Homework Six

Calculus I

College of the Atlantic

Due Friday, October 21, 2022

There are two parts to this assignment.

Part 1: WeBWorK. Do Homework 06A and 06B on WeBWorK. The WeBWorK page is here: `https://webwork.runestone.academy/webwork2/coa-feldman-es1024i-fall-2022/`. I recommend doing the WeBWorK part of the homework first. This will enable you to benefit WeBWorK's instant feedback before you do part two.

Part 2: Non-WeBWorK problems. Here are some instructions for how to submit this part of the assignment.

- Do the problems by hand using pencil (or pen) and paper. There is no need to type this assignment.
- Make a pdf scan of your work using genius scan or some similar scanning app. Please make the homework into a single pdf, not multiple pdfs.
- Submit the assignment on google classroom. Please don't email it to me.
- If you want, you can do the non-WeBWorK problems in pairs and submit only one assignment for the two of you.

Here are some non-WeBWorK problems.

1. The temperature T of an object as a function of time is described by the following function:
$$T(t) = 20 + 40e^{-kt} , \tag{1}$$
where $k = 0.003$, t is measured in seconds, and temperature is measured in Celsius.

   (a) Sketch $T(t)$.

   (b) What is the initial temperature of the object?

   (c) What is the temperature of the object after a long time (as t gets very large)?

   (d) At what time is the temperature 30 Celsius?

   (e) At $t = 200$, at what rate is the object cooling?

2. Consider the function $f(x) = xe^x$.

   (a) For what values of x is $f(x)$ concave up? Figure this out by taking two derivative of $f(x)$ and then determing what range of x values makes the second derivative positive.

   (b) Sketch the function using limits that make it clear where the concavity changes.

3. (Hint: Thinking about units will be very helpful.) Let $f(v)$ be the gas consumption in liters/km of a car going at a speed v, measured in km/h4. This means that $f(v)$ tells you how many liters of gas the car uses to go one kilometer when it is traveling at a speed of v. Suppose we know that

$$f(80) = 0.05 \text{ , and } f'(80) = 0.0005 \ . \tag{2}$$

   (a) Let $g(v)$ be the distance the same car gravels on one liter of gas if it is traveling at speed v.

      i. How are $f(v)$ and $g(v)$ related? (Your answer should be an equation.)

      ii. Determine $g(80)$ and $g'(80)$.

      iii. What is the practical meaning of $g'(80)$?

   (b) Let $h(v)$ be the gas consumption in liters per hour. So $h(v)$ tells you how many liters of gas the car uses in one hour if it is traveling at a speed of v.

      i. How are $f(v)$ and $h(v)$ related? (Your answer should be an equation.)

      ii. Determine $h(80)$ and $h'(80)$.

      iii. What is the practical meaning of $h'(80)$?