PRINCIPLES - LESSON 10B
POWERS TO POWERS / PRODUCTS TO POWERS

Recall:

Shortcut to multiplying powers with like bases: ADD EXPONENTS

Simplify.

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

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

FIND THE RULE

Simplify.

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

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

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

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.

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

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

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

FIND THE RULE

Simplify.

ex9) $(2a^2)^3 = 2a^2 \cdot 2a^2 \cdot 2a^2$

$= 2 \cdot 2 \cdot 2 \cdot a^2 \cdot a^2 \cdot a^2 = (2)^3(a^2)^3 = \boxed{8a^6}$

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ex10) $(-4h^3k^4j^5)^2 = (-4h^3k^4j^5) \cdot (-4h^3k^4j^5)$

$= (-4) \cdot (-4) \cdot h^3 \cdot h^3 \cdot k^4 \cdot k^4 \cdot j^5 \cdot j^5$

$= (-4)^2(h^3)^2(k^4)^2(j^5)^2 = \boxed{16h^6k^8j^{10}}$

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.

ex11) $(-3a^3b^2c^4)^5 = (-3)^5(a^3)^5(b^2)^5(c^4)^5$

$= \boxed{-243a^{15}b^{10}c^{20}}$

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ex12) $(2x^4y^8z^{11})^3(-1x^5y^2z)^2$

$= (2)^3(x^4)^3(y^8)^3(z^{11})^3 \cdot (-1)^2(x^5)^2(y^2)^2(z^1)^2$

$= 8x^{12}y^{24}z^{33} \cdot 1x^{10}y^4z^2$

$= \boxed{8x^{22}y^{28}z^{35}}$

USING THE FIRST THREE EXPONENT RULES

Simplify.

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

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

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

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