5.2 – Multiplication Properties of Exponents

Multiplying Powers with Same Base Property → $a^m \cdot a^n = a^{m+n}$ } when multiplying powers with the SAME BASE ADD the exponents.

Ex: $3^2 \cdot 3^3 = 3^{2+3} \to 3^5 \to 243$; $x^4 \cdot x^7 = x^{4+7} \to x^{11}$; $2a \cdot 4a^6 = (2 \cdot 4)a^{1+6} \to 8a^7$ (coeff.)

* When simplifying an exponential expression with more than one variable →

Combine the powers only with the EXACT SAME BASE!

i.e.. $a^2b^3 \cdot a^{-4}b^7$

$a^{2+-4} \cdot b^{3+7}$

$a^{-2}b^{10} \to \frac{b^{10}}{a^2}$

Raising a Power to a Power Property → $(a^m)^n = a^{m \cdot n}$ } Power raised to a Power, multiply the exponents.

Ex: $(5^2)^3 = 5^{2 \cdot 3} \to 5^6 \to 15{,}625$; $(x^3)^5 = x^{3 \cdot 5} \to x^{15}$

* When simplifying an exponential expression that ~~are~~ is being raised to another power →

FIRST simplify expressions (INSIDE) before raising anything to another power

Raising a Product to a Power Property → $(ab)^n \to a^{1 \cdot n} b^{1 \cdot n} \to a^n b^n$

Ex: $(3x)^4 = 3^{1 \cdot 4} x^{1 \cdot 4} \to 3^4 x^4 \to 81x^4$; $(2z^4)^3 = 2^{1 \cdot 3} z^{4 \cdot 3} \to 2^3 z^{12} \to 8z^{12}$

Example 1: Simplify each expression using all exponent properties. NO NEGATIVE EXPONENTS

a.) $c^4 \cdot d^{-3} \cdot c^2$

$c^{4+2}d^{-3}$

$c^6 d^{-3} \to \frac{c^6}{d^3}$

b.) $5t^{-2} \cdot 2t^6$

$(5 \cdot 2)t^{-2+6}$

$10t^4$

c.) $\frac{1}{a^{-4} \cdot a^2 \cdot b^{-1}}$

$\frac{1}{a^{-4+2}b^{-1}}$

$\frac{1}{a^{-2}b^{-1}} \to a^2 b$

d.) $(-4x^5yz^2)(x^{-5}y^{-3}z)$

$-4x^{5+-5}y^{1+-3}z^{2+1}$

$-4x^0y^{-2}z^3$

$\frac{-4(1)z^3}{y^2} \to \frac{-4z^3}{y^2}$

e.) $c^5(c^3)^{-2}$

$c^5 \cdot c^{3 \cdot -2}$

$c^5 \cdot c^{-6}$

$c^{5+-6} \to c^{-1} \to \frac{1}{c}$

f.) $(a^4)^2(a^2)^5$

$a^{4 \cdot 2} \cdot a^{2 \cdot 5}$

$a^8 a^{10}$

$a^{8+10} \to a^{18}$

g.) $(2x^3y^{-4})^{-3}$

$2^{1 \cdot -3} x^{3 \cdot -3} y^{-4 \cdot -3}$

$2^{-3}x^{-9}y^{12}$

$\frac{y^{12}}{2^3 x^9} \to \frac{y^{12}}{8x^9}$

h.) $(3f^4g^{-3}f^2)^3(g^5f^2g)^{-1}$

$(3f^{4+2}g^{-3})^3(g^{5+1}f^2)^{-1}$

$(3f^6g^{-3})^3(g^6f^2)^{-1}$

$3^3 f^{6 \cdot 3} g^{-3 \cdot 3} \cdot g^{6 \cdot -1} f^{2 \cdot -1}$

$27f^{18+-2}g^{-9+-6} \to 27f^{16}g^{-15} \to \frac{27f^{16}}{g^{15}}$

Power raised to a Power!

i.) $(x^{a-3})^2$

$x^{(a-3)2}$

x^{2a-6}

j.) $(m^{2x})^{x+5}$

$m^{2x(x+5)}$

m^{2x^2+10x}