12 **EXPONENTS AND THEIR PROPERTIES (4.1, 4.2)**

Basic Definitions and Notation

2^3 means $2 \cdot 2 \cdot 2$ or 8 The number 3 is the **exponent**. The number 2 is the **base**.
x^4 means $x \cdot x \cdot x \cdot x$ 4 is the **exponent**; x is the **base**.

WARNING!
The base of an exponent is the symbol directly in front of the exponent.

-2^3 means $-(2 \cdot 2 \cdot 2)$ The symbol directly in front of the exponent is 2.
$(-2)^3$ means $(-2)(-2)(-2)$ The symbol directly in front of the exponent is a parenthesis. The exponent belongs to everything in the parentheses.
$3x^4$ means $3(x \cdot x \cdot x \cdot x)$
$(3x)^4$ means $(3x)(3x)(3x)(3x)$
$-x^4$ means $-(x \cdot x \cdot x \cdot x)$

x^{-3} means $\frac{1}{x^3}$ A negative exponent means the reciprocal of the base with a *positive exponent*. It does not indicate a negative number!

$-x^{-3} = -\frac{1}{x^3}$ The negative sign *in front* remains. The negative exponent produces a reciprocal.

Properties of Exponents

1. $\mathbf{x^a \cdot x^b = x^{a+b}}$ **Product Rule:** When **multiplying** 2 quantities with the same base, keep the common base and **add the exponents.**

Example: $5^3 \cdot 5^4 = (5 \cdot 5 \cdot 5) \cdot (5 \cdot 5 \cdot 5 \cdot 5) = (5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5) = 5^7 = 5^{3+4}$

2. $\frac{\mathbf{x^a}}{\mathbf{x^b}} = \mathbf{x^{a-b}}$ $\mathbf{(x \neq 0)}$ **Quotient Rule:** When **dividing** 2 quantities with the same base, keep the common base and s**ubtract** the denominator exponent from the numerator exponent.

Example: $\frac{3^6}{3^2} = \frac{3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3}{3 \cdot 3} = \frac{\cancel{3} \cdot \cancel{3} \cdot 3 \cdot 3 \cdot 3 \cdot 3}{\cancel{3} \cdot \cancel{3}} = 3 \cdot 3 \cdot 3 \cdot 3 = 3^4 = 3^{6-2}$