M9

Exponent Laws

For any real number "a" and any integers "m" and "n" the following is true:

!It is very important that the base is the same for each power, the rules do not work otherwise! !

Law	Formula	Example
Product Law	$a^m \times a^n = a^{m+n}$ if both bases are the same and multiplied, you can add the exponents together.	$5^2 \times 5^4 = 5^{2+4} = 5^6$ Proof: $5^2 \times 5^4$ $5\times5 \times 5\times5\times5\times5$ 6 Times $= 5^6$
Quotient Law	$a^m \div a^n = a^{m-n}$ if both bases are the same and divided, you can subtract the exponents togethe $\frac{a^m}{a^n} = a^{m-n}$	$6^8 \div 6^3 = 6^{8-3} = 6^5$ Proof: $\frac{6^8}{6^3} = \frac{6\cdot6\cdot6\cdot6\cdot6\cdot6\cdot6\cdot6}{6\cdot6\cdot6}$ 5 times 6^5
Power Law	if you have a power to a power you multiply the exponents $(a^m)^n = a^{m\times n}$	$(7^2)^3 = 7^{2\times3} = 7^6$ Proof: $(7^2)^3 = (7^2)(7^2)(7^2)$ $(7\times7)(7\times7)(7\times7)$ 6 times 7^6

For any real numbers "a" and "b" and any integers "m" and "n" the following is true:

Law	Formula	Example
Power of a Product	$(a \times b)^m = a^m \times b^m$	$(2x)^3 = 2^3 \cdot x^3 = 8 \cdot x^3$
Power of a Quotient	$b \neq 0$ $(a \div b)^m = a^m \div b^m$ $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$	$\left(\frac{3}{x}\right)^2 = 3^2 \div x^2 = 9 \div x^2$ or $\frac{3^2}{x^2} = \frac{9}{x^2}$
Exponent of zero	$a \neq 0$ $a^0 = 1$	$15^0 = 1$
Base of positive one	$1^a = 1$	$1^{500} = 1$
Base of negative one	$(-1)^a = 1$ if and only if a is even $(-1)^a = -1$ if and only if a is odd	$(-1)^{20} = +1$ $(-1)^{31} = -1$

Rule	Formula	Example
A base with a negative exponent	$a^{-m} = \frac{1}{a^m}$ → Base goes to denominator → Exponent changes to positive	Base $(5x)^{-1} = \frac{1}{(5x)^1} = \frac{1}{5x}$ Base $4^{-2} = \frac{1}{4^2} = \frac{1}{16}$ Base $7x^{-3} = \frac{7}{x^3}$
A fraction with bases with one or more negative exponents	$b \neq 0$ and $a \neq 0$ (Not Not) $\frac{a^{-m}}{b^{-n}} = \frac{b^n}{a^m}$ $\left(\frac{a}{b}\right)^{-m} = \left(\frac{b}{a}\right)^{m}$	$\frac{x^{-3}}{y^{-9}} = \frac{y^9}{x^3}$ $\frac{a^{-2}}{b^3} = \frac{1}{a^2 b^3}$ 'b' stayed put because it is positive exponent $\frac{a^7}{b^{-9}} = \frac{a^7 b^9}{1}$ or $a^7 b^9$

More examples

11. Write without negative exponents

a) $2^{-3} = \frac{1}{2^3} = \frac{1}{8}$

b) $\left(\frac{1}{8}\right)^{-7} = \frac{8^7}{1} = 8^7$

c) $2x^{-4} = \frac{2}{x^4}$

d) $(3x)^{-5} = \frac{1}{(3x)^5} = \frac{1}{3^5 x^5}$

e) $\frac{a^{-4}}{b^{-5}} = \frac{b^5}{a^4}$

f) $\frac{x^{-6}}{y^3} = \frac{1}{y^3 x^6}$