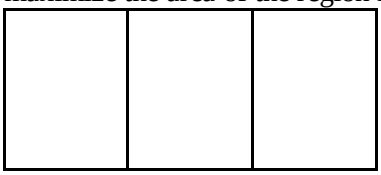
MCV4U - Chapter Three Assignment: Applications of the Derivative

Provide clear solutions to the following problems. A grading scheme is not provided. You should be able to guess a rough approximation of what each question will be worth (and perhaps even what type of points - KTCA - the question has.) I would prefer, however, that you focus on the mathematics you present rather than the number of points a question may be worth. You will receive a ***Communications grade, out of 10*** for how well your math is presented, including well drawn pictures which describe the problem. I hope for excellence from you. Feel free to ask questions.

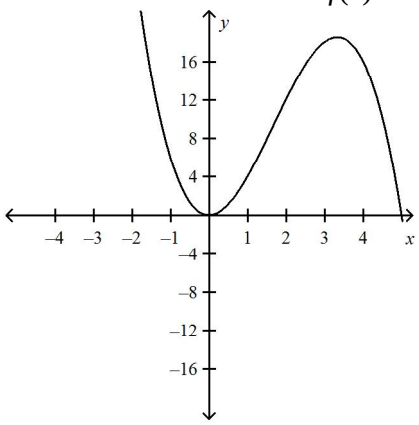
Due: *Friday, October 16, 2015.*

1. A housing committee wants a rectangular swimming pool and surrounding deck with a total area of 150 m^2. The deck is 3 m wide at each end of the pool and 2 m wide on each side. Find the dimensions of the pool that has the maximum area.
2. A rectangular region is to be enclosed and subdivided with fencing as illustrated. Find the dimensions that will maximize the area of the region if 640 m of fencing is available. Assume the smallest a dimension can be is 50 m.



3. Determine f'' if $f(x) = \sqrt{x^3 + 2}$.
4. For $y = \dfrac{x}{2 + x^2}$, determine $\dfrac{d^2y}{dx^2}$ when $x = 1$.
5. Let the function $s(t) = (3t - 7)^2$ describe the position of a particle at time t. With respect to time t, when is the particle moving in a positive direction? (Assume "to the right" is the positive direction of motion.)
6. A farmer is building a new cylindrical silo with a flat roof and an earthen floor (so no metal is needed for the floor) that will hold 20 000 m^3 of corn. What dimensions should the farmer construct his silo if he wants to use the least material for construction? Assume that the minimum radius the silo can be is 5 m.

7. Let the graph below represent a derivative function, $f'(x)$. For which values of x is the 'original' function, $f(x)$, increasing?
For which values of x does $f(x)$ have a horizontal tangent?



8. Let the quadratic function $s(t) = -\frac{5}{2}x^2 + 10x + 15$ represent the motion of a toy car as it travels near a sensor.

   a) At what time t will the car's distance from the sensor be the greatest?
   b) What is its velocity when the car is at that point?
   c) Is the car moving toward or away from the the sensor at $t = 6$ seconds? (*careful...think it through*)

9. A woman wants to construct a box whose base length is twice the base width. The material to build the top and bottom is \$9/m^2 and the material to build the sides is \$6/m^2. If the woman wants the box to have a volume of 70 m^3, determine the dimensions of the box (in metres) that will minimize the cost of production. What is the minimum cost? Assume that the smallest any dimension can be is 2 m.

10. Car A is 40 km east of Car B and begins moving west at 40 km/h. At the same moment, Car B begins to move north at 70 km/h. What is the closest distance, in kilometres, the cars will be from each other? At what time t, in hours, will that distance occur?

11. A landlord manages 100 apartments in a complex downtown and charges his tenants monthly. When the rent is \$800 a month, all of the apartments are rented. For every \$15 increase in rent, one apartment becomes empty. On average, each apartment needs \$60 invested in maintenance and repairs each month. The landlord wants to know how much he should charge per month in order to have the greatest profit. Could he make a greater profit without all of the apartments rented? Explain with sound mathematics.

12. A fireman has to reach a burning building. Determine the length of the shortest ladder that will reach over a 2 metre high fence to the burning building which is 1 metre behind the fence. (*A good picture will help with this one, and the notion of similarity*)