Section 4.2: Exponential Functions

Monday, February 24, 2014
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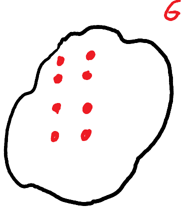
Goals:

1. To evaluate exponential functions.
2. To graph exponential functions.
3. To solve applications.



t (in hrs)	$N(t)$ = # of bacteria after t hrs
6:00pm → 0	$1 = 2^0$
1	$2 = 2^1$
2	$4 = 2^2$
3	$8 = 2^3$
4	$16 = 2^4$
5	$32 = 2^5$
⋮	
t	2^t

$N(t) = 2^t$

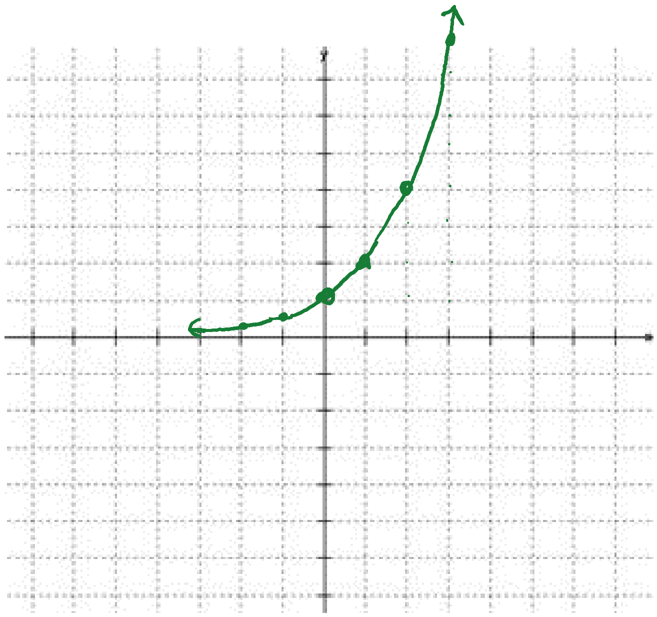
So, after 20 hrs, there are $N(20) = 2^{20}$
$= 1{,}048{,}576$ bacteria

Def: Any function of the form $f(x) = a^x$ is called <u>exponential</u>. $(a > 0,\ a \neq 1)$

Note: The nth term of a geometric sequence, $a_n = a_1 r^{n-1}$ is an exponential function in the variable n, where n is a whole number.

ex Graph

a) $f(x) = 2^x$

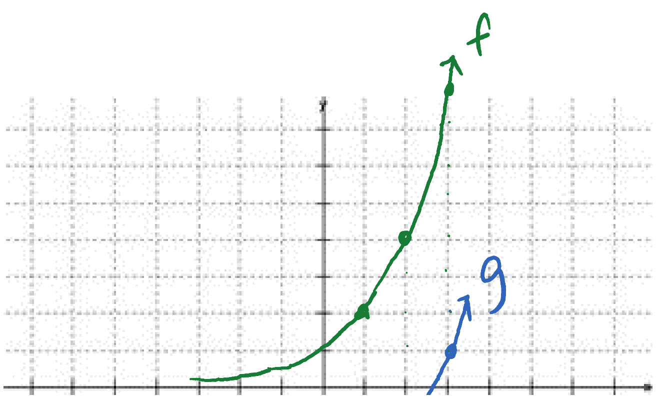


y=0 is an asymptote

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

b) $g(x) = 2^{x-1} - 3$

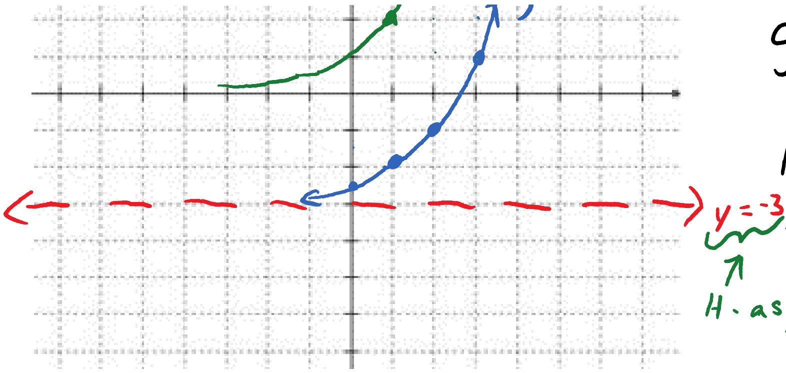
use transformations treat $y = f(x) = 2^x$ as a base fctn.



$y = f(x) = 2^x$

$g(x) = 2^{x-1} - 3$

$g(x) = f(x-1) - 3$



$g(x) = f(x-1) - 3$

H-shift : right 1

V-shift : down 3

ex Describe how to use the graph of $f(x) = 2^x$ to get the graph of...

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

$= -f(x)$

reflection across x-axis

b) $k(x) = 2^{-x}$

$= f(-x)$

reflection across y-axis

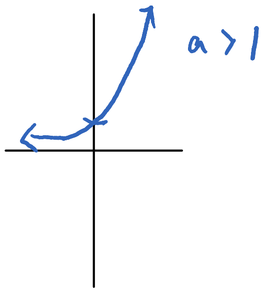
c) $\ell(x) = -2^{x+1} + 5$

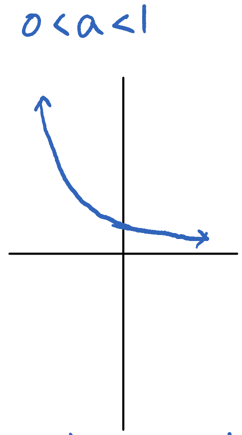
$= -f(x+1) + 5$

1. reflection across x-axis
2. v-shift : 5
3. h-shift : -1

Notes: ① Domain of $f(x) = a^x$ is $(-\infty, \infty)$

② Range of $f(x) = a^x$ is $(0, \infty)$





③ The natural exponential function is...

$$y = e^x, \text{ where } e \approx 2.718\ldots$$

ex

Use a graphing utility to graph the function. If the function has a horizontal asymptote, state the equation of the horizontal asymptote.

$f(x) = \dfrac{12}{1 + 5.5e^{-0.2x}}$,

$x \geq 0$

Horizontal asymptote: $y =$ ✗

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$$f(x) = \frac{12}{1 + 5.5e^{-0.2x}}, \quad x \geq 0$$

Assignment Previewer
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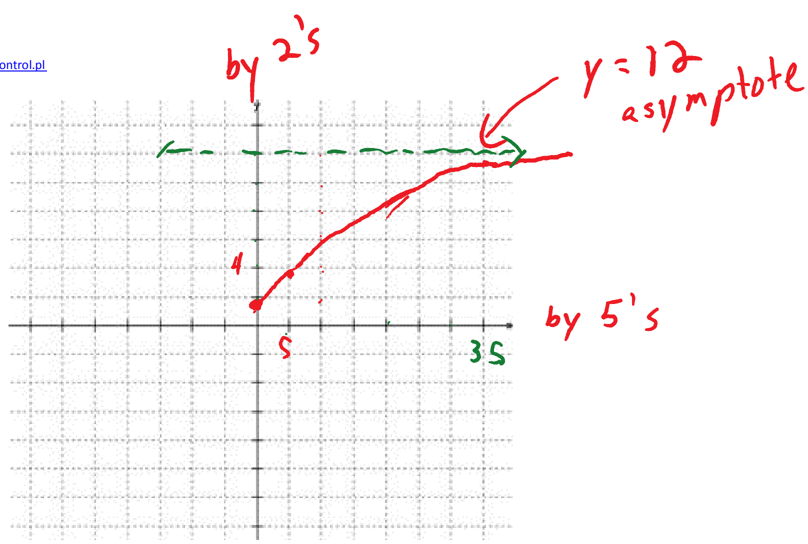

ex

The function $A(t) = 200e^{-0.014t}$ gives the amount of medication, in milligrams, in a patient's bloodstream t minutes after the medication has been injected into the patient's bloodstream.

(a) Find the amount of medication, to the nearest milligram, in the patient's bloodstream after 30 minutes.

✖ mg

(b) Use a graphing utility to determine how long it will take, to the nearest minute, for the amount of medication in the patient's bloodstream to reach 50 milligrams.

✖ min

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