


PRINCIPLES - LESSON 10A

MULTIPLYING POWERS WITH LIKE BASES

Recall:

Multiplication = Sped-Up Addition

ADDITION


$$2 + 2 + 2 + 2 + 2$$


MULTIPLICATION

$$2 \cdot 5$$


Exponents = Sped-Up Multiplication

MULTIPLICATION

$$3 \cdot 3 \cdot 3 \cdot 3$$


EXPONENTS

$$3^4$$


PARTS OF A POWER

When two or more numbers are multiplied, each number is called a **factor**. An **exponent** is used to show how many times the factor, or **base**, is multiplied.

When all of the factors are written out separately, the expression has been **EXPANDED**.

$$7^3 = 7 \cdot 7 \cdot 7$$

The diagram illustrates the components of a power. On the left, the number 7 is labeled as the **BASE** with an arrow pointing to it. To its right is the number 3, labeled as the **EXPONENT** with an arrow pointing to it. An equals sign follows. To the right of the equals sign are three 7s separated by multiplication dots (7 · 7 · 7). Arrows point from the word **FACTORS** below to each of the three 7s.

EXPONENT REVIEW

Expand and then simplify.

ex1) 3^4

$$= \frac{3 \cdot 3 \cdot 3 \cdot 3}{\text{expanded}} = \boxed{81} \text{ simplified}$$

ex2) 5^3

$$= \frac{5 \cdot 5 \cdot 5}{\text{expanded}} = \boxed{125} \text{ simplified}$$

ex3) x^6

$$= \frac{x \cdot x \cdot x \cdot x \cdot x \cdot x}{\text{expanded}} = \boxed{x^6} \text{ simplified} \quad \left(\text{This expression was simplified from the start!} \right)$$

FIND THE RULE

Expand and then simplify.

ex4) $2^3 \cdot 2^4$

$$= 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 2^7 = \boxed{128}$$

ex5) $x^5 \cdot x^3$

$$= x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x = \boxed{x^8}$$

MULTIPLYING POWERS WITH THE SAME BASE

Shortcut to multiplying powers with like bases: **ADD EXPONENTS**

Exponent Rule 1: Multiplying Powers with Like Bases

$$x^m \cdot x^n = x^{m+n}$$

MULTIPLYING POWERS WITH THE SAME BASE

Simplify.

$$\text{ex6) } y^8 \cdot y^{15} = y^{8+15} = \boxed{y^{23}}$$

$$\text{ex7) } k^{13} \cdot k^1 = k^{13+1} = \boxed{k^{14}}$$

$$\text{ex8) } a^6 \cdot b^4 = \boxed{a^6 b^4}$$

**Our rule only works when we have LIKE bases.
We cannot add the exponents on different variables.**

MULTIPLYING POWERS WITH THE SAME BASE

Simplify.

We can use the commutative property to change the order of multiplication.

$$\text{ex9) } \underline{5} \underline{a^3} \underline{b^7} \cdot \underline{3} \underline{a^2} \underline{b^4} \underline{c^9}$$

$$= 5 \cdot 3 \cdot a^3 \cdot a^2 \cdot b^7 \cdot b^4 \cdot c^9$$

$$= 15 \cdot a^{3+2} \cdot b^{7+4} \cdot c^9$$

$$= \boxed{15a^5b^{11}c^9}$$

When multiplying two expressions, always **MULTIPLY COEFFICIENTS FIRST.**

MULTIPLYING POWERS WITH THE SAME BASE

Simplify.

$$\text{ex10) } (-2x^2y^4)(-5x^6y^1)$$

$$= -2 \cdot (-5) \cdot x^2 \cdot x^6 \cdot y^4 \cdot y^1$$

$$= 10 \cdot x^{2+6} \cdot y^{4+1}$$

$$= \boxed{10x^8y^5}$$

MULTIPLYING POWERS WITH THE SAME BASE

Simplify.

$$\text{ex11) } (m^6 n^{13} p^{10}) (-mn^4)$$

$$= 1 \cdot (-1) \cdot m^6 \cdot m^1 \cdot n^{13} \cdot n^4 \cdot p^{10}$$

$$= -1 \cdot m^{6+1} \cdot n^{13+4} \cdot p^{10}$$

$$= \boxed{-m^7 n^{17} p^{10}}$$

MULTIPLYING POWERS WITH THE SAME BASE

Simplify.

$$\text{ex12)} \quad (\underline{-4a^3b^2}) (\underline{1a^5b^4}) (\underline{-3a^5})$$

$$= -4 \cdot 1 \cdot (-3) \cdot a^3 \cdot a^5 \cdot a^5 \cdot b^2 \cdot b^4$$

$$= 12 \cdot a^{3+5+5} \cdot b^{2+4}$$

$$= \boxed{12a^{13}b^6}$$