Rate of Change Lab (8/21)

Tuesday, August 20, 2019 9:27 AM

Calculus **Names**____

Rates of Change Lab

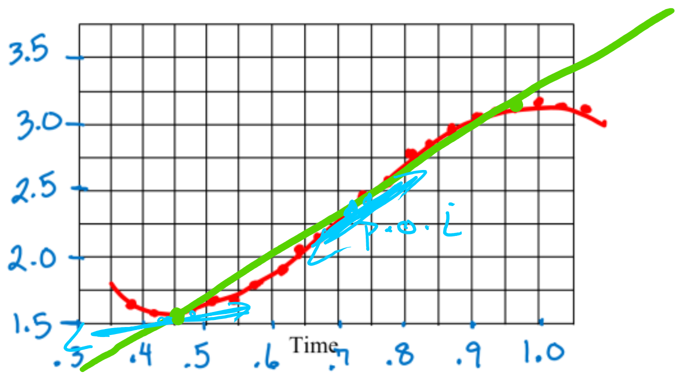
A motion detector was placed on the floor and a slinky was oscillated steadily above the motion detector for a short time. As you may expect, the motion was sinusoidal. The collected data for one rising section of the graph is in the tables below.

Time (sec)	.387	.419	.452	.484	.516	.548	.581	.613	.645	.677	.710
Dist. (m)	1.595	1.565	1.561	1.580	1.626	1.693	1.783	1.897	2.017	2.158	2.305

point of inflection

Time (sec)	.742	.774	.806	.839	.871	.903	.935	.968	1.000	1.032	1.065
Dist. (m)	2.480	2.614	2.751	2.860	2.957	3.041	3.103	3.141	3.194	3.174	3.172

1) Here is a plot of the data from above.



2) On the sketch above, connect a low point to a high point with a line. Use the data to calculate the slope of the line you drew. Show work. INCLUDE UNITS AND ROUND TO 3 DECIMAL PLACES.

$$\frac{\Delta y}{\Delta x} = \frac{3.194 - 1.561}{1 - .452} \approx 2.980 \text{ m/sec}$$

3) What physical characteristic of motion does the slope represent?

Avg Velocity (moving up 2.980 m/sec)

~~over~~ from $t = .452$ & $t = 1$

(over)

4) If you use ***any*** two points fairly close together to calculate slope, would you expect a difference from the slope found in step 2? Including units, calculate the slope between two consecutive points:

a. near the bottom of the graph

(.452, 1.561) & (.484, 1.580)

$\frac{\Delta y}{\Delta x} = 0.594$ m/sec

b. near the inflection point

(.710, 2.305) & (.742, 2.480)

$\frac{\Delta y}{\Delta x} = 5.469$ m/sec

5) On the graph above, sketch the lines which would pass through each pair of points you chose in 4a, b.

6) Which of the three lines drawn (steps 2 & 5) more closely approximate a tangent to the curve? Which of the lines is clearly not a tangent (it is a secant)?

tangent lines: 4a & 4b

secant: # 2

7) What place on the curve indicates when the slinky was moving the fastest? Explain your answer.

p.o.i steepest slope

8) What characteristic of motion does each slope represent? Answer in complete sentences. You must include the terms, "secant, tangent, average rate of change and instantaneous rate of change."

secant line slope shows the avg. rate of Δ. (avg. velocity)

tangent line slope → instantaneous rate of Δ.

9) We could model the data with a function $f(x)$.

Given that $(x, f(x))$ and $(x+h, f(x+h))$ are two points on the function, give a geometric interpretation of:

a) $\dfrac{f(x+h)-f(x)}{(x+h)-x}$

slope between 2 pts on f(x)

secant slope

b) $\lim\limits_{h\to 0}\dfrac{f(x+h)-f(x)}{h}$

slope @ one pt. on f(x)

slope of the tangent line.