January 20, 2023

Exponential Functions

$y = b^x$ ← variable
← constant

$b > 0,\ b \neq 1$

$y = 7^x$

0	$7^0 = 1$
1	$7^1 = 7$
2	$7^2 = 49$

$y = 14^{2x+3}$

$y = 0^x$

0^1	0
0^2	0
0^3	0

Exponential Growth

$y = b^x$

Exponential Decay

$y = b^{-x}$ ← flip over y-axis

$y = b^x$ ← $0 < b < 1$

$y = \left(\frac{7}{5}\right)^x$ growth

$y = 4^{3-x}$ decay

$y = \left(\frac{1}{3}\right)^{7+x}$ decay

$y = (0.83)^{9-x}$ growth

decay

decay

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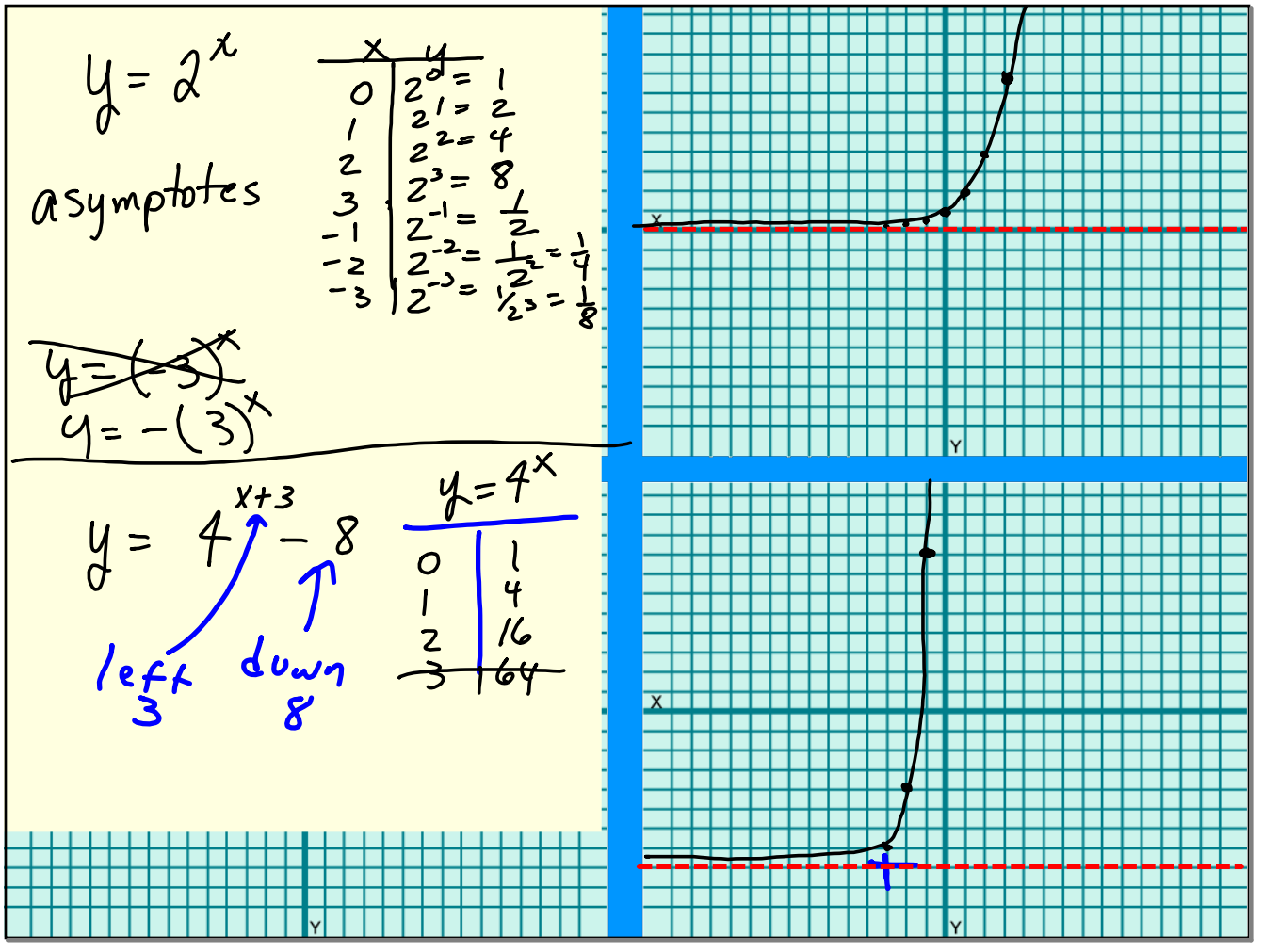


$y = 3(2^{-(x-6)}) - 7$

$6 - x$

Right 6 | Down 7

$y = \sqrt{9-x}$

$\sqrt{-(x-9)}$

0	3
−1	6
−2	12
−3	24

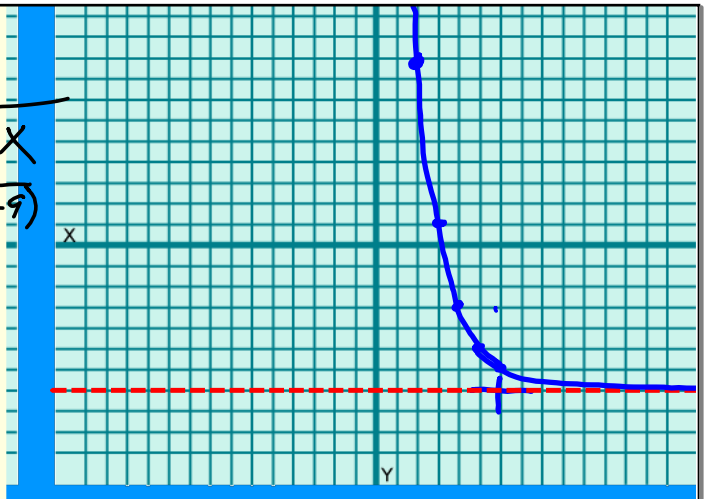
$y = -3^{x-4} + 6$

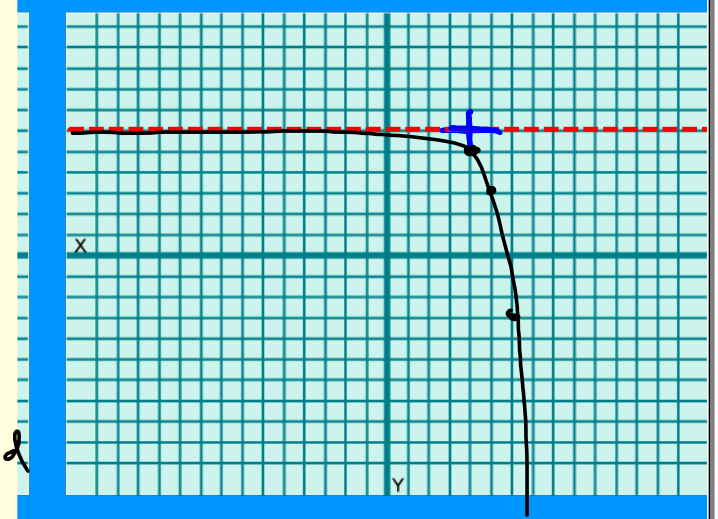
Right 4 | up 6

0	−1
1	−3
2	−9
3	−27

$y = -2^x$ flip over x-axis change y-coord

$y = 2^{-x}$ flip over y-axis change x-coord





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Compound Interest

$$A = P\left(1 + \frac{r}{n}\right)^{nt}$$

- A: Final Amt
- P: Principal (start)
- r: int. rate
- t: time
- n: # of times compounded in a year

$200 x 1.04 = 0.04 (4% inc.)

Compounded
- monthly $n = 12$
- quarterly $n = 4$
- Semi-annually $n = 2$
- bi monthly $n = 6$
- Semi-monthly $n = 24$

Exponential Growth (Main in control)

$$N = N_0(1 \pm r)^t$$

- N: Final Amt
- N_0: initial amt
- r: rate of growth
- t: time

KSU Tuition

2012 $7200

7.6% per year

What is tuition in 2022?

$$N = 7200(1 + 0.076)^{10}$$

$$7200(1.076)^{10}$$

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$e = \left(1 + \frac{1}{n}\right)^n = 2.718$ Leonard Euler (Oiler)

e = Nature Number

$n = 1 \quad \left(1 + \frac{1}{1}\right)^1 = 2$

$n = 2 \quad \left(1 + \frac{1}{2}\right)^2 = 2.25$ } 0.25

$n = 3 \quad \left(1 + \frac{1}{3}\right)^3 = 2.37$ } 0.12

$n = 4 \quad \left(1 + \frac{1}{4}\right)^3 = 2.44$ } 0.07

Nature Formula

$$q = q_0 \cdot e^{kt}$$

q: Final, q_0: Initial

Bacteria

300 bacteria

$K = 0.125$

In how many hours will there be 1000 bacteria?

$1000 = 300 \cdot e^{0.125t}$

$f_1(x) = 300 \cdot e^{0.125x}$

$f_2 = 1000$

Graph & Intersect

9.63 hrs

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