3.7 Negative and Zero Exponents

Ex. 1 Complete the table of values for $y = 2^x$. Graph $y = 2^x$.

x	$y=2^x$
5	32
4	16
3	8
2	4
1	2
0	1

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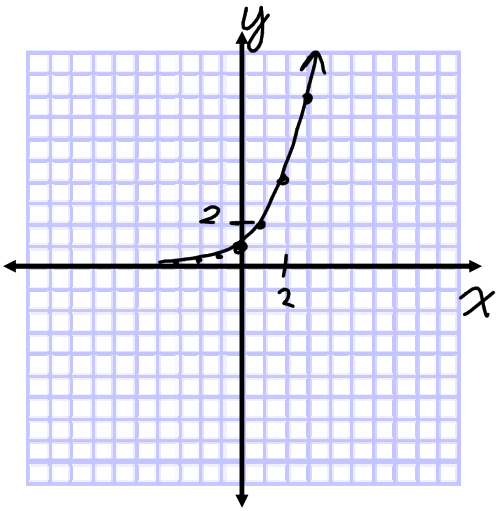
no decimals...use fractions

x	$y=2^x$
-1	$\frac{1}{2}$
-2	$\frac{1}{4}$
-3	$\frac{1}{8}$
-4	$\frac{1}{16}$
-5	$\frac{1}{32}$
-6	$\frac{1}{64}$



Describe the graph. How does it compare to $y = x^2$?

click for graph

- As x increases, y increases
- As x approaches $-\infty$ ($\leftarrow$) graph is flattening out
- As x approaches $+\infty$ ($\rightarrow$) graph becomes rapidly larger.

Will the graph ever cross the x-axis? Explain.

No, only getting closer and closer

But why? (3:00 - 4:00 mark)

http://www.youtube.com/watch?v=68I5vjZec2Y

Ex. 2 Complete the table for $y = 3^x$.

x	$y=3^x$
5	243
4	81
3	27
2	9
1	3
0	1

no decimals...use fractions

x	$y=3^x$
-1	$\frac{1}{3}$
-2	$\frac{1}{9}$
-3	$\frac{1}{27}$
-4	$\frac{1}{81}$
-5	$\frac{1}{243}$
-6	$\frac{1}{729}$

Think about what a negative exponent means!

Ex. 3 Use the pattern in the previous examples to determine the value of:

a) $4^{-1} = \frac{1}{4}$

b) $5^{-2} = \frac{1}{5^2} = \frac{1}{25}$

c) $7^{-3} = \frac{1}{7^3} = \frac{1}{343}$

d) $4^{-2} = \frac{1}{16}$

e) $5^0 = 1$

f) $4^0 = 1$

g) $9^0 = 1$

h) $435^0 = 1$

Rule: for any non-zero base "a"

$a^0 = 1$ and $a^{-k} = \frac{1}{a^k}$

Ex. 4 Evaluate. No decimals.

a) 2^{-3}

$= \frac{1}{2^3}$

$= \frac{1}{8}$

b) 3^{-4}

$= \frac{1}{3^4}$

$= \frac{1}{81}$

c) 5^{-3}

$= \frac{1}{5^3}$

$= \frac{1}{125}$

d) 6^{-2}

$= \frac{1}{6^2}$

$= \frac{1}{36}$

e) $(-2)^{-4}$

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

$= \frac{1}{16}$

f) $(-3)^{-1}$

$= \frac{1}{-3}$

$= -\frac{1}{3}$

g) $(-4)^{-3}$

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

$= \frac{1}{-64}$

$= -\frac{1}{64}$

h) -5^{-2}

$= -\frac{1}{5^2}$

$= -\frac{1}{25}$

Ex. 5 Evaluate. No decimals.

a) $\left(\frac{1}{4}\right)^{-2}$

$= \left(\frac{4}{1}\right)^{2}$

$= 4^2$

$= 16$

b) $\left(\frac{-2}{3}\right)^{-3}$

$= \left(\frac{3}{-2}\right)^{3}$

$= \frac{3^3}{(-2)^3}$

$= \frac{27}{-8}$

$= -\frac{27}{8}$

c) $\left(\frac{-1}{5}\right)^{-1}$

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

$= -5$

d) $\left(\frac{4}{3}\right)^{-2}$

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

$= \frac{3^2}{4^2}$

$= \frac{9}{16}$

Ex. 6 A bacteria colony decays by ½ of its original population every 5 hours.

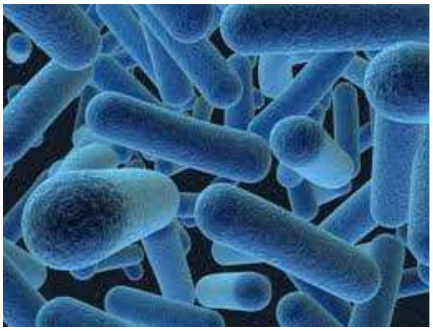
a) What fraction remains after 20 hours? 30 hours? 50 hours?

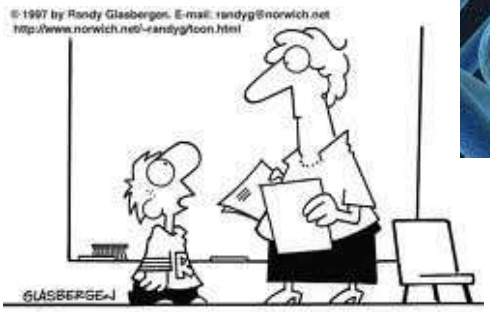
b) Write each fraction from a) as a power with a negative exponent.

Tomorrow

c) If the colony started with 32768 bacteria. How many remain after 25 hours?

Practice Time:
page 199
#1-5,8,11





"I couldn't do my homework because my computer has a virus and so do all my pencils and pens."