

ABU DWGICHO - OLHE - OLFA (P/AN/04/007

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

When  $y = 150$

$t = 0$

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

$$150 = 2000 - 49.9688(1) + 50c$$

$$150 = 1950.0322 + 50c$$

$$-1800.032 = 50c$$

$$c = -36.00064 //$$

$$Q = \frac{-e^{0.025t}}{1.000625} (\cos t - 0.025) + c$$

$$\int e^{0.025t} \sin t = \frac{-e^{0.025t}}{1.000625} (\cos t - 0.025) + c$$

Since  $\int e^{0.025t} \sin t = \frac{-e^{0.025t}}{1.000625} (\cos t - 0.025) + c$

$$\therefore y e^{0.025t} = 50 \left[ \frac{e^{0.025t}}{0.025} - \frac{c^{0.025t}}{1.000625} (\cos t - 0.025) + c \right]$$

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

divide through by  $e^{0.025t}$

$$y = \frac{2000 - 50}{1.000625} (\cos t - 0.025) + \frac{50c}{e^{0.025t}} //$$



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

Using integration by part,  $\int u \cdot dv = uv - \int v du$

$$\int e^{0.025t} \sin t \cdot dt$$

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

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

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

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

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

Using integration by part,  $\int u dv = uv - \int du$

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

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

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

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

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

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

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

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

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

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

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



From

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

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

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

∴ By separating

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

Multiply both sides by dt

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

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

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

Using linear equation method

$$\frac{dy}{dx} + py = Q$$

$$\therefore P = 0.025, Q = 50(1 + \sin t)$$

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

$$I-F = e^{p \cdot dt}$$

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

$$\therefore y = I \cdot F = \int Q \cdot I \cdot F \cdot dt$$

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

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

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

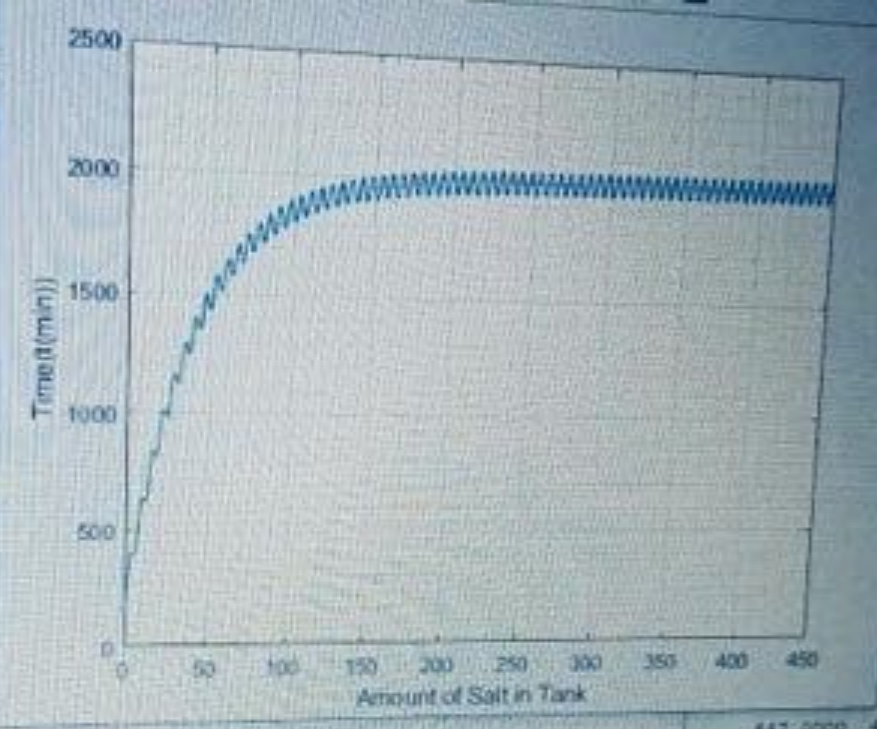
$$y e^{0.025t} = 50 \int e^{0.025t} \cdot dt + \int e^{0.025t} \cdot dt$$



```

1 - commandwindow
2 - clear
3 - clc
4 - close all
5 - sym s t
6 - s=solve('Dm*(0.025*s) - 50*(1-sin(t))', 'm')
7 - tn=0:0.5:450
8 - sn=subs(s,tn)
9 - plot(tn,sn)
10 - grid on
11 - grid minor
12 - xlabel('Amount of Salt in Tank')
13 - ylabel('Time t (min)')
14
15
16

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through 876  
 25.5000 436.5000 424.5000 427.5000 427.5000  
 through 882  
 28.5000 429.0000 429.5000 429.5000 441.5000  
 through 888  
 31.5000 442.0000 442.5000 443.0000 443.5000  
 through 894  
 34.5000 445.0000 445.5000 446.0000 446.5000  
 through 900

447.0000 447.5000 448.0000 448.5000 449.0000 449.5000  
 Column 901  
 450.0000  
 sn =  
 1 150.0000 - (2000+1882)\*11/21\*exp(-0.025\*150) + 1/0.025\*1000

