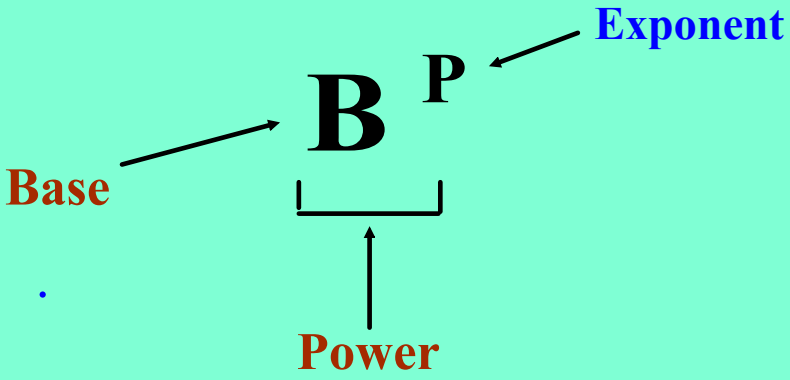
Laws of Exponents



Example: Identify the base and the exponent for each expression

a) 4^{3}

Base: 4

Exponent: 3

b) 7^{23}

Base: 7

Exponent: 23

c) a^{b}

Base: a

Exponent: b

Laws Of Exponents

Law #1:

$$b^{m} \times b^{n} = b^{m+n}$$

- when multiplying powers with the **same** base you add the exponents

Examples: $5^{3} \times 5^{6} = 5^{3+6} = 5^{9}$

$(z^{6})(z^{4}) = z^{6+4} = z^{10}$

Exercise:

Simplify the following using the laws of exponents

a) $3^{2} \times 3^{4}$ b) $4^{3} \times 3^{4}$ c) $(q^{7})(q)$ q^{8} d) $p \times p^{3} \times p^{2}$

e) $(2x^{3})(4x^{2})$ f) $(3z^{3})(6z^{12})$ $18z^{15}$

$\frac{6^{4}}{6^{2}} = 6^{4-2} = 6^{2} = 36$

$a^{18} \div a^{6} = a^{12}$

$c^{18} \div a^{6}$

$\frac{x^{4}}{x^{4}} = 1$

$20x^{4}$ / $5x^{4}$

$4(5x^{0})$ (1)

4

Law #3: $(b^m)^n = b^{mn}$ $((6^2)^4 = 6^8$

Law #4: $(db)^m = a^m b^m$ $(x^7)^3 = x^{21}$

$(2x^2y^4)^3 = 2^3x^6y^3 = 8x^6y^3$

- when brackets are involved you must multiply the exponents

Examples:

$(5^3)^5 = 5^{(3)(5)} = 5^{15}$

$(m^8)^4 = m^{(8)(4)} = m^{32}$

$(e^2f)^3 = e^{(2x3)} f^{(1x3)} = e^6f^3$

Exercise:

Simplify the following using Laws of Exponents

a) $(m^3)^4$ b) $(x^2y^4)^3$ c) $(2d^3)^3$ d) $(2m^4n)^2(m^3n^2)$

$(2^2m^8n^2)(m^3n^2)$

$(4m^8n^2)(m^3n^2)$

$4m^{11}n^4$

Law #2: $b^m \div b^n = b^{m-n}$

- when dividing powers with the **same** base you subtract the exponents

Examples:

$7^5 \div 7^2 = 7^{5-2} = 7^3$

$\frac{g^{13}}{g^4} = g^{13-4} = g^9$

Exercise:

Simplify the following using exponent laws

a) $5^{23} \div 5^{12}$ b) $\frac{x^{34}}{x^{19}}$ c) $c^3 \div e^2$

d) $\frac{12x^3}{4x^1}$ 3^2 e) $\frac{25c^{30}}{5c^{23}}$

Law #5: $\left(\frac{a}{b}\right)^n = \left(\frac{a^n}{b^n}\right)$

Examples:

$\left(\frac{2}{3}\right)^5 = \left(\frac{2^5}{3^5}\right)$

Law #6: $b^{-m} = \frac{1}{b^m}$

Examples:

6^{-2} $\quad \frac{1}{6^2} = \frac{1}{36}$

$\frac{x^7 y^{-2} z^6}{a^{-3} b^2 c^{-7}}$

$\frac{x^7 z^6 a^3 c^7}{y^2 b^2}$

$\frac{27^{-\frac{2}{3}}}{1}$

$\frac{1}{27^{\frac{2}{3}}}$

$\frac{1}{\left(\sqrt[3]{27}\right)^2}$

$\frac{1}{3^2} = \frac{1}{9}$

Law #7: $\left(\frac{a}{b}\right)^{-n} = \left(\frac{b^n}{a^n}\right)$

Examples:

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

$\frac{3^{-3}}{4^{-3}} = \frac{4^3}{3^3}$

$\left(\frac{2}{5}\right)^{-2}$

$\left(\frac{5}{2}\right)^2$

$\frac{5^2}{2^2} = \frac{25}{4}$

Law #8: $b^0 = 1$

- any power raised to the exponent 0 (zero) is equal to 1

$2017 \cdot a^0$

$2017 \cdot 1$

2017

$$\left(\frac{z^6 y^7 a^{95} \cdot 605 z^6}{y^3 a^{12} c^{-75} d^{2016}}\right)^0$$

i)

$$\frac{2u^3v^3 \cdot (3u^2)^2}{2u^2}$$

BEDMAS

$(u^2)^2$

$$\frac{2u^3v^3 \cdot 9u^4}{2u^2} = \frac{18u^7v^3}{2u^2}$$

$$= 9u^5v^3$$

$$\frac{(4xy^2)^3}{(4y^3)^4 \cdot 2y^3}$$

3. Use the laws of exponents to simplify the following (Express all answers with positive exponents) (18)

a) $[(-2x^3y)(5x^3y^4)]^{-3}$

b) $\left(\frac{a^2b^4c}{a^5b^2c}\right)^3$

c) $\left(\frac{4p^2}{q^6}\right)^{-3}$	d) $\frac{(3x^2y^3)(2x^3y^9)^3}{2x^{-2}y}$