Name: KEY
Date: _____

# Math 9
## Lesson 2.5 ~ Exponent Laws (Part 2)

**Power of a Power**

| Power | As Repeated Multiplication | As a Product of Factors | As a Power |
|---|---|---|---|
| $(2^4)^3$ | $2^4 \times 2^4 \times 2^4$ | $(2\times2\times2\times2)\times(2\times2\times2\times2)\times(2\times2\times2\times2)$ | $2^{12}$ |
| $(3^2)^4$ | $3^2 \times 3^2 \times 3^2 \times 3^2$ | $(3\times3)\times(3\times3)\times(3\times3)\times(3\times3)$ | $3^8$ |
| $[(-4)^3]^2$ | $(-4)^3 \times (-4)^3$ | $(-4)(-4)(-4) \times (-4)(-4)(-4)$ | $(-4)^6$ |

**Exponent Law for a Power of a Power:**

$$(a^m)^n = a^{mxn} \qquad a \neq 0$$

To raise a power to a power, multiply the exponents. The variable *a* is any integer, except 0. The variables *m* and *n* are any whole numbers.

**Power of a Product**

| Power | As Repeated Multiplication | As a Product of Factors | As a Product of Powers |
|---|---|---|---|
| $(2 \times 5)^3$ | $(2\times5)\times(2\times5)\times(2\times5)$ | $(2\times2\times2)\times(5\times5\times5)$ | $2^3 \times 5^3$ |
| $(3 \times 4)^2$ | $(3\times4)\times(3\times4)$ | $(3\times3)\times(4\times4)$ | $3^2 \times 4^2$ |
| $(5 \times 3)^4$ | $(5\times3)\times(5\times3)\times(5\times3)\times(5\times3)$ | $(5\times5\times5\times5)\times(3\times3\times3\times3)$ | $5^4 \times 3^4$ |

**Exponent Law for a Power of a Product:**

$$(a \times b)^m = a^m \times b^m \qquad a, b \neq 0$$

The variables *a* and *b* are any integers, except 0. The variable *m* is any whole number.

**Exponent Law for a Power of a Quotient:**

$$(a \div b)^n = a^n \div b^n \qquad a, b \neq 0$$

The variables *a* and *b* are any integers, except 0. The variable *m* is any whole number.

**Example # 1:** Write $[(-7)^3]^4$ as a power.

$= (-7)^{3\times4}$

$= \boxed{(-7)^{12}}$

**Example # 2:** Evaluate $(6 \times 7)^2 + [(-3)^8 \div (-3)^6]^3$.

$= 6^2 \times 7^2 + [(-3)^{8-6}]^3$

$= 6^2 \times 7^2 + [(-3)^2]^3$

$= 6^2 \times 7^2 + (-3)^{2\times3}$

$= 6^2 \times 7^2 + (-3)^6$

$= 36 \times 49 + 729$

$= \boxed{2493}$

## Practice

**1.** Write as a product of powers.

**a)** $(5 \times 2)^4 = \boxed{5^4 \times 2^4}$

**b)** $(12 \times 13)^2 = \boxed{12^2 \times 13^2}$

**c)** $[3 \times (-2)]^3 = \boxed{3^3 \times (-2)^3}$

**d)** $[(-4) \times (-5)]^5 = \boxed{(-4)^5 \times (-5)^5}$

**2.** Write as a quotient of powers.

**a)** $(5 \div 8)^0 = \boxed{5^0 \div 8^0}$

**b)** $[(-6) \div 5]^7 = \boxed{(-6)^7 \div 5^7}$

**c)** $\left(\frac{3}{5}\right)^2 = \boxed{3^2 \div 5^2} = \boxed{\frac{3^2}{5^2}}$

**d)** $\left(\frac{-1}{-2}\right)^3 = \boxed{(-1)^3 \div (-2)^3} = \boxed{\frac{(-1)^3}{(-2)^3}}$

**3.** Write as a power.

**a)** $(5^2)^3 = 5^{2\times3} = \boxed{5^6}$

**b)** $[(-2)^3]^5 = (-2)^{3\times5} = \boxed{(-2)^{15}}$

**c)** $(4^4)^1 = 4^{4\times1} = \boxed{4^4}$

**d)** $(8^0)^3 = 8^{0\times3} = \boxed{8^0}$

**4.** Evaluate.

**a)** $[(6 \times (-2)]^2 = 6^2 \times (-2)^2$
$= 36 \times 4 = \boxed{144}$

**b)** $-(3 \times 4)^2 = -(3^2 \times 4^2) = -(9 \times 16)$
$= -(144)$

**c)** $\left(\frac{-8}{-2}\right)^2 = \frac{(-8)^2}{(-2)^2} = \frac{64}{4} = \boxed{16}$

**d)** $(10 \times 3)^1 = 10^1 \times 3^1 = 10 \times 3$
$= \boxed{30}$

**e)** $[(-2)^1]^2 = (-2)^2$
$= \boxed{4}$

**f)** $[(-2)^1]^3 = (-2)^3$
$= \boxed{-8}$

**5.** Find any errors and correct them.

**a)** $(3^2)^3 = 3^5$
multiply exponents (not add)
$= 3^6$

**b)** $(3 + 2)^2 = 3^2 + 2^2$
cannot apply laws to addition
$= (3+2)^2 = 5^2$

**c)** $(5^3)^3 = 5^9$
no error

**d)** $\left(\frac{2}{3}\right)^8 = \frac{2^8}{3^8}$
no error

**e)** $(3 \times 2)^2 = 36$
no error

**f)** $\left(\frac{2}{3}\right)^2 = \frac{4}{6}$
square 3 (not times by 2)
$= \frac{2^2}{3^2} = \frac{4}{9}$

**g)** $[(-3)^3]^0 = (-3)^3$
$3 \times 0 = 0$ (not 3)
$(-3)^0$

**h)** $[(-2) \times (-3)]^4 = -6^4$
$(-2) \times (-3) = 6$ (not $-6$)
$= 6^4$

2.4 **8.** Write as a power.

**a)** $6^3 \times 6^7 =$ $6^{10}$

**b)** $(-4)^2 \times (-4)^3 =$ $(-4)^5$

**c)** $(-2)^5 \times (-2)^4 =$ $(-2)^9$

**d)** $10^7 \times 10^1 =$ $10^8$

**9.** Write as a power.

**a)** $5^7 \div 5^3 =$ $5^4$

**b)** $\frac{10^5}{10^3} =$ $10^2$

**c)** $(-6)^8 \div (-6)^2 =$ $(-6)^6$

**d)** $\frac{5^{10}}{5^6} =$ $5^4$

**e)** $8^3 \div 8^1 =$ $8^2$

**f)** $\frac{(-3)^4}{(-3)^0} =$ $(-3)^4$

2.5 **10.** Write as a power.

**a)** $(5^3)^4 =$ $5^{12}$

**b)** $[(-3)^2]^6 =$ $(-3)^{12}$

**c)** $(8^2)^4 =$ $8^8$

**d)** $[(-5)^5]^4 =$ $(-5)^{20}$

**11.** Write as a product or quotient of powers.

**a)** $(3 \times 5)^2 =$ $3^2 \times 5^2$

**b)** $(2 \times 10)^5 =$ $2^5 \times 10^5$

**c)** $[(-4) \times (-5)]^3 =$ $(-4)^3 \times (-5)^3$

**d)** $\left(\frac{4}{3}\right)^5 =$ $\frac{4^5}{3^5}$

**e)** $(12 \div 10)^4 =$ $12^4 \div 10^4$

**f)** $[(-7) \div (-9)]^6 =$ $(-7)^6 \div (-9)^6$