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18/ENG03/045

CIVIL ENGINEERING

Amount of salt present in the tank at any given time T as y ; its time rate of change is given as

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

Accumulation rate = input rate - output rate

∴ Accumulation rate of salt = input rate of salt - output rate of salt

Since 50gal of brine enters the tank per minute, and it is given that one gallon = $(1 + 0.017)$ lb of dissolved salt

∴ at time $T = 1$

$$\begin{aligned}(1 + 0.017) &= (1 + 0.017) \\ &= 1 + 0.017 \\ &= 1.017 \approx 1.02 \text{ lb of salt}\end{aligned}$$

∴ Amount of salt entering the tank (ie Y_{in})

$$\begin{aligned}Y_{in} &= \frac{50 \text{ gal}}{\text{min}} \left(\frac{1.02 \text{ lb}}{\text{gal}} \right) = 50.87 \\ &= 51 \frac{\text{lb}}{\text{min}}\end{aligned}$$

Recall that the tank contains 1200gal of water which 150lb of salt is dissolved initially and 30 gallons of the solution leaves the tank per minute.

$$\left(\text{ie } \frac{30 \text{ gal}}{1200 \text{ gal}} = 0.025 = 2.5\% \text{ of tank content.} \right),$$

in the tank

therefore 2.5% of the salt present leaves per minute (ie Y_{out})

$$= 2.5\% \text{ of } y$$

$$\frac{dy}{dt} \frac{\text{lb}}{\text{min}} = \frac{51 \text{ lb}}{\text{min}} - 2.5\% \text{ of } \frac{\text{lb}}{\text{min}}$$

$$\frac{dy}{dt} = 51 - 0.025y$$

$$= 2.5\% \left(\frac{-2.5\%y}{-2.5\%y} + \frac{51}{2.5\%} \right) = \left(\frac{51}{0.025} \right)$$

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

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

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

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

$$\ln(y-2040) = -0.025t + C$$

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

$$y - 2040 = e^{-0.025t} \cdot e^C$$

$$y = y_0 e^{-0.025t} + 2040$$

recall that 150lb was dissolved initially

$$\therefore y = 150$$

$$\Rightarrow 150 = y_0 e^{-0.025t} + 2040$$

$$150 - 2040 = y_0 \times 1$$

$$y_0 = -1890$$

$$\therefore y = -1890(e^{-0.025t}) + 2040$$

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

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

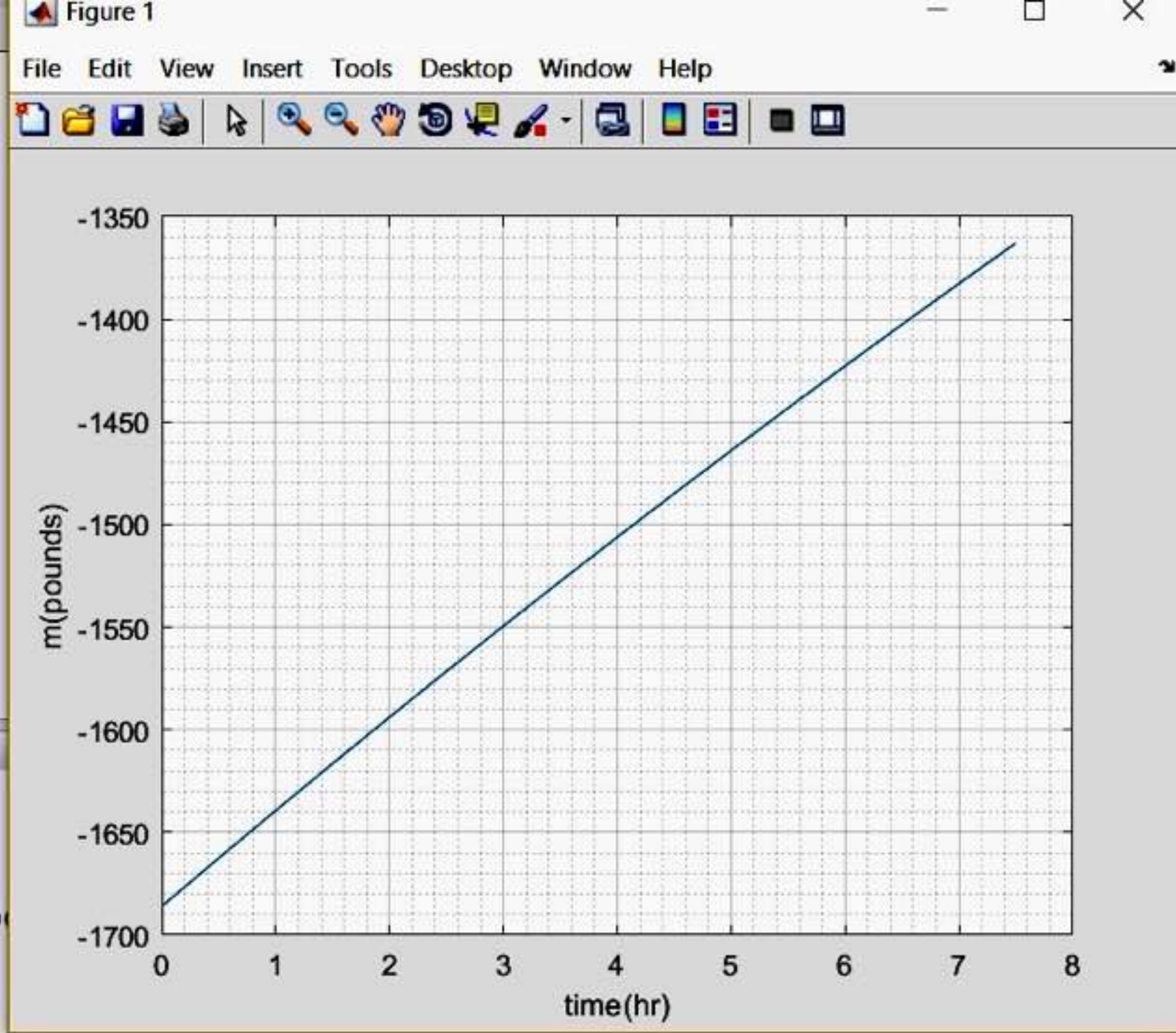
```
okopido.m x +
1 - commandwindow
2 - clear
3 - clc
4 - close all
5 - syms m t
6 - t = [0:0.5:7.5]
7 - m = 204 - 1890*exp(-0.025*(t))
8 - plot(t,m)
9 - xlabel('time(hr)')
10 - ylabel('m(pounds)')
11 - grid on
12 - grid minor
```

Command Window

```
t =
    0    0.5000    1.0000    1.5000    2.0000    2.5000    3.0000
    3.5000    4.0000    4.5000    5.0000    5.5000    6.0000    6.5000
    7.0000    7.5000

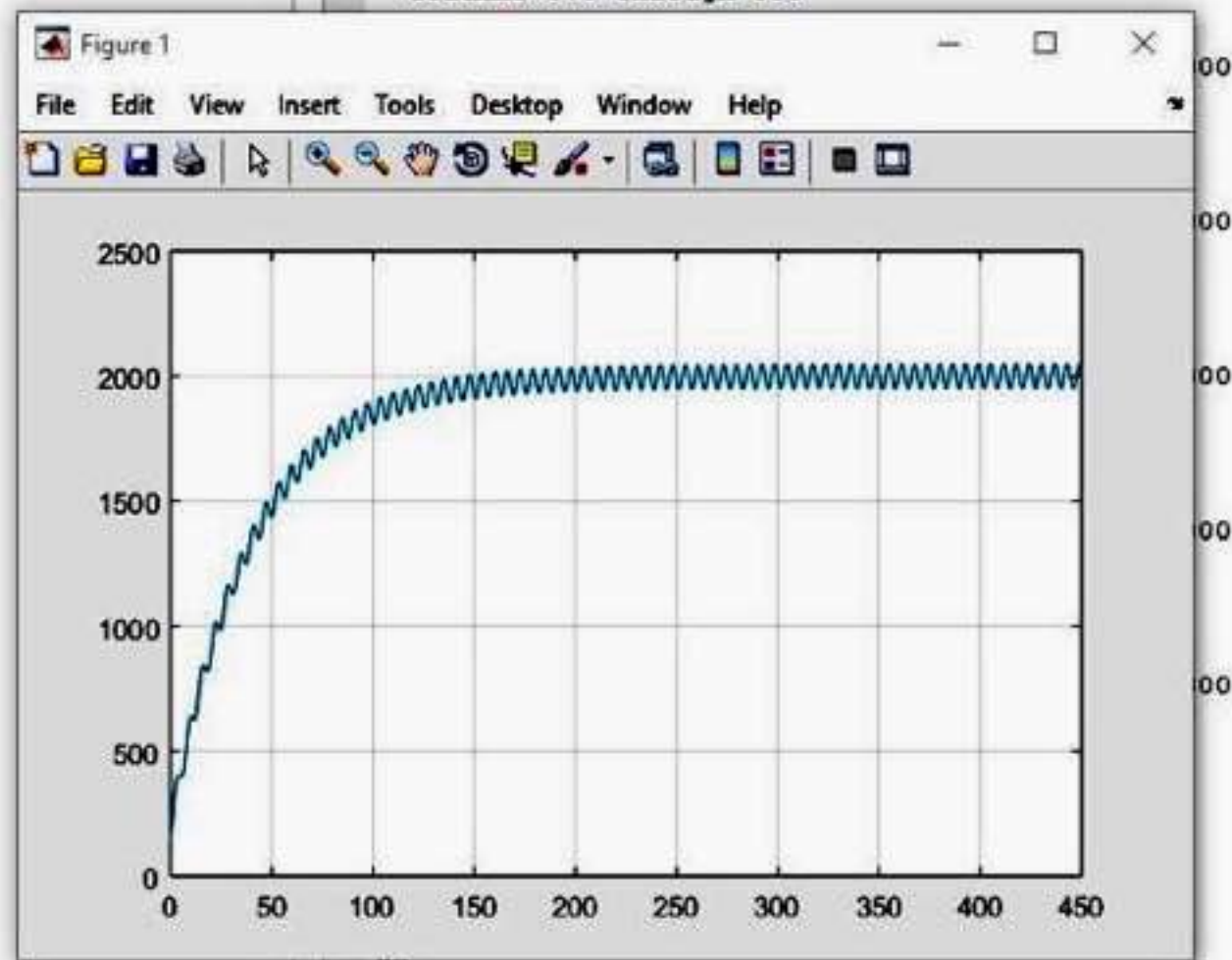
m =
1.0e+03 *
-1.6860 -1.6625 -1.6393 -1.6164 -1.5938 -1.5715 -1.5494 -1.5277 -1.5061 -1.4849 -1.4639 -1.4432 -1.4227 -1.4025 -1.3826 -1.3629
```

fx >>



Activate Windows
Go to Settings to activate Windows.

```
1 - commandwindow
2 - clear
3 - clc
4 - close all
5 - syms m t
6 - ans=dsolve('Dm+0.025*m=50+50*sin(t)', 'm(0)=150')
7 - t=0:0.5:450
8 - tn=subs(ans,t)
9 - plot(t,tn)
10 - grid on
```



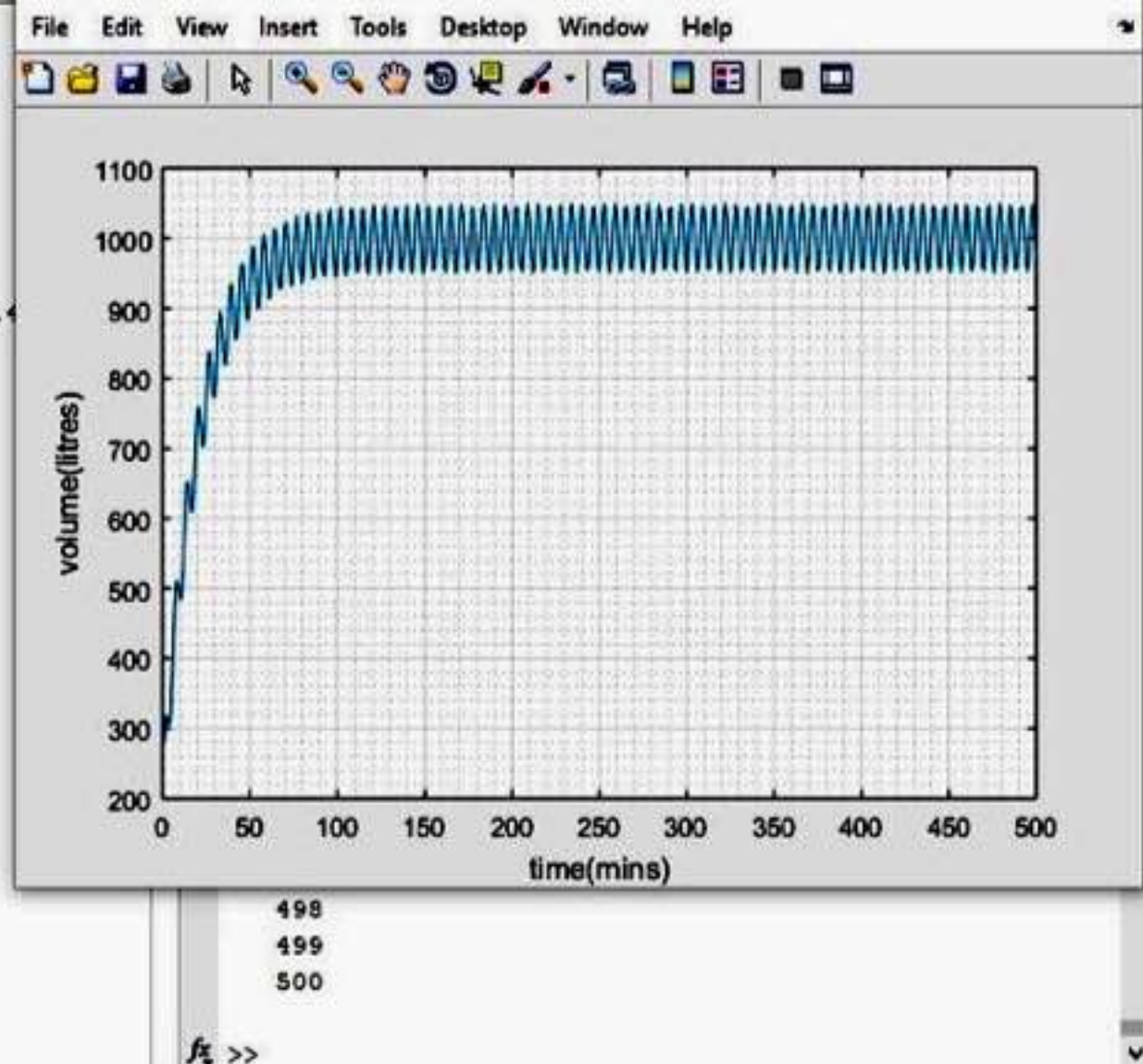
$$[150, 2000 - (2000 \cdot 1601^{1/2}) \cdot \cos(\text{atan}(1/40) + 1/2)] / 1601$$

fx >>

```

1 - commandwindow
2 - clear
3 - clc
4 - close all
5 - syms t
6 - values=[]
7 - t=1:1:500
8 - mean=1000-((exp(-0.05*t))*800)
9 - y=1000+(50/1.0025)*sin(t)+(2.5/1.0025)*cos(t)-((exp(-0.05*t))*802.4
10
11 - if rem(t,2) ==0
12 -     values=[values,mean]
13 - else
14 -     values=[values,y]
15 - end
16 - excelvalues=transpose(values)
17 - mins=transpose(t)
18 - plot(t,values)
19 - grid on
20 - grid minor
21 - xlabel('time(mins)')
22 - ylabel('volume(litres)')
23 - xlswrite('odevbesdata.xlsx',{'t(min)'),'veriler','A1')
24 - xlswrite('odevbesdata.xlsx',mins,'veriler','A2')
25 - xlswrite('odevbesdata.xlsx',{'V(Litre)'},'veriler','B1')
26 - xlswrite('odevbesdata.xlsx',excelvalues,'veriler','B2')
27

```



498
499
500

f₂ >>