

Indices

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Indices (Power Rules)

The Power Rules can be summarised as shown below:-

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

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

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

$$2^5 \cdot 2^7 = 2^{(5+7)} = 2^{12} = 4096$$

$$b^4 \cdot b^{15} = b^{19}$$

Division example

$$\frac{2^7}{2^5} = 2^{(7-5)} = 2^2 = 4$$

$$\frac{b^{15}}{b^4} = b^{11}$$

Power of a power example

$$(2^5)^2 = 2^{(5 \cdot 2)} = 2^{10} = 1024$$

$$(b^4)^{15} = b^{60}$$

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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

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

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

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

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

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Combination of rules example

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

Step 1: Rules of arithmetic do brackets first

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

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

Step 2: Do power of power

$$(3^{11})^2 = 3^{22}$$

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

Step 3: Do division

$$\frac{3^{22}}{3^{20}} = 3^{(22-20)} = 3^2 = 9$$