Adegoke-alagbe Samuel Charles
18/ENG03/006
Civil Engineering

1a

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

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

$$= \frac{50 lb}{min}$$

$$M_{out} = \frac{30}{1200} = 0.025 \text{ i.e } 2.5\% \text{ of } m$$

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

(b)

$u = \sin t \qquad v = e^{0.025t}$

$\frac{du}{dt} = \cos t \qquad \int u\,dt = \frac{e^{0.025t}}{0.025}$

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

$$\int \cos t \cdot \frac{e^{0.025t}}{0.25}$$

using Integration by parts

$u = \cos t \qquad \frac{du}{dt} = -\sin t$

$v = \frac{e^{0.025t}}{0.25} \qquad \int u\,dv = \frac{e^{0.025t}}{0.00625}$

$$\int \cos t \cdot \frac{e^{0.025t}}{0.025} = \cos t \cdot \frac{e^{0.025t}}{0.00625} - \int -\sin t \cdot \frac{e^{0.25t}}{0.00625}$$

$$\int \sin t \cdot e^{0.025t} = \sin t \frac{e^{0.025t}}{0.025} - \cos t \cdot \frac{e^{0.0025t}}{0.00625}$$

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

$$\sin t \cdot e^{0.025t} + \int \sin t \, \frac{e^{0.025t}}{0.000625}$$

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

$$\sin t \, e^{0.025t} + \frac{1}{0.000625} \int \sin t \, e^{0.025} = \frac{0.025 \sin t \, e^{0.025} - \cos e^{0.025}}{0.000625}$$

$$160 \int \sin t \, e^{0.025t} = \frac{0.025 \sin t \, e^{0.025} - \cos t \, e^{0.025}}{0.000625}$$

$$\sin e^{0.025t} - \frac{0.025 \sin t \, e^{0.025} - \cos t \cdot e^{0.025}}{1.00625}$$

~~$M = 150 + 16$~~

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

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

$$IF = e^{\int p \, dt}$$

$$p = 0.025$$

$$\int p \, dt = \int 0.025 \, dt = 0.025t$$

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

$$\Rightarrow m \cdot f = \int Q \cdot IF$$

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

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

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

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

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

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

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

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

By integration by part

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

Recall that

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

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

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

Editor - C:\Users\Peggysamz\Documents\MATLAB\samuelcharles2.m

adegokesamz.m | salvation.m | lastmathquiz.m | saviourofGod.m | samuelcharles1.m | samuelcharles2

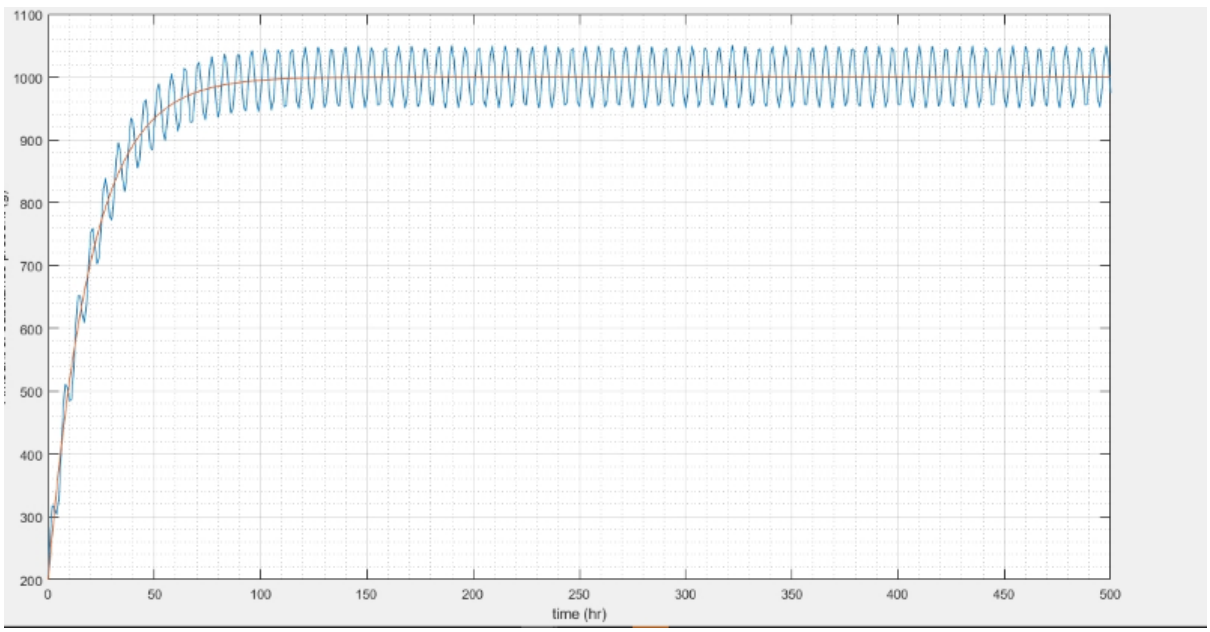
```
 clc
close all
clearvars
t = 0:0.5:7.5;
y =0.0769*exp(-t/40)-(2000*1601^(1/2)*cos(t + atan(1/40))) /1601 + 2000
plot(y,t)
xlabel ('Time (hr)')
ylabel('Amount of substance present (g)')
grid on
grid minor
```

Command Window

```
    1.9501    1.9568    1.9741    1.9978    2.0220    2.0409    2.0497    2.0464    2.0

Columns 14 through 16

    1.9515    1.9632    1.9839
```



2....

2.

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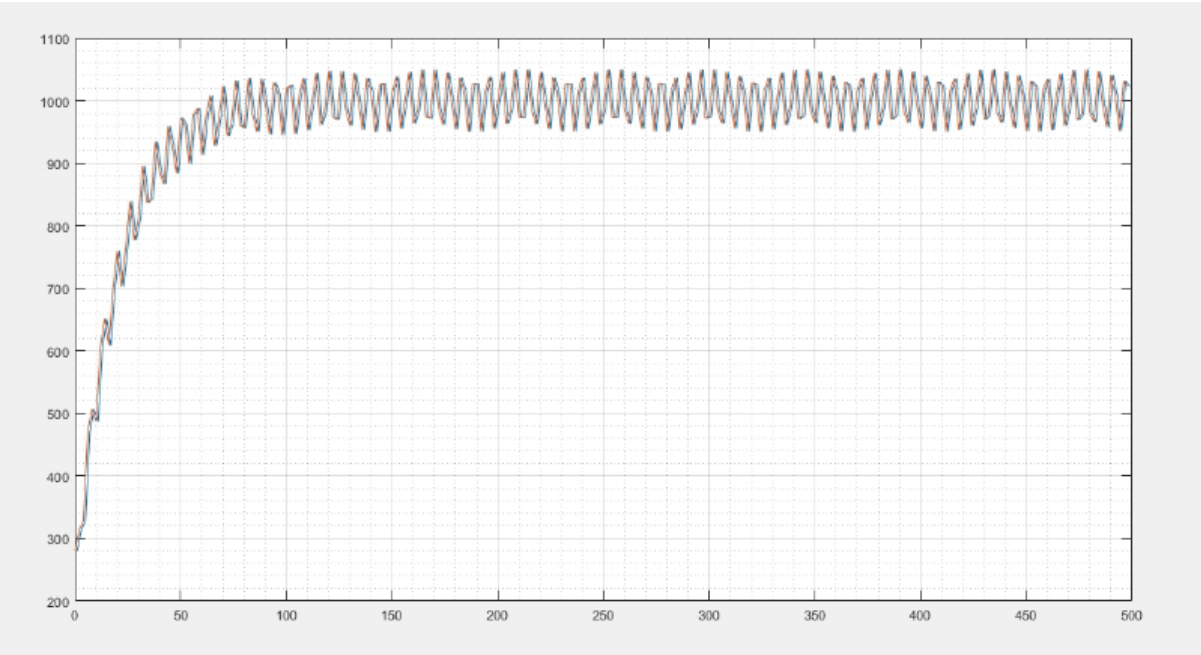
Editor - C:\Users\Peggysamz\Documents\MATLAB\samuelcharles2.m

adegokesamz.m | salvation.m | lastmathquiz.m | saviourofGod.m | samuelcharles1.m | samuelcharles2.m

```
clear
clc
close all
format short g
syms t
y=(50/0.05)+((50/1.0025)*sin(t))+((50*0.05/1.0025)*cos(t))-(802.49*exp(-0.05*t))
ym=1000-(800*exp(-0.05*t))
t=0:1:500
t1=t(2:2:500)
t2=t(1:2:500)
Y=subs(y,t1)
Ym=subs(y,t1)
mdata={'t(min)', 'V(litres)';Y,Ym}
plot(t1, Y, t2, Ym)
grid on
grid minor
```

Command Window

```
2×2 cell array
```