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ELECT-ELECT

18/ENG04/070

Volume of water in tank = 1200 gal.
amount of salt in water at $t=0$ is 150 lb
amount of salt in tank at any instance is m .

$$\frac{dy}{dt} = \frac{dm}{dt} = \text{rate in} - \text{rate out}$$
$$\frac{dm}{dt} = \frac{50 \text{ gal}}{\text{min}} \cdot (1 + \sin t) \text{ lb} - \frac{m \text{ lb} \cdot 30 \text{ gal}}{\text{min}}$$
$$\frac{dm}{dt} = 50(1 + \sin t) - 30m$$

30 gal = 2.5% of 1200 gal = 0.025

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

separating the variable, we have,

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

a) $\Rightarrow \therefore \frac{dm}{dt} + 0.025m = 50(1 + \sin t)$ is the differential eqn.

b) Solving the eqn using

$$\frac{dy}{dx} + Py = Q \Rightarrow \frac{dm}{dt} + Pm = Q$$
$$IF = e^{\int P \cdot dt} = e^{\int 0.025 dt}$$
$$IF = e^{0.025t} \Rightarrow y \cdot IF = \int Q \cdot IF dt$$
$$\therefore m \cdot e^{0.025t} = \int 50(1 + \sin t) \cdot e^{0.025t} \cdot dt$$

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

$$m \frac{dy}{dt} \cdot e^{-0.025t} = 50 \int e^{-0.025t} \cdot dt + \int e^{-0.025t} \sin t \, dt$$

$$m \frac{dy}{dt} \cdot e^{-0.025t} = 50 \cdot \frac{e^{-0.025t}}{0.025} + \int e^{-0.025t} \sin t \, dt$$

we would have to integrate $\int e^{-0.025t} \sin t \, dt$ by parts
 let $u = e^{-0.025t} \Rightarrow du = -0.025 \cdot e^{-0.025t}$
 $dv = \sin t \Rightarrow v = -\cos t$

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

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

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

$$Q = -e^{-0.025t} \cos t + 0.025 \left(e^{-0.025t} \sin t - 0.025 \int e^{-0.025t} \sin t \, dt \right)$$

recall $Q = \int e^{0.025t} \sin t \, dt$.

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

$$Q = (-e^{-0.025t} \cos t) + (e^{-0.025t} \cdot 0.025 \sin t) - (0.25 \times 10^{-4} Q) + C$$

$$Q - 6.25 \times 10^{-4} Q = e^{-0.025t} \cos t + 0.025 e^{-0.025t}$$

$$\Rightarrow Q = \frac{e^{-0.025t}}{1 - 0.000625} (\cos t - 0.025) + C$$

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$$m = 2000$$

from the ques
when $y = 1$

$$150 = 20$$

$$150 =$$

$$\Rightarrow m = 2$$

$$m = \frac{2000 - 50}{1.000625} (0.025t - 0.025 \sin t) + \frac{50}{e^{0.025t}}$$

from the question;
when $y = 150$, $t = 0$

$$150 = \frac{2000 - 50}{1.000625} (1 - 0) + 50C$$

$$150 = 2000 - 49.9688 + 50C$$

$$50C = -1800.0312$$

$$C = -36.0006$$

gg

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onlinequiz.m x Test4c.m x mathsexcelclass1.m x Mathsassign5.m x +
1 - commandwindow
2 - clear
3 - clc
4 - close all
5 - syms m t
6 - A=dsolve('Dm+0.025*m=(1+sin(t))*50','m(0)=150')
7 - t=0:0.5:400
8 - tn=subs(A,t)
9 - plot(t,tn)
10 - grid on
11 - grid minor

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sdfgb


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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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