

U4D1_T Exponent Laws

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U4D1_T
Exponent ...

U4D1 MCR3UI

Exponent Laws

Integral Exponents

An expression of the form a^n is called a power.

Positive Integral Exponent
 $a^n = \underbrace{a \cdot a \cdot a \dots a}_{n \text{ of them}}$

 Negative Integral Exponent
 $a^{-n} = \left(\frac{1}{a}\right)^n = \frac{1}{a^n}$

 Zero Exponent
 $a^0 = 1, a \neq 0$

 $\frac{7}{7} = 1, 7^1 \div 7^1 = 7^{1-1} = 7^0$

Law for...	General Form	Example
Multiplication of powers	$x^m \cdot x^n = x^{m+n}$	$5^4 \cdot 5^7 = 5^{4+7} = 5^{11}$ *keep base the same*
Division of Powers	$\frac{x^m}{x^n} = x^{m-n}$	$\frac{4^6}{4^2} = \frac{4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4}{4 \cdot 4} = 4^{6-2} = 4^4$
Power of a Power	$(x^m)^n = x^{m(n)}$	$(6^5)^2 = 6^{5 \times 2} = 6^{10}$
Power of a Product	$(xy)^n = x^n y^n$	$(3y)^3 = (3)^3 (y)^3 = 27y^3$
Power of a Quotient	$\left(\frac{x}{y}\right)^n = \frac{x^n}{y^n}$	$\left(\frac{3}{2}\right)^4 = \frac{(3)^4}{(2)^4} = \frac{81}{16}$

NOTE: $(x+y)^n$ does NOT have a similar rule.

Example 1. Simplify. Express your answer with positive exponents

a) $x^{-3} \cdot x^{-5} = x^{-3+(-5)} = x^{-8} = \frac{1}{x^8}$
 e) $(4x^3y^2)(7x^2y^4) = 28x^{3+2}y^{2+4} = 28x^5y^6$
 b) $m^2 \div m^{-3} = m^{2-(-3)} = m^{2+3} = m^5$
 f) $\left(\frac{3x^2}{z^3}\right)^2 = \frac{(3)^2(x^2)^2}{(z^3)^2} = \frac{9x^4}{z^6} = \frac{4}{5}x^{-2}y^6 = \frac{4y^6}{5x^2}$
 c) $\frac{a^5b^3}{a^2b^2} = a^{5-2}b^{3-2} = a^3b$
 g) $\frac{(2x^{-2}y)^3}{10x^{-4}y^{-3}} \xrightarrow{\text{BEDMAS}} \frac{(2)^3(x^{-2})^3(y)^3}{10x^{-4}y^{-3}} = \frac{8x^{-6}y^3}{10x^{-4}y^{-3}} = \frac{8}{10}x^{-6+4}y^{3+3} = \frac{4}{5}x^{-2}y^6 = \frac{4y^6}{5x^2}$
 d) $(-2c^3d^{-5}e)^2 = (-2)^2(c^3)^2(d^{-5})^2(e)^2 = 4c^6d^{-10}e^2 = \frac{4c^6e^2}{d^{10}}$
 h) $\frac{(-2x^{-3}y)(-12x^{-4}y^{-2})}{6xy^{-3}} = \frac{24x^{-7}y^{-1}}{6x^1y^{-3}} = 4x^{-7-1}y^{-1+3} = 4x^{-8}y^2 = \frac{4y^2}{x^8}$

Example 2. Evaluate. Answers should be left as reduced fractions (decimal answers are not acceptable). Do not use a calculator!!!

a) $\left(\frac{3}{4}\right)^{-2} = \left(\frac{4}{3}\right)^2 = \frac{4^2}{3^2} = \frac{16}{9}$
 b) $\frac{(-6)^0}{2^{-3}} = (-6)^0(2)^3 = 1(8) = 8$
 c) $\frac{(2^{-4}+2^{-9})x^{2^6}}{2^{-3}} = \frac{2^{-4}+2^{-9}}{2^{-3}} \times \frac{2^6}{2^6} = \frac{2^{-4}+2^{-9}}{2^{-3}} \times 2^6 = \frac{2^{-4+6}+2^{-9+6}}{2^{-3+6}} = \frac{2^2+2^{-3}}{2^3} = \frac{4+1}{8} = \frac{5}{8}$
 d) $\frac{3^{-5}}{3^{-4}+3^{-3}} \times \frac{3^5}{3^5} = \frac{3^0}{3^1+3^2} = \frac{1}{3+9} = \frac{1}{12}$

3 - 1 - 0

$$= \frac{7+1}{8}$$

$$= 3+9 \checkmark$$

$$\begin{aligned} & \frac{5^{-200} + 5^{-198}}{5^{-199} - 5^{-200}} \times \frac{5^{200}}{5^{200}} \\ &= \frac{5^0 + 5^2}{5 - 5^0} \\ &= \frac{1+25}{5-1} \\ &= \frac{26}{4} \\ &= \frac{13}{2} \end{aligned}$$