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 18/ENG07/007
 Petroleum Engineering
 ENG 282

Answers

(1a) From $\frac{dy}{dt} = Y_{in} - Y_{out}$
 $\frac{dy}{dt} = 50(1 + \sin t) - 2.5\% \text{ of } y$
 $Y_{out} = \frac{30}{100} = 0.025 = 2.5\%$

$Y_{out} = 2.5\% \text{ of } y = \frac{1}{40}y$
 $\frac{dy}{dt} = 50(1 + \sin t) - 0.025y$

By separating the variables,
 $\frac{dy}{dt} + 0.025y = 50(1 + \sin t)$

$\Rightarrow 1 + 0.025y \, dy = 50(1 + \sin t) \, dt$

(1b) $\frac{dy}{dt} = 50(1 + \sin t) - 0.025y$
 $\frac{dy}{dt} + 0.025y = 50(1 + \sin t)$

Using linear equation method;

$\frac{dy}{dt} + Py = Q$
 $P = 0.025, \quad Q = 50(1 + \sin t)$

$\therefore \int P \cdot dt = 0.025t$

I.F = $e^{\int P \cdot dt}$

I.F = $e^{0.025t}$

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

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

$y \cdot e^{0.025t} = 50 \int e^{0.025t} + e^{0.025t} \sin t \cdot dt$

$y \cdot e^{0.025t} = 50 \int \frac{e^{0.025t} \cdot dt}{0.025} + \int e^{0.025t} \sin t \cdot dt$

Integration by part

$\int U \, dv = UV - \int V \, du$

$U = e^{0.025t} \quad dv = \sin t$

$du = 0.025 e^{0.025t} \quad V = -\cos t$

$\therefore \int e^{0.025t} \sin t = e^{0.025t} \cdot (-\cos t) - \int (-\cos t) \cdot 0.025 e^{0.025t} \, dt$

$$\int e^{0.025t} \sin t = -e^{0.025t} \cos t + 0.025 \int e^{0.025t} \cos t + C$$

$$\int u dv = uv - \int v du$$

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

$$du = 0.025 e^{0.025t}, \quad v = \sin t$$

$$= -e^{0.025t} \cos t + 0.025 \left[e^{0.025t} \sin t - \int \sin t \cdot 0.025 e^{0.025t} \right]$$

$$= -e^{0.025t} \cos t + 0.025 \left[e^{0.025t} \sin t - 0.025 \int \sin t e^{0.025t} \right]$$

$$\text{Let } Q = \int e^{0.025t} \sin t$$

$$Q = -e^{0.025t} \cos t + 0.025 \left[e^{0.025t} \sin t - 0.025 Q \right]$$

$$Q = -e^{0.025t} \cos t + 0.025 e^{0.025t} \sin t - 0.00625 Q$$

$$Q + 0.00625 Q = -e^{0.025t} \cos t + 0.025 e^{0.025t} \sin t$$

$$1.00625 Q = -e^{0.025t} (\cos t - 0.025 \sin t)$$

$$Q = \frac{-e^{0.025t}}{1.00625} (\cos t - 0.025 \sin t) + C$$

$$y = \frac{2000}{1.00625} (\cos t - 0.025 \sin t) + \frac{50C}{e^{0.025t}}$$

$$\text{When } y = 150, \quad t = 0$$

$$150 = \frac{2000}{1.00625} (1 - 0) + \frac{50C}{1}$$

$$150 = 2000 - 49.968(1) + 50C$$

$$150 = 1950.032 + 50C$$

$$\frac{50C}{50} = \frac{-1800.032}{50}$$

$$C = -36.00064$$

$$Q = \frac{-e^{0.025t}}{1.00625} (\cos t - 0.025 \sin t) + C$$

$$\int e^{0.025t} \sin t = \frac{-e^{0.025t}}{1.00625} (\cos t - 0.025 \sin t) + C$$

$$y \cdot e^{0.025t} = 50 \left[\frac{e^{0.025t}}{0.025} - \frac{e^{0.025t}}{1.000625} (cost - 0.025) + C \right]$$

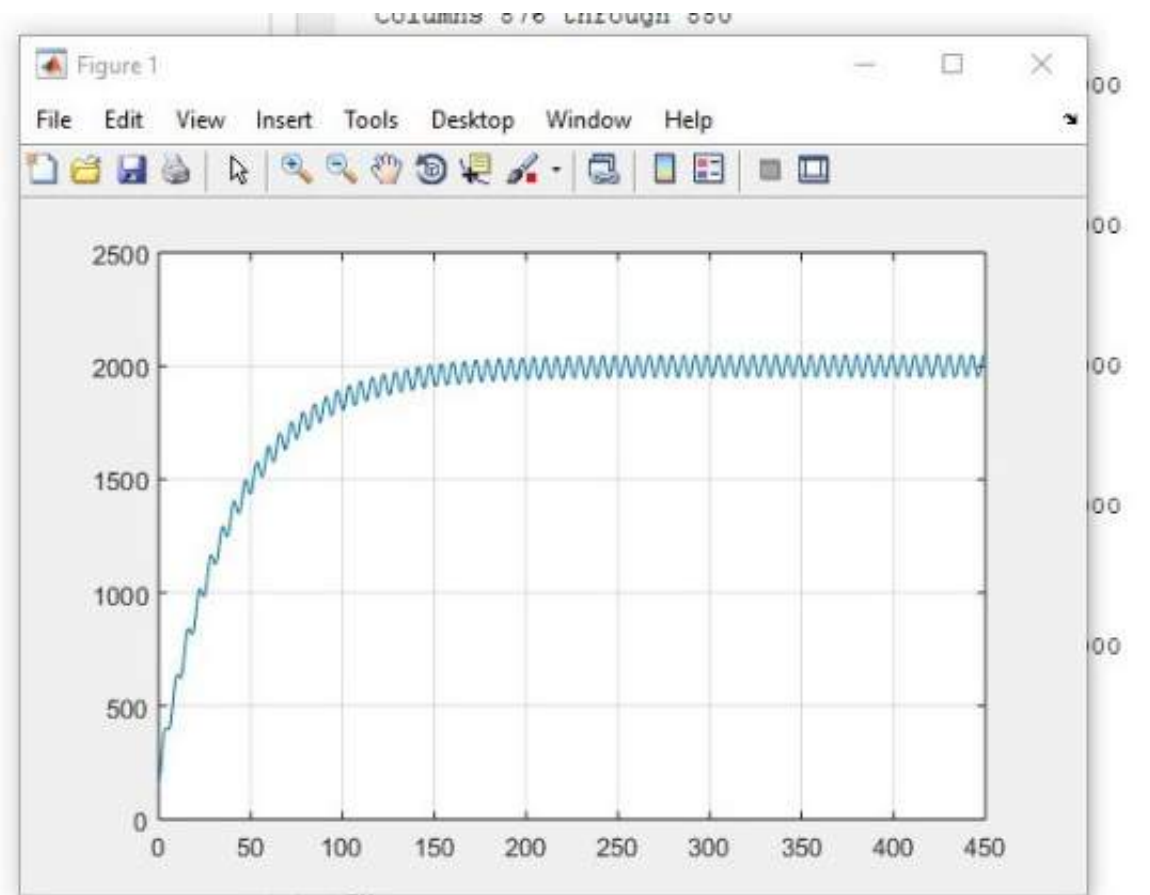
$$y \cdot e^{0.025t} = 2000 e^{0.025t} - \frac{50 \cdot e^{0.025t}}{1.000625} (cost - 0.025) + 50C$$

$$y = 2000 - \frac{50}{1.000625} (cost - 0.025) + \frac{50C}{e^{0.025t}}$$

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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

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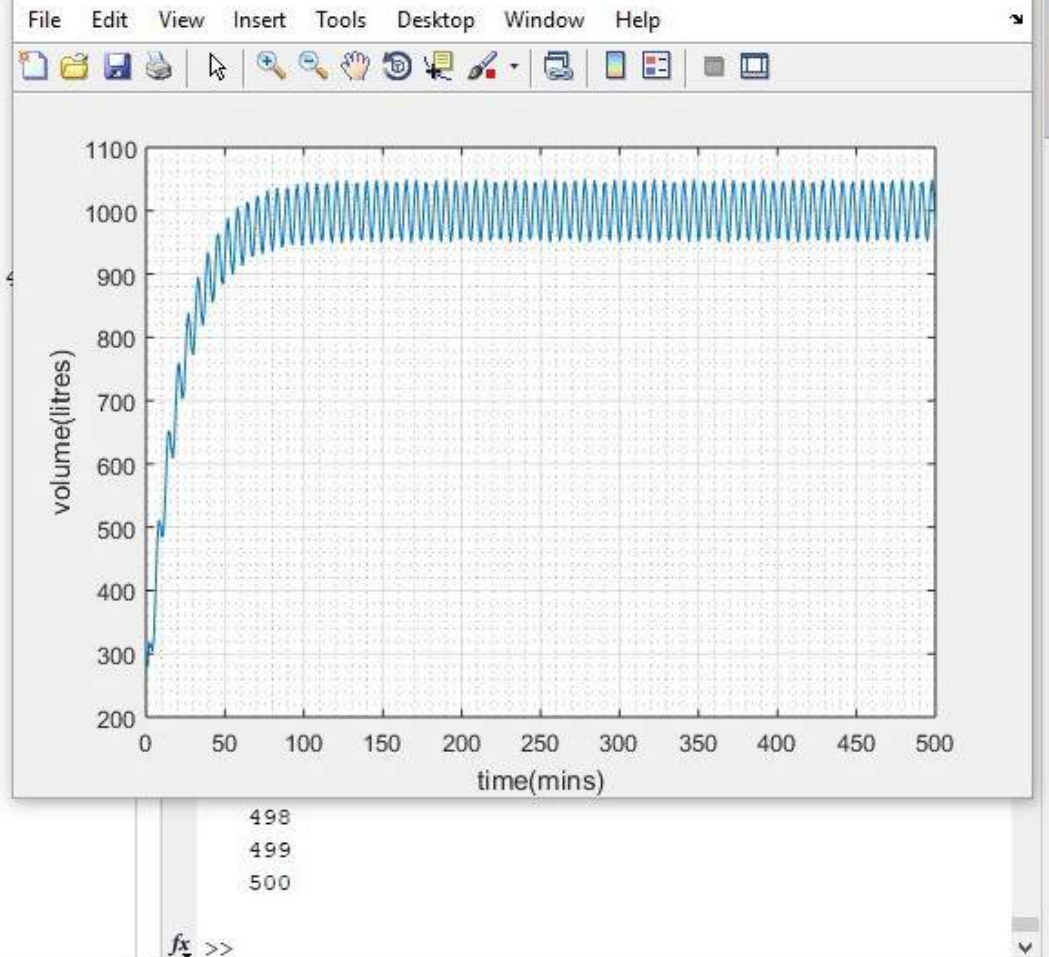
[ 150, 2000 - (2000*1601^(1/2))*cos(atan(1/40) + 1/2
fx >>

```

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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

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B2 : X ✓ fx 279.963914100068

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	t(min)	V(Litre)																			
2		1	279.9639																		
3		2	318.1907																		
4		3	313.8601																		
5		4	303.601																		
6		5	327.9009																		
7		6	393.9593																		
8		7	469.1423																		
9		8	511.0566																		
10		9	506.5922																		
11		10	484.0395																		
12		11	487.1398																		
13		12	534.9268																		
14		13	604.2824																		
15		14	651.2431																		
16		15	651.4694																		
17		16	622.6706																		
18		17	608.3676																		
19		18	637.9229																		
20		19	699.585																		
21		20	751.3315																		
22		21	759.541																		
23		22	729.9392																		
24		23	702.3679																		
25		24	714.1865																		
26		25	765.9535																		
27		26	820.9421																		
28		27	838.9333																		
29		28	813.2194																		
30		29	776.7953																		