Name: _____ **TC**

Classwork 20

Warm up and review

1. Find $\lim_{x \to \infty} \frac{3x^4 - 2x^2 + x - 5}{5x^4 - 3x + 1/x}$

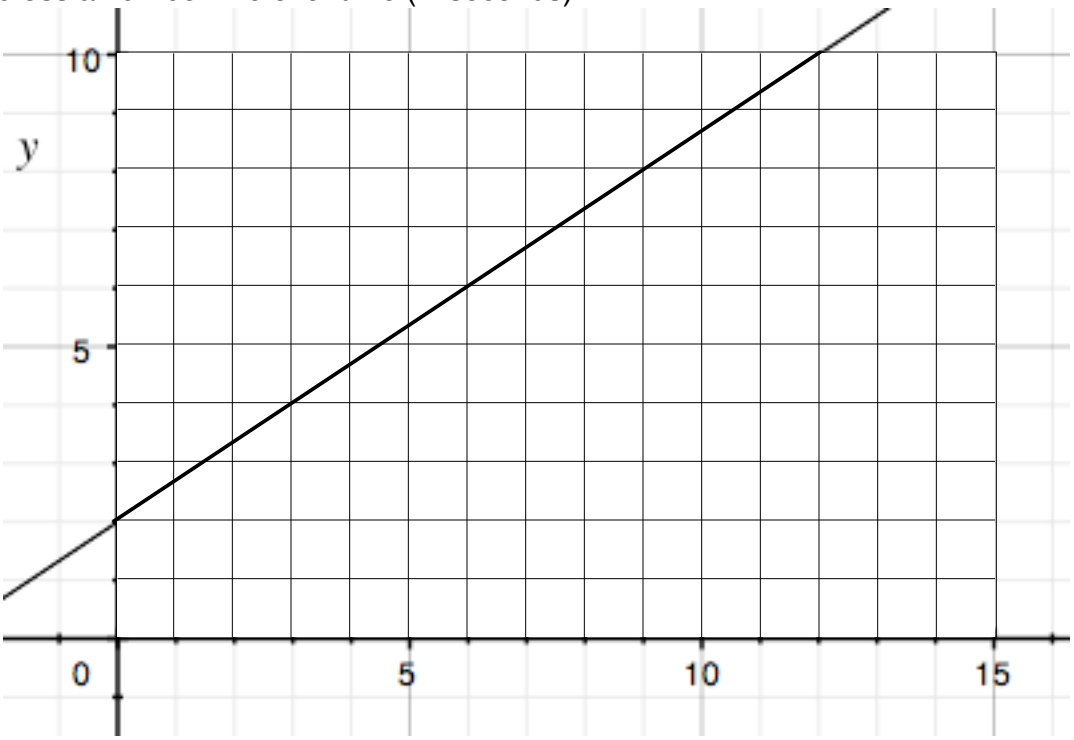
2. Lily climbs 25 stairs in 2 minutes. Find her speed in stairs per minute.

3. At 11:15, Jose is 20 feet away from the lunch counter. At 11:18, Jose is still 5 feet away from the lunch counter. What was his average speed during that time period?

4. Find the limit of

$$\sqrt{56 + \sqrt{56 + \sqrt{56 + \sqrt{56 \ldots}}}}$$

5. Use the graph below to answer the questions. It shows the position (in inches) of a penny sliding across a number line over time (in seconds).



a) Find the penny's position at each time.

i. 3 seconds ii. 9 seconds iii. 12 seconds iv. 0 seconds

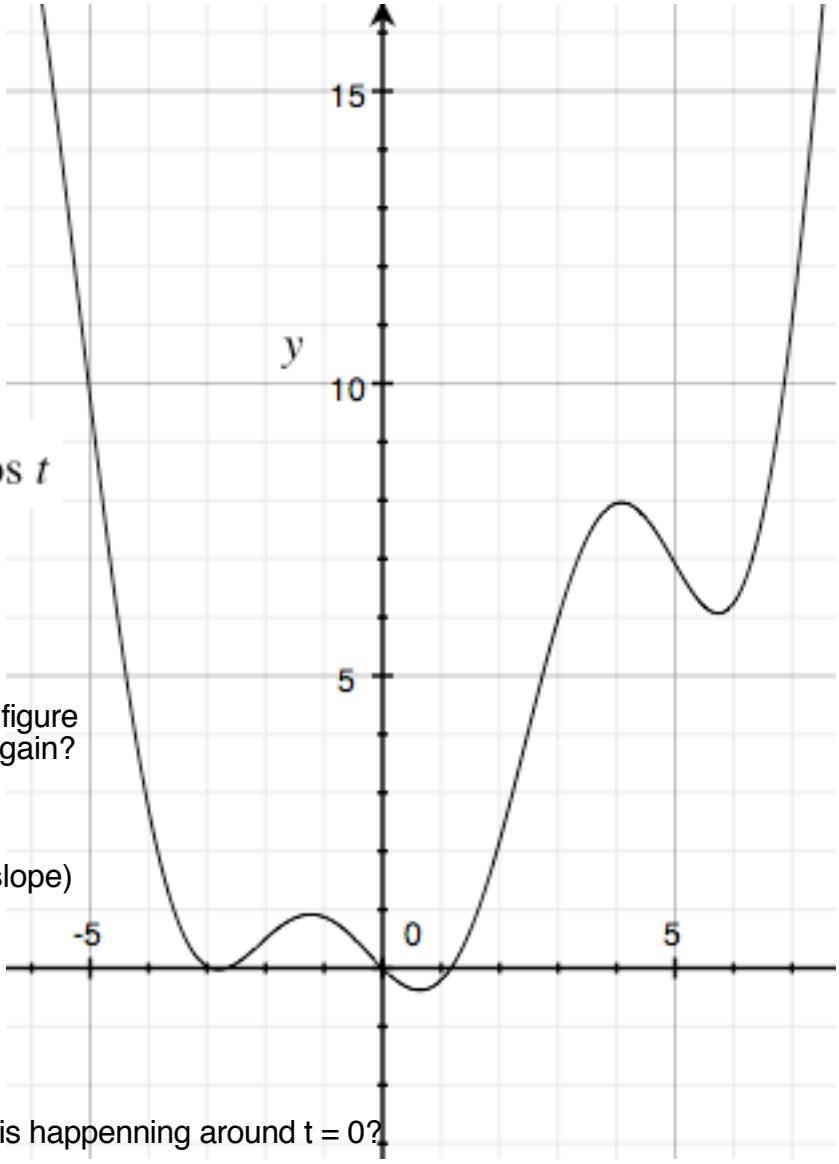
b) Find the penny's speed.

c) Find the penny's speed at exactly 9 seconds.

d) Why can't you answer (c) by doing s = d/t = 8 inches/9 seconds = .8888... in/s ?

Picking up where we left off...

6. 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 $d = \frac{1}{3}t^2 - t\cos t$

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 between this point and (0, 0)**
1				
.5				
.1				
.01				
.001				
.0001				
.00001				
.000001				

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

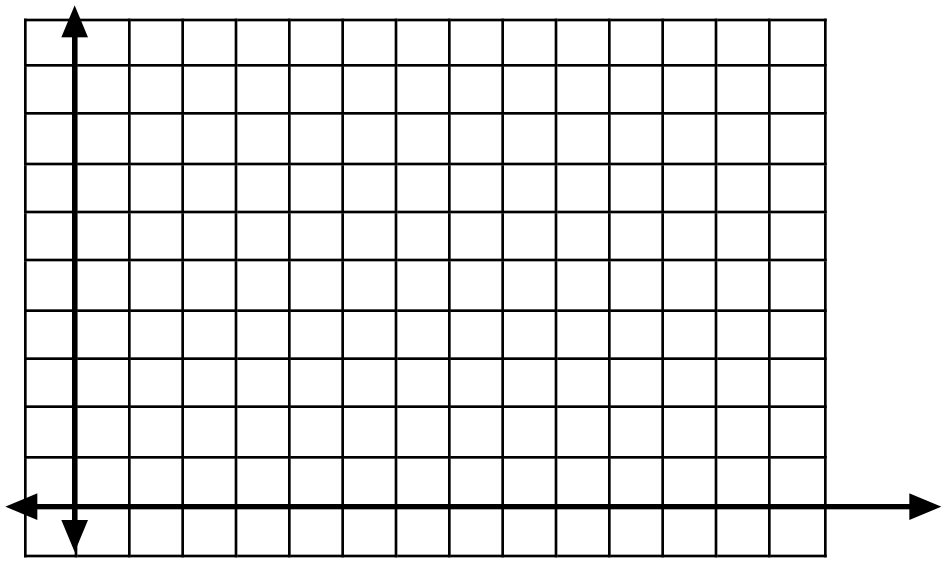
j) Why is this answer close to what the tangent line gave us?

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.**

7. Roy is biking around Brooklyn. His position over time is described by the equation
$y = -1/2x^2 + 4x$

a) Graph Roy's position on the y- axis and time on the x-axis. (Position is in miles and time is in hours.)



b) Find the average speed over each interval.

i. 0 hours to 6 hours

ii. 1 hour to 5 hours

iii. 2 hours to 4 hours

iv. 2.5 hours to 3.5 hours
(hint: use the equation, not the graph)

v. 2.8 hours to 3.2 hours

vi. 2.9 hours to 3.1 hours

vii. 2.95 hours to 3.05 hours

viii. 2.999 hours to 3.001 hours

c) What do you predict for the **instantaneous speed** at 3 hours?

d) Find the instantaneous speed at 3 hours using the graph.

e) Write a **limit expression** for the instantaneous speed.

Practice Problem

1. The distance travelled by a bird over time is described by $y = 0.2x^3 - x$. Y represents distance in miles and x represents time in hours.

a) Make a graph of the position of the bird over time.

b) Calculate the average speed using intervals near $x = 4$.

c) What is the instantaneous speed at $x = 4$?

d) Show on the graph how you could find instantaneous speed.