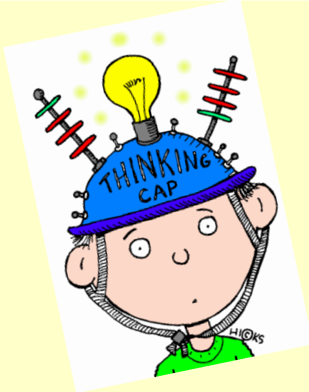
Curriculum Outcome

(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:
“Learning the laws of Exponents "
Simplifying expressions before we try to evaluate them.

Grade 9 Warm Up



Simplify then Evaluate

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

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

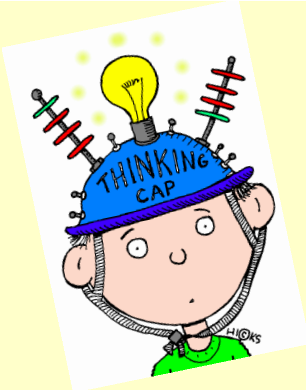
3) $$\frac{2^4(2^3 \div 2^2) - 4^0}{3(3^4 + 2^2)}$$

$$x^0 = 1$$

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

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

Grade 9 Warm Up



Simplify then Evaluate

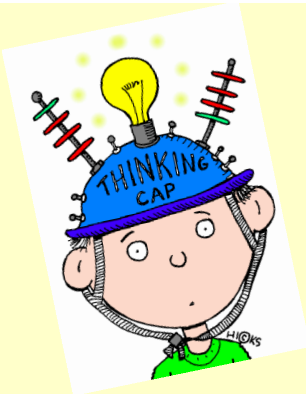
1) $\underbrace{(-2)^7 \div (-2)^3} - \underbrace{(-2)^5 \div (-2)^2}$

$$\boxed{(-2)^4 \quad - \quad (-2)^3}$$

$$= 16 \quad - \quad (-8)$$

$$= \boxed{24}$$

Grade 9 Warm Up



Simplify then Evaluate

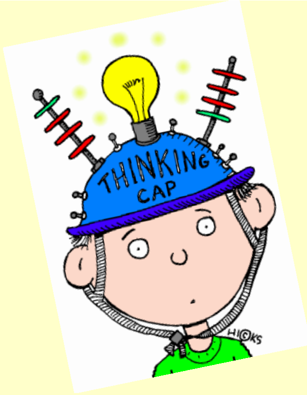
2) $$\underbrace{(-4)^9 \div (-4)^5} + \underbrace{(-4)^5 \div (-4)^2}$$

$$\boxed{(-4)^4 + (-4)^3}$$

$$256 + (-64)$$

$$= 192$$

Grade 9 Warm Up



Simplify then Evaluate

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

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

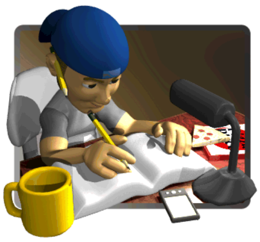
$$2^4 \quad (2^1)$$

$$\boxed{2^5 - 4^0}$$

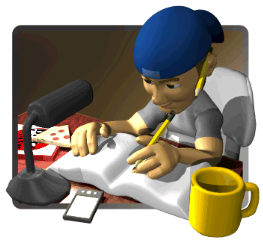
$$\boxed{\frac{2^5 - 4^0}{3(3^4 + 2^2)}} = \frac{32 - 1}{3(81+4)}$$

$$3(85)$$

$$= \boxed{\frac{31}{255}} = 0.1215$$



Section 2.5
Exponent Laws II

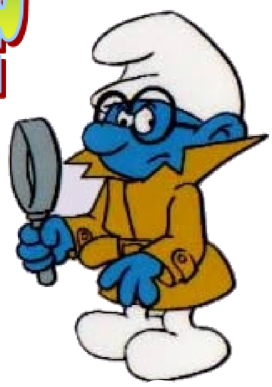


Fill in the following chart

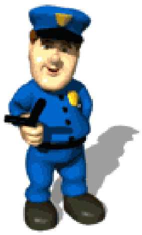
Power	As Repeated Multiplication	As a Product of Factors	As a power
$(3^2)^5$	$(3^2)(3^2)(3^2)(3^2)(3^2)$ $(3\cdot3)(3\cdot3)(3\cdot3)(3\cdot3)(3\cdot3)$	$3^{2\times5}$	3^{10}
$(4^2)^3$	$(4^2)(4^2)(4^2)$ $4\cdot4\cdot4\cdot4\cdot4\cdot4$	$4^{2\times3}$	4^6
$[(-2)^4]^3$			

What do we notice?

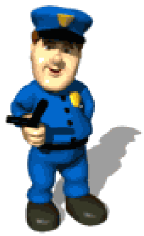
$$(2^3)^4$$



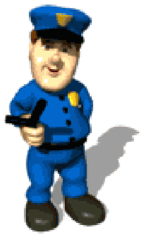
Exponent Law for a Power of a Power



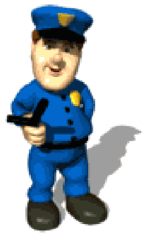
To raise a power to a power, multiply the exponents.



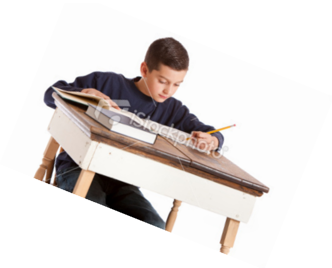
$$(a^m)^n = a^{mn}$$



example: $(2^5)^3 = 2^{15}$



Try this



Express the following as a single power

1) $(5^7)^8$ $= 5^{56}$

2) $(10^2)^3$ $= 10^6$

3) $[(-2)^4]^3$ $= (-2)^{12}$

Express the following as a single power then evaluate

1) $(2^3)^2$
$= 2^6$
$= 64$

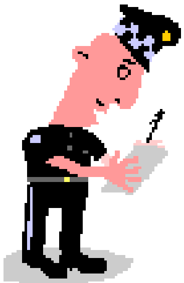
2) $(5^2)^3$
$= 5^6$
$= 15625$

3) $[(-3)^2]^4$
$= (-3)^8$
$= 6561$

Fill in the following chart

Power	As Repeated Multiplication	As a Product of Factors	As a product of Powers
$(2^3 \times 3^2)^2$ ×4	$(2^3 \times 3^2)(2^3 \times 3^2)$ $2 \cdot 2 \cdot 2 \cdot 3 \cdot 3 \; 2 \cdot 2 \cdot 2 \; 3 \cdot 3$	$2^{3 \times 2} \times 3^{2 \times 2}$	$2^6 \times 3^4$
$((-3) \times 5)^2$			

Exponent Law for a Power of a Product



$$(ab)^m = a^m b^m$$

×

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example:

$$(7^3 \times 2^5)^4 = 7^{12} \times 2^{20}$$

What about a power of a quotient?

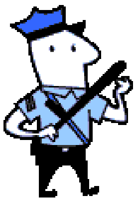
Let's Investigate

$$\left(\frac{4^{1}}{5^{1}}\right)^{3} = \frac{4}{5}\,\frac{4}{5}\,\frac{4}{5} = \frac{4^{3}}{5^{3}}$$

$$\left(\frac{4^{2}}{5^{4}}\right)^{3} = \frac{4^{6}}{5^{12}}$$

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:

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

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

Evaluating Powers of Product and Quotients

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

Method 1

Use the exponent law for a power of a product

$[(-6)^1 \times 4^1]^2$

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

$= 36 \times 16$

$= 576$

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

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

Applying Exponent Laws and Order of Opertations

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

$$10^3 + (\underbrace{2^3})^4$$

$$\boxed{10^3 + 2^{12}}$$

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

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

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

$$[\,(-2)^3 \;\times\; (-2)^2\,]^2 - [\,(-3)^3 : (-3)^2\,]^4$$

$$(-2^{5})^{2} \quad - \quad (-3^{1})^{4}$$

$$\boxed{(-2)^{10} \quad - \quad (-3)^{4}}$$