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18/ENGO2/013
COMPUTER ENGINEERING

1.) 1200 gal of water \Rightarrow initial aggregation
150 lb of Salt

50 gal of brims (salt & water) \Rightarrow Inlet
(1 + sint) lb

30 gal Per minute \Rightarrow out

Using balance's law;

(Accumulation rate of Salt with a system) = (Intake rate of salt into the system) - (output rate of salt within the system)

$$\text{Therefore } \frac{dm}{dt} = m_{in} - m_{out}$$

$$m_{in} = \frac{50 \text{ gal}}{\text{min}} \times \frac{(1 + \text{sint}) \text{ lb}}{5 \text{ gal}} = \frac{50(1 + \text{sint}) \text{ lb}}{\text{min}}$$

$$m_{out} = \frac{30 \text{ gal}}{1200 \text{ gal}} = 0.025 = 2.5\% \text{ of } m$$

$$\frac{dm}{dt} \times \frac{\text{lb}}{\text{min}} = \frac{50(1 + \text{sint}) \text{ lb}}{\text{min}} - 2.5\% \text{ of } \frac{m \text{ lb}}{\text{min}}$$

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

Collecting $-0.025m$ from the equation

$$\begin{aligned} \therefore -0.025m + 50(1 + \text{sint}) \\ = -0.025 \left(\frac{-0.025m}{-0.025} + \frac{50(1 + \text{sint})}{-0.025} \right) \end{aligned}$$

$$\therefore \frac{dm}{dt} = -0.025(m - 2000(1 + \text{sint}))$$

CROSS MULTIPLY

$$\therefore dm = -0.025(m-2000(1+\sin t)) dt$$

Then divide it by $(m-2000(1+\sin t))$

$$\frac{dm}{m-2000(1+\sin t)} = -0.025 dt$$

$$= \int \frac{dm}{m-2000(1+\sin t)} = \int -0.025 dt$$

$$\int \frac{dm}{m-2000(1+\sin t)} = -0.025 \int dt$$

$$\ln [m-2000(1+\sin t)] = -0.025t + C$$

$$m-2000(1+\sin t) = e^{-0.025t+C}$$

$$m-2000(1+\sin t) = e^{-0.025t} + e^C$$

$$m-2000(1+\sin t) = M_0 \cdot e^{-0.025t}$$

$$m-2000(1+\sin t) = M_0 \cdot e^{-0.025t}$$

$$m = M_0 e^{-0.025t} + 2000(1+\sin t)$$

Recall that $t=0$ mins initially; therefore $m=150$ lb

$$150 = M_0 e^{-0.025 \cdot 0} + 2000(1+\sin 0)$$

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$$-M_0 = 2000 - 150$$

$$-M_0 = 1850 \quad \text{divide both sides } \times (-1)$$

$$= M_0 = -1850 //$$