AP PHYSICS MR KELLER

SUMMER REVIEW – PRACTICE SET #1

Part I: These questions are intended to see if you can find derivatives for the functions on our list. If you are coming out of Honors Precalc, this should be a quick review. If you are coming out of regular Precalc, you may want to have that list of functions and their derivatives in front of you.

Find the derivative of each (with respect to the given variable)

1. $f(x) = 5x^2 - 3x + 4$

2. $f(x) = \sqrt{3x}$

3. $f(x) = 25e^{4x}$

4. $f(t) = I_0 e^{-kt}$ note: I_0 and *k* are constants.

5. $x(t) = 6\cos 10t$

6. $x(t) = A\sin \omega t$ note: A and ω are constants.

7. $f(x) = \frac{3}{x}$

8. $f(x) = \frac{1}{3x}$

9. $v(t) = 20 - 20e^{-3t}$

10. $v(t) = v_f - v_f e^{-kt}$ note: v_f and *k* are constants.

11. $x(t) = 3t^2 - t + 44$

12. $r(\theta) = K\sin(2\theta)$ note: *K* is a constant.

Continued…

Part II: These questions are intended to confirm that you understand what the derivative formulas tell you.

Suppose the position of an object (in meters) at time t (in seconds) was given by the equation:

$x(t) = 100 + 50t - 5t^2$

Use a website or a graphing calculator to obtain graph of the function for 0 < t < 10 seconds. Put your graph in the box provided.

1. Find the location of the object at t=1 second and at t=3 seconds.

2. Find the *average* velocity between t=1 and t=3 seconds. Then, on the graph, draw the secant line from t=1 to t=3 seconds. What does the average velocity tell us about that segment?

3. Find a formula for the instantaneous velocity as a function of time.[*]

4. Apply the formula you just found to determine the *instantaneous* velocities at t=1 and t=3 seconds. Then, draw the tangent lines at t=1 and t=3. What do the instantaneous velocities tell us about the tangent lines?

5. Looking ahead: take your derivative formula and set it equal to 0, solving for t. Then find that point on the graph and draw the tangent line. What is interesting about the point you have just found?

6. Noticing a kinematics shortcut: look again at the instantaneous velocities you found at t=1 and t=3 seconds. Find the average of those two instantaneous velocities. Compare your answer to the average velocity you calculated for #2 -- using no calculus! What do you see?

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[*] In case you didn't recognize it, I just asked you to find a derivative formula!

7. Having successfully answered the last question, you may suspect that there is a rule:

The average velocity for a given time interval is the average of the instantaneous velocities at the beginning and end of the interval.

Let's see if this works with another function:

$x(t) = \frac{100}{t}$ between t=1 and t=5 seconds.

a. Find the position at t=1 and at t=5 and then find the average velocity for the interval.

b. Derive the formula for the velocity as a function of time.

c. Find the instantaneous velocities at t=1 and t=5 seconds.

d. Find the average of those two instantaneous velocities. Do we have a match?

As I hope you now see, the average velocity is NOT always the average of the velocities. So when does it work? We'll review this in the fall.