MCV4U
Optimization Assignment

Name:_____
Due Date: _____

Answer all questions on loose leaf paper. Be sure to show all applicable work and express all answers in simplest form. Marks are awarded for presentation and technical correctness.

1. McDonalds has taken a market survey and has found that the yearly demand for their hamburgers is given by $p = \frac{800000 - x}{200000}$, where p is the price in dollars.

   a) Find the marginal revenue when x = 100 000.

   b) McDonalds estimates that the cost, in dollars, of making x hamburgers is C(x) = 125 000 + 0.42x. Find the marginal profit when x = 400 000 and explain what your answer means.

2. If 3000 cm^2 of material is available to make a box with a square base and open top, find the largest possible volume of the box.

3. Ottawa Travel advertises a package plan for a Florida vacation. The fare for the flight is $400/person plus $8/person for each unsold seat on the plane. The plane holds 120 passengers and the flight will be cancelled if there are fewer than 50 passengers. What number of passengers will maximize revenue? Be sure to use derivatives to solve this equation.

4. A rectangular wooden bedding chest will be built so that its length is 2.5 times its width. The top, front, and two sides of the chest will be oak. The back and bottom of the chest will be cedar. The volume of the chest must be 0.5 m^3. Oak costs 1.5 times as much as cedar. Find the dimensions that will minimize the cost of the chest.

5. A rectangular dog kennel will be surrounded by a fence and then divided into two sections by a block wall. The area of the kennel must be 72 m^2. Fencing costs $10/m and the block wall costs $20/m. What should be the dimensions of the kennel to minimize the costs?

6. Pepsi-Cola wants to sell its product in 355 ml cans. The metal used for the top and bottom of the can costs $1.40/$m^2$. The metal used for the side costs $0.50/$m^2$. The metal left over after the circles for the top and bottom of one can are cut out of one rectangle will be scrapped. Find the dimensions of the can that will minimize the cost of the materials. What is the cost of 1 can?

7. A cylindrical pot, without a top, is to have a volume of 1000 cm^3. The bottom will be made of copper and the rest of aluminum. Copper is five times as expensive as aluminum. Determine the dimensions that will minimize the cost of the pot.

8. A closed container is made with a hemisphere on top of a cylinder. The height and radius of the cylinder are h and r respectively. Find the ratio of h to r so that the volume is maximum if the total surface area is a constant A.

9. A pickup truck is 20 km due west of an SUV and is travelling east at a constant speed of 80 km/h. Meanwhile, the SUV is going south at 100 km/h. When will the truck and the SUV be closest to each other? What is the minimum distance between them?

10. Cable service is being installed in a new subdivision. The cable must cross a 25 metre wide river and reach a point which is 58 metres downstream from its starting point on the other bank. Laying cable under water costs three times as much as laying it over ground. How should the cable be routed to minimize the cost?