OLOGBOSERE ANTHONIA
MECHATRONICS
18/ENG05/049
ENG 282
ASSIGNMENT V

1. $\frac{dy}{dt} = y_{in} - y_{out}$ $\quad y = m$

$m_{in} = \frac{50\,gal}{min} \times \frac{(1+\sin t)\,lb}{gal} = \frac{50(1+\sin t)\,lb}{min}$

$m_{out} = \frac{30\,gal}{1200\,gal} = 0.025m$

$\therefore \frac{dm}{dt} = m_{in} - m_{out}$

$\frac{dm}{dt} = 50(1+\sin t) - 0.025m$

$\frac{dm}{dt} + 0.025m = 50(1+\sin t)$

Using Integrating Factor Method

$P = 0.025 \quad \int P\,dt = 0.025t$

$\therefore IF = e^{0.025t}$

But $m(IF) = \int Q(IF)\,dt$

$m(e^{0.025t}) = \int 50(1+\sin t)(e^{0.025t})\,dt$

Using integration by parts

where $u = 1+\sin t \quad dv = e^{0.025t}$

$du = \cos t \quad v = e^{0.025t}/0.025$

$\therefore m(e^{0.025t}) = 50\left[(1+\sin t)\left(\frac{e^{0.025t}}{0.025}\right) - \int \frac{e^{0.025t}}{0.025}\cdot \cos t\,dt\right]$

$$m(e^{0.025t}) = 50\left[\frac{(1+\sin t)(e^{0.025t})}{0.025} - \frac{1}{0.025}\int e^{0.025t}\cdot\cos t\cdot dt\right]$$

$$m(e^{0.025t}) = 2000\left((1+\sin t)(e^{0.025t}) - \int e^{0.025t}\cdot\cos t\cdot dt\right)$$

Applying Integration by Parts

$u = \cos t \qquad dv = e^{0.025t}$

$du = -\sin t \qquad v = e^{0.025t}/0.025$

$$m(e^{0.025t}) = 2000\left[(1+\sin t)(e^{0.025t}) - \left[\cos t\left(\frac{e^{0.025t}}{0.025}\right) - \int \frac{e^{0.025t}}{0.025}(-\sin t)\right]\right]$$

$$m(e^{0.025t}) = 2000\left[(1+\sin t)(e^{0.025t}) - \frac{(\cos t)(e^{0.025t})}{0.025} - \frac{1}{0.025}\int e^{0.025t}\cdot\sin t\cdot dt\right]$$

$$m(e^{0.025t}) = 2000(1+\sin t)(e^{0.025t}) - 8000(\cos t)(e^{0.025t}) - 800\left(\int e^{0.025t}\cdot dt\right)$$

Solving using matlab mfile and dsolve function

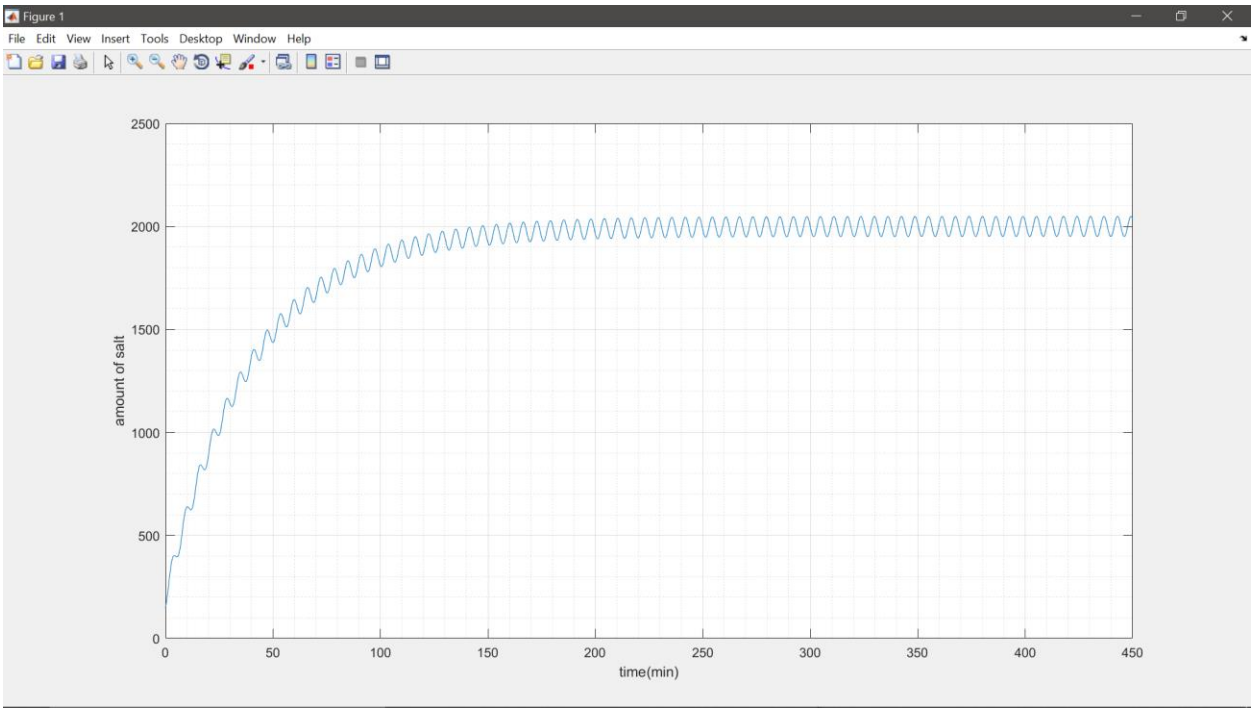
$$m = 2000 - \frac{(2000\sqrt{1601})\cos(t + \operatorname{atan}(1/40))}{1601} - \frac{2881850\cdot e^{(-t/40)}}{1601}$$

NUMBER 1b

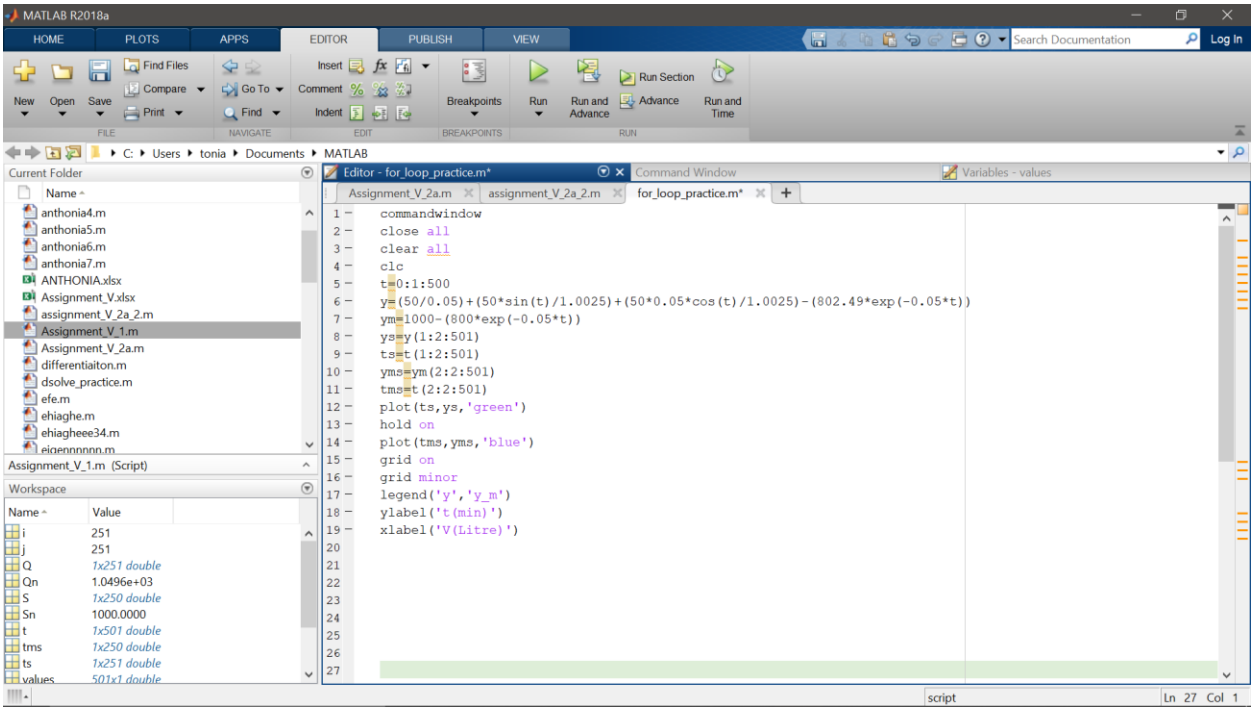
```
commandwindow
clear all
clc
close all
syms m(t)
eqn = diff(m,t)+ 0.025*m == 50*(1+sin(t))
condition = m(0) == 150
answer = dsolve(eqn,condition)
pretty(answer)

t = [0:0.5:450]
A = subs(answer)
plot(t,A)
xlabel('time(min)')
ylabel('amount of salt')
grid on
grid minor
```

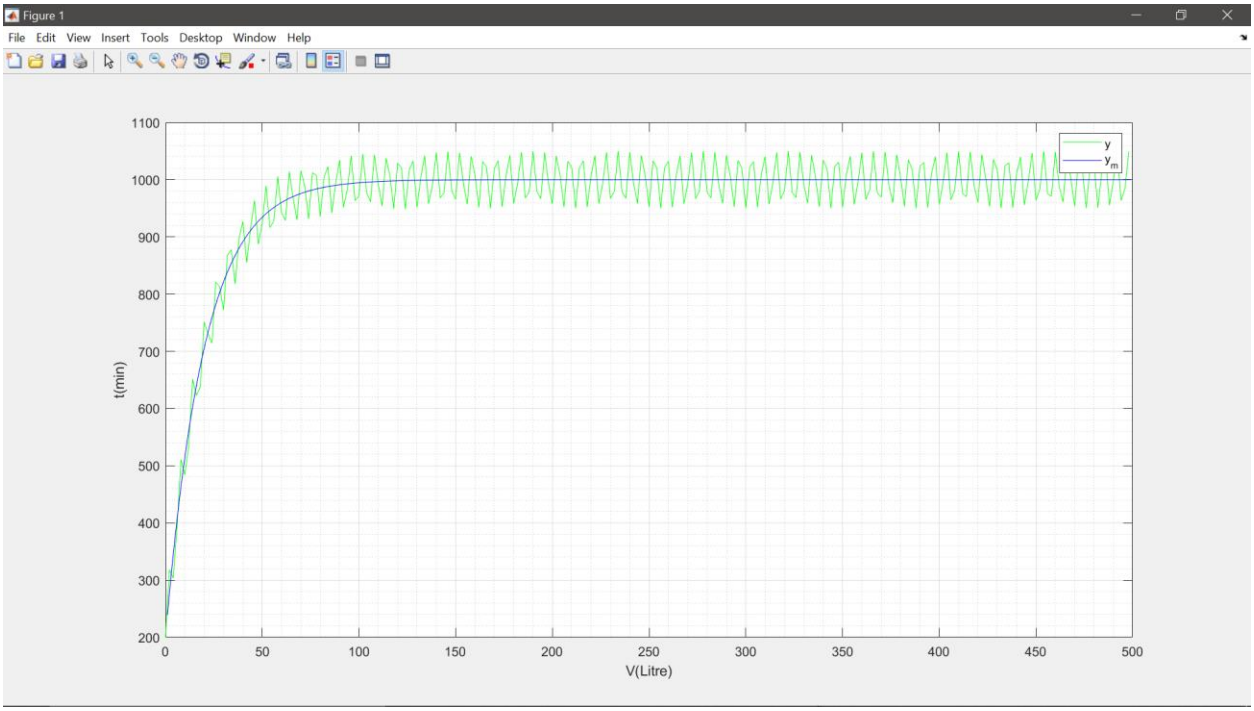
Number 1b, dynamic response



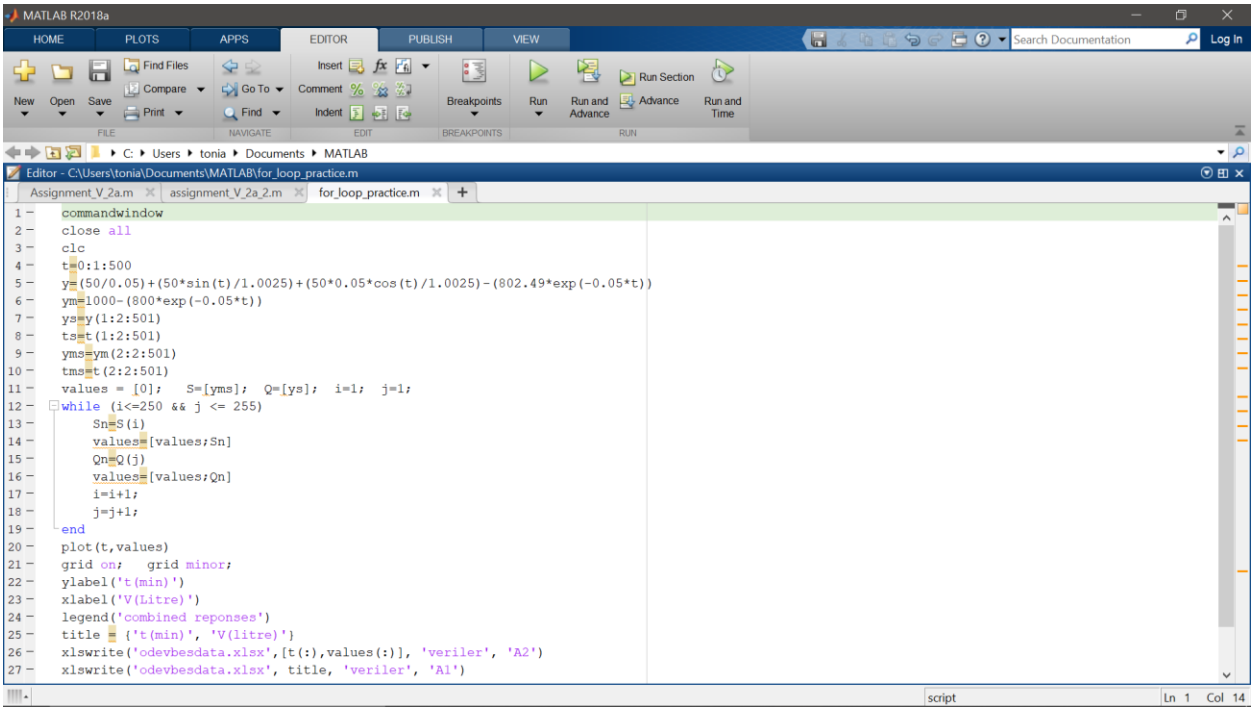
Number 2a



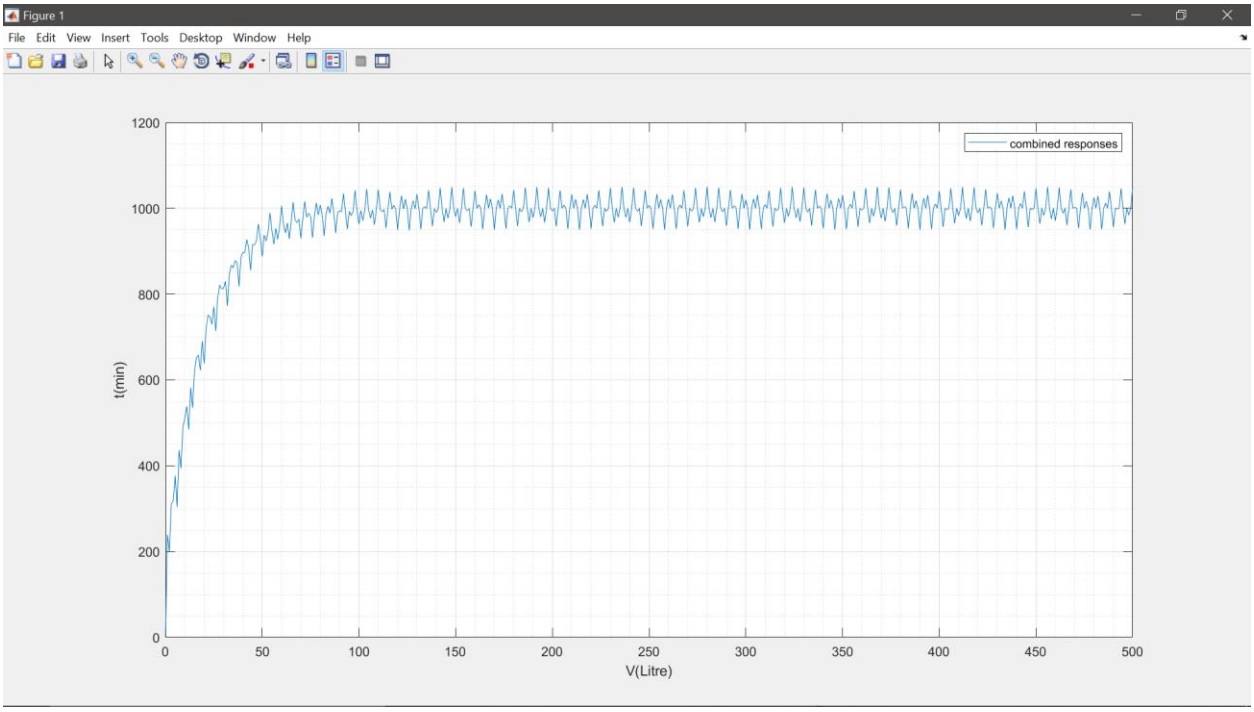
Number 2a



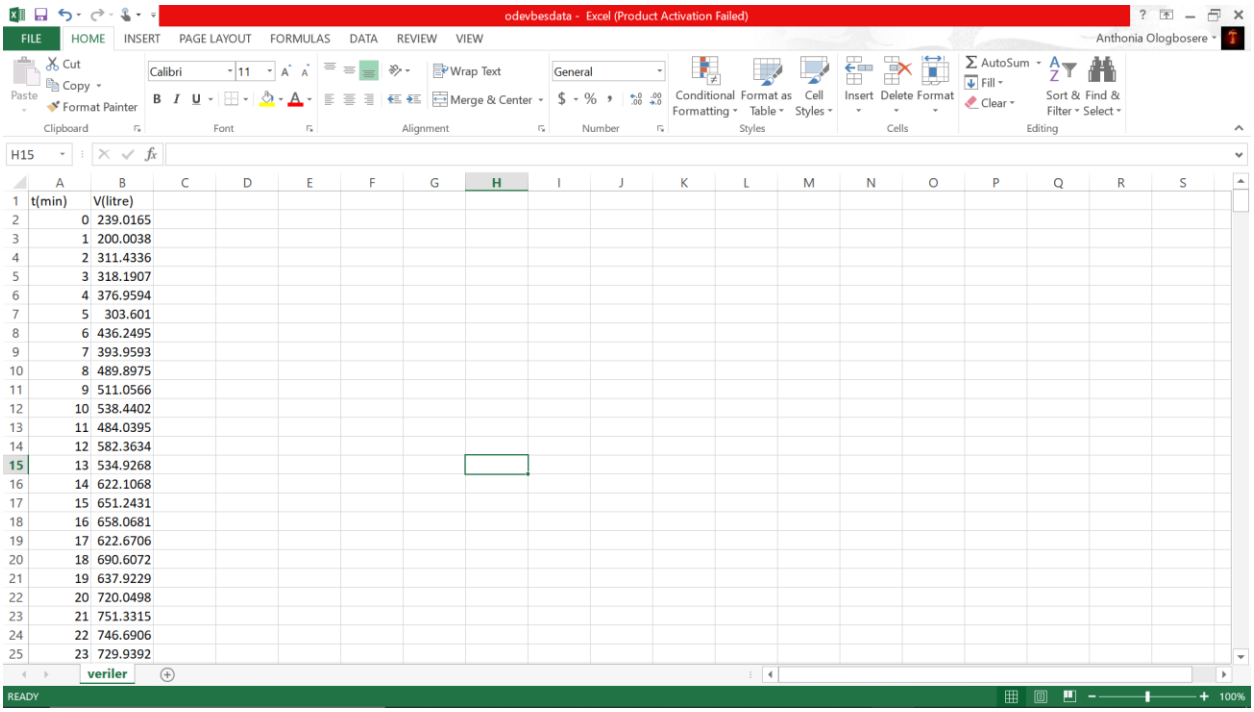
Number 2b



Number 2b



Number 2c



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