1.1 #s 27-30 Simplify the Difference Quotient.

27 $f(x) = 4 + 3x - x^2 \Longrightarrow$

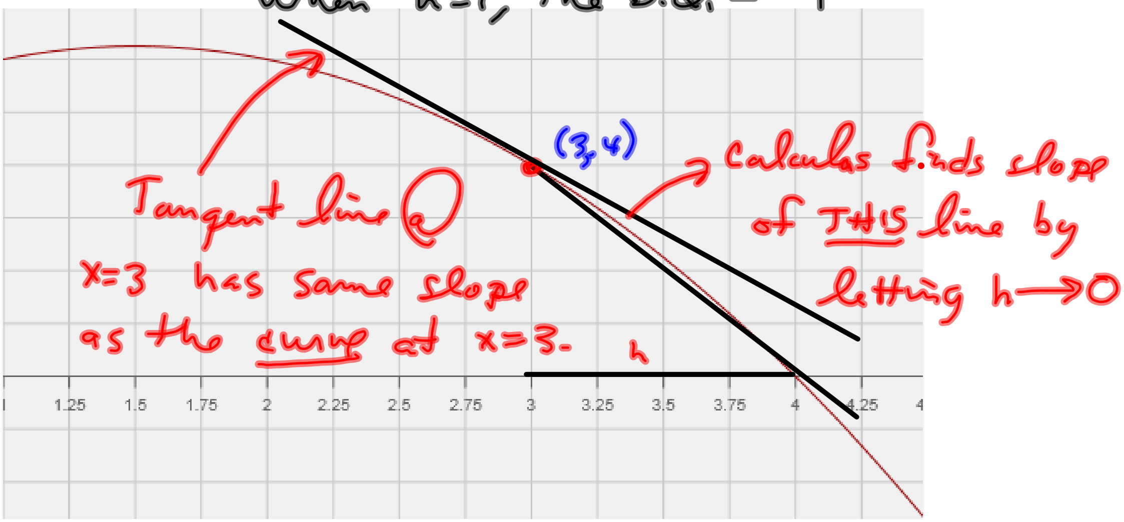
$$\frac{f(3+h) - f(3)}{h} = \frac{4 + 3(3+h) - (3+h)^2 - [4 + 3(3) - 3^2]}{h}$$

$$= \frac{4 + 9 + 3h - (9 + 6h + h^2) - [4 + 9 - 9]}{h}$$

$$= \frac{13 + 3h - 9 - 6h - h^2 - 4}{h} = \frac{-3h - h^2}{h} = \frac{h(-3-h)}{h}$$

$= -3 - h$ = Slope of the line in the picture.

When $h = 1$, the D.Q. $= -4$



§1.3 - 1.5 assignments are up.

http://www.harryzaims.com/201/201-fall-13/homework/201-assignments-fall-13.pdf

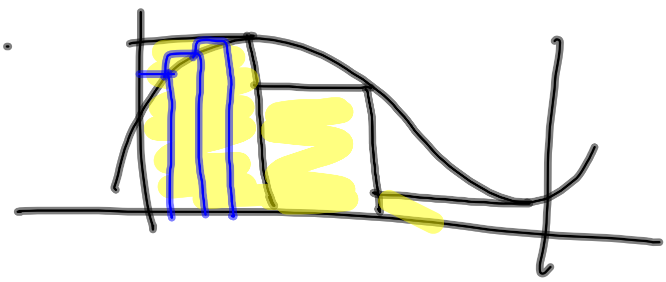
SEC	Problems
1.1	#s 21, 25 – 43, 47 – 59, 63, 73, 77 (Odds only)
1.2	#s 5, 7, 9, 13 (Not a whole lot assigned. You should read and ask questions, though.)
1.3	#s 17 – 23, 27 – 31, 35, 43, 51, 54 (All odds, except for #54)
1.4	#s 5, 9
1.5	#s 1, 3, 5, 6, 7, 11, 15, 19, 23[1], 25[2], 27, 29, 35, 38

[1] We will eventually do this sort of limit analytically (i.e., with algebra techniques)

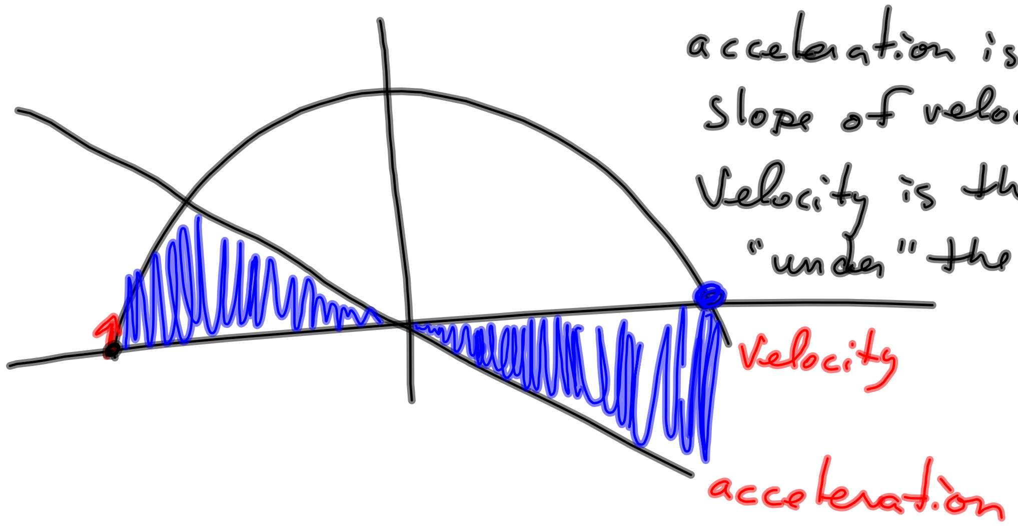
[2] $FACT: x^n - 1 = (x-1)(x^{n-1} + x^{n-2} + \ldots + x^2 + x + 1)$ e.g. $x^3 - 1 = (x-1)(x^2 + x + 1)$ This is a fun fact(orization) that we will use to prove our power rule for derivatives in a week or so.

§1.4 Our Goal: To find the slope of a curve at a single point. We generalize the notion of a straight line between 2 points to get there. This is Differential Calculus. Smooth

Integral Calculus: Generalize the area of a rectangle to find the area under a curve. Continuous.



acceleration is the slope of velocity
Velocity is the area "under" the acceleration



~~Ex~~ #29:

$$f(x)=\frac{1}{x} \Longrightarrow \frac{f(x)-f(a)}{x-a} = \frac{f(a+h)-f(a)}{a}$$

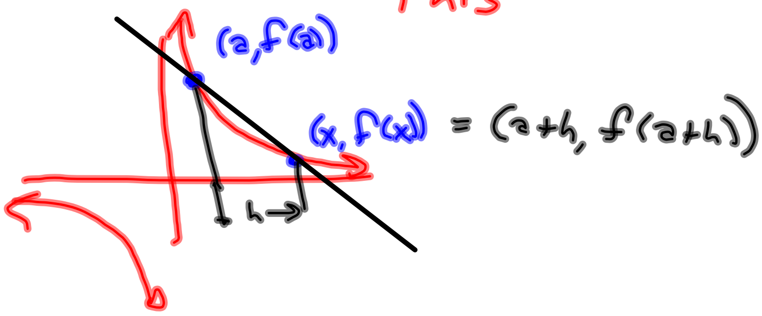
Make the substitution $x=a+h$

$$= \boxed{\frac{\frac{1}{x}-\frac{1}{a}}{x-a}} = \frac{\frac{1}{a+h}-\frac{1}{a}}{h}$$

$a+h$

Simplify this

Simplifying THIS is equivalent.



$$\frac{\frac{1}{x}-\frac{1}{a}}{x-a} = \frac{\frac{a}{xa}-\frac{x}{xa}}{x-a} = \frac{\frac{a-x}{ax}}{\left(\frac{x-a}{1}\right)} = \frac{a-x}{ax}\cdot\frac{1}{x-a}$$

$$= \frac{-(x-a)}{ax}\cdot\frac{1}{(x-a)} = \boxed{\frac{-1}{ax}} \xrightarrow{x\to a} \boxed{-\frac{1}{a^2}}$$

DONE

For the sequel.

Let $x = a+h$. Then we have

$$\frac{f(a+h)-f(a)}{a+h-a} = \frac{\frac{1}{a+h}-\frac{1}{a}}{h} = \frac{\frac{a-(a+h)}{a(a+h)}}{h}$$

$$= \frac{\frac{a-a-h}{a(a+h)}}{h} = \frac{\frac{-h}{a(a+h)}}{\left(\frac{h}{1}\right)} = \frac{-\cancel{h}}{a(a+h)}\cdot\frac{1}{\cancel{h}}$$

$$= -\frac{1}{a(a+h)} \xrightarrow{h\to 0} -\frac{1}{a^2}$$

Now $x \to a$ is equivalent to $h \to 0$

Aug 21-12:44 PM

The slope of the secant line between 2 points comes closer to the slope of the tangent line at <u>one</u> point by taking the 2 points closer & closer together.

This is the NUMERICAL APPROACH to $\boxed{\text{limits.}}$

§1.5 then go back to 1.4.

<u>The Limit</u>

We say the limit as x approaches 2 of x^2+x is 6, because we can make x^2+x close to 6 by taking x close to 2.

$$\lim_{x\to 2}(x^2+x)=6$$

Let $f(x)=x^2+x$.

$f(1)=2$

$f(1.5)=3.75$

$f(1.8)=5.04$

$f(1.9)=5.51$

$f(1.99)=5.95$

$f(1.999)=5.995$

Let $f(x)=\dfrac{x^2-1}{x-1}$

$f(1)\ \nexists$ <u>But</u>

$\lim_{x\to 1} f(x)=2$

$f(.999)=1.999$

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

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

Graph of $f(x)$: