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NO ONLINE COMPONENT
STEWERT 8E Early Transitions

Calc II

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NO CANVAS

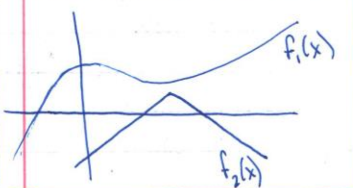
"Function of x" (denoted by $f(x)$)
- one (and only one) real number (as output) to a given real # (input)

Inverse function $[f^{-1}(y) = x]$

invertible: $y = 2x + 1 \longrightarrow x = \frac{y-1}{2}$

not invertible: $y = x^2 \rightarrow x = \pm\sqrt{y}$

Continuous function

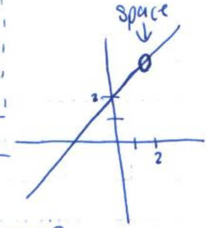


limit of function:

$$\lim_{x\to 2} (x^2+1) = 2^2+1 = 5$$

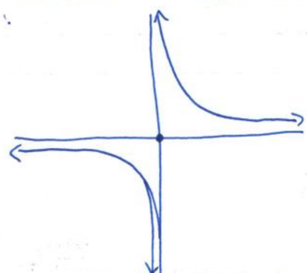
$f(x) = \frac{x^2-4}{x-2}$ $\lim_{x\to 2} f(x) = 4$

$f(2) = DNE$

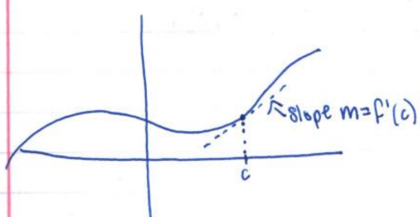


Continuous functions have:
$f(x)$ is continuous @ $x = c$
1) $f(c)$ is defined 2) $\lim_{x\to c} f(x)$ must exist 3) $f(c) = \lim_{x\to c} f(x)$ MUST AGREE

pathology:



$$f(x) = x^{-1} \text{ if } x \neq 0$$
$$= 0 \text{ if } x = 0$$



Given $f(x)$ find $\lim_{\Delta x\to 0} \left[\overbrace{\frac{f(x+\Delta x) - f(x)}{\Delta x}}^{\text{"Newton quotient"}} \right]$

Everything we do is BASED off of this

1) $f(x) = \underline{\text{constant}}$
$\lim_{\Delta x\to 0} \left[\frac{c-c}{\Delta x}\right] = \boxed{0}$

2) $f(x) = \underline{x}$
$f'(x) = \lim_{\Delta x\to 0} \left[\frac{(x+\Delta x)-x}{\Delta x}\right] = \boxed{1}$

3) $f(x) = x^2$

$$\lim_{\Delta x\to 0} \left[\frac{(x+\Delta x)^2 - x^2}{\Delta x}\right] \Rightarrow \lim_{\Delta x\to 0} \left[\frac{\overset{\text{cancel}}{x^2} + 2x\Delta x + (\Delta x)^2 \overset{\text{cancel}}{- x^2}}{\Delta x}\right] = \lim_{\Delta x\to 0} \left[2x + \Delta x\right] = \boxed{2x}$$

$\to f'(x) = nx^{n-1}$

4) $f(x) = x^n$

$f'(x) = \lim_{\Delta x \to 0}\left[\frac{(x+\Delta x)^n - x^n}{\Delta x}\right]$

$\binom{n}{k} = \frac{n!}{k!(n-k)!}$ $\quad n! = 1\cdot 2\cdot 3 \cdots (n-1)\cdot n$

$(\underset{x}{a}+\underset{\Delta x}{b})^n = \sum_{k=0}^{n}\binom{n}{k}a^k b^{n-k}$ $\quad = \lim_{\Delta x \to 0}\left[\frac{\sum_{k=0}^{n}\binom{n}{k}x^k(\Delta x)^{n-k} - x^n}{\Delta x}\right]$

$k = n$ $\quad \binom{n}{n}x^n(\Delta x)^0 = x^n$

$k = n-1$ $\quad \binom{n}{n-1}x^{n-1}(\Delta x)^1 = \frac{nx^{n-1}\cancel{(\Delta x)}}{\cancel{\Delta x}}$

5) $f(x) = \sin(x)$

$\lim_{\Delta x \to 0}\left[\frac{\sin(x+\Delta x) - \sin(x)}{\Delta x}\right]$

$\lim_{\Delta x \to 0}\left[\frac{\sin(x)\cos(\Delta x) + \cos(x)\sin(\Delta x) - \sin(x)}{\Delta x}\right]$

$\lim_{\Delta x \to 0}\left[\sin x\frac{\cos\Delta x}{\Delta x} + \cos x\overbrace{\frac{\sin\Delta x}{\Delta x}}^{1} - \sin x\right] = \cos x$

$\sin x\left(\frac{\cos\Delta x}{\Delta x} - 1\right)$

diff ↓
$\sin x$
$\cos x$
$-\sin x$
$-\cos x$
$\sin x$

after 4 they cycle back

6) $f(x) = e^x$ $\quad f'(x) = e^x$
$g(x) = 2^x$ $\quad g'(x) = (\ln 2)2^x$
$h(x) = b^x$ $\quad h'(x) = \ln b \cdot b^x$

Chain Rule:

$(e^{\sin x})' = e^{\sin x}\cdot\cos x$

f
g
x

$f(g(x))$ $\quad f(g) = g^2+1$
$g(x) = e^x$
$f(g(x)) = e^{2x}+1$

$[f(g(x))]' = f'(g(x))\cdot g'(x)$

$$\boxed{y = \sin^{-1}x} \neq \frac{1}{\sin x}$$

Leibniz	Newton
$\frac{dy}{dx}$	$= y'(x)$

"I'm looking for the angle in which the sin is given" $\Leftarrow$

$$x = \sin y$$
$$y = \arcsin x$$

$$\boxed{\sin^2 y + \cos^2 y = 1}$$

$$\frac{dx}{dx} = \frac{d(\sin y)}{y} \cdot \frac{dy}{dx}$$

$$1 = \cos y \cdot \frac{dy}{dx}$$

$$\frac{dy}{dx} = \frac{1}{\cos y} = \frac{1}{\sqrt{1-x^2}}$$

$$[f(x) \pm g(x)]' = f'(x) \pm g'(x)$$

$$[f(x) \cdot g(x)]' = f'(x) \cdot g(x) + f(x) \cdot g'(x)$$

$$\left[\frac{f(x)}{g(x)}\right]' = \frac{g(x)f'(x) - g'(x)f(x)}{[g(x)]^2}$$

~~Bring the bottom up, ...~~

$$\{\ln[f(x)]\}' = \frac{1}{f(x)} \cdot f'(x) = \boxed{\frac{f'(x)}{f(x)}}$$

$$(\ln x)' = \boxed{x^{-1}}$$

$f(x)$	$f'(x)$
constant (c)	0
x	1
x^n	nx^{n-1}
x^r	rx^{r-1}
$c\,g(x)$	$c\,g'(x)$
$g(x) \pm h(x)$	$g'(x) \pm h'(x)$
$g(x)h(x)$	$g'(x)h(x) + g(x)h'(x)$

$n @ \mathbb{N}$

$r @ \mathbb{R}$

$f(x)$	$f'(x)$
$[g(x)]^n$	$n[g(x)]^{n-1} \cdot g'(x)$
"composition(s) of function"	
$g(h(x))$	$\Rightarrow g'(\square) \cdot h'(x)$
"chainrule"	$g'(h(x)) \cdot h'(x)$
$\ln\lvert x\rvert$	$1/x$ $x \neq 0$
$\ln(g(x))$	$g'(x)/g(x)$ "scaling it" "% change"
$e^{g(x)}$	$e^{g(x)} \cdot g'(x)$