# 2.4 - Exponent Laws I

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**Math 9** *Name:* KEY

**2.4 – Exponent Laws I** *Date:* _____

**Exponent Laws are rules that we use when we are <u>combining</u> and <u>simplifying</u> powers.**

**Investigate**

| Product | Each Power Expanded | Re-write as a Single Power |
|---|---|---|
| $3^3 \times 3^4$ | $(3\times3\times3)\times(3\times3\times3\times3)$ | $3^7$ $3+4=7$ |
| $5^4 \times 5^2$ | $(5\times5\times5\times5)\times(5\times5)$ | $5^6$ $4+2=6$ |
| $(-2)^3 \times (-2)^2$ | $(-2)\cdot(-2)\cdot(-2)\cdot(-2)(-2)$ | $(-2)^5$ $3+2=5$ |
| $10^3 \times 10^0$ | $(10\times10\times10)\cdot 1$ $[10^0=1]$ | $10^3$ $3+0=3$ |

**Conclusion:** When we MULTIPLY powers that have the same BASE we keep the BASE and ADD the powers.

→ $b^x \times b^y = b^{x+y}$ (same base)

**Example 1: Write each expression as a single power:**

a) $4^5 \times 4^7$

base = 4 Power = 5+7

$4^{5+7} = 4^{12}$

b) $3^9 \times 3^1$

base = 3 Power = 9+1

$3^{9+1} = 3^{10}$

c) $(-13)^{12} \times (-13)^{11}$

base = −13

Power = 12+11

$(-13)^{12+11} = (-13)^{23}$

**Example 2: Evaluate:**

a) $5^2 \times 5^6$

$5^{2+6} = 5^8 = 390625$

b) $(-3)^4 \times (-3)^2$

$(-3)^{4+2} = (-3)^6 = 729$

+ve because there are 6 −ve signs (even)

c) $(-2)^5 \times (-2)^4$

$(-2)^9 = -512$

−ve because there are 9 −ve signs (odd)

Extension : Evaluate! $2^3 \times 3^2$ Bases are not same!!

$= 8 \times 9 = 72$ //

**Investigate**

| Quotient | Each Power Expanded | Re-write as a Single Power |
|---|---|---|
| $3^5 \div 3^4 = \frac{3^5}{3^4}$ | $\frac{3\times3\times3\times3\times3}{3\times3\times3\times3}$ | $3^1$ $5-4=1$ |
| $5^7 \div 5^4 = \frac{5^7}{5^4}$ | $\frac{5\times5\times5\times5\times5\times5\times5}{5\times5\times5\times5}$ | $5^3$ $7-4=3$ |
| $(-2)^6 \div (-2)^3 = \frac{(-2)^6}{(-2)^3}$ | $\frac{(-2)(-2)(-2)(-2)(-2)(-2)}{(-2)(-2)(-2)}$ | $(-2)^3$ $6-3=3$ |
| $10^3 \div 10^0 = \frac{10^3}{10^0}$ | $\frac{10\times10\times10}{1}$ | $10^3$ $3-0=3$ |

**Conclusion:** When we DIVIDE powers that have the same BASE we keep the BASE and SUBTRACT the powers.

→ $b^x \div b^y = \frac{b^x}{b^y} = b^{x-y}$

Numerator Power − Denominator Power

**Example 3: Write each expression as a single power, then evaluate:**

a) $8^7 \div 8^3$ $8^{7-3} = 8^4$

b) $3^{12} \div 3^8$ $3^{12-8} = 3^4$

c) $(-5)^{10} \div (-5)^6$ $(-5)^{10-6} = (-5)^4$

**Example 4: Evaluate using exponent laws and correct order of operations:**

a) $3^3 + 3^2 \times 3^4$

$= 3^3 + 3^6$

$= 27 + 729$

$= 756$ //

b) $(-2)^5 \times (-2)^2 \div \left[(-2)^8 \div (-2)^5\right] + (-2)^3$

$= (-2)^7 \div (-2)^3 + (-2)^3$

$= (-2)^4 + (-2)^3$

$= 16 + -8$

$= 16 - 8 = 8$ //