Homework Three

Calculus I

College of the Atlantic

Due Friday, October 4, 2024

There are two parts to this assignment.

Part 1: WeBWorK. Do Homework 03A and 03B on WeBWorK. The WeBWorK page is here: `https://webwork-hosting.runestone.academy/webwork2/coa-feldman-es1024-fall2024`. 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.

- If you like working on a tablet, go for it.

- 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. (Between my two classes I will be receiving around 60 assignments a week. Keeping track of them all in email is challenging.)

- 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 amount of caffeine in the one's body is described by the following function:

$$f(t) = Q_0 e^{-0.17t} \, , \tag{1}$$

where Q_0 is the amount of caffeine in the body at time $t = 0$, and time is measured in hours.

   (a) Make a graph of the function. For your graph, assume that $Q_0 = 100$ mg.

   (b) Use your graph to estimate the half-life of caffeine in your body.

   (c) Re-write Eq. (1) in the following form:

$$f(t) = Q_0 a^t \, . \tag{2}$$

   (d) Use logarithms to solve exactly for the half-life of caffeine.

2. Air pressure P decreases exponentially with height h, where h is the height above sea level. The pressure is given by the following function:

$$P = p_0 e^{-0.00012h} ,$$ (3)

where h is measured in meters above sea level, and P_0 is the pressure at sea level.

(a) What is the air pressure, as a percent of the pressure at sea level, on the top of Mount Kilimanjaro?

(b) What is the air pressure, as a percent of the pressure at sea level, on the top of Wheeler Peak, in New Mexico, USA?

(c) What is the air pressure, as a percent of the pressure at sea level, on the top of Cadillac Mountain?

3. In an electrical outlet in the US, the voltage V (in volts) is given as a function of time t (in seconds) by the formula:

$$V(t) = V_0 \sin(120\pi t) .$$ (4)

(a) What does V_0 represent in terms of voltage? (Note: the answer is *not* the initial voltage.)

(b) What is the period of this function?

(c) How many oscillations are there in one second?

(d) In Europe, most of Asia, Africa, and the Middle East electricity oscillates 50 times in one second. Write down a function that describes $V(t)$ describes this electricity. That is, write down a function similar to Eq. (4), but which oscillates 50 times in one second.