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19/ENG01/016
Chemical Engineering

* SORRY SIR, I DO NOT HAVE MATHAB,

1a. apply balance law

Accumulation rate = Input rate of salt − Output rate of salt

The amount of salt present in the tank (y) at any time (t), its rate of change is given by

$dy/dt = y_{in} - y_{out}$

at $t = 1$; $(1 + \sin t)$

$= (1 + \sin(1)) = 1.02$ lb of salt

the amount of salt entering the tank is

$y_{in} = 50\ gal/min \times 1.02\ lb/gal = 51\ lb/min$

The tank contains 1200gal of brine and 30 gallons of the solution leaves the tank per minute

i.e $30\ gal / 1200\ gal = 0.025$

2.5% of the brine will leave the tank per minute

$y_{out} = 2.5\%$ of y

$\therefore dy/dt\ lb/min = 51\ lb/min - 2.5\%$ of $y\ lb/min$

B. $dy/dt = 51 - 0.025y$

$dy/dt = -0.025\left[\frac{-0.025y}{-0.025y} + \frac{51}{-0.025}\right] = -0.025(y - 2040)$

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

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

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

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

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

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

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

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when $t = 0$ $y = 150$ (6)

$150 = y_0 \cdot e^{0} + 2040$

$150 - 2040 = y_0$

$y_0 = -1890$

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

c.

```
syms t
t = 0:1:450
y = (-1890*exp(-0.025*t)) + (2040)
plot (t,y)
title ('y against t')
```

2.

```
Syms t
t = 0:1:500
y =(50/0.5) + ((50/1.0025)*sin(t)) + (((50*0.05)/1.0025)*cos(t))-
    (802.49*exp(-0.05*t))
ymax = 1000 - (800*exp(-0.05*t))

plot (t,y)
title ('y against t')

hold on
plot (t, ymax)
hold off
```