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

Simplify the following

$$\frac{(2x^4y^6)\cdot(5x^3y^5)}{(6xy)\cdot(3x^2y^3)} =$$

=

Exponent Laws II

Fill in the following chart

Power	As Repeated Multiplication	As a Product of Factors	As a power
$(v^2)^5$	$v^2 \times v^2 \times v^2 \times v^2 \times v^2$	v x v x v x v x v x v x v x v x v x v x v x v	v^{10}
$[(e)^2]^3$	$(e)^2 \times (e)^2 \times (e)^2$	(e)x (e) x (e) x (e) x (e) x (e)	$(e)^6$

What do we notice?

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. $(y^2)^5$

$= y^{10}$

3. $(x^4)^3$

$= x^{12}$

4. $(y^6)^7$

$= y^{42}$

Let's Explore

Fill in the following chart

Power	Repeated Multiplication	As a product	Power of Products
$(e^3 \times r^2)^2$	$(e^3 \times r^2) \times (e^3 \times r^2)$	(e)(e)(e) (r)(r) x (e)(e)(e) (r)(r)	$e^6 \times r^4$
$[(-y)^2 \times (z)^2]^3$	$[(-y)^2 \times (z)^2] \times [(-y)^2 \times (z)^2] \times [(-y)^2 \times (z)^2]$	(-y)(-y)(z)(z) x (-y)(-y)(z)(z) x (-y)(-y)(z)(z)	$(-y)^6 \times (z)^6$

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

$= x^8y^{12}$

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

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

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

$= 6^2x^4$

$= 36x^4$

Let's Explore

Fill in the following chart

Power	Repeated Multiplication	As a product	Power of Quotient
$\left(\frac{a}{b}\right)^3$	$\left(\frac{a}{b}\right)\left(\frac{a}{b}\right)\left(\frac{a}{b}\right)$	$\frac{a \times a \times a}{b \times b \times b}$	$\frac{a^3}{b^3}$
$\left[\frac{(m)^3}{(h)^2}\right]^4$	$\left[\frac{(m)^3}{(h)^2}\right] \times \left[\frac{(m)^3}{(h)^2}\right] \times$ $\left[\frac{(m)^3}{(h)^2}\right] \times \left[\frac{(m)^3}{(h)^2}\right]$	$\frac{(m)(m)(m)}{(h)(h)} \times \frac{(m)(m)(m)}{(h)(h)}$ $\times \frac{(m)(m)(m)}{(h)(h)} \times \frac{(m)(m)(m)}{(h)(h)}$	$\frac{m^{12}}{(h)^8}$

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

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

3) Quotient Rule

When you divide like bases you Subtract the exponents

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

4) Power to a Power Rule

With a power to a power we multiply exponents

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

5) Power of Product Rule

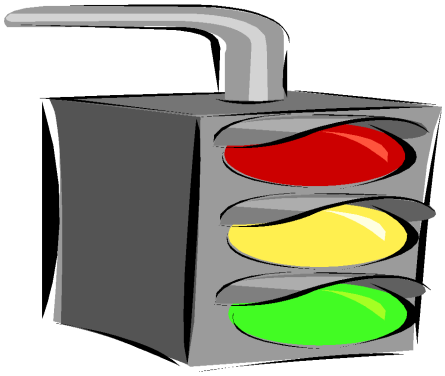
With a power of products we multiply exponents

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

6) Power of Quotient Rule

With a power of quotient we multiply exponents

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



Class/Homework

STUDY RULES

Worksheet

Power & Product Rule

Math 9 Name_____ ID: 1

Power & Product of Power Rule

Date_____ Period____

Simplify. Your answer should contain only positive exponents.

1) $(k^4)^3$

2) $(7n^2)^2$

3) x^3

4) $(2x^2)^4$

5) $(a^2)^3$

6) $(6n)^2$

7) $(2n)^3$

8) $(6x)^4$

9) $(6x)^2$

10) $(a^3)^4$

11) $(4m^2)^4$

12) $(x^0)^3$

13) $(4m^2n^3)^2$

14) $(8a^3b^2)^4$

15) $(3uv^3)^4$

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

17) $(5u^4)^2$

18) $(x^4)^4$

19) $2xy^4 \cdot 4xy^3$

20) $5x^2y^4 \cdot 4y^2$

21) $8m^4 \cdot 4mn^3$

22) $5n^0 \cdot 7m^4$

23) $\dfrac{7x^4y^4}{x^2y^3}$

24) $\dfrac{6a^4b^3}{7b^2}$

25) $\dfrac{3m^2n^3}{8mn^3}$

26) $\dfrac{3y}{8x^0}$

27) $(3m^0n^4)^2$

28) $(2x^2)^2$

29) $(7a^3b^2)^3$

30) $(5x^4y^2)^4$