

Homework Three

Calculus I

College of the Atlantic

Due Friday, September 30, 2022

There are two parts to this assignment.

Part 1: WeBWorK. Do Homework 03A and 03B 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.
- 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:

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

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:

$$f(t) = Q_0 a^t. \quad (2)$$

- (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:

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

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:

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

- (a) What does V_0 represent in terms of 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.