MAP 4CI Unit 6 – Algebraic Models Lesson 1: Exponent Laws

1. Multiplication Law: $x^m \times x^n = x^{m+n}$

When multiplying powers with the same base, keep the base the same and add the exponents.

Ex 1.	$x^3 \times x^2$	(Note: $x^3 \times x^2 = x \cdot x \cdot x \cdot x \cdot x$)	Ex. 2	$2^3 \times 2^4$
	$=x^{3+2}$			$= 2^{3+4}$
	$= x^{5}$			=2 ⁷
				=128

2. Division Law: $x^m \div x^n = x^{m-n}$

When dividing powers with the same base, keep the base the same and subtract the exponents.

Ex. 1
$$x^5 \div x^2$$
 Ex. 2 $2^4 \div 2^3$ Note: $2^4 \div 2^3$
 $= x^{5-2}$ $= 2^{4-3}$ $= \frac{2^4}{2^3}$
 $= x^3$ $= 2^1$ $= \frac{2 \cdot 2 \cdot 2 \cdot 2}{2 \cdot 2 \cdot 2}$
 $= 2$

3. Power of a Power Law: $(x^m)^n = x^{m \times n}$

If a power is raised to an exponent, multiply the exponents.

Ex.
$$(x^3)^2 = x^{3\times 2}$$

 $= x^6$
4. Power of a Product Law: $(x \cdot y)^m = x^m y^m$

NOTE: This rule does NOT apply to the power of a sum or difference!

Ex. 1 $(x \cdot y)^5 = x^5 y^5$ = $(3x^5 y^3)^2$ = $(3)^2 (x^5)^2 (y^3)^2$ = $9x^{10} y^6$

5. Power of a Quotient Law: $\left(\frac{x}{y}\right)^m = \frac{x^m}{y^m}$

If a Quotient is raised to an exponent, distribute the exponent to every factor in the numerator and denominator.

Ex. 1
$$\left(\frac{x}{y}\right)^2 = \left(\frac{x}{y}\right) \left(\frac{x}{y}\right)$$

 $= \frac{x^2}{y^2}$
Ex. 2 $\left(\frac{2}{3}\right)^2$
Ex. 3 $\left(\frac{2x^3}{3y^2}\right)^3 = \frac{(2)^3 (x^3)^3}{(3)^3 (y^2)^3}$
 $= \frac{2^2}{3^2}$
 $= \left(\frac{8x^9}{27y^6}\right)$
 $= \frac{4}{9}$

6. Zero Exponents: $x^0 = 1$

Any power with an exponent of zero is equal to one.

Ex. 1
$$(-2)^0 = 1$$
 Ex. 2 $-2^0 = -(2^0)$ Ex. 3 $(-237x^3y^7)^0 = 1$
= -1

Proof:

$3^2 \div 3^2$	$3^2 \div 3^2$
$=\frac{3\times3}{3\times3}$	=3 ²⁻²
$=\frac{9}{9}$	= 3 ⁰
=1	So, $3^0 = 1$
7. Negative Expo	nents: $x^{-m} = \frac{1}{x^m}$

A negative in the exponent of a power means to 'flip the base' or 'take the reciprocal'. A negative exponent has nothing to do with the sign of the number.

Ex. 1
$$x^{-2} = \frac{1}{x^2}$$
 Ex. 2 $4^{-2} = \frac{1}{4^2}$ Ex. 3 $\left(\frac{4}{5}\right)^{-3} = \left(\frac{5}{4}\right)^3$ Ex. 4 $\left(\frac{1}{3}\right)^{-2} = \left(\frac{3}{1}\right)^2$
= $\frac{5^3}{4^3}$ = 3^2
Ex. 4 Simplify first, then evaluate using x = 2. = $\frac{125}{64}$ = 9

= 9

Ex. 4 Simplify first, then evaluate using x = 2.

