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1) Using "balance law", The acceleration rate of Salt within a System is equal to the input rate of the salt into the System minus the output rate of the salt from the System.

Acceleration rate of Salt within a System
= Input rate of Salt into the System − Output rate of Salt from the System

Let the amount of Salt Present in the tank at any time "t" be "y".

Time rate of Change of $y = \frac{dy}{dt} = y_{in} - y_{out}$

If 50gal enters the tank Per minute and one gallon Contains $(1 + \sin t) = (1 + \sin(1)) = 1.02lb$

Hence the amount of Salt entering into the tank is

$50gal/min \times 1.02lb = 51lb/min$

The tank Contains 1200 gal of water with dissolved Salt and 30 gal of the Solution exist the tank Per min i.e $= \frac{30gal}{1200gal} = 0.025$

$= 25\%$ of the Content of the tank

So 25% of the Salt Present Inside the tank will also Leave the tank Per minute. i.e

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

a) $\frac{dy}{dt} = 51lb/min - 25\%$ of $y\,lb/min$

b) $\frac{dy}{dt} = 51 - 0.025y$; $\frac{dy}{dt} = -0.025y + 51$

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

$$\frac{dy}{dt} = -0.02(y - 2040$$

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

$$\int \frac{dy}{y-2040} = -0.025 \int dt \; ; \quad \ln(y-2040) = -0.025t + C$$

$$y - 2040 = e^{-0.025t + C} \; ; \quad y - 2040 = e^{-0.024} \cdot e^{C}$$

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

$$y = y_0 e^{-0.025t} + 2040 \; ; \quad \text{Remeber when } t = 1 \; y = 150$$

$$150 = y_0 e^{-0.025(1)} + 2040 \; ; \quad 150 - 2040 = y_0 \times 1$$

$$y_0 = -1890$$

So;

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

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