October 5, 2022

Exponential Functions

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

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

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

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

$$7^{-2} = \frac{1}{7^2} = \frac{1}{49}$$

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

$$(x+y)^2$$

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

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

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

$$\left(\frac{1}{8} + \frac{1}{2}\right)^{-1}$$

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

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

$$= \boxed{\frac{8}{5}}$$

Exponential Functions

Constant base
Variable exponent

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

$y = 2^x$

Domain: $(-\infty, \infty)$

Range: $(0, \infty)$

Make Common Bases!

Solve.

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

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

$$3^{-6x} = \left(3^{3/4}\right)^{x+3}$$

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

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

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

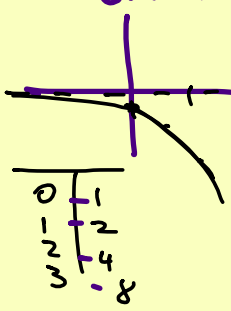
$$\frac{-27x}{-27} = \frac{9}{-27}$$

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

$y = 2^x$

0	$2^0 = 1$
1	$2^1 = 2$
2	$2^2 = 4$
3	$2^3 = 8$
-1	$2^{-1} = 1/2$
-2	$2^{-2} = 1/4$

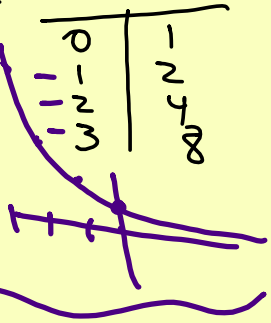
$y = -2^x$ reflects over x-axis

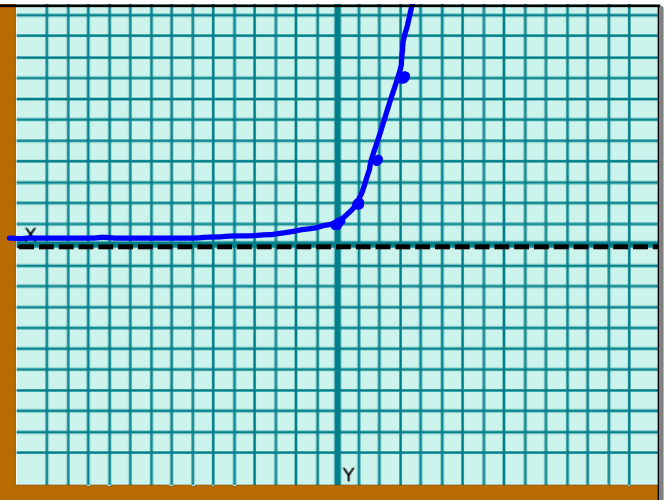


0	-1
1	-2
2	-4
3	-8

$y = 2^{-x}$

0	1
-1	2
-2	4
-3	8





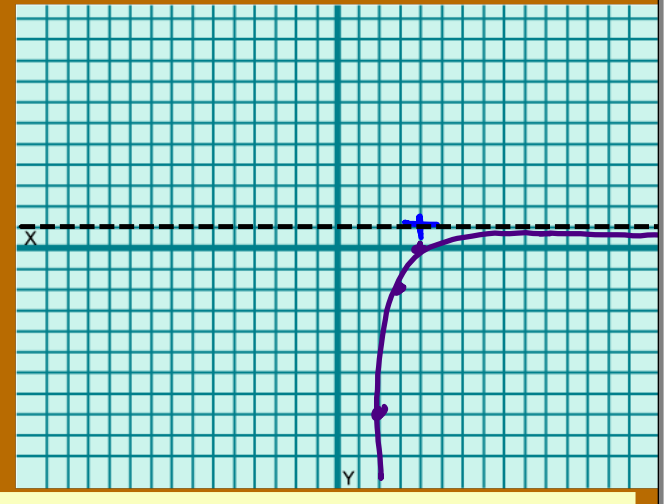
$y = -3^{4-x} + 1$

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

Right 4 Up 1

$y = 3^x$

0	1
-1	3
-2	9



$y = e^x$

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

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

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

$n = 3 \quad 2.37$ — 0.12

$n = 4 \quad 2.44$ — 0.07

Compound Interest

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

A = End, P = start

n = # of times compounded in a year

r

monthly $n = 12$

quarterly $n = 4$

$A = Pe^{rt}$

Exponential Growth

Man-controlled

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

Continuous Growth

Nature events

$q = q_0 e^{kt}$

Culture of Bacteria

$q = q_0 e^{Kt}$ $K = 0.42$

20 bacteria

How many will there be in 12 hrs.

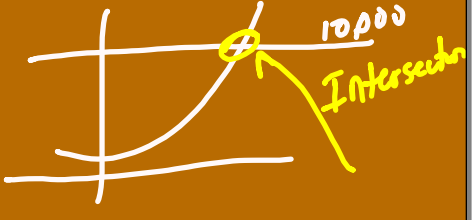
$q = 20e^{0.42(12)} \approx 3089$

When will there be 10,000 bacteria?

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

$f_1 = 20e^{0.42x}$

$f_2 = 10{,}000$



$f_1 = 20e^{0.42x}$

Ctrl-T

12
48

$20e^{0.42x}$ | $x = 12$