

CALCULUS ASSIGNMENT  
\*OPTIMIZATION\*

[34 marks]

1. A truck traveling at  $x$  (in kilometers per hour), where  $40 \leq x \leq 120$ , uses gasoline at the rate of  $r(x)$  (in liters per hundred kilometers), where  $r(x) = \frac{1}{100} \left( \frac{50000}{x} + 0.06x^2 \right)$
- [3] a) Determine the fuel consumption at speeds of 60, 80 and 100 km/h.  
[3] b) What speed will result in the lowest fuel cost for a trip of 1000 km?  
[1] c) What is the lowest total cost for the trip if fuel costs \$1.25/L?
2. Using the concepts of calculus determine the  $x$  coordinate of the point on the graph of  $2x + 3y - 6 = 0$  closest to  $(8,5)$ . Provide a sketch with your solution.  
[6]
3. Find the dimensions of the rectangle of maximum area with a base on the  $x$ -axis lying underneath the parabola  $y = 3x(10 - x)$ . Provide a sketch with your solution.  
[6]
4. A rectangular sheet of metal with perimeter  $12\pi$  meters will be rolled and formed into the lateral side of a cylindrical container.
- [5] a) Find the dimensions of the container with the largest volume.  
[4] b) It's possible there exists a relationship between  $r$  and  $h$  that gives a maximum volume for any perimeter. Investigate this idea. (Hint...try different perimeters)
5. A pipeline is to be constructed from a refinery across a 1 km wide swamp to storage tanks. The refinery is 5 km east and 1 km south of the storage tanks. See the figure below. The cost of construction over the swamp is \$2 000 000 per kilometer and \$1 250 000 per kilometer over land. How should the pipeline be made so that the cost of construction is a minimum? Determine the minimum cost.  
[6]

