January 23, 2025

Exponential Functions

$y = b^x$ ← variable; ← constant #

$b > 0,\ b \neq 1$

$y = 0^x$

1	0^1
2	$0^2 = 0$
3	$0^3 = 0$

Exponential Growth

$y = b^x$

$b > 1$

$y = 7^x$ $y = \left(\frac{8}{3}\right)^x$

$y = 2^{-x}$

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

Exponential Decay

$y = b^{-x}$

$y = 6^{-x}$

$y = b^x$

$0 < b < 1$

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

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

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

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

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

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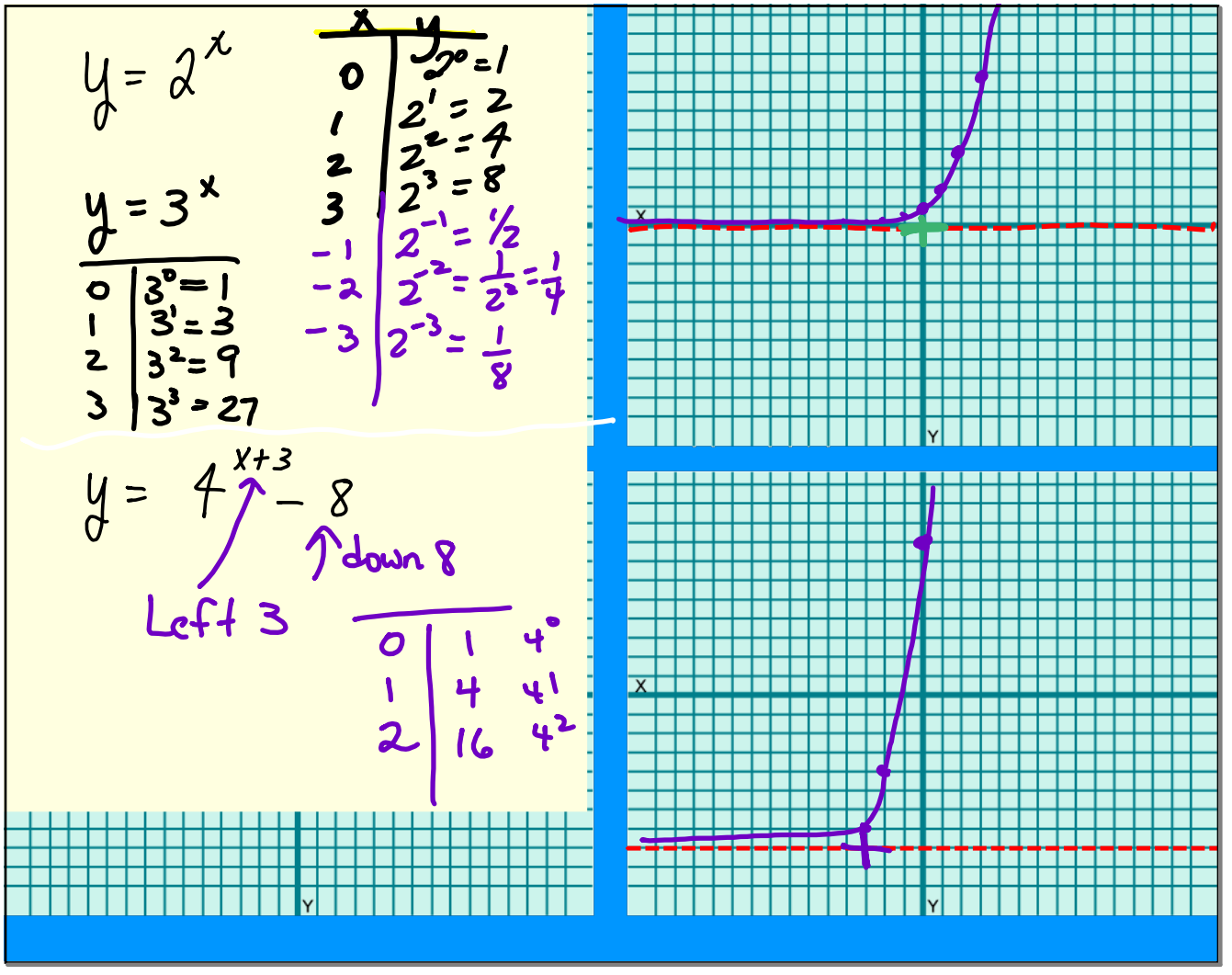


$y = -(3)^{x-4} + 6$

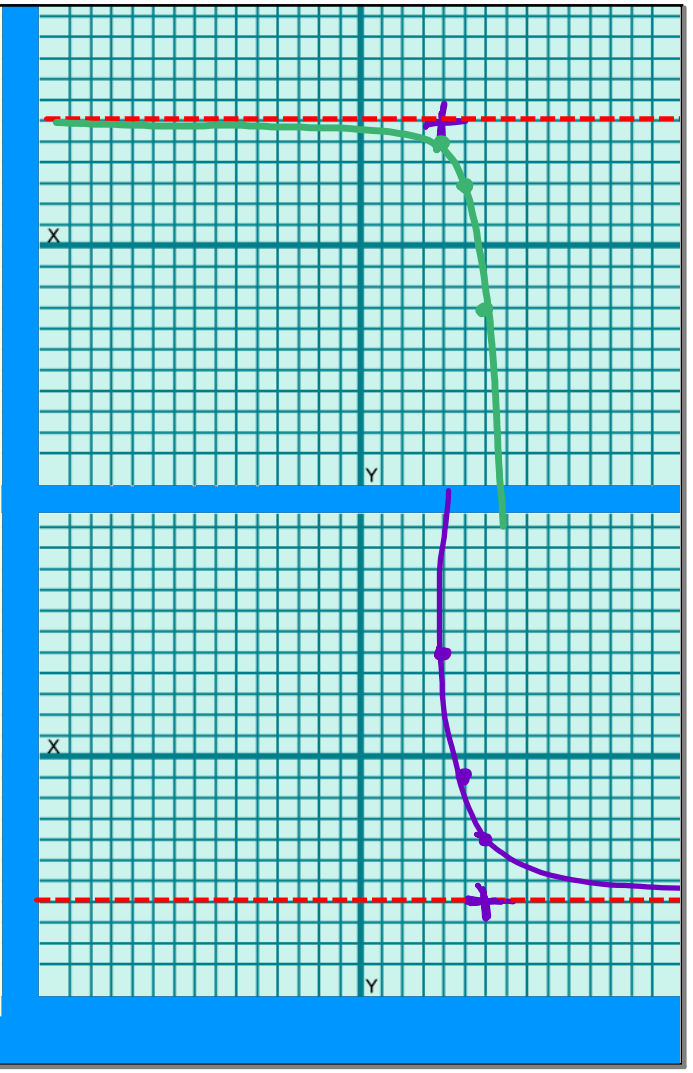
Right 4 UP 6

0	-1
1	-3
2	-9

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

right 6 down 7

0	1	3
-1	2	6
-2	4	12
-3	8	24



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Compound Interest

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

- A: Final Amt
- P: Principal
- r: interest rate
- n: # of times compounded in a year
- t: time

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: growth/decay rate
- t: time

$$A = 3000(1 - 0.026)^t \quad (2.6\%)$$
$$A = 3000(0.974)^t$$
$$A = 5006(1.078)^t$$

KSU Tuition

2024 12,~~418~~

7.25% per year

What is the predicted tuition for ~~this year?~~ 2030?

$$N = 12{,}418(1 + 0.0725)^6$$
$$= 18{,}899$$

When will tuition be $25,000?

$$25{,}000 = 12{,}418(1.0725)^t$$
$$f_1 = 12418(1.0725)^x$$
$$f_2 = 25{,}000$$

Graph & intersect

$x = 10$ yrs

2034

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

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

$= 2.44$ } 0.07

$\approx \boxed{2.718}$

Nature Formula

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

- q: Final
- q_0: start
- k: Constant of growth/decay

Bacteria

300 bacteria

$K = 0.125$

In how many hours will there be 1000 bacteria?

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

$$f_1 = 300e^{0.125x}$$

$$f_2 = 1000$$

Graph & Intersect