Applications

This is an optional assignment that will provide up to six percentage points extra credit on your final exam. At least one question on your final will be derived from the following list so even if you choose not to participate in the activity, you still must master the material.

Each group of two to three people can choose from the following list of questions and announce this so that no two groups do the same question. On Monday your group will be given 15 to 25 minutes to present the question, answer, and explanation to the class. If time permits examples working with your formula would be appreciated as those are the questions that will likely appear on the final.

1. Let p be a function of t recording the distance of an object (on Earth) from a fixed point and let α be the instantaneous acceleration at time t. Find a formula for the position function much like we found a formula for the velocity function in class. Make sure you use the facts that the derivative of p is the instantaneous velocity and that the derivative of the instantaneous velocity is acceleration. Do the problem again but for objects on Mars (you might need to look up what the gravity on Mars is like).

2. Recall in a competitive market that your marginal revenue and price of the object have a close relationship. Use this and *calculus* to find a revenue function for producing q outputs. Is this function consistent with how you normally calculate revenue? Why is the formula that you came up with have no $R(0)$ term like the cost function we derived in class (and on page 264 of your text)?

3. In chemistry there are integrated rate laws that are used to answer questions like "How long will it take for x moles per liter of A to be used up?". Seeing as there are different kinds of reactions (some reactions require two chemicals to react whereas some need only one) there are different integrated rate laws.

   We looked at the first-order reaction in class and found a formula relating the concentration of a chemical at time t to time. Repeat this process and find a formula relating the concentration of a chemical at time t and time for a second-order reaction with only one reactant recorded by

   $$\text{Rate} = -\frac{\Delta[A]}{\Delta t} = k[A]^2$$

   Working examples with the resulting formula would be great but not necessary. You could either come to me and I'll provide you with some data or you might look at the chemistry book used on campus by Silberberg (Section 16.4).

4. The *present value* P of a future payment B, is the amount that would have to be deposited in a bank account today to product exactly B in the account at the relevant time in the future. (There is an excellent example about this definition using approximation on page 49 in your text involving the lottery.) In Precalculus you learn that loans, saving accounts, and much of money involves exponential growth and the function P_0e^{rt} (or P_0a^t).

Use calculus to find a formula to describe present value of an income stream described by a function $S(t)$.

Working examples with the resulting formula would be great but not necessary. You could either come to me and I'll provide you with some data or you might look at your text in Section 6.3.