October 4, 2023

Exponential Functions

$y = 4^x$ $\quad y = b^x \quad b > 0, b \neq 1$

$y = 0^x$

4: constant base; x: variable exponent

Domain: $(-\infty, \infty)$ $\mathbb{R}$

Range: $(0, \infty)$

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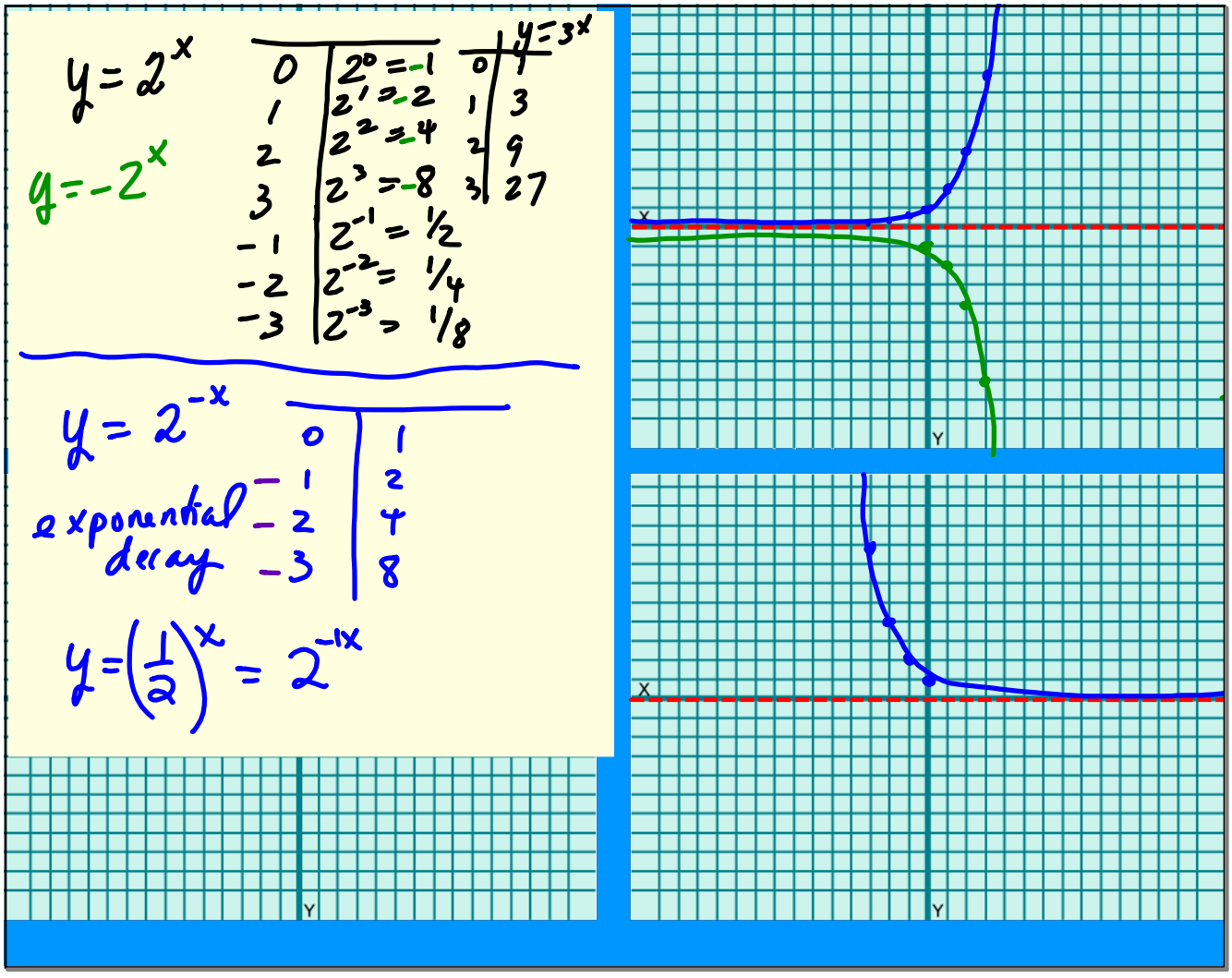


$y = -3^{-(x-4)} + 1$

Right 4 Up 1

0	1
-1	3
-2	9

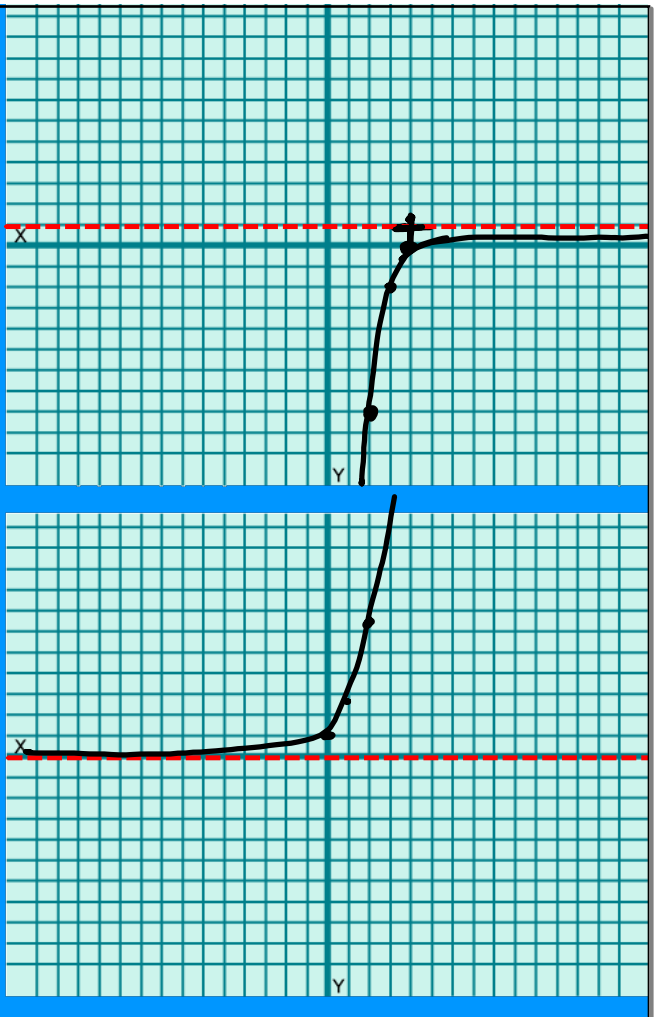
$y = e^x$

0	$e^0 = 1$
1	$e^1 = 2.7$
2	$e^2 = 7.4$

$e \approx \left(1 + \frac{1}{n}\right)^n \approx 2.718$

Leonard Euler

Nature Number



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$$\frac{(a^2b^3)(a^{-5}b^2)^3}{a^{-4}b^2}$$

$$= \frac{(a^2b^3)(a^{-15}b^6)}{a^{-4}b^2}$$

$$= \frac{a^{-13}b^{9-2}}{a^{-4}b^7}$$

$$= \frac{b^7}{a^9}$$

$$\left(\frac{2}{3}\right)^{-2} = \left(\frac{3}{2}\right)^2 = \frac{9}{4}$$

$$\sqrt[5]{a^2} = a^{2/5}$$

$$\left(4^{-3/2} + 2^{-1}\right)^{-1}$$

$$= \left(\frac{1}{\sqrt{4^3}} + \frac{1}{2}\right)^{-1}$$

$$\left(\frac{1}{2^3} + \frac{1}{2}\right)^{-1}$$

$$\left(\frac{1}{8} + \frac{4}{8}\right)^{-1}$$

$$= \left(\frac{5}{8}\right)^{-1} = \boxed{8/5}$$

Solve.

$$\left(\frac{1}{9}\right)^{3x} = \left(\sqrt[4]{27}\right)^{x+3}$$

Make a common base!

$$\left(\frac{1}{3^2}\right)^{3x} = \left(\sqrt[4]{3^3}\right)^{x+3}$$

$$\left(3^{-2}\right)^{3x} = \left(3^{3/4}\right)^{x+3}$$

$$3^{-6x} = 3^{\frac{3}{4}x + \frac{9}{4}}$$

$$4\left[-6x = \frac{3}{4}x + \frac{9}{4}\right]$$

$$-24x = 3x + 9$$

$$+24x \quad +24x$$

$$\frac{-9}{27} = \frac{27x}{27}$$

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

$$6\left[5x = \frac{2}{3} + \frac{7}{2}x\right]$$

$$30x = 4 + 21x$$

Compound Interest

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

$$A = Pe^{rt}$$

Final Amount

Starting Amt

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

Exponential Growth (Man controls)

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

Continuous Growth (Nature)

$$N = N_0 e^{kt}$$

Culture of Bacteria

$N = N_0 e^{kt}$ $\quad k = 0.42$

20 bacteria

How many in 12 hours?

$N = 20e^{(0.42)(12)} =$

≈ 3089 bacteria

When will there be 10,000 bacteria?

$10{,}000 = 20e^{0.42t}$

$f_1 = 10{,}000$

$f_2 = 20e^{0.42x}$