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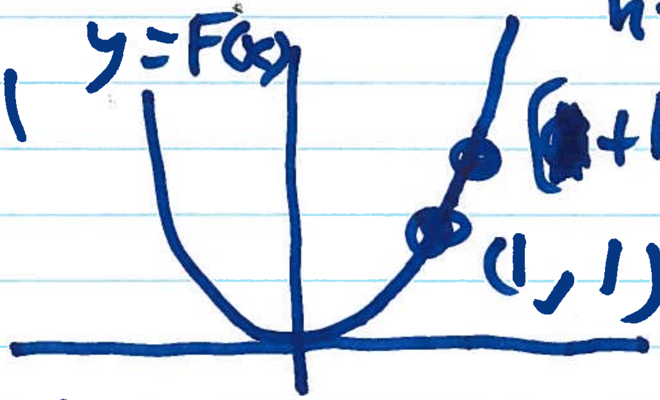
A function $f(x)$ approaches the value L as x approaches a, $\lim_{x \to a} f(x) = L$

Example: $F(x) = x^2$ $\quad a = 1$

$h = 1, .1, .01,$

$F(a) = 1$



$(1+h, (1+h)^2)$

$(1.1, 1.1^2) = (1.1, 1.21)$

Slope: $\frac{1.21 - 1}{1.1 - 1} = \frac{.21}{.1} = \underline{2.1}$ $\qquad \underline{1 + 2h + h^2}$

$(1.01)^2$

$(1.01, 1.\underline{0201})$

$\frac{1.0201 - 1}{1.01 - 1}$ Slope $\left(\frac{.0201}{.01} \right) \frac{\Delta y}{} = 2.\underline{01}$

Slope: $(1,1)$

$(1+h, (1+h)^2 = 1+2h+h^2)$

$y = F(x) = x^2 \quad a=1 \quad h$

$(a, F(a)) \quad (a+h, F(a+h))$

$$\frac{F(a+h)-F(a)}{a+h-a} = \frac{F(a+h)-F(a)}{h}$$

$$\frac{\cancel{1}+2h+h^2-\cancel{1}}{h} = \frac{2h+h^2}{h}$$

$h=.1 \quad 2 \cdot .1 + .1^2 = \frac{.2+.01}{.1} = \frac{.21}{.1}$

$= 2.1$

$h=.01 : 2.01$

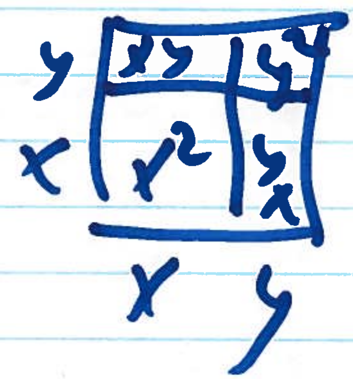
$$1$$

$(x+y)^1$: $1x^1y^0 \quad 1x^0y^1$

$(x+y)^2$: $1x^2y^0 + 2x^1y^1 + 1x^0y^2$ ⇐

$(x+y)^3$: $1x^3y^0 + 3x^2y^1 + 3x^1y^2 + 1x^0y^3$

$$(x+y)^2 = x^2 + 2xy + y^2$$



$$\begin{array}{r} 11 \\ \times\ 11 \\ \hline 11 \\ 11 \\ \hline 121 \\ \vdots \end{array}$$

$$(10+1)^2$$

$$\begin{array}{r} 121 \\ \times\ 11 \\ \hline 121 \\ 121 \\ \hline 1331 \end{array}$$

$$(x+y)^2 = x^2 + 2xy + y^2$$

$$(x+y)^3 = (x+y)(x+y)^2$$

$$= (x+y)(1x^2 + 2xy + 1y^2)$$

$$\begin{array}{ccccc}
1x^3 & +2x^2y & +1xy^2 & & \\
 & 1x^2y & +2xy^2 & +1y^3 & \\
\hline
\end{array}$$

$$\begin{array}{ccccc}
1 & 3 & 3 & 1 & \\
 & 1 & 3 & 3 & 1 \\
\hline
1 & 4 & 6 & 4 & 1
\end{array}$$

$$\frac{2h+h^2}{h} = \frac{h(2+h)}{\cancel{h}}$$

$$= 2+h$$

$h = .1$: 2.1

$h = .01$: 2.01

$h = .001$: 2.001

$h = 0$: 2

?? $\frac{0}{0}$

Δ

$$\lim_{h \to 0} \frac{\overbrace{2h+h^2}^{f(h)}}{h} = \overbrace{2}^{=L}$$

$\overset{\shortparallel}{a}$

$$\lim_{x \to a} f(x) = L \qquad \frac{2x+x^2}{x} \to 2$$

$$\boxed{\begin{gathered} \forall \epsilon > 0 \ \exists \delta > 0 \ \ni \\ 0 < |x-a| < \delta \Rightarrow |f(x) - L| < \epsilon \end{gathered}}$$

For every epsilon greater than ~~zero~~ zero there ~~e~~ exists a delta greater than zero such that If x is within δ of a but not equal to a Then f(x) is within ϵ of L.

$$|f(x) - L| < \epsilon$$

$$|x^2 - 1| < .1$$

$$-.1 < x^2 - 1 < .1$$

$$1 - .1 < x^2 < 1 + .1$$

$$0 < |x - a|$$

$$|x - a| \neq 0$$

$$x \neq a$$