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 MATRIC NO: 18/ENG06/056

(1a) $\frac{dm}{dt} = M_{in} - M_{out}$
 $M_{in} = 50 \frac{gal}{min} \times (1 + \sin t) \frac{lb}{gal} = 50 \frac{lb}{min}$
 $M_{out} = \frac{30}{1000} = 0.025 \text{ i.e. } 2.5\% \text{ of } M$
 $\frac{\partial M}{\partial t} = 50(1 + \sin t) - 0.025M$

(1b) $U = \sin t \quad V = e^{0.025t}$
 $\frac{\partial U}{\partial t} = \cos t \quad \int \frac{\partial V}{\partial t} = \frac{e^{0.025t}}{0.025}$

$$50 \int \sin t \cdot e^{0.025t} = \sin t \frac{e^{0.025t}}{0.025} - \int \cos t \cdot \frac{e^{0.025t}}{0.025}$$

$$\int \cos t \cdot \frac{e^{0.025t}}{0.025}$$

Integrating by parts

$$U = \cos t \quad \frac{\partial U}{\partial t} = -\sin t$$

$$V = \frac{e^{0.025t}}{0.025} \quad \int \frac{\partial V}{\partial t} = \frac{e^{0.025t}}{0.00625}$$

$$\int \cos t \cdot \frac{e^{0.025t}}{0.025} = \cos t \cdot \frac{e^{0.025t}}{0.00625} - \int -\sin t \cdot \frac{e^{0.025t}}{0.00625}$$

$$\int \sin t \cdot e^{0.025t} = \frac{\sin t \cdot e^{0.025t}}{0.025} - \cos t \cdot \frac{e^{0.025t}}{0.00625}$$

$$\sin t \cdot e^{0.025t} = \frac{\sin t \cdot e^{0.025t}}{0.025} - \cos t \cdot \frac{e^{0.025t}}{0.00625}$$

$$\frac{\partial M}{\partial t} = 50(1 + \sin t) = 0.025M$$

$$\frac{\partial M}{\partial t} + 0.025M = 50(1 + \sin t)$$

$$y' + py = Q$$

$$p = 0.025$$

$$Q = 50(1 + \sin t)$$

$$\Rightarrow m \cdot y = \int Q \cdot y$$

$$M \cdot e^{0.025t} = \int 50(1 + \sin t) \cdot e^{0.025t}$$

$$\text{But } \int 50(1 + \sin t) \int e^{0.025t} = \int 50e^{0.025t} + 50 \sin t e^{0.025t}$$

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

But $\int 50 \sin t + e^{0.025t} = 50 \int \sin t e^{0.025t}$

$$50 \int \sin t e^{0.025t} \Rightarrow 50 \int \sin t e^{0.025t}$$

$$50 \int \sin t \cdot e^{0.025t}$$

Integrating By parts

$$= 50 \int \sin t e^{0.025t} - 49.97 (0.025 \sin t e^{0.025t} - \cos t e^{0.025t})$$

Recall

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

$$= 50 \int e^{0.025t} dt = 50 \times \frac{e^{0.025t}}{0.025} = 2000 e^{0.025t}$$

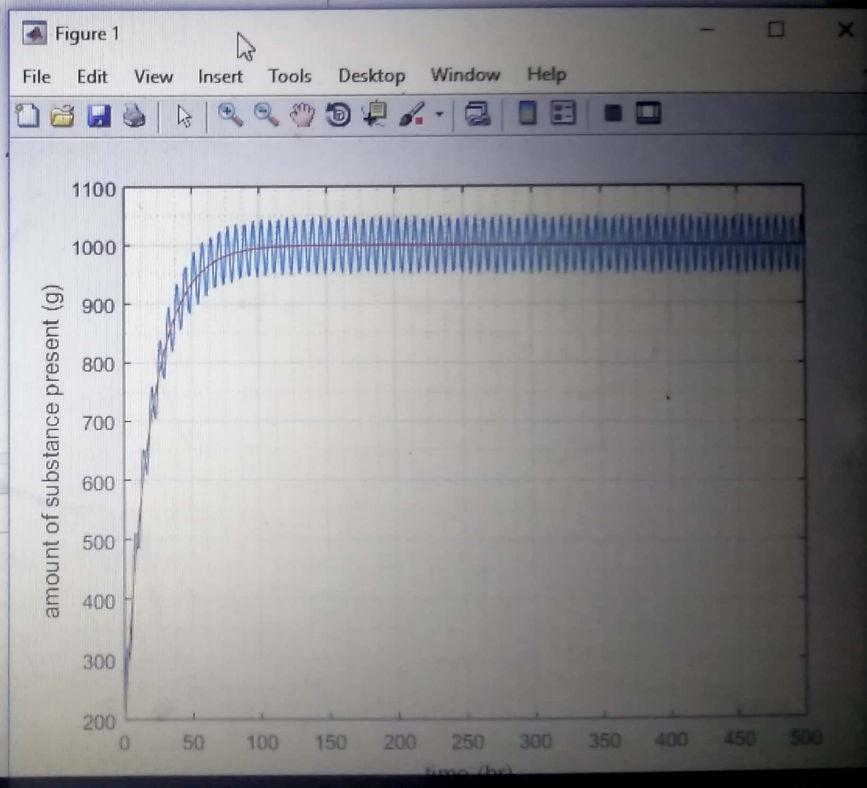
$$M e^{0.025t} = 2000 e^{0.025t} + 49.97 (0.025 \sin t e^{0.025t} - \cos t e^{0.025t})$$

```
Untitled2.m x +  
1 - commandwindow  
2 - clear  
3 - clc  
4 - clear all  
5 - clearvars  
6 - t = 0:1:500;  
7 - x = ((1000)+(49.88)*(sin(t))+(2.49)*(cos(t)))-802.  
8 - plot(t,x)  
9 - xlabel('Time (hr)')  
10 - ylabel('amount of substance present (g)')  
11 - hold on  
12 - y=(1000-800*exp(-0.05*t));  
13 - plot(t,y)  
14 - xlabel('time (hr)')  
15 - ylabel('amount of substance present (g)')  
16 - hold off  
17 - grid on
```

Command Window

New to MATLAB? See resources for [Getting Started](#).

>>



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