

2.2 Properties of Exponents

$$2^3 = 2 \cdot 2 \cdot 2 = 8$$

← exponent

→ base

$$2^5 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 32$$

$$2^n = 2 \cdot 2 \cdot 2 \cdots n \text{ times}$$

If a is a real \neq , then:

$$a^n = a \cdot a \cdot a \cdots n \text{ times}$$

$$a^0 = 1$$

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

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

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$$3^0 = 1 \quad \left. \begin{array}{l} \nearrow \div 3 \\ \searrow \cdot 3 \end{array} \right\} \div 3$$

$$3^1 = 3 \quad \searrow \cdot 3$$

$$3^2 = 9 \quad \searrow \cdot 3$$

$$3^3 = 27$$

⋮

$$0^0 = \text{undef.} \quad \left. \begin{array}{l} \nearrow \neq 0 \\ \searrow \neq 0 \end{array} \right\} \neq 0$$

$$0^1 = 0 \quad \searrow \cdot 0$$

$$0^2 = 0$$

$$9^0 = 1$$

$$2^{-2} = \frac{1}{2^2} = \frac{1}{4}$$

$$\frac{1}{3^{-3}} = 3^3 = 27$$

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Properties of Exponents:

1. Product of Powers: $\underline{a^m} \cdot \underline{a^n} = a^{m+n}$

$2^4 \cdot 2^6 = 2^{4+6} = 2^{10} =$

$x^2 \cdot x^4 = x^6$
 ~~$x \cdot x \cdot x \cdot x \cdot x \cdot x$~~

2. Quotient of Powers: $\frac{a^m}{a^n} = a^{m-n}$

$\frac{y^{12}}{y^8} = y^{12-8} = y^4$

$\frac{y^8}{y^{-3}} = y^{8-(-3)} = y^{8+3} = y^{11}$

$\frac{y^4}{y^7} = y^{4-7} = y^{-3} = \frac{1}{y^3}$

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

$(z^4)^3 = z^{12}$

$(q^2)^{-4} = q^{-8} = \frac{1}{q^8}$

4. Power of a product: $(a \cdot b)^n = a^n \cdot b^n$

$(x^2 \cdot y^3)^3 = x^6 y^9$

5. Power of a Quotient: $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$

$\left(\frac{x}{z}\right)^3 = \frac{x^3}{z^3}$

$\left(\frac{xy^2}{z}\right)^4 = \frac{x^4 y^8}{z^4}$

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Simplify:

$$\underline{3x^2y^{-2}} \cdot (\underline{-2x^3y^{-4}})$$

$$-6x^5 \overset{-6}{\underset{\curvearrowright}{y}} = \frac{-6x^5}{y^6}$$

$$\underline{2z^1} (\underline{3x^2}) (\underline{5z^{-3}})$$

$$30x^2 \overset{-2}{\underset{\curvearrowright}{z}} = \frac{30x^2}{z^2}$$

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Simplify:

$$9a^2b^3 \cdot (\underline{-2a^5b^{-3}})^2$$

$$\underline{9a^2b^3} \cdot (\underline{4a^{10}b^{-6}})$$

$$36a^{12}b^{-3} = \frac{36a^{12}}{b^3}$$

$$\left(\frac{-4y^7}{2z^4y^3} \right)^4 = \frac{1y^{28}}{16z^{16}y^{12}} = \frac{y^{28-12}}{16z^{16}} = \frac{y^{16}}{16z^{16}}$$

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