Properties of exponents

Consider the following:

$x * x * x * y * x * y * y * y * y * x * y * x * x * x$

Is there a shorter way to write this?

*Yes! By using **exponents**.*

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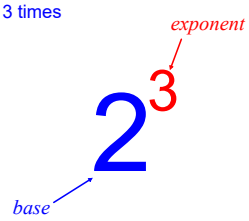
Properties of exponents

What does 2^3 mean?

$2 * 2 * 2 = 8$

It means 2 multiplied 3 times



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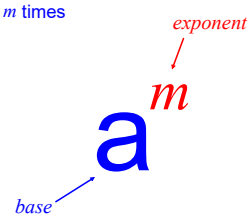
Properties of exponents

What does a^m mean?

$a * a * a * \ldots * a$

It means a multiplied m times



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Properties of exponents

Back to this ... rewrite the following using exponents:

$x * x * x * y * x * y * y * y * y * x * y * x * x * x$

...there are 8 x's ... x^8

...and there are 6 y's ... y^6

$$x^8 y^6$$

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Properties of exponents

$2^3 = 2 \cdot 2 \cdot 2$ $2^4 = 2 \cdot 2 \cdot 2 \cdot 2$

$2^3 * 2^4 = \overbrace{(2 \cdot 2 \cdot 2)}^{2^3} \cdot \overbrace{(2 \cdot 2 \cdot 2 \cdot 2)}^{2^4}$

$= 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

$= 2^7$

3 + 4

$$2^3 * 2^4 = 2^7$$

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Properties of exponents

multiplying add

$$a^m * a^n = a^{m+n}$$

same base

when multiplying same base, add exponents

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Properties of exponents

$a^m \cdot a^n = a^{m+n}$

$3^2 \cdot 3^5 = 3^{2+5} = 3^7 = 2187$

$(-4)(-4)^5 = (-4)^1(-4)^5 = (-4)^{1+5} = (-4)^6 = 4096$

$x^4 \cdot x^7 = x^{4+7} = x^{11}$

$x^3x^2y^4xy = x^3x^2x^1y^4y^1 = x^{3+2+1}y^{4+1} = x^6y^5$

$rs^7tr^2st = r^1r^2s^7s^1t^1t^1 = r^{1+2}s^{7+1}t^{1+1} = r^3s^8t^2$

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Properties of exponents

$2^3 = 2 \cdot 2 \cdot 2$ $2^4 = 2 \cdot 2 \cdot 2 \cdot 2$

$\frac{2^4}{2^3} = \frac{2 \cdot 2 \cdot 2 \cdot 2}{2 \cdot 2 \cdot 2} = \frac{\cancel{2 \cdot 2 \cdot 2} \cdot 2}{\cancel{2 \cdot 2 \cdot 2}} = 2 = 2^1$

$\frac{2^4}{2^3} = 2^{4-3} = 2^1$

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Properties of exponents

dividing subtract

$\frac{a^m}{a^n} = a^{m-n}$

same base

when dividing same base, subtract exponents

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Properties of exponents

$\frac{a^m}{a^n} = a^{m-n}$

$\frac{3^5}{3^2} = 3^{5-2} = 3^3 = 27$

$\frac{(-2)^6}{(-2)} = \frac{(-2)^6}{(-2)^1} = (-2)^{6-1} = (-2)^5 = -32$

$\frac{g^{11}}{g^2g^4} = g^{11-6} = g^5$

$\frac{6x^3y}{3x^2} = 2x^{3-2} \cdot y = 2x^1y = 2xy$

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Properties of exponents

$2^3 = 2 \cdot 2 \cdot 2$ $2^4 = 2 \cdot 2 \cdot 2 \cdot 2$

$(2^3)^4 = (2^3)(2^3)(2^3)(2^3)$

$= \overbrace{(2 \cdot 2 \cdot 2)}^{2^3}\overbrace{(2 \cdot 2 \cdot 2)}^{2^3}\overbrace{(2 \cdot 2 \cdot 2)}^{2^3}\overbrace{(2 \cdot 2 \cdot 2)}^{2^3}$

$= 2^{12}$

$(2^3)^4 = 2^{3*4} = 2^{12}$

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Properties of exponents

power of a power multiply

$(a^m)^n = a^{m*n}$

when have power of a power, multiply exponents

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Properties of exponents

$(a^m)^n = a^{m*n}$

$(3^5)^2 = 3^{5*2} = 3^{10} = 59{,}049$

$[(-2)^3]^3 = (-2)^{3*3} = (-2)^9 = -512$

$(2^{-3})^2 = 2^{-3*2} = 2^{-6} = ???$

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Properties of exponents

the basic ones...

$a^m * a^n = a^{m+n}$

$\frac{a^m}{a^n} = a^{m-n}$

$(a^m)^n = a^{m*n}$

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Properties of exponents

$a^0 = 1$

the zero power

anything raised to the zero power equals one

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Properties of exponents

$a^0 = 1$

$(-3^5)^0 = 1$

$[(-2)^0]^3 = 1$

$x^0 = 1$

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Properties of exponents

$a^{-n} = \frac{1}{a^n}$

flip the fraction

negative power

negative exponent, flip the fraction

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Properties of exponents

$a^{-n} = \frac{1}{a^n}$

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

$\left(\frac{1}{3}\right)^{-1} = \frac{3}{1} = 3$

$(3^5)^{-1} = 3^{(5)(-1)} = 3^{-5} = \frac{1}{3^5} = \frac{1}{243}$

$(3^{-5})^{-1} = 3^{(-5)(-1)} = 3^5 = 243$

$(2^{-3})^2 = 2^{-3*2} = 2^{-6} = \frac{1}{2^6} = 64$

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Properties of exponents

"distribute" the exponent

$$(ab)^n = a^n b^n$$

different bases raised to a power

different* bases *raised* to a power, *distribute exponent

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Properties of exponents

$$(ab)^n = a^n b^n$$

$(3x)^2 = 3^2x^2 = 9x^2$

$(3^2x^2y)^2 = 3^{2*2}x^{2*2}y^2 = 3^4x^4y^2 = 81x^4y^2$

$(2^{-3}3^2)^2 = 2^{-3*2} \cdot 3^{2*2} = 2^{-6} \cdot 3^4 = \frac{3^4}{2^6} = \frac{81}{64}$

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Properties of exponents

fraction

distribute

different bases

$$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$$

fraction* raised to a power, *power up, power down

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Properties of exponents

$$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$$

$\left(\frac{1}{3}\right)^2 = \frac{1^2}{3^2} = \frac{1}{9}$

$\left(\frac{x^2}{2y^3}\right)^3 = \frac{x^{2*3}}{2^3y^{3*3}} = \frac{x^6}{8y^9}$

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Properties of exponents

the basic ones...

$a^m \cdot a^n = a^{m+n}$

$\frac{a^m}{a^n} = a^{m-n}$

$(a^m)^n = a^{m*n}$

the weird ones...

$a^0 = 1$

$a^{-n} = \frac{1}{a^n}$

distribute the exponent...

$(ab)^n = a^n b^n$

$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$

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Properties of exponents

$\frac{5x^4y^3}{8x^5} \cdot \frac{3x^3y^5}{6y^4} = \frac{(5x^4y^3)(3x^3y^5)}{(8x^5)(6y^4)}$ *combine fractions*

$= \frac{15x^7y^8}{48x^5y^4}$ *combine like terms ...in numerator ...then in denominator*

$= \frac{{}^{5}\cancel{15}x^{7-5}y^{8-4}}{{}_{16}\cancel{48}}$ *cancel in the fraction*

$= \frac{5x^2y^4}{16}$ *simplify*

$a^m \cdot a^n = a^{m+n}$

$\frac{a^m}{a^n} = a^{m-n}$

$(a^m)^n = a^{m*n}$

$a^0 = 1$

$a^{-n} = \frac{1}{a^n}$

$(ab)^n = a^n b^n$

$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$

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Properties of exponents

Solve for x

$2 \cdot 2^{x} = 2^{2}$

$2^{x+4} = 2^{2}$

$x+4 = 2$

$x = -2$

for the equation to be equal the *exponents* must be the same since the *bases* are the same!

$a^m \cdot a^n = a^{m+n}$

$\frac{a^m}{a^n} = a^{m-n}$

$(a^m)^n = a^{m \cdot n}$

$a^0 = 1$

$a^{-n} = \frac{1}{a^n}$

$(ab)^n = a^n b^n$

$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$

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Pre L5.1 HW Problems

Worksheet #1-33

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