## Curriculum Outcome

(N1) Demonstrate an understanding of powers with integral bases (excluding base 0) and whole number exponents by: representing repeated multiplication using powers; using patterns to show that a power with an exponent of zero is equal to one; solving problems involving powers.

(N2) Demonstrate an understanding of operations on powers with integral bases (excluding base 0) and whole number exponents.

**Student Friendly:**

"Exponent Law for a Quotient of Powers"

# Section 2.4
## Exponent Laws 1

&

# Section 2.5
## Exponent Laws II

# Exponent Law for a Product of Powers

To multiply powers with the **SAME** base, add the exponents.

$$a^m \times a^n = a^{m+n}$$

must be the same base

Example:

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

$$= (-5)^9$$

Write each expression as a single power then evaluate

1) $3^3 \text{ x } 3^2$

$3^5$

2) $2^2 \text{ x } 2^5$

$2^7$

# Exponent Law for a Quotient of Powers


To divide powers with the **SAME** base, subtract the exponents.

$$a^m \div a^n = a^{m-n}$$

must be the same base

Example: $$\frac{(3)^{12}}{(3)^3} = 3^9$$

Write each expression as a single power then evaluate

1) $\dfrac{2^6}{2^2}$

$= 2^4$

2) $\dfrac{(-4)^7}{(-4)^5}$

$= (-4)^2$

Write each expression as a single power then evaluate

1) $\frac{7^9}{7^4}$

$= 7^5$

2) $\frac{(-5)^7}{(-5)^3}$

$= (-5)^4$

# Exponent Law for a Power of a Power

**To raise a power to a power, multiply the exponents.**

$$(a^m)^n = a^{m \times n}$$

Examples:

Simplify:

1) $(5^7)^3$

$= 5^{21}$

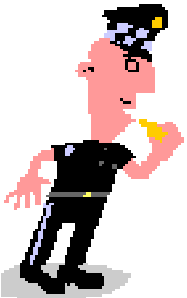
2) $(10^2)^3$

$= 10^6$

3) $[(-2)^4]^3$

$= (-2)^{12}$

# Exponent Law for a Power of a Product



$$(a^n b^t)^m = a^{mxn} b^{mxt}$$

Example:

Simplify the following

a) $(7^3 \text{ x } 2^5)^4$

$= (7^{12} \text{ x } 2^{20})$

b) $[ (-5)^6 \text{ x } (-2)^8 ]^5$

$= (-5)^{30} \text{ x } (-2)^{40}$

# Exponent Law for a Power of a Quotient

$$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$$

BUT $b \neq 0$

Examples:

Simplify the following

a) $\left[\frac{4^3}{5^2}\right]^7$

$= \frac{4^{21}}{5^{14}}$

b) $[2^8 \div 3^2]^4$

$= 2^{32} \div 3^8$

# Exponent Laws

## 1) Zero Rule

-Anything raised to the exponent of zero is 1

$(-5)^0 = 1$ or $(x)^0 = 1$

## 2) Product of Powers Rule

When you multiply like bases you add the exponents

$(2)^3 \times (2)^5 = (2)^8$ or $(a)^m \times (a)^n = (a)^{m+n}$

## 3) Quotient Rule

When you divide like bases you Subtract the exponents

$\frac{(-4)^7}{(-4)^5} = (-4)^2$ or $(a)^m \div (a)^n = (a)^{m-n}$

## 4) Power to a Power Rule

With a power to a power we multiply exponents

$(2^5)^3 = (2)^{15}$ or $(a^m)^n = (a)^{mn}$

## 5) Power of Product Rule

With a power of products we multiply exponents

$[(5^5) \times (6^4)]^3 = 5^{15} \times 6^{12}$

or $[(a^m) \times (b^n)]^p = (a)^{mp} \times (b)^{np}$

## 6) Power of Quotient Rule

With a power of quotient we multiply exponents

$$\left[\frac{(-3)^6}{(5)^3}\right]^2 = \frac{(-3)^{12}}{(5)^6}$$

# Evaluating Powers of Product and Quotients

$[(-6) \times 4]^2$

Method 1

Use the exponent law for a power of a product

$[(-6) \times 4]^2$

$= (-6)^2 \times 4^2$

$= 36 \times 16$

$= 576$

Method 2

Use the order of operations

$[(-6) \times 4]^2$

$= [-24]^2$

$= 576$

You Decide

**Try some more (use which ever method you want)**

2) $-(5 \times 2)^3$

$= -(5^3 \times 2^3)$

or

$= -(10^3)$

3) $\left(\frac{21}{-3}\right)^3$

$= \frac{21^3}{(-3)^3}$

or

$= (-7)^3$

# Applying Exponent Laws and Order of Opertations

**Simplify using laws of exponents:**

$(5 \times 2)^3 + (2^8 \div 2^5)^4$

$10^3 + (2^3)^4$

$10^3 + 2^{12}$

or

$(5 \times 2)^3 + (2^8 \div 2^5)^4$

$(5^3 \times 2^3) + (2^{32} \div 2^{20})$

$(5^3 \times 2^3) + (2^{12})$

If evaluated you get the same answer

1000 +4096

5096

(125 x 8) +4096

1000 + 4096

5096

Simplify using laws of exponents:

$$(4^2 \times 4^3)^2 - (5^4 \div 5^2)^2$$

$(4^5)^2 - (5^2)^2$

$4^{10} - 5^4$

$(4^4 \times 4^6) - (5^8 \div 5^4)$

$4^{10} - 5^4$

Simplify using laws of exponents:

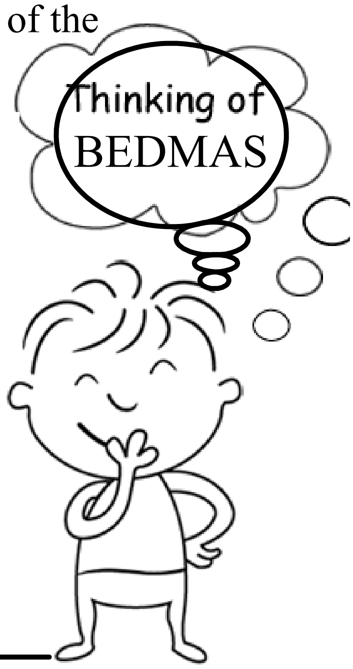
$$[\ (-2)^5 \times (-2)^2\ ]^2 - [\ (-3)^5 \div (-3)^2\ ]^4$$

$$[\ (-2)^7\ ]^2 - [\ (-3)^3\ ]^4$$

$$(-2)^{14} - (-3)^{12}$$

# Remember to always use BEDMAS when evaluating

**Simplify** first (using exponent law I) THEN **Evaluate** each of the following:




1) $3^{10} \div 3^{6} + 3^{2}$

$3^4 + 3^2$

$81 + 9$

**90**

2) $-2^3(2^9 \div 2^7) - 2^1$

$-2^3\,(2^2) - 2^1$

$-2^5 - 2^1$

$-32 - 2$

**-34**

3) $\dfrac{10^{1003}}{10^{1000}} - 1$

$= 10^3 - 1$

$1000 - 1$

**999**


Simplify then Evaluate

1) $(-2)^7 \div (-2)^3 - (-2)^5 \div (-2)^2$

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

$16 - (-8)$

$24$


Simplify then Evaluate

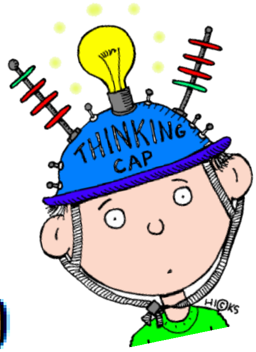
2) $(-4)^9 \div (-4)^5 + (-4)^7 \div (-4)^2$

$(-4)^4 + (-4)^5$

$256 + (-1024)$

$-768$

Simplify then Evaluate




3) $$\frac{2^4(2^3 \div 2^2) - 4^0}{3(3^4 \div 3^2)}$$

Top:

$2^4 (2^3 \div 2^2) - 4^0$

$2^4 (2^1) - 4^0$

$2^5 - 4^0$

$32 - 1$

$31$

Bottom:

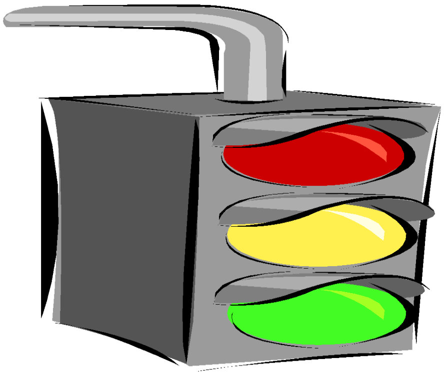
$3 (3^4 \div 3^2)$

$3 (3^2)$

$3^3$

$27$

$\frac{\text{Top}}{\text{Bottom}} = \frac{31}{27}$



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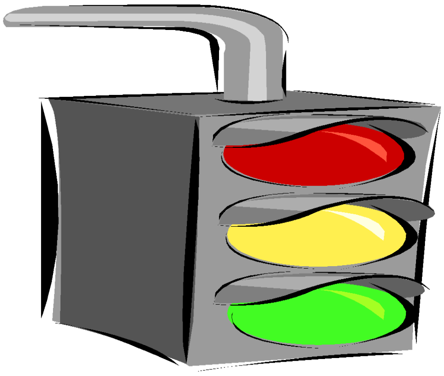
**Questions**

3, 4acegh, 5bdfh, 7, 8, 10, 11, 13, 17, 18, 19



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**Questions**

4def, 5abc, 6, 7, 8ab, 9,
10, 14, 15, 16, 17, 19

**Plus Worksheet**

# Attachments

Exponent Law 1 Review.pdf

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