Indices

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Indices (Power Rules)

The Power Rules can be summarised as shown below:-

$$X^m \cdot X^n = X^{(m+n)} \qquad \frac{X^m}{X^n} = X^{(m-n)} \qquad \left(X^m\right)^n = X^{m \cdot n}$$

$$X^0 = 1 \qquad X^{-m} = \frac{1}{X^m} \qquad X^{\frac{m}{n}} = \left(\sqrt[n]{X}\right)^m$$

Note that when applying the rules the base values (in this case X) MUST be the same it is not true that:-

$$X^m \cdot Y^n \neq (XY)^{(m+n)}$$

Product example

$$2^5 \cdot 2^7 = 2^{(5+7)} = 2^{12} = 4096 \qquad b^4 \cdot b^{15} = b^{19}$$

Division example

$$\frac{2^7}{2^5} = 2^{(7-5)} = 2^2 = 4 \qquad \frac{b^{15}}{b^4} = b^{11}$$

Power of a power example

$$\left(2^5\right)^2 = 2^{(5 \cdot 2)} = 2^{10} = 1024 \qquad \left(b^4\right)^{15} = b^{60}$$

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Special example

$2^0 = 1$ $\qquad$ $b^0 = 1$

Any base to the power 0 is 1

Negative power example

$2^{-5} = \frac{1}{2^5} = \frac{1}{32}$ $\qquad$ $b^{-2} = \frac{1}{b^2}$

Fractional power example

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

This says take the cubic root of two, then raise the result to the power five.

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

This says take the square root of b and the rise that result to the power three.

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Combination of rules example

$$\frac{\left(3^4 \cdot 3^5 \cdot 3^2\right)^2}{3^{20}}$$

Step 1: Rules of arithmetic do brackets first

$$3^{(4+5+2)} = 3^{11}$$

We now have $\frac{\left(3^{11}\right)^2}{3^{20}}$

Step 2: Do power of power

$$\left(3^{11}\right)^2 = 3^{22}$$

We now have $\frac{3^{22}}{3^{20}}$

Step 3: Do division

$$\frac{3^{22}}{3^{20}} = 3^{(22-20)} = 3^{22} = 9$$