r^2t^3)(-6r^5x^2t)$

$$\boxed{24r^7x^2t^4}$$

Power of a Power: A power raised to another power, multiply exponents.

Ex: $(a^n)^m = a^{nm}$

Simplify each expression.

3) $[(2^3)^2]^4$

$$(2^6)^4$$

$$\boxed{2^{24}}$$

4) $[(2^2)^2]^4$

$$(2^4)^4$$

$$\boxed{2^{16}}$$

Power of a Product: Find the power of each factor & then multiply

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

Simplify each expression.

5) $(3xy^4)((-2y)^2)^3$

$$(3xy^4)(4y^2)^3$$

$$(3xy^4)(64y^6)$$

$$\boxed{192xy^{10}}$$

6) $\left(\frac{1}{2}a^2b^2\right)^3 [(-4b)^2]^2$

$$\left(\frac{1}{8}a^6b^6\right)(16b^2)^2$$

$$\left(\frac{1}{8}a^6b^6\right)(256b^4)$$

$$\boxed{32a^6b^{10}}$$

Quotient of Powers: When dividing bases, subtract exponents.

Ex: $\frac{(a^n)}{(a^m)} = a^{n-m}$

Ex: Simplify

7) $\frac{x^3y^4}{x^2y^1}$

$$x^{3-2} y^{4-1}$$

$$\boxed{xy^3}$$

8) $\frac{k^7m^{10}}{k^5m^3}$

$$\boxed{k^2m^7}$$

9) $\frac{x^7y^{12}}{x^6y^3}$

$$x^{7-6} y^{12-3}$$

$$\boxed{xy^9}$$

Power of a Quotient:

Raise everything inside parentheses to the power outside.

Ex: $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$

Ex: Simplify

10) $\left(\frac{5x^5y}{6}\right)^2$

$$\frac{5^2 \times 5^{5(2)} \times y^2}{6^2}$$

$$\boxed{\frac{25x^{10}y^2}{36}}$$

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

$$\frac{3^3 \times x^{12}}{4^3}$$

$$\boxed{\frac{27x^{12}}{64}}$$

12) $\left(\frac{2y^2}{3z^3}\right)^2$

$$\boxed{\frac{4y^4}{9z^6}}$$

13) $\left(\frac{4x^3}{5y^4}\right)^3$

$$\boxed{\frac{64x^9}{125y^{12}}}$$

Zero Exponents:

Any nonzero number raised to zero equals 1.

Ex: $a^0 = 1$

Ex: Simplify

14) $\frac{b^4c^2d^0}{b^2c^1}$

$$\boxed{b^2c}$$

15) $\left(\frac{2f^4g^7h^3}{15f^3g^9h^6}\right)^0$

$$\boxed{1}$$

16) $\left(\frac{12m^8n^7}{8m^5n^{10}}\right)^0$

$$\boxed{1}$$

Negative Exponents:

a^{-n} is the reciprocal of a^n .

Ex: $a^{-n} = \frac{1}{a^n}$ or $\frac{1}{a^{-n}} = a^n$

Ex: Simplify

17) $\frac{v^{-3}x^2}{w^{-6}}$

$$\frac{v^{-3}x^2}{w^{-6}}$$

$$\frac{v^3x^2}{w^6}$$

$$\boxed{\frac{x^2y^6}{v^3}}$$

18) $\frac{32a^{-8}b^3c^{-4}}{4a^3b^5c^{-2}}$

$$8a^{-8-3}b^{3-5}c^{-4-(-2)}$$

$$8a^{-11}b^{-2}c^{-2}$$

$$\boxed{\frac{8}{a^{11}b^2c^2}}$$

19) $\frac{5j^{-3}k^2m^{-6}}{25k^{-4}m^{-2}}$

$$\frac{1}{5}j^{-3}k^{2-(-4)}m^{-6-(-2)}$$

$$\frac{1}{5}j^{-3}k^6m^{-4}$$

$$\boxed{\frac{k^6}{5j^3m^4}}$$