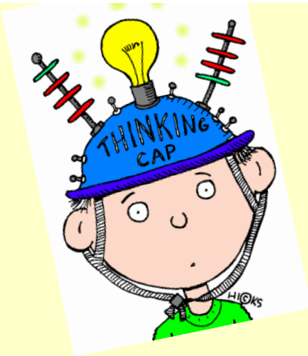
Curriculum Outcome

(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:
“Laws of exponents :
Power of powers and power of product"

Grade 9 Warm Up



Simplify using exponent laws

1) $(2^4)^3$ 2) $[(-2)^2 \times (-2)^4]^2$ 3) $[(-1)^{11}]^3$

Write each expression as a product or quotient of powers. Then evaluate.

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

2) $\left(\frac{6}{5}\right)^4$

Simplify then evaluate:

$$\frac{(3^2 \times 3^4)^5}{(3^2)^5\,(3^6)^2}$$

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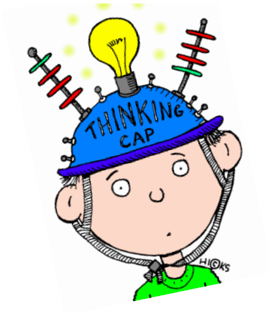


Simplify using exponent law 1 or 2, then evaluate

1) $(2^4)^3$

$= 2^{12}$

$= 4096$

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

$[(-2)^6]^2$

$= (-2)^{12}$

$= 4096$

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

$= (-2)^4 \times (-2)^8$

$= (-2)^{12}$

$= 4096$

3) $[(-1)^{11}]^3$

$= (-1)^{33}$

$= -1$

Write each expression as a product or quotient of powers. Then evaluate.

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

$[-15]^2$

$= 225$

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

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

$[9 \times 25]$

$= 225$

2) $\left(\frac{6}{5}\right)^4$

$\frac{6^4}{5^4} = \frac{1296}{625}$

$=$

Simplify then evaluate:

$$\frac{(3^2 \times 3^4)^5}{(3^2)^5 (3^6)^2} = \frac{(3^6)^5}{(3)^{10}(3)^{12}} = \frac{3^{30}}{3^{22}}$$

$= 3^8$

$$\left[x^2 \times x^4\right]^2$$

$$\left[x^6\right]^2$$

$$x^{12}$$

Evaluating Powers of Product and Quotients

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

Method 1

Use the exponent law for a power of a product

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

=

=

=

Method 2

Use the order of operations

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

=

=

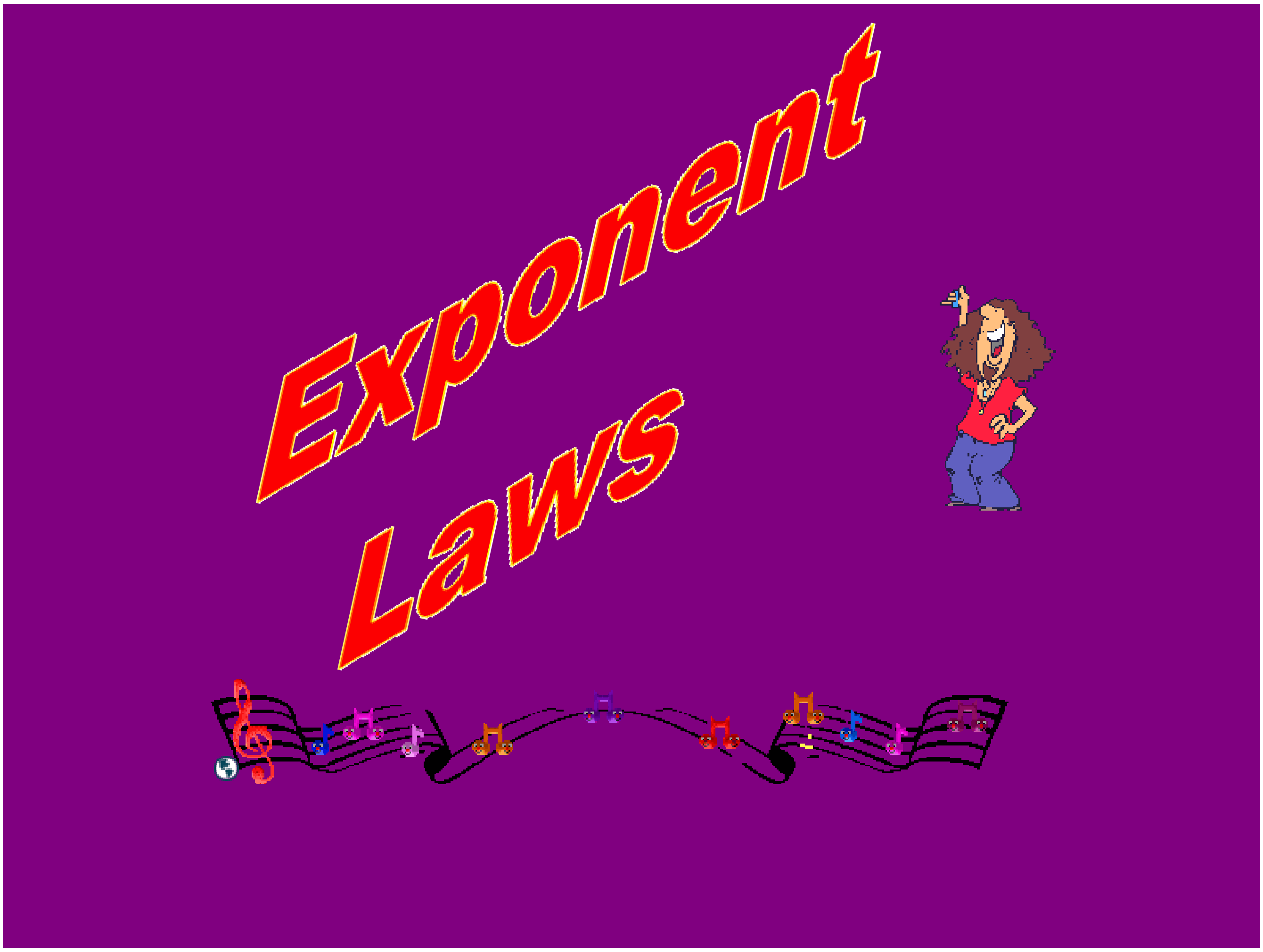
You Decide

Try some more (use which ever method you want)

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

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

$$\frac{3^8}{3^{10}} = 3^{-2}$$


Exponent
Laws

What about a power of a quotient?

Let's Investigate

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

Step 1) Write the above as a repeated multiplication.

Step 2) Look at the numerators can you express that as a single power

Step 3) Look at the denominators can you express that as a single power

What did you discover?

Exponent Law for a Power of a Quotient

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

BUT $b \neq 0$

examples:

$$\left[\frac{4^3}{5^2}\right]^7 = \frac{4^{21}}{5^{14}}$$

$$\left[2^8 \div 3^2\right]^2 = 2^{16} \div 3^4$$

Laws Exponents

1) $x^0 = 1$

example: $(-3)^0 = 1$

$200^0 = 1$

2) $(x^a)(x^b) = x^{a+b}$

example: $(-2)^5 \times (-2)^6 = (-2)^{11}$

3) $x^a \div x^b = x^{a-b}$

example: $(4^7) \div (4^5) = 4^2$

4) $(x^a)^b = x^{(a)(b)}$

example: $(3^2)^6 = 3^{12}$

5) $(x^a \times y^b)^c = (x^{ac})(y^{cb})$

example: $(3^2 \times 4^5)^7 = 3^{14} \times 4^{35}$

6) $(x^a \div y^b)^c \Rightarrow x^{ac} \div y^{bc}$

example: $(2^3 \div 4^5)^2 = 2^6 \div 4^{10}$

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

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

$$4^{10} - 5^4$$

Class/Homework

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