Properties of Exponents

Let a and b be real numbers and let m and n be integers.

Property Name	Definition	Example
Product of Powers	$a^m \cdot a^n = a^{m+n}$	$5^3 \cdot 5^{-1} = 5^2$
Power of a Power	$(a^m)^n = a^{mn}$	$(3^3)^2 = 3^6$
Power of a Product	$(ab)^m = a^m b^m$	$(2 \cdot 3)^4 = 2^4 \cdot 3^4$
Negative Exponent	$a^{-m} = \frac{1}{a^m}, a \neq 0$	$7^{-2} = \frac{1}{7^2} = \frac{1}{49}$
Zero Exponent	$a^0 = 1, a \neq 0$	$(-89)^0 = 1$
Quotient of Powers	$\frac{a^m}{a^n} = a^{m-n}, a \neq 0$	$\frac{6^{-3}}{6^{-6}} = 6^{-3-(-6)} = 6^3$
Power of a Quotient	$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}, b \neq 0$	$\left(\frac{4}{7}\right)^2 = \frac{4^2}{7^2}$

Evaluate the expression.

a. $(-3^2 \cdot 5)^3 = (-9 \cdot 5)^3 = (-45)^3 = -91{,}125$

b. $\left(\frac{1^4}{3^2}\right)^{-2} = \left(\frac{1}{9}\right)^{-2} = \left(\frac{9}{1}\right)^2 = 9^2 = 81$

Shortcut: negative exponent → change level ... make positive

$\left(\frac{2}{3}\right)^{-4} = \left(\frac{3}{2}\right)^4 = \frac{3^4}{2^4} = \frac{81}{16}$

$\frac{a^{-3} b^2}{c^{-4}} = \frac{b^2 c^4}{a^3}$