3.1½ POWERS OF TEN & THE ZERO EXPONENT RULE

Name:_____ Block____

Investigation: Complete the following table for the ***powers of ten.***

Power	Expanded Form	Standard Form	Number in Words
10^9	$10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10$	1 000 000 000	1 billion
10^8	$10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10$	100 000 000	one hundred million
10^7	$10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10$	10 000 000	ten million
10^6	$10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10$	1 000 000	1 million
10^5	$10 \cdot 10 \cdot 10 \cdot 10 \cdot 10$	100 000	one hundred thousand
10^4	$10 \cdot 10 \cdot 10 \cdot 10$	10 000	ten thousand
10^3	$10 \cdot 10 \cdot 10$	1 000	one thousand
10^2	$10 \cdot 10$	100	one hundred
10^1	$10 \cdot$	10	ten
10^0	1	1	one

Have another look at the chart above, can you see the following patterns?

~ for powers of 10, the exponent = the number of zeros

~ dividing by ÷ 10 for each descending power

~ zero exponent = 1 (always)

We could make **similar tables** for any power with *any base not equal to zero.*

★This means that we can write 1 for any power with exponent zero.

For example:

9^0 = 1

200^0 = 1

$(-3)^0$ = 1

K^0 = 1

$(\text{flower})^0$ = 1

(any number that isn't 0)^0 = 1

always!

$$x^0 = 1$$

"Zero Exponents"

Properties of Exponents

$$\frac{x^a}{x^b} = x^{a-b} \quad \text{so} \quad \frac{x^2}{x^2} = x^{2-2} = x^0$$

but as fractions $\frac{a}{a} = 1$ that's why!

THE ZERO EXPONENT RULE:

*"any base number or any base variable (letter) raised to the zero exponent, is **always equal to 1**"*

...BUT the base cannot also be zero.

$$x^0 = 1, \quad x \neq 0$$

Example #1: Evaluate each expression

a) $8^0 = 1$ b) $(-8)^0$ 1 c) $-(-8)^0 = -1$

$-(-8)^0$
$-(1)$
$= -1$

carry the negative value through

PRACTICE

Evaluate the following:

1. 6^0 $= 1$
2. $-(6)^0$ $-(1) = -1$
3. $(-6)^0$ $= 1$
4. -6^0 $-1 = -1$
5. $2^0 + 3^0$ $1 + 1 = 2$
6. $2^0 - 3^0$ $1 - 1 = 0$
7. $3^0 \times 4^0$ $1 \times 1 = 1$
8. $(2^0 + 3^0)^0$ $(1+1)^0$ $(2)^0 = 1$

Homework

ASSIGNMENT #2 Complete the Following Worksheet on "The Zero Power Rule"

$x^0 = 1$, when $x \neq 0$

Applying the Exponent Rule for Zero Exponents

Evaluate the following powers.

1) n^0 $= 1$

2) $(3x)^0$
$(1)^0 = 1$

3) $5y^0$
$5 \cdot y^0$
$5 \cdot 1 = 5$

4) $-8a^0$
$-8 \cdot (a)^0$
$-8 \cdot 1 = -8$

5) $(a+b)^0$
$a^0 + b^0$
$1 + 1 = 2$

6) $a^0 + b^0$
$1 + 1 = 2$

7) $3x^0y$
$3 \times (1) \times y$
$3 \times y = 3y$

8) $10(mn)^0$
$10 \times (m^0 \times n^0)$
$10 \times (1 \times 1)$
$10 \times (1) = 10$

9) $(0.005w)^0abc$
$(0.005^0 \times w^0) \times a \times b \times c$
$(1 \times 1) \times a \times b \times c$
$1 \cdot a \cdot b \cdot c = abc$

10) $\left(\frac{1}{2b}\right)^0 = \frac{1^0}{(2b)^0} = \frac{1^0}{(2^0 \cdot b^0)} = \frac{1}{(1 \cdot 1)}$
$= 1$

11) $-\left(\frac{1}{5}\right)^0$
$-(1) = -1$

12) $2a^0 + (2a)^0 + 2^0a$
$(2^0 \times a^0) + (2^0 \times a^0) + (2^0 \cdot a)$
$(1 \times 1) + (1 \times 1) + (1 \cdot a)$
$1 + 1 + a$
$2 + a = 2 + a$

13) $(9x)^0 - 9x^0 - (-9x)^0$
$(9^0 \cdot x^0) - 9 \cdot x^0 - (-9^0 \cdot x^0)$
$(1 \cdot 1) - (9 \cdot 1) - (-1 \cdot 1)$
$1 - 9 + 1 = -7$

14) $(m+2)^0 - m^0 - 2m^0$
$(m^0 + 2^0) - 1 - (2 \cdot 1)$
$(1 + 1) - 1 - 2 = -1$
14) $(m+2)^0 - m^0 - 2m^0$

15) $\frac{(t+v)^0}{t^0 + v^0}$ $\frac{(t^0 + v^0)}{t^0 + v^0} = \frac{1+1}{1+1} = \frac{2}{2} = 1$

16) $\frac{4m(n-5p)^0}{5m^0}$ $\frac{4m(\text{Mer } 1)}{5 \cdot 1} = \frac{4m}{5}$

17) $\left(\frac{ab^2}{cd^3}\right)^0$ $\frac{a^0 \cdot b^{2 \cdot 0}}{c^0 \cdot d^{3 \cdot 0}} = \frac{1 \cdot 1}{1 \cdot 1} = 1$

18) $\frac{p^2r^0}{p^0r^3}$ $= \frac{p^2 \cdot 1}{1 \cdot r^3} = \frac{p^2}{r^3}$

19) $(xy)^0 + x^0 - y^0 - x^0y^0$
$(x^0 \cdot y^0) + 1 - 1 - (1 \cdot 1)$
$1 + 1 - 1 - 1 = 0$

20) $5^0(3 + z^0)$
$1 \cdot (3 + 1)$
$1 \cdot (4) = 4$