

9) From

$$\frac{dy}{dt} = ym - yact$$

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

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

By separating the variables

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

Multiply both sides by dt

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

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

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

Using the linear equation method,

$$\frac{dy}{dt} + P_y = Q$$

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

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

$$I.F = e^{\int P \cdot dt} = e^{0.025t}$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Using integration by part,

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

$$y = e^{0.025t}, \quad dy = 0.025 e^{0.025t} dt$$

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

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

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

$$L.H.S = \int e^{0.025t} \sin t$$

$$R.H.S = -e^{0.025t} \cos t + 0.025 \int e^{0.025t} \sin t - 0.025 \int e^{0.025t} \sin t$$

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

$$Q + 6.25 \int Q = -e^{0.025t} \cos t + 0.025 e^{0.025t} \int e^{0.025t} \sin t - 0.025 \int e^{0.025t} \sin t$$

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

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

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

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

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$$y e^{0.025t} = 50 \left[\frac{e^{0.025t} \cos t}{0.025} - \frac{e^{0.025t} \sin t}{1.00625} \right] + C$$

$$y e^{0.025t} = 2000 e^{0.025t} - 50 \cdot e^{0.025t} \left[\cos t + (-0.025) \right] + 50C$$

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

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$$150 = \frac{200 - 50}{1.070625} (1.0) + \frac{50C}{1}$$

$$150 = 200 - 49.9168(1) + 50$$

$$150 = 191.0832 + 50C$$

$$-1800 \cdot 0.80 = 50C$$

$$C = \frac{-1800 \cdot 0.80}{50}$$

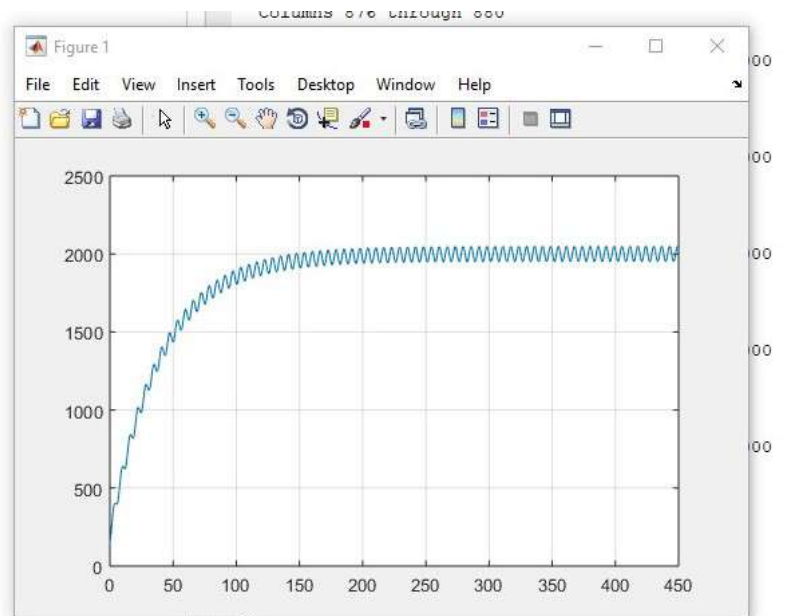
50

$$\therefore C = -36.80064$$

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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)]/1
fx >>
<

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