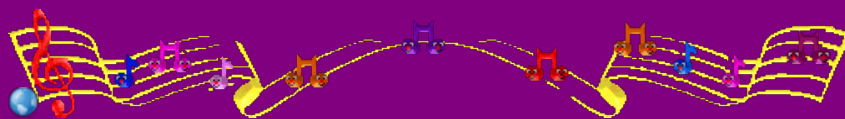


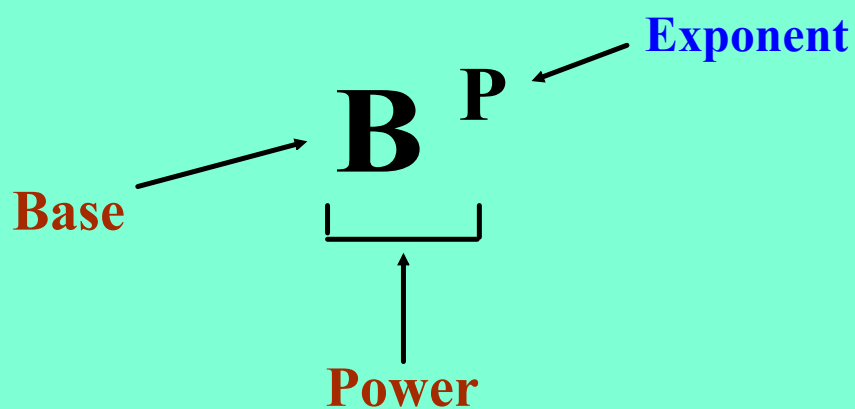


LAWS OF EXPONENTS

Exponent LAws



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:

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

$$(z^6)(z^4) = \quad =$$

Exercise:

Simplify the following using the laws of exponents

a) $3^2 \times 3^4$

b) $4^3 \times 3^4$

c) $(q^7)(q)$

d) $p \times p^3 \times p^2$

e) $(2x^3)(4x^2)$

f) $(3z^3)(6z^{12})$

$$\begin{aligned} &8x^3 \cdot x^2 \\ &8x^{3+2} \\ &8x^5 \end{aligned}$$

$$= 2^3 (a^6 b^3) a^4 b^5$$

$$= 2^3 \underbrace{a^6 \cdot a^4 \cdot b^3 \cdot b^5}_{\text{when mult add ex}}$$

$$= \begin{matrix} \downarrow \\ 8 \end{matrix} a^{6+4} b^{3+5}$$

$$= 8 a^{10} b^8$$

$$2x^2 + 3x^2$$
$$5x^2$$

$$\begin{array}{c} x^2 \\ xx \end{array} \cdot \begin{array}{c} x^3 \\ xxx \end{array} = x^{2+3} = x^5$$

$$x^1 \cdot x^1 = x^2$$

Law #3: $(b^m)^n = b^{mn}$

Law #4: $(ab)^m = a^m b^m$

- when brackets are involved you must multiply the exponents

Examples:

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

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

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

Exercise:

Simplify the following using Laws of Exponents

a) $(m^3)^4$

b) $(x^2 y^4)^3$

c) $(2d^3)^3$

$$\begin{aligned} & (2^1 d^3)^3 \\ & 2^3 d^9 \\ & \downarrow \text{eval} \\ & = 8 d^9 \end{aligned}$$

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

$$\begin{aligned} & 2^2 m^8 n^2 m^3 n^2 \\ & \downarrow \\ & 4 m^{11} n^4 \end{aligned}$$

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

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

Examples:

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

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

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

e) $\frac{25c^{30}}{5c^{23}}$

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

Examples:

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

Ex) $\left(\frac{a^3 n^4}{a^2 n^7}\right)^3$

Simplify inside first

$$\left(a^{\cancel{3}^1} n^{\cancel{4}^{-3}}\right)^3$$

$$a^3 n^{-9}$$

$$a^3 \frac{1}{n^9} = \frac{a^3}{n^9}$$

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

flip base then exponent positive

Examples:

$$\left(\frac{6}{1}\right)^{-2} = \left(\frac{1}{6}\right)^2 = \frac{1^2}{6^2} = \frac{1}{36}$$

$$\left(\frac{2}{3}\right)^{-\frac{1}{3}} \xrightarrow[\text{base change exp}]{\text{exponents flip}} \left(\frac{3}{2}\right)^{\frac{1}{3}} = \sqrt[3]{\frac{3}{2}}$$

Radicals

$$\begin{aligned} &8^{\frac{2}{3}} \\ &= \left(\sqrt[3]{8}\right)^2 \\ &= (2)^2 \\ &= 4 \end{aligned}$$

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

Examples:

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

Law #8: $b^0 = 1$

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

$$(-6)^0 = 1$$

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

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

i)

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

$$\frac{(2u^3 v^3)(9u^4)}{2u^2}$$

$$\frac{18 u^7 v^3}{2u^2}$$

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

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

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

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



$$d) \frac{(3x^2y^3)(2x^3y^9)^3}{2x^{-2}y}$$



Expand and simplify:

i) $3x(x^2 - 7x + 5)$

ii) $(2x-7)(3x^2 - 4y + 6)$

iii) $(4x-5)^2$

iv) $(2x)(x-3) - (5x)(x+1)$

