14 $3^{-2} = \frac{1}{3^2} = \frac{1}{9}$

20 $-4^{-\frac{3}{2}} = -\frac{1}{4^{3/2}} = -\frac{1}{(4^{1/2})^3} = -\frac{1}{2^3} = -\frac{1}{8}$

$4^{\frac{3}{2}} = 4^{\frac{1}{2}\cdot 3} = 4^{3\cdot\frac{1}{2}}$

$= (4^{\frac{1}{2}})^3$

$a^{b+c} = a^b a^c$

$a^{-b} = \frac{1}{a^b}$

$3^9 = 3^{2+7} = 3^2 \cdot 3^7$

$\frac{a^b}{a^c} = a^{b-c}$

$\sqrt[n]{a^s} = a^{\frac{s}{n}}$

Propesp ties of exponents

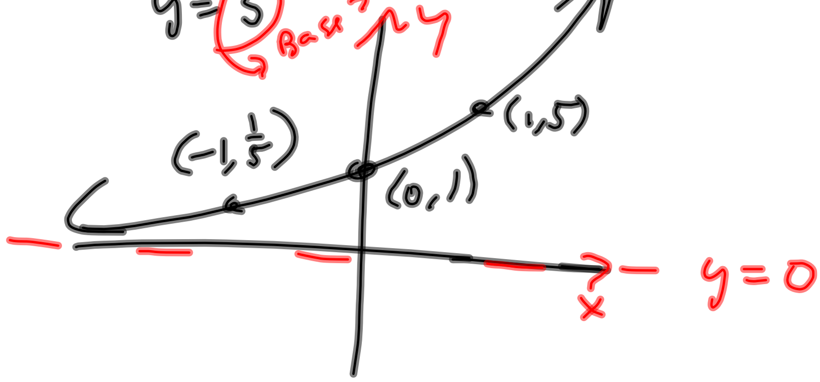
$\sqrt[n]{x} = x^{\frac{1}{n}}$

Chapter P like crazy man

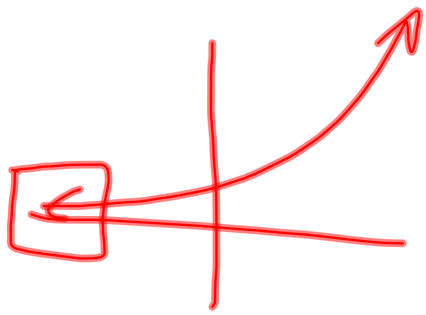
$\frac{(3x^5\sqrt{y})^{-3}}{(5z^{-2})^{-11}} = \frac{3^{-3}x^{-15}y^{-\frac{3}{2}}}{5^{-11}z^{22}}$

$= \frac{5^{11}}{3^3 x^{15} y^{3/2} z^{22}}$

$y = 5^x$ Base > 1

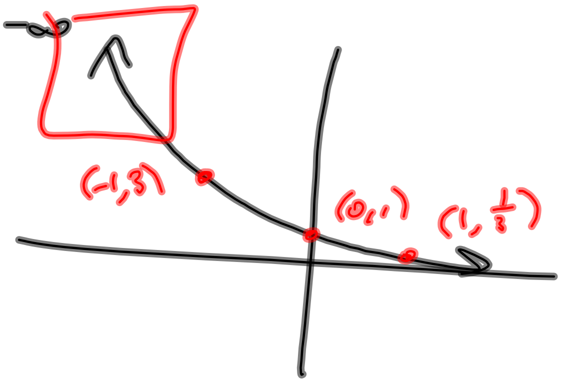


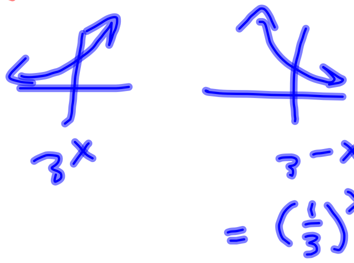
$$\lim_{x \to \infty} 3^x = \infty$$



$$\lim_{x \to -\infty} 3^x = 0$$

$$\lim_{x \to -\infty} \left(\tfrac{1}{3}\right)^x = \infty \qquad \left(\tfrac{1}{3}\right)^x = \left(3^{-1}\right)^x = 3^{-x}$$





$$e = \lim_{x \to \infty} \left(1 + \tfrac{1}{x}\right)^x \approx \underline{2.71828}$$

$f(x) = b^x$ grows proportionally to its size.

Growth rate = K · size

Slope = $K f(x)$

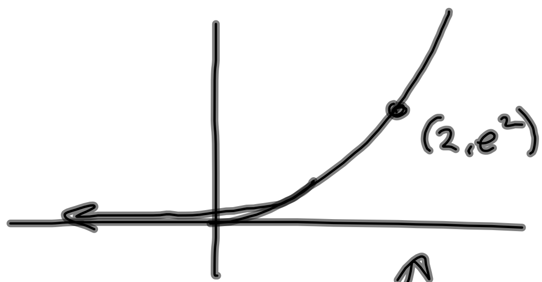
$f'(x) = K f(x)$ for some constant K.

e^x = exactly as steep as it is tall.

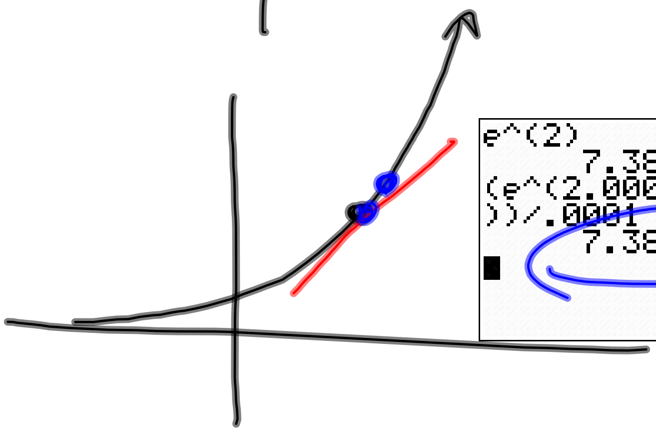
$f(2) = e^2$ = slope @ $x=2$, as well.

<u>Euler</u> $2^x < e^x < 3^x$

2.718^x



$(2, e^2) \approx (2, 7.389056)$



```
e^(2)
         7.389056099
(e^(2.0001)-e^(2
))/.0001
         7.389425564
```

Approximate slope

```
e^(2)
         7.389056099
```

height

$$\text{Slope} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{e^{x_2} - e^{x_1}}{x_2 - x_1}$$

x_1	x_2
2	2.1
2	2.01
2	2.001
2	2.0001

$$\frac{e^{2.0001} - e^{2}}{2.0001 - 2} = \frac{e^{2.0001} - e^{2}}{.0001}$$

$$\left(\frac{1}{2}\right)^{x} = 8 = 2^{3} = \left(\frac{1}{2}\right)^{-3}$$

$$x = -3$$

$$\left(\frac{4}{9}\right)^{x}\left(\frac{8}{27}\right)^{1-x} = \frac{2}{3}$$

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

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

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

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

$$\left(\frac{2}{3}\right)^{5x} = \left(\frac{2}{3}\right)^{1}$$

$$5x = 1$$

$$x = \frac{1}{5}$$