Rules of Exponents

If x, y are real numbers and m, n are positive integers then:

Product Rule	$x^m \cdot x^n = x^{m+n}$	$x^2 \cdot x^3 = x^{2+3} = x^5$
Quotient Rule	$\frac{x^m}{x^n} = x^{m-n}$	$\frac{x^5}{x^3} = x^{5-3} = x^2$
Power Rule	$(x^m)^n = x^{m \cdot n}$	$(x^2)^3 = x^{2 \cdot 3} = x^6$
Zero Exponent	$x^0 = 1, x \neq 0$	$(x^2)^0 = 1$
Distributive over Multiplication (First)	$(xy)^n = x^n y^n$	$(-2x)^5 = (-2)^5 x^5 = -32x^5$
Distributive over Division (Second)	$\left(\frac{x}{y}\right)^n = \frac{x^n}{y^n}$	$\left(\frac{2x}{-3y}\right)^3 = \frac{(2x)^3}{(-3y)^3} = \frac{8x^3}{-27y^3}$

Example 1: Multiplication and the rules of exponents

Simplify each expression.

a) $x^4 \cdot x^2$

b) $2^3 \cdot 2^2$

c) $\left(x^4 y^3\right) \cdot \left(xy^2\right)$

d) $(2x)^4 \cdot (2x)^5$

e) $r^5 \cdot r^4 \cdot r^0$

f) $(x+y)^5 (x+y)^3$

Example 2: Division and the rules of exponents

a) $\dfrac{x^4}{x^2}$

b) $\dfrac{2^5}{2^2}$

c) $\dfrac{(2x)^6}{(2x)^2}$

d) $\dfrac{(-2x)^5}{(2x)^3}$

e) $\dfrac{(x+y)^8}{(x+y)^2}$

f) $\dfrac{10x^5}{4x^4}$

g) $\dfrac{10x^5y^3}{4x^4y^6}$

Example 3: Power and first distributive rule of exponents

a) $\left(2^4\right)^5$

b) $\left(x^4\right)^3$

c) $\left(-y^2\right)^4$

d) $\left(a^2b^5\right)^2$

e) $\left(-2x^3y^4\right)^3$

f) $\left(ab^2\right)^5\left(a^3b^4\right)^3$

Example 4: Second distributive rule of exponent

a) $\left(\frac{2}{y}\right)^3$

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

c) $\left(\frac{-y^2}{x^5}\right)^4$

d) $\left(\frac{ab^4}{c^3}\right)^3$

e) $\left(\frac{-2x^2y}{3z^3}\right)^3$

f) $\left(\frac{-2x^2y}{3z^3}\right)^0$

g) $\left(\frac{-2x^2y}{3z^3}\right)^3\left(\frac{-x^2z^2}{2y^4}\right)^4$