Good afternoon Happy Thursday!

Agenda:
-30 minutes Pre-Calc Review quiz

-Intermediate value theorem

-Infinite limits and Limits at infinity

-Squeeze Theorem

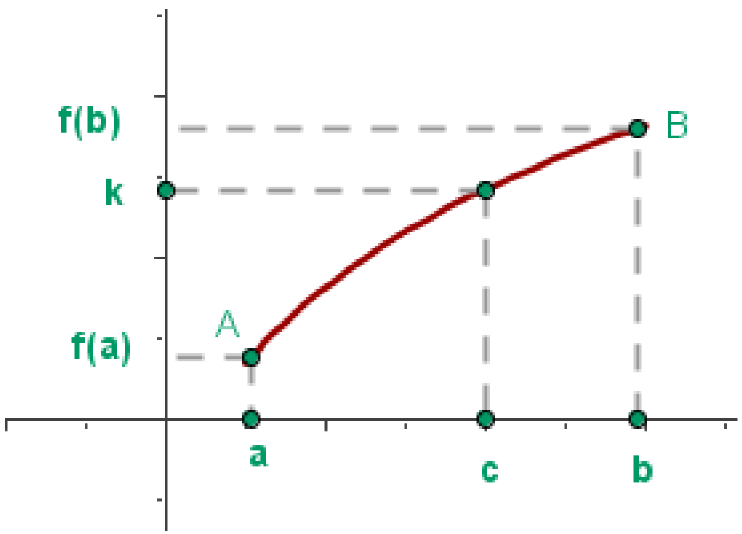
Intermediate Value Theorem(1st real theorem)

If f is continuous on [a,b], f(a)≠f(b), and k is any number between f(a) and f(b), then

there is at least one number *c* in [a,b] such that f(c) =k.

** this is an existence theorem**

Ex



Application of IVT

$f(x) = x^3 + 2x - 1$

show it has a zero
(root)

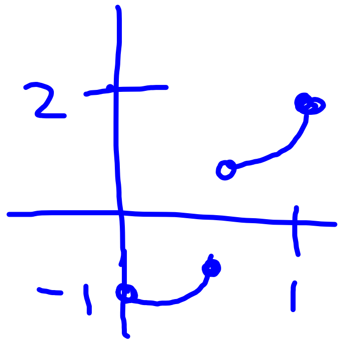
$[0, 1]$

$-1 < 0 < 2$

$f(0) = -1$

$f(0) < f(c) = 0 < f(1)$

$f(1) = 2$



Infinite limits:
What is an infinite limit?

Consider y=3/(x-2)

H.A. $y=0$

V.A. @ $x=2$

$$\lim_{x\to 2} \frac{3}{x-2} \Rightarrow \frac{3}{1.9-2} = \frac{3}{-.1} = -30$$

$$\frac{3}{1.99-2} = \frac{3}{-.01} = -300$$

$$\frac{3}{1.999-2} = \frac{3}{-.001} = -3000$$

$$\lim_{x\to 2^-} \frac{3}{x-2} = -\infty$$

$$\lim_{x\to 2^+} \frac{3}{x-2} = \infty$$

Note that our answer lim f(x)=∞ does not mean the limit exists! In fact it tells how if fails to exist, by representing the unbounded behavior of f(x) at c.

Properties:

$$\lim_{x\to c} f(x) = \infty$$

$$\lim_{x\to c} g(x) = L$$

$$f \pm g = \infty \qquad f \cdot g = \infty \quad L>0$$

$$= -\infty \quad L<0$$

$$\frac{g}{f} = 0 \qquad \frac{1}{\infty} = 0$$

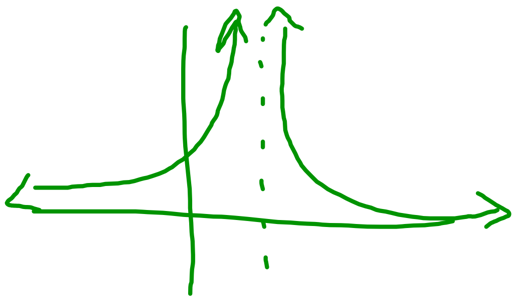
Vertical Asymptote:
IF f(x) approaches infinity (negative infinity) as x approaches c, from the right or left, then the line $\boxed{x=c \text{ is a vertical asymptote}}$ of the graph f.

Ex)

$$\frac{1}{(x-1)^2} \qquad \frac{1}{.00001}$$

$$\lim_{x \to 1^-} \frac{1}{(x-1)^2} = \infty$$

$$\lim_{x \to 1^+} \frac{1}{(x-1)^2} = \infty$$



Ex)

$$\lim_{x \to 2^-} \tan \frac{\pi x}{4}$$

$$\infty$$

$$\lim_{x \to 2^+} \tan \frac{\pi x}{4}$$

$$-\infty$$

Limits at infinity:

Consider: f(x)= 3x2/(x2+1)

$$\lim_{x\to\infty} \frac{\cancel{3x^2}/x^2}{x^2/x^2+1/x^2} = \frac{\infty}{\infty} \text{ indeterminant}$$

$y = 3$

$$\lim_{x\to\infty} \frac{3}{1+\frac{1}{x^2}} = \frac{\lim_{x\to\infty} 3}{\lim_{x\to\infty} 1 + \lim_{x\to\infty} \frac{1}{x^2}} = \frac{3}{1+0}$$

$$\frac{1}{(10000)^2} = 0.000000001 \qquad \frac{3}{1} = \boxed{3}$$

$$\lim_{x\to-\infty} \frac{3x^2/x^2}{x^2/x^2+1/x^2} = \frac{\lim_{x\to-\infty} 3}{\lim_{x\to-\infty} 1 + \lim_{x\to-\infty} \frac{1}{x^2}}$$

$\to 0$

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

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$$\lim_{x\to\infty} \frac{c}{x^r} = 0$$

$$\lim_{x\to-\infty} \frac{c}{x^r} = 0$$

x^r defined when $x<0$

$$\lim_{x\to\infty} e^{-x} \to \frac{1}{e^x} = 0$$

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

Horizontal Asymptote:

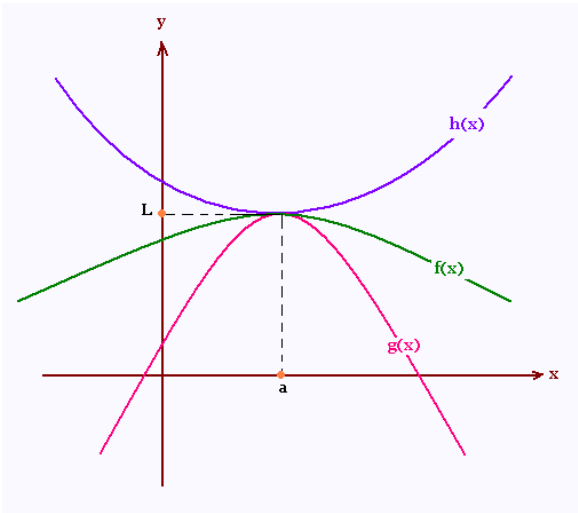
The line y=L is a horizontal aysmptote of the graph f when

$f(x)$

Squeeze theorem:

If h(x)≤f(x)≤g(x) for all x in an open interval containting c, except possibly at c, and if

then



3 special cases:

1)

2)

3)