

Exponent Properties

$$3^2 = 9$$

$$3^2 = 3 \cdot 3$$

$$3^3 = 3 \cdot 3 \cdot 3$$

$$a^6 = a \cdot a \cdot a \cdot a \cdot a \cdot a$$

$$b^n = \underbrace{b \cdot b \cdot b \cdot \dots}_{\text{multiplicity } n}$$

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

$$a^m \cdot a^n = a^{m+n} \quad * \text{ Product Property}$$

$$\frac{a^4}{a^2} = \frac{\cancel{a} \cdot \cancel{a} \cdot a \cdot a}{\cancel{a} \cdot \cancel{a} \cdot 1} = a^{4-2} = a^2$$

$$\frac{a^m}{a^n} = a^{m-n}$$

$$* \text{ Quotient Property}$$

Exploration

$$a^3 = a \cdot a \cdot a$$

$$a^2 = a \cdot a = \frac{a^3}{a} = \frac{a \cdot \cancel{a} \cdot \cancel{a}}{\cancel{a}}$$

$$a^1 = a = \frac{a^2}{a} = \frac{\cancel{a} \cdot a}{\cancel{a}}$$

$$a^0 = 1 = \frac{\cancel{a}}{\cancel{a}} = 1 \quad \leftarrow \text{Zero Power}$$

$$a^{-1} = \frac{1}{a} = \frac{1}{a}$$

$$a^{-2} = \frac{1}{a^2} = \frac{1}{\frac{1}{\frac{1}{a}}}$$

$$\begin{aligned} \frac{1}{a} &= a \\ \frac{1}{a} &= \frac{a}{1} \\ \frac{1}{\frac{1}{a}} &= \frac{1}{\frac{1}{a}} = \frac{1}{a^2} \end{aligned}$$

K (CF)

$$a^{-m} = \frac{1}{a^m}$$

$$a^{-8} = \frac{1}{a^8}$$

Indeterminate forms

$$0^0$$

$$\frac{0}{0}$$

$$(a^3)^2 = (aaa)(a \cdot a \cdot a)$$

$$= a \cdot a \cdot a \cdot a \cdot a \cdot a$$

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

$$(a^3)^2 = a^{3 \cdot 2} = a^6$$

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

$$(a^n)^m = a^{n \cdot m} = a^{m \cdot n} \quad \times \text{Power of Power}$$

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

$$= (a \cdot a)(a \cdot a)(a \cdot a)$$

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

$$(a^2)^3 = a^{2 \cdot 3} = a^6$$

$$(a^7)^8 = a^{8 \cdot 7} = a^{56}$$

$$6^2 = 6 \cdot 6 = 36$$

$$(3 \cdot 2)^2 = (3 \cdot 2)(3 \cdot 2)$$

$$= 3 \cdot 2 \cdot 3 \cdot 2$$

$$= 3 \cdot 3 \cdot 2 \cdot 2$$

$$(3 \cdot 2)^2 = 3^2 \cdot 2^2$$

$$(ab)^m = a^m \cdot b^m \quad \text{Power of Product.}$$

"distribute the powers"

$$(3a)^3 = 3^3 a^3$$

$$= 27a^3$$

$$(2xy^2)^5 = 2^5 x^5 (y^2)^5$$

$$= 2^5 x^5 y^{10}$$

$$= 32x^5y^{10}$$

$$6^2 = 36$$

$$\left(\frac{12}{2}\right)^2 = \left(\frac{12}{2}\right)\left(\frac{12}{2}\right)$$

$$\left(\frac{12}{2}\right)^2 = \frac{12^2}{2^2}$$

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

Power of Quotient

$$\left(\frac{4a}{b}\right)^3 = \frac{(4a)^3}{b^3}$$

$$= \frac{4^3 a^3}{b^3}$$
$$= \frac{64a^3}{b^3}$$

$$* \left(\frac{a}{b}\right)^{-1} = \frac{a^{-1}}{b^{-1}} = \frac{b}{a} = \frac{1}{\frac{a}{b}}$$

$$\left(\frac{a}{b}\right)^{-1} = \frac{a^{-1}}{b^{-1}}$$
$$= \frac{1}{a} \div \frac{1}{b}$$
$$= \frac{1}{a} \cdot \frac{b}{1}$$
$$= \frac{b}{a}$$

Exponent Properties

Product Property

$$a^m \cdot a^n = a^{m+n}$$

Quotient Property

$$\frac{a^m}{a^n} = a^{m-n} \quad a \neq 0$$

Zero Exponent

$$a^0 = 1$$

Negative Exponent

$$a^{-m} = \frac{1}{a^m} \rightarrow \frac{1}{a^{-m}} = a^m$$

Power of Power: $(a^m)^n = a^{m \cdot n} = (a^n)^m$

Power of Product $(ab)^m = a^m \cdot b^m$

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

$$\left(\frac{ab\dots}{cd\dots}\right)^m = \frac{a^m b^m \dots}{c^m d^m \dots}$$

$$\left(\frac{a}{b}\right)^{-1} = \frac{b}{a}$$

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

$$84 z^5$$

$$\frac{84 z^5}{48 z^3 s^6}$$

$$\frac{7 \cdot 7 s^{10-6}}{4 z^{3-1}}$$

$$\frac{7 s^4}{4 z^2}$$

$7 s^4$
$4 z^2$

$$(8z^9 r)(3z^{12} r^{-5})$$

$$\left(\frac{7y^3w^{-2}}{5y^{-3}w^{-2}}\right)^{-3}$$

$$= \left(\frac{7y^8y^3w^2}{5w^7}\right)^{-3}$$

$$= \left(\frac{7y^{11}}{5w^7}\right)^{-3}$$

$$= \left(\frac{5w^7}{7y^{11}}\right)^3$$

$$= \frac{5^3(w^7)^3}{7^3(y^{11})^3} = \frac{125w^{21}}{343y^{33}}$$

[PEMDAS
write in terms of positive exponents]

[simplified]

[negative exponent]

[power of power]