MATH 1430 – EXAM 3 (TAKE-HOME DUE 11/24/20)

Answer ALL 3 questions

You must show *all* your work to receive full credit.
Please answer each question on a new page.

1. The production of a chemical satisfies the following differential equation

$$\frac{dP}{dt} = \frac{20}{(1+4t)^2}$$

where t is time in days and P is the amount in moles.

(a) Use integration by substitution to find the solution, $P(t)$, starting from the initial condition $P(0) = 0$.

(b) Sketch the rate of change ($\frac{dP}{dt}$) **and** the solution.

(c) What happens to $P(t)$ as $t \to \infty$?

2. (a) An ecologist samples the density of a particular plant species along a 1km transect and obtains the following data:

Distance (m)	Density (individual plants/m)
0	21
200	13
400	15
600	18
800	7
1000	4

Determine the left-hand and right-hand estimates (Riemann sums) for the total number of individual plants along the 1km transect.

(b) Find the exact (absolute) area under the curve of the following function

$$s(x) = (x-2)(x+1)$$

between $x = 1$ and $x = 4$.

3. An outbreak of a novel infectious disease is initially growing at a rate of

$$f(t) = 1.5e^{0.12t}$$

new cases per day (where t is time in days).

(a) Evaluate a definite integral to find the number of new cases that occur during the first 2 weeks.

(b) What's the average number of daily new cases in the first 2 weeks?

(c) If the rate was initially given by

$$g(t) = 1.5 + 0.12t$$

new cases per day (where t is time in days), how many fewer cases would occur during the first 2 weeks?