

# PRINCIPLES - LESSON 10B

## POWERS TO POWERS / PRODUCTS TO POWERS

**Recall:**

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

**Simplify.**

$$\text{ex1) } x^5 \cdot x^{12} = x^{5+12} = \boxed{x^{17}}$$

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$$\text{ex2) } n^8 \cdot n^3 = n^{8+3} = \boxed{n^{11}}$$

# FIND THE RULE

**Simplify.**

$$\text{ex3) } (n^3)^4 = n^{\overset{3}{\cdot} \overset{3}{\cdot} \overset{3}{\cdot} \overset{3}{\cdot}} = n^{3+3+3+3} = \boxed{n^{12}}$$

$$\text{ex4) } (r^2)^5 = r^{\overset{2}{\cdot} \overset{2}{\cdot} \overset{2}{\cdot} \overset{2}{\cdot} \overset{2}{\cdot}} = r^{2+2+2+2+2} = \boxed{r^{10}}$$

$$\text{ex5) } (c^3)^3 = c^{\overset{3}{\cdot} \overset{3}{\cdot} \overset{3}{\cdot}} = c^{3+3+3} = \boxed{c^9}$$

# POWERS TO POWERS

Shortcut to raising powers to powers:

**MULTIPLY EXPONENTS**

**Exponent Rule 2: Powers to Powers**

$$(x^m)^n = x^{mn}$$

# POWERS TO POWERS

**Simplify.**

$$\text{ex6) } (b^7)^{10} = b^{7 \cdot 10} = \boxed{b^{70}}$$

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$$\text{ex7) } (j^4)^8 = j^{4 \cdot 8} = \boxed{j^{32}}$$

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$$\text{ex8) } (p^7)^9 = p^{7 \cdot 9} = \boxed{p^{63}}$$

# FIND THE RULE

Simplify.

$$\begin{aligned}\text{ex9) } (2a^2)^3 &= \underline{2a^2} \cdot \underline{2a^2} \cdot \underline{2a^2} \\ &= 2 \cdot 2 \cdot 2 \cdot a^2 \cdot a^2 \cdot a^2 = (2)^3 (a^2)^3 = \boxed{8a^6}\end{aligned}$$

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$$\begin{aligned}\text{ex10) } (-4h^3k^4j^5)^2 &= (\underline{-4h^3k^4j^5}) \cdot (\underline{-4h^3k^4j^5}) \\ &= (-4) \cdot (-4) \cdot h^3 \cdot h^3 \cdot k^4 \cdot k^4 \cdot j^5 \cdot j^5 \\ &= (-4)^2 (h^3)^2 (k^4)^2 (j^5)^2 = \boxed{16h^6k^8j^{10}}\end{aligned}$$

# POWER OF A PRODUCT

**Shortcut to finding a power of a product:**

**RAISE EVERYTHING INSIDE PARENTHESIS SEPARATELY TO THE EXPONENT OUTSIDE. ALWAYS START WITH THE COEFFICIENT.**

**Exponent Rule 3: Power of a Product**

$$(xy)^m = x^m y^m$$

# NEGATIVE BASES

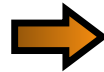
Recall:

**NEGATIVE BASE  
TO ODD POWER**



**NEGATIVE ANSWER**

**NEGATIVE BASE  
TO EVEN POWER**



**POSITIVE ANSWER**

The ONLY way to  
have a negative base

1. Negative sign must be **INSIDE**  $(-)$
2. Exponent must be **OUTSIDE**  $( )^2$

# USING THE FIRST THREE EXPONENT RULES

Simplify.

$$\begin{aligned}\text{ex11) } (-3a^3b^2c^4)^5 &= (-3)^5 (a^3)^5 (b^2)^5 (c^4)^5 \\ &= \boxed{-243a^{15}b^{10}c^{20}}\end{aligned}$$

$$\begin{aligned}\text{ex12) } (2x^4y^8z^{11})^3 (-x^5y^2z)^2 &= (2)^3 (x^4)^3 (y^8)^3 (z^{11})^3 \cdot (-1)^2 (x^5)^2 (y^2)^2 (z^1)^2 \\ &= 8x^{12}y^{24}z^{33} \cdot 1x^{10}y^4z^2 \\ &= \boxed{8x^{22}y^{28}z^{35}}\end{aligned}$$



# USING THE FIRST THREE EXPONENT RULES

Simplify.

$$\text{ex13) } (-2m^8n^{10}p^6)^4 (-2m^7n^{15})^3 (-1m^4np^3)^{12}$$

$$= (-2)^4 (m^8)^4 (n^{10})^4 (p^6)^4 \cdot (-2)^3 (m^7)^3 (n^{15})^3 \cdot (-1)^{12} (m^4)^{12} (n^1)^{12} (p^3)^{12}$$

$$= 16m^{32}n^{40}p^{24} \cdot -8m^{21}n^{45} \cdot 1m^{48}n^{12}p^{36}$$

$$= \boxed{-128m^{101}n^{97}p^{60}}$$