## 8.1: Apply Exponent Properties Involving Products

**Goals:** *Multiply expressions with exponents
*Raise expressions with exponents to a power

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**Product Properties of Exponents**

1. $a^m \cdot a^n = a^{m+n}$
2. $(a^m)^n = a^{mn}$
3. $(ab)^m = a^m \cdot b^m$

**Write the following expressions out as products:**

$a^2 = a \cdot a$ $\qquad$ $a^3 = a \cdot a \cdot a$

**So then how would you multiply….?**

$a^2 \cdot a^3 = a \cdot a \cdot a \cdot a \cdot a = a^5$

**Can you come up with a rule to multiply expressions that have the same base and also have exponents?**

If the bases are the same and you are MULTIPLYING, the shortcut says you can add the exponents.

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

**Use the rule to multiply the following. Write your answer as an exponent:**

**Ex:** $7^3 \cdot 7^5$

$7^8$

**Ex:** $4^7 \cdot 4^6$

$4^{13}$

**Ex:** $9 \cdot 9^8 \cdot 9^2$

$9^{11}$

**Ex:** $8^5 \cdot 8 \cdot 8^2$

$8^8$

**Ex:** $(-5)(-5)^6$

$(-5)^7$
$-5^7$

**Ex:** $(-3)^3(-3)$

$(-3)^4$
$3^4$

**Ex:** $x^7 \cdot x^3$

$x^{10}$

**Ex:** $b \cdot b^3 \cdot b^5 \cdot b^2$

$b^{11}$

**Write out the following expression as a product:**

$(a^2)^3 = a^2 \cdot a^2 \cdot a^2 = (a \cdot a) \cdot (a \cdot a) \cdot (a \cdot a) = a^6$

**Can you come up with a rule to simplify an expression with an exponent raised to a power?**

When raising a power to a power, the shortcut says you can multiply the exponents.

**Use the rule to simplify the following expressions. Write your answer as an exponent:**

**Ex:** $(3^4)^2$

$3^8$

**Ex:** $(2^5)^3$

$2^{15}$

**Ex:** $[(-6)^5]^2$

$6^{10}$

**Ex:** $[(y + 2)^2]^6$

$(y + 2)^{12}$

**Ex:** $(4^2)^7$

$4^{14}$

**Ex:** $(2^7)^4$

$2^{28}$

**Ex:** $(y^3)^3$

$y^9$

**Ex:** $[(n + 8)^2]^9$

$(n + 8)^{18}$

**Write out the following expression a product:**

$(ab)^3 = (ab)(ab)(ab) = a \cdot a \cdot a \cdot b \cdot b \cdot b = a^3 \cdot b^3$

**Can you come up with a rule to simplify a product being raised to a power?**

When raising a product to a power, you can raise both/all to the exponent.

**Use your rule to simplify the following expressions. Write your answer as an exponent:**

**Ex:** $(23 \cdot 17)^5$

$23^5 \cdot 17^5$

**Ex:** $(24 \cdot 13)^8$

$24^8 \cdot 13^8$

**Ex:** $(34 \cdot 9)^6$

$34^6 \cdot 9^6$

**Simplify the following expressions:**

**Ex:** $(9xy)^2$

$81x^2y^2$

**Ex:** $(-4z)^2$

$16z^2$

**Ex:** $-(4z)^2$

$-16z^2$

**Ex:** $(9m^3n^4)^2$

$81m^6n^8$

**Ex:** $(4mn)^3$

$64m^3n^3$

**Ex:** $(-2g)^4$

$16g^4$

**Ex:** $-(5x)^2$

$-25x^2$

**Ex:** $(2x^3)^2 \cdot x^4$

$2x^{10}$

**Ex:** $(3d^5)^2 \cdot d$

$3d^{11}$

**Ex:** $5 \cdot (5x^2)^4$

$3125x^8$