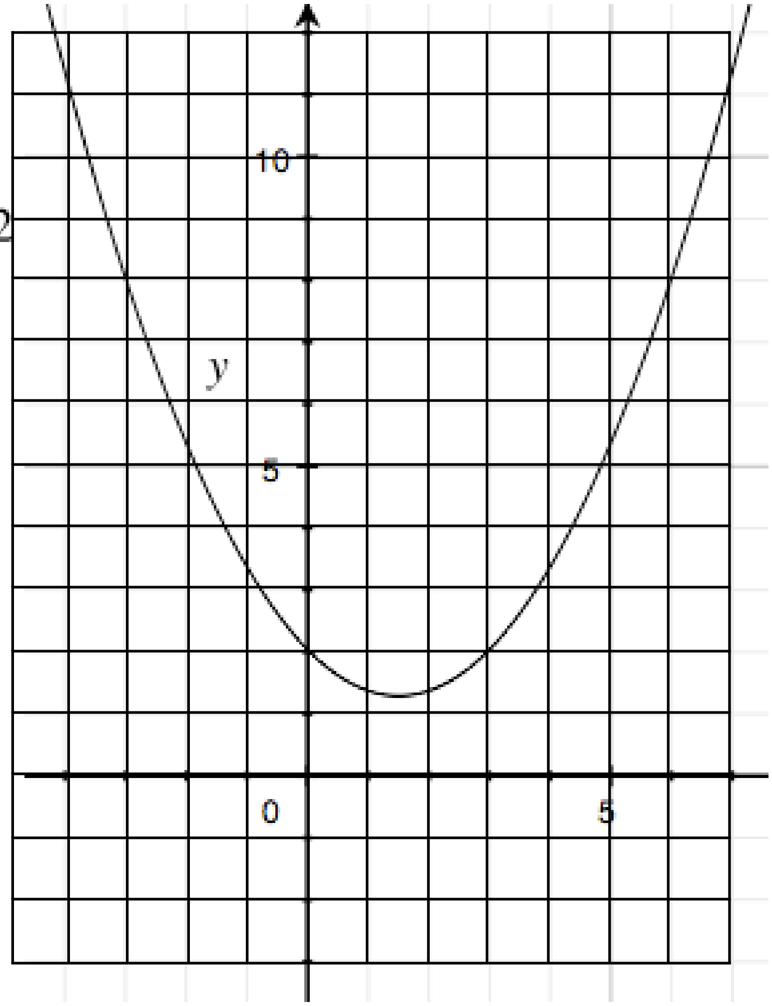
Name: ___________________________ AP

Classwork 23

1. a) Use the distance vs. time graph to approximate the object's exact speed at t = 0



b) Write an equation for your tangent line.

c) The original equation is $y = \frac{1}{3}x^2 - x + 2$
Put both your original equation and the tangent line into the calculator. How well did you do? Zoom in to x = 0.

d) Let's see if there's another way we could figure out the slope (speed). What's the formula again?

e) What could we do to get an average speed that is really close to the instantaneous speed at t = 0?

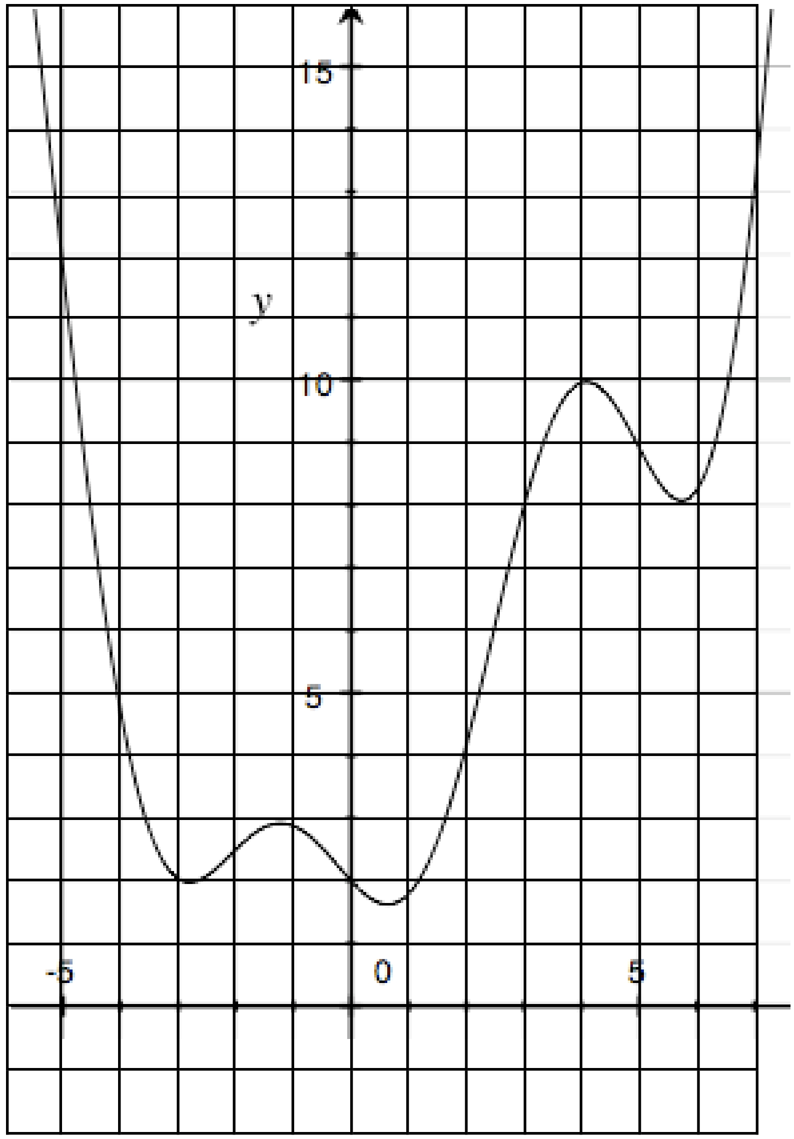
Let's fill in the following chart:

x	**y**	**Slope between this point and (0, 2)**
1		
.5		
.1		

What are we doing to the point that we are using to find a slope with (0, 2)?

Let's say we renamed the difference between the x value we are using and 0 with the variable **h**. Write a limit to express what is happenning to **h** and what happens to the slope as a result**.**

2. a) Use the distance vs. time graph below to approximate the object's exact speed at:



i. $t = 2$

ii. $t = -5$

iii. $t = 0$

b) Write an equation for your tangent line for $t = 0$.

c) The original equation is

$$y = \frac{1}{3}x^2 - x\cos x + 2$$

Put both your original equation **and** the tangent line into the calculator. How well did you do? Zoom in to $x = 0$.

d) Let's see if there's another way we could figure out the slope (speed). What's the formula again?

e) Calculate the average speed (average slope) between $t = -5$ and $t = 5$.

f) Draw that average speed on the graph.

g) Why doesn't this tell us much about what is happenning around $t = 0$?

h) What could we do to get an average speed that is really close to the instantaneous speed at $t = 0$?

Let's fill in the following chart for slopes between (0, 0) and a point nearby.

x	**y**	**Δx**	**Δy**	**Slope**
1				
.5				
.1				
.01				
.001				
.0001				

i) What is our approximation approaching? What would you say is the **exact** slope at x = 0 (t = 0) ?

j) Why is this answer close to what the tangent line gave us?

k) What is happenning to Δx? What is happenning to Δy as a result? Explain why this indicates that calculus is going to be necessary.

l) Let's say we renamed the difference between the x value we are using and 0 with the variable **h**. Write a limit to express what is happenning to **h.**

3. Let's say we are dealing with the graph of $f(x) = \dfrac{\frac{1}{3}x^4 - 5x^2 + 1}{x^2 + 2x + 4}$

a) Investigate the slope around x = 1 using a chart.

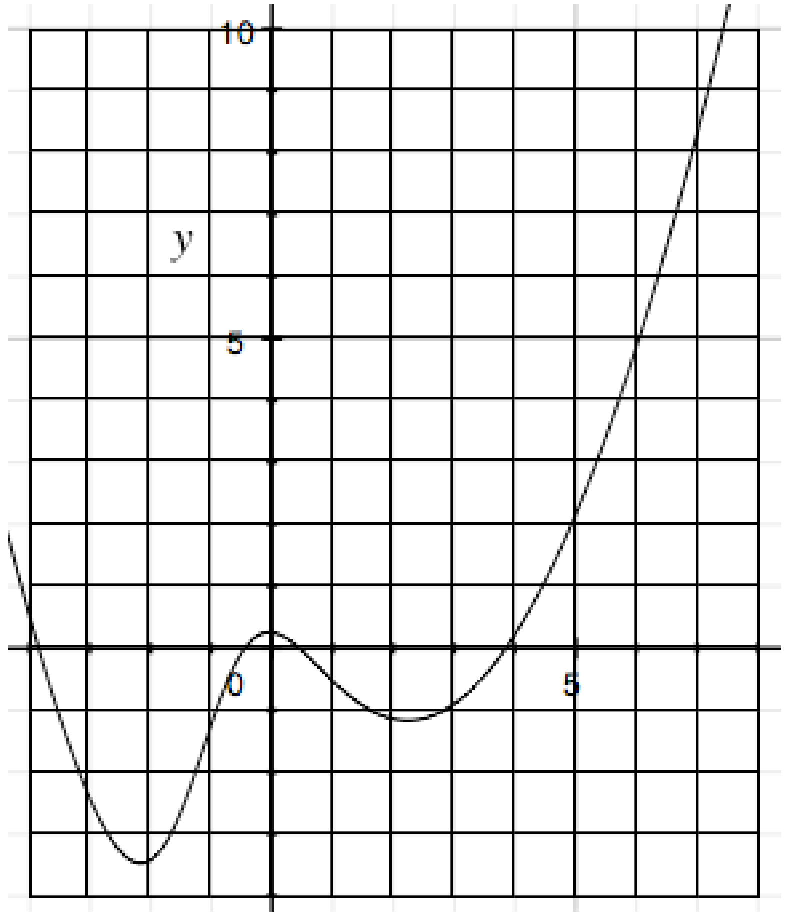
First point		Second point		Δx "**h**"	Δ f(x)	slope
x	f(x)	x	f(x)			

b) Investigate the slope around x = 5 using the chart. This time, however, Δx is given.

First point		Second point		Δx "**h**"	Δ f(x)	slope
5				.8		
				.2		
				.05		
				.001		
So in general, in terms of only **x** , **h**, and **f(x)....**						
x						

c) Use the graph to check your answers

d) Write a limit to express the exact slope at a point **x.**



<u>Practice problem</u>

1. Use a small Δx near the point given to find the approximate slope at that point.

a) $f(x) = 3x - 2$ $x = 2$

b) $f(x) = x^2 - 4x + 1$ $x = 3$

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