CHAPTER 7: EXPONENTS AND EXPONENTIAL FUNCTIONS

7.1
APPLY EXPONENT PROPERTIES INVOLVING PRODUCTS

Exponents

- Exponent – the number of times the base is multiplied by itself
- EX: $4^3 = 4 \cdot 4 \cdot 4$

  * The base of 4 is multiplied by itself 3 times.

1) Product of Powers Property

- When you multiply like bases, ADD the exponents.
- EX:

$5^3 \cdot 5^4 = 5^{3+4} = 5^7$ * like base is 5

$x^9 \cdot x^2 = x^{9+2} = x^{11}$ * like base is x

EX:

- Simplify the expression. Write your answer using exponents. → Don't multiply out the numbers
- $(-7)^2(-7)^8$

  $(-7)^{2+8}$

  $\boxed{(-7)^{10}}$
- $x^2 \cdot x^6 \cdot x^1$

  x^{2+6+1}

  $\boxed{x^9}$

2) Power of a Power Property

- When you raise a power to a power, MULTIPLY the exponents.
- EX: $(2^4)^3 = 2^{4\cdot 3} = 2^{12}$ * A power of 2^4 is being raised to another power of 3

  $(x^5)^3 = x^{5\cdot 3} = x^{15}$ * A power of x^5 is being raised to another power of 3

EX:

- Simplify the expression. Write your answer using exponents.
- $(4^2)^7$

$4^{2\cdot 7}$

$\boxed{4^{14}}$

- $[(-2)^4]^5$

$(-2)^{4\cdot 5}$

$\boxed{(-2)^{20}}$

- $[(m + 1)^6]^3$

$(m+1)^{6\cdot 3}$

$\boxed{(m+1)^{18}}$

3) Power of a Product Property

- When a product is raised to a power, raise each factor to the power.
- EX:

$(4\cdot 10)^2 = 4^2 \cdot 10^2$

* Product is $4\cdot 10$
* Factors are 4 and 10
* Raise 4 and 10 to the 2nd power

$(9xy)^4 = 9^4x^4y^4$

* $9xy$ is the product
* 9, x, and y are the factors
* Raise 9, x, and y to the 4th power

EX:

- Simplify each expression. Write your answer using exponents.
- $(20 \cdot 17)^3$

$\boxed{20^3 \cdot 17^3}$

EX: Simplify each expression. → As much as possible. Multiply out numbers.

- $(-4x)^2$

  $(-4)^2 x^2$

  $\boxed{16x^2}$

- $-(4x)^2$

  $-(4)^2 x^2$

  $\boxed{-16x^2}$

$(2x^3)^2 \cdot x^4$

$(2)^2 (x^3)^2 \cdot x^4$

$4x^6 \cdot x^4$

$\boxed{4x^{10}}$

- $(-10x^6)^2 \cdot x^2$

$(-10)^2(x^6)^2 \cdot x^2$

$100\underline{x^{12}} \cdot \underline{x^2}$

$\boxed{100x^{14}}$

- $(3x^5)^3(2x^7)^2$

$(3)^3(x^5)^3 \cdot (2)^2(x^7)^2$

$\underline{27}\,\underline{\underline{x^{15}}} \cdot \underline{4}\,\underline{\underline{x^{14}}}$

$\boxed{108x^{29}}$

Order of Magnitude

- The **order of magnitude** of a quantity is the power of 10 that is closest to the actual value of the quantity.
  - An estimate (often used for really big/small numbers)
- EX:

$8 \approx 10 \approx 10^1$

$90 \approx 100 \approx 10^2$

$1025 \approx 1000 \approx 10^3$

$7{,}005 \approx 10{,}000 \approx 10^4$

$80{,}250 \approx 100{,}000 \approx 10^5$

* The number of zeros in the estimate matches the exponent in the power of 10.

- [Order of Magnitude]

EX:

- A box of staples contains 10^4 stables. How many stables do 10^2 boxes contain?

\# boxes (staples per box)

$10^2(10^4)$

$\boxed{10^6 \text{ staples}}$

EX:

- There are about 1 billion grains of sand in 1 cubic foot of sand. Use order of magnitude to find about how many grains of sand are in 25 million cubic feet of sand.

1 billion = 1,000,000,000 = 10^9

25 million = 25,000,000 ≈ 10,000,000 ≈ 10^7

cubic feet (grains of sand per cubic foot)

$10^7(10^9)$

$\boxed{10^{16} \text{ grains of sand}}$