

Balogun Oluwatunmbi Akinola

18/ENGG03/020

Civil Engineering

ENGG282 Assignment V

1) Applying the balance law

Accumulation rate of = Input rate of salt - Output rate of salt

Salt within a system into a system from the system denoting the amount of salt present in the tank of any time t as y , its time rate of change is given as,

$$\frac{dy}{dt} = y_{in} - y_{out}$$

Since 50 gal of brine enter the tank per minute and one gallon contains $[1 + 5 \sin t]$ lb of salt;

1) at $t = 1$; $[1 + 5 \sin t] = [1 + 5 \sin C] = 1.02$ lb of salt; \therefore It means that the amount of salt ~~emerging~~ entering the tank is $y_{in} =$

$$= \frac{50 \text{ gal}}{\text{min}} \times \frac{1.02 \text{ lb}}{\text{gal}} = \frac{51.16}{\text{min}}$$

The tank contains 1200 gal of water with the dissolved salt & 30 gallons of solution leaves the tank per minute.

That is $\frac{30 \text{ gal}}{1200 \text{ gal}} = 0.025$ of the content of the tank. If that's the case; 2.5% of the salt present in the tank will also leave the tank per minute in other words;

2.5% of y
a) Therefore; $\frac{dy}{dt} \text{ lb/min} = 51 \text{ lb/min} - 2.5\% \text{ of } y \text{ lb/min}$

b) $\frac{dy}{dt} = 51 - 0.025y$; $\frac{dy}{dt} = 0.025y + 51$,
 $\frac{dy}{dt} = 0.025 \left[\frac{-0.025y}{-0.025} + \frac{51}{-0.025} \right]$; $\frac{dy}{dt} = \frac{-0.025}{(y-2040)}$

$$\frac{dy}{(y-2040)} = -0.025 dt; \int \frac{dy}{(y-2040)} = \int -0.025 dt;$$

$$\int \frac{dy}{(y-2040)} = 0.025 \int dt; \ln(y-2040) = -0.025t + C;$$

$$y - 2040 = e^{-0.025t + C}; y - 2040 = e^{-0.025t} e^C;$$

$$y = y_0 \cdot e^{-0.025t} + 2040; \text{ Given that when } t = 1$$

(initially) $y = 150 \text{ lb}$;

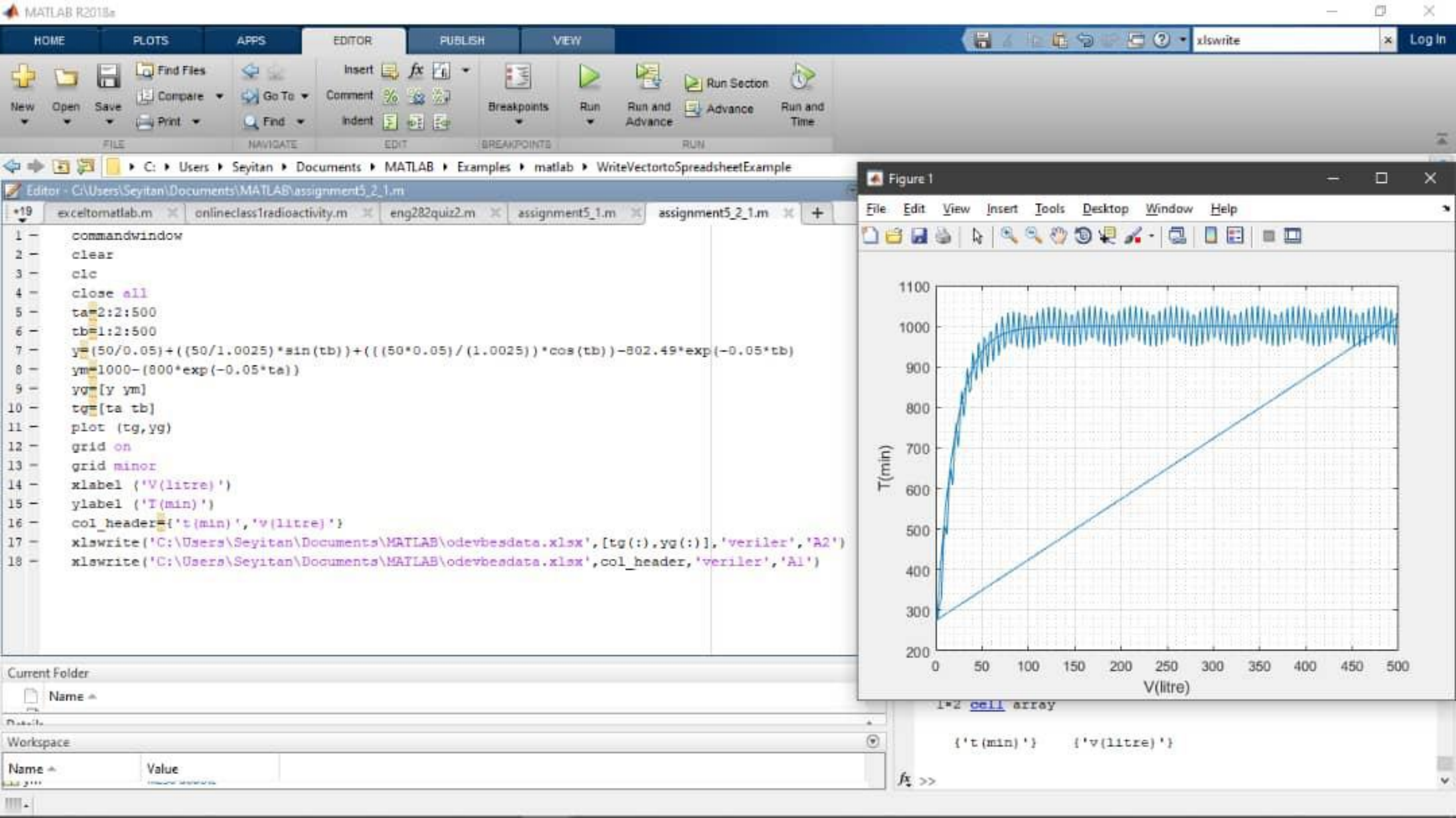
$$150 = y_0 e^{-0.025} + 2040; 150 - 2040 = y_0 \times 1$$

$$y_0 = -1890$$

So;

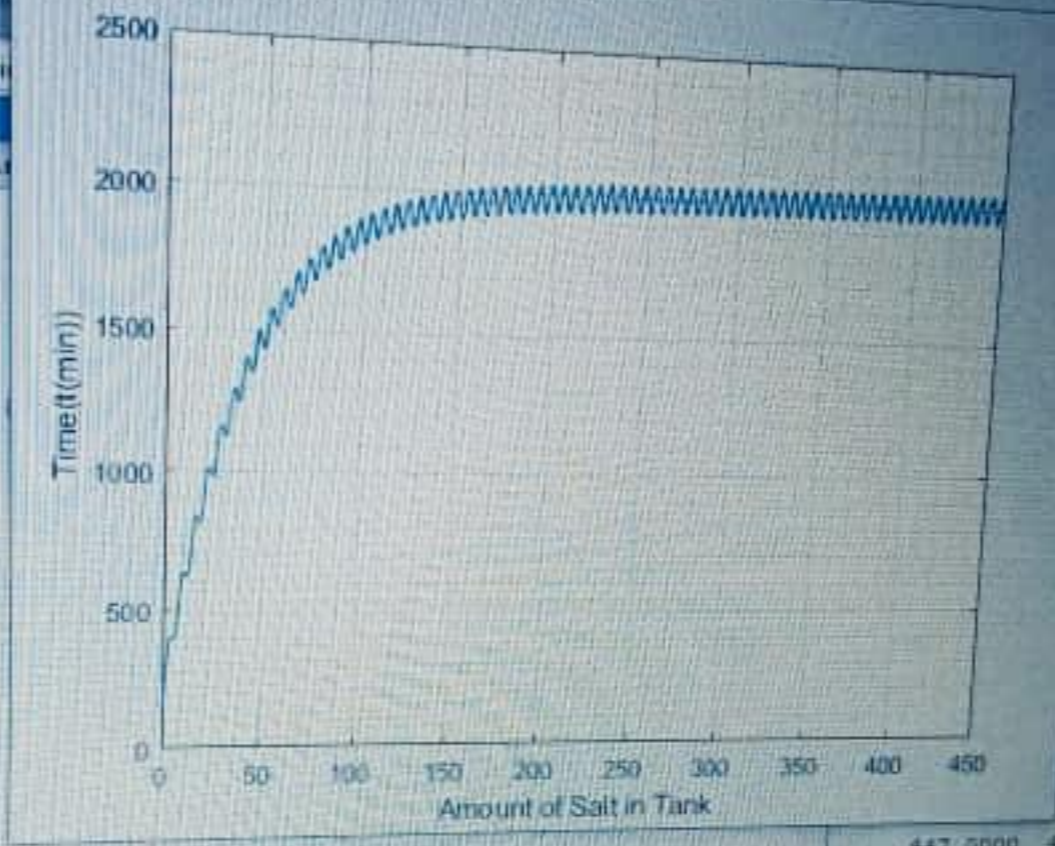
$$y = -1890e^{-0.025t} + 2040$$

$$y = 2040 - 1890e^{-0.025t}$$



```

1 - commandwindow
2 - clear
3 - clc
4 - close all
5 - syms m t
6 - s=dsolve('Dm+(0.025*m) = 50*(1+sin(t))', 'm(0)=0')
7 - tn=0:0.5:450
8 - sn=subs(s,tn)
9 - plot(tn,sn)
10 - grid on
11 - grid minor
12 - xlabel('Amount of Salt in Tank')
13 - ylabel('Time t (min)')
14
15
16
    
```



through 876
 25.5000 436.0000 436.5000 437.0000 437.5000
 through 882
 38.5000 438.0000 438.5000 440.0000 440.5000
 through 888
 41.5000 442.0000 442.5000 443.0000 443.5000
 through 894
 44.5000 445.0000 445.5000 446.0000 446.5000
 through 900

447.0000 447.5000 448.0000 448.5000 449.0000 449.5000
 Column 901
 450.0000

Current Folder
 Name
 Details
 Workspace

sn =
 [150, 2000 - (2000*1492)^(1/21)*exp(atanh(1/49)) + (1/21)*1492