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 :
What happens to the exponent when you multiply like bases?"

Warm Up
Grade 9

Power	Base	Exponent	Expanded Form	Standard Form
4^7	4	7	4x4x4x4x4x4x4	16 384
2^6	2	6	2x2x2x2x2x2	64
5^3	5	3	5x5x5	125
$(-6)^5$	-6	5	(-6)x(-6)x(-6)x(-6)x(-6)	-7776
-5^4	5	4	- 5x5x5x5	-625
8^5	8	5	8x8x8x8x8	32 768
3^7	3	7	3x3x3x3x3x3x3	2187
$(-7)^3$	(-7)	3	(-7)x(-7)x(-7)	-343
$(10)^3$	10	3	10x10x10x10	1000
$(-9)^3$	-9	3	(-9)x(-9)x(-9)	-729
6^4	6	4	(6)x(6)x(6)x(6)	46 656
$(-2)^4$	(-2)	4	(-2)x(-2)x(-2)x(-2)	16
$(-12)^3$	-12	3	(-12)x(-12)x(-12)	-1728
-3^5	3	5	- 3x3x3x3x3	-243

2) Write the following as a powers of 10:

a) 68 706 324

4) Write the following in standard form:

a) $(5 \times 10^4$ $(7 \times 10^1) + (6 \times 10^0)$

Things to remember about exponents:

1. Any base without an exponent has an "invisible" exponent of **1**.

EXAMPLE: $8 = 8^1$ $x = x^1$

2. Any base with an exponent **0**, equals **1**.

EXAMPLE: $6^0 = 1$ $(-6)^0 = 1$ $x^0 = 1$

3. Be careful when calculating negative numbers with exponents.

EXAMPLE: $(-3)^2 = (-3)x(-3) = 9$

$-3^2 = -(3^2) = -(3x3) = -9$

$-x^2 = -(x^2)$

Product Rule

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

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

must be the same base

Example:

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

$$= (-u)^9$$

Write each of the following as a single power

1) $a^2 \times a^4$ = a^6

2) $(-y)^5 \times (-y)^3$ = $(-y)^8$

3) $y^5 \times y$ = y^6

$3y^6 \times 5y^4$

$= 15y^{10}$

$2d^{14} \times 2d^9$

$= 4d^{23}$

Quotient Rule

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

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

must be the same base

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

Write each of the following as a single power

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

$= h^5$

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

$= (-d)^4$

EXAMPLES:

1. $(x^5)(x^6)$

$= x^{11}$

2. $-y^3\ y^5$

$= -y^8$

3. $\frac{x^{10}}{x^6}$

$= x^4$

4. $\frac{y^7}{y^4}$

$= y^3$

5. $\frac{-2x^2\ x^4}{x^3}$

$= x^{11}$

6. $y^2 + y^3 \times y^2$

$= y^2 + y^5$

TRY THIS!

$$\frac{3X^4 \cdot 6X^2}{2X^3}$$

$$= \frac{18\ x^6}{2x^3}$$

$$= 9x^3$$

TRY THIS!

$$\frac{-8X^2 \;\; 4X^7}{2X^2}$$

$$= \frac{-32\ x^9}{2x^2}$$

$$= -16x^7$$

Power of a Power Rule

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

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

Examples:

Simplify:

1) $(x^7)^3$ $= x^{21}$

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

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

EXAMPLES:

1. $(x^0)^4$

$= x^0$

2. $(3y^2)^5$

$= 3^5y^{10}$

$= 243y^{10}$

3. $(x^4)^3$

$= x^{12}$

4. $(2y^6)^7$

$= 2^7y^{42}$

$= 128y^{42}$

Power of a Product Rule

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

Example:

Simplify the following

a) $(m^3 \times n^5)^4$

$= (m^{12} \times n^{20})$

b) $[(-f)^6 \times (-g)^8]^5$

$= (-f)^{30} \times (-g)^{40}$

EXAMPLES:

1. $(xy)^3$

$= x^3y^3$

2. $(x^2y^3)^4$

$= x^6y^{12}$

3. $(-xy^5)^3$

$= -x^3y^{15}$

4. $(-6x^2)^2$

$= 6^2x^4$

$= 36x^4$

Power of a Quotient Rule

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

Examples:

Simplify the following

a) $\left[\frac{d^3}{e^2}\right]^7$

$= \frac{d^{21}}{e^{14}}$

b) $[w^8 \div y^2]^4$

$= w^{32} \div y^8$

EXAMPLES:

1. $\left(\frac{x}{y}\right)^2$

$= \frac{x^2}{y^2}$

2. $\left(\frac{3x^2}{2y^2}\right)^3$

$= \frac{3^3x^6}{2^3y^6}$

$= \frac{27x^6}{8y^6}$

3. $\left(\frac{x^4}{y^3}\right)^4$

$= \frac{x^{16}}{y^{12}}$

4. $\left(\frac{2y^3}{y^2}\right)^5$

$= \frac{2^5y^{15}}{y^{10}}$

$= 32y^5$

Exponent Laws

1) Zero Rule

-Anything raised to the exponent of zero is 1

$(-x)^0 = 1$ 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

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

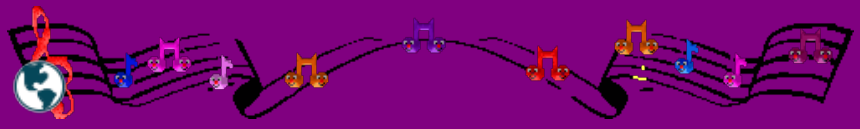
Use your rules to simplify the following:

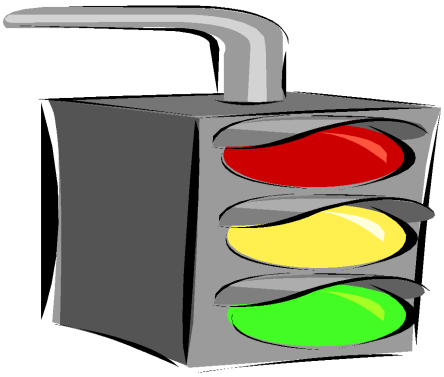
$$\left[\frac{(r)^8 \times (r)^6}{(r)^3 \times (r)^9}\right] + \left[\frac{(-y)^7 \times (-y)^5}{(-y)^2 \times (-y)^6}\right] + \left[\frac{r^6}{y^4}\right]^0$$

$$\left[\frac{r^{14}}{r^{12}}\right] + \left[\frac{(-y)^{12}}{(-y)^8}\right] + 1$$

$$r^2 + (-y)^4 + 1$$

Exponent Laws





STUDY RULES

Worksheet 1 & 2

All Questions