Homework 3 Oracle

Sandy Urazayev*

67; 12021 H.E.

Section 2.3

Problem 1

We model the tank problem the following way of

$$\frac{dx}{dt} = R_{in} - R_{out}$$

Then

$$\frac{dx}{dt} = -\frac{2x}{200} = -\frac{x}{100}$$

We know the original concentration of $1g/L$, then apply the separable equations method

$$\int \frac{100}{x} dx = \int -1 dt$$

Solving it yields

$$x = 200e^{-\frac{t}{100}}$$

We need to find the time that will elapse before the concentration of dye in the tank reaches 1%. So

$$\frac{x(t)}{x(0)} = 0.01 \implies 0.01 = e^{-\frac{t}{100}}$$

Solving for t returns that $t = 100\ln 100$ min ≈ 460.5 min.

*University of Kansas (ctu@ku.edu)

Problem 4

Part (a)

So our kinetic and potential energies are equal. Then

$$mgh = \frac{1}{2}mv^2 \implies v = \sqrt{2gh}$$

Part (b)

Recall

$$\frac{dv}{dt} = A(h)\frac{dh}{dt} \quad \text{and} \quad \frac{dv}{dt} = av$$

So then because constant α is contracting, the change is negative

$$A(h)\frac{dh}{dt} = -\alpha a\sqrt{2gh}$$

Problem 9

Section 2.5

Problem 3

Problem 5

Problem 9

Problem 13