Zero & Negative Exponents

Do Now:

Discovery:

Simplify

$\frac{12}{12} =$ $\frac{5}{5} =$ $\frac{x}{x} =$

Simplify

$\frac{x^4}{x^4}$

Zero Exponents

Rule #1:

An Exponent of ZERO

$a^0 =$

$3^0 =$ $(-3)^0 =$ $x^0 =$

a) $(-6)^0 =$

b) $x^0 =$

c) $-(7)^0 =$

d) $(25xyz)^0 =$

e) $-y^0 =$

f) $word^0 =$

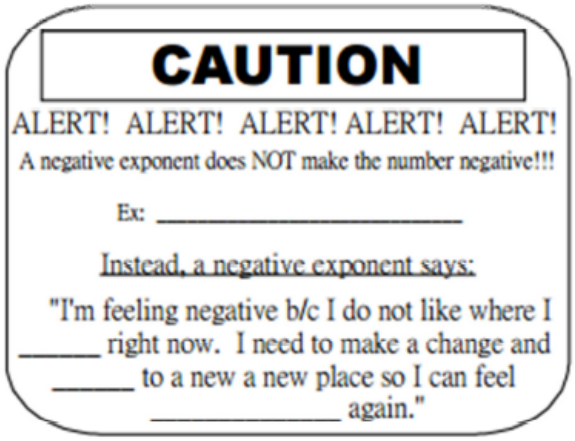
REMEMBER: anything to the zero power is 1

$15^0 = 1$

$-(8x)^0 = -1 \rightarrow (8x)^0 = 1$ but the – sign is not raised to the 0 power

$\left(-\frac{4}{3}\right)^0 = 1$

Negative Exponents



RULE:

$$10^{-2} = \frac{1}{10^2}$$

All negative exponents can be written as a fraction with 1 in the numerator and the positive exponent in the denominator.

Let's Try:

1. $\frac{1}{6^{-2}}$	**2.** $\frac{2}{x^{-2}}$	**3.** $\frac{y^{-3}}{3}$
4. -2^0	**5.** $(-3)^{-2}$	**6.** $\frac{1}{2^{-2}}$
7. $\left(\frac{1}{4}\right)^{-2}$	**8.** 3^{-2}	**9.** $(-3x)^2$

1. 2^{-4}	**2.** 4^{-2}	**3.** x^{-6}
4. $3z^{-2}$	**5.** $\frac{1}{3^{-2}}$	**6.** 5^{0}
7. $2^{-5} \cdot 2^{3}$	**8.** $x^{3} \cdot x^{-7}$	**9.** $\frac{3^{3}}{3^{5}}$
10. $\frac{x^{4}}{x^{-6}}$	**11.** x^{0}	**12.** 1001^{-1}

Zero & Negative Exponents

Directions: Rewrite each item as an equivalent expression in exponential notation.

Answers should only have positive exponents.

1) $\frac{5 \cdot 5 \cdot 5 \cdot 5}{5 \cdot 5} =$

2) $\frac{(-2)}{(-2)} =$

3) $\frac{(0.12)(0.12)(0.12)}{(0.12)(0.12)} =$

4) $\frac{7 \cdot 7 \cdot 7}{7 \cdot 7 \cdot 7 \cdot 7 \cdot 7} =$

5) $\frac{15^6}{15^9} =$

6) $\frac{(-7)^5}{(-7)^3} =$

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

8) $\frac{12^4}{3^4} =$

9) $\frac{6^9}{6^9} =$

10) $\frac{7^4 \cdot 7^5}{7^9} =$

11) $\frac{(9^3)^0 \cdot 5^2}{5^5} =$

Write the following algebraic problems in exponential notation.

12) $\frac{x^7}{x^3} =$

13) $\frac{a^2b}{a^6b^2} =$

14) $\frac{t^5}{t^5} =$

15) $\frac{x^4y^2}{x^3y^8} =$

Rewrite each item as an equivalent expression in exponential notation.
Answers should only have positive exponents.

16) $2^{-5} =$

17) $(-6)^{-4} =$

Tell whether each statement is correct. Show work to support your answer.

18) $(-5)^{-3} = \frac{1}{(-5)^{-3}}$

19) $\frac{8^4}{8^4} = 8$

20) $7^0 = \frac{7^5}{7^5}$

21) $\frac{x^8}{x^4} = x^2$

22) $5^6 \cdot \frac{1}{25} = 5^8$

23) $(7^4)^{-2} = \frac{1}{49^4}$

Intro to Exponential Functions

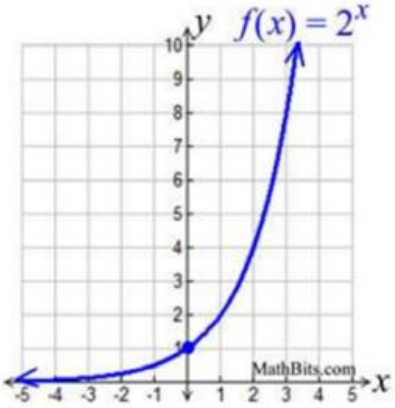
Simplify the Following:

1] $(-4)^2$	2] -4^2	3] $3^2 \bullet (-2)^3$
4] $a^2 \bullet a^3$	5] $(d^4)(d^6)$	6] $(x^4)^3$
7] $(2x^2y^3)^4$	8] $z^0 \bullet z^2$	9] x^{-3}
10] 5^{-2}	11] $(-2x^2)(6x^3)(x^2)$	12] $\frac{12a^{-2}}{4}$

Features of Exponential Functions

An exponential function with base b is defined by $f(x) = ab^x$
where $a \neq 0$, $b > 0$, $b \neq 1$, and x is any real number.
The base, b, is constant and the exponent, x, is a variable.

In the following example, $a = 1$ and $b = 2$.



x	$y = f(x)$
-2	$2^{-2} = \frac{1}{4}$
-1	$2^{-1} = \frac{1}{2}$
0	$2^0 = 1$
1	$2^1 = 2$
2	$2^2 = 4$
3	$2^3 = 8$

Shape: Most exponential graphs will have this same arcing shape.

Rate of Change:
This graph does not have a constant rate of change, but it has constant ratios. It is growing by common factors over equal intervals.

Features (for this graph):
- the domain is all Real numbers.
- the range is all positive real numbers (not zero).
- graph has a y-intercept at (0,1). Remember any number to the zero power is 1.
- when $b > 1$, the graph increases. The greater the base, b, the faster the graph rises from left to right.
- when $0 < b < 1$, the graph decreases.
- has an asymptote (a line that the graph gets very, very close to, but never crosses or touches). For this graph the asymptote is the x-axis ($y = 0$).

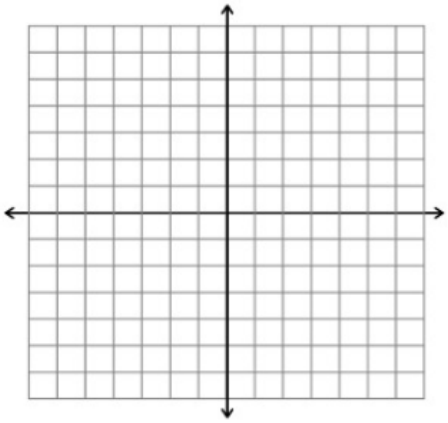
	x	y	
+1	-2	$\frac{1}{4}$	×2
+1	-1	$\frac{1}{2}$	×2
+1	0	1	×2
+1	1	2	×2
+1	2	4	×2
	3	8	

MathBits

As x increases by +1, y increases by x 2.

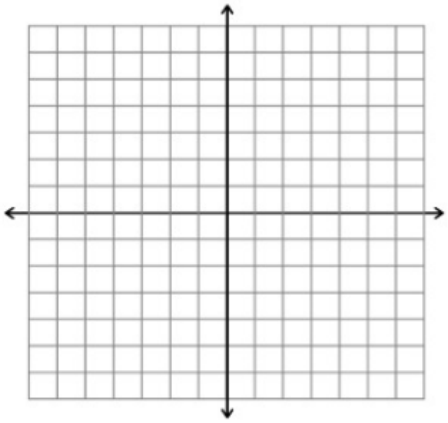
Graphing Exponential Functions:

1] $f(x) = 2^x$



x	y
-1	
0	
1	
2	

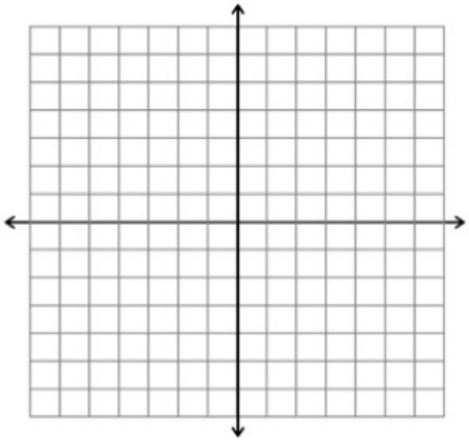
2] $g(x) = 3^x$



x	y
-1	
0	
1	
2	

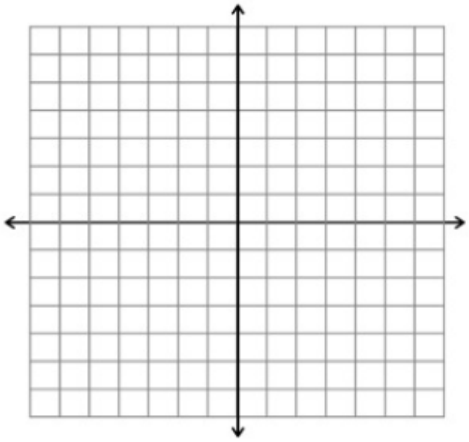
Observations:

3] $f(x) = 0.5^x$



x	y
-1	
0	
1	
2	

4] $h(x) = -2^x$



x	y
-1	
0	
1	
2	

Observations: