Connection Project
Calculus 101, Fall 2008
Professor Donnay

Teams of two students will do a project together. You will choose one of the following problems to do for your project. By Wednesday November 19th, submit the attached Decision Form to Professor Donnay in which you say what project you will work on and who your partner will be.

I will give a more detailed description of what should be included in your project write up a bit later, but the basics are as follows. You should explain clearly what the problem is about. You should then solve the problem, showing all your steps clearly and explaining your work. You should include diagrams and graphs as needed to explain and illustrate your work. Your paper should be type written; Microsoft word has an equation feature that lets you type in equations. (However if you have trouble with this, you can write in your equations by hand into the type written paper).

The final version of your project is due by 5pm on Thursday December 11th. If you submit a draft to me by 4pm on Monday December 8th, I will give it back to you by 5 pm on Tuesday December 9th with a provisional grade and comments on how to improve it. I will be available to talk with you about your project any time until 4 pm on Wednesday December 10th. After that time, I will not be available. Please plan your schedule accordingly.

Project Choices:

1. Applications to Business and Economics (Section 4.7 and Section 3.7)

   The Apple store has been selling 500 iPods a week at a price of $250 each. A market survey indicates that for each $20 rebate offered to customers, the number of iPods sold will increase by 80 per week.

   a. Determine the demand function \( p(x) \) (also called the price function) where \( x \) is the number of iPods sold per week.

   b. Determine the revenue function \( R(x) \). How many iPods should the Apple store sell to maximize revenue? (Be sure to explain why your answer is the global maximum.) What amount of rebate will produce this maximum revenue? What is the maximum revenue?

   c. The weekly cost, in dollars, associated with producing and selling \( x \) iPods is

   \[
   C(x) = 29,000 + 90x.
   \]

   (See Section 3.7 for a discussion of the cost function). How many iPods should the Apple store sell to maximize its profit? (Be sure to explain why your answer is the global maximum.) What is this maximum amount of profit? What is the profit produced per iPod sold?

   d. What level of rebate will produce this maximum profit?

2. Motion: Acceleration, Velocity and Distance, Section 4.9

Read the statement of problem 70 on p. 281.
a. Determine the acceleration $a(t)$, velocity $v(t)$ and position function $s(t)$ for the rocket from the moment it is launched until the parachute opens. Graph these functions. Hint: First determine $a(t), v(t), s(t)$ while the rocket is being accelerated upward. Then determine $a(t), v(t), s(t)$ while the rocket is in free fall.

b. At what time does the rocket reach its maximum height? What is this maximum height?

Extra Credit: Determine and graph $v(t)$ and $s(t)$ from the time the parachute opens until the rocket lands. At what time does the rocket land?

3. Related Rates, Section 3.8

Read the statement of the "swimming pool" problem, # 26 on p. 187 in Section 3.8

a. Determine the volume of water in the swimming pool when the depth of water at the deepest point in the pool is 5 ft.

b. Find a general formula $V(d)$ for the volume of water in the pool as a function of the depth $d$ of water providing that $0 \leq d \leq 6$. The units for $d$ are ft and the depth is measured from the deepest part of the pool.

c. Find a general formula $V(d)$ for the volume of water in the pool as a function of the depth $d$ when $d \geq 6$. What is largest value of $d$ for which this formula makes sense? Why?

d. If the pool is being filled at a rate of $0.8ft^3/min$, how fast is the water level rising when the depth at the deepest point is 5 ft?

e. If the pool is being filled at a rate of $0.8ft^3/min$, how fast is the water level rising when the depth at the deepest point is 8ft?

Connections Project: Decision Form

Name:

My partner is:

We will do project (circle one): 1  2  3