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Course ENG 254, ENGINEERING MATHEMATICS II

1. 50 gal of brine enters the tank per minute.
1 gal contains $(1+\sin t)$ lb of salt.
at $t = 1$
$(1+\sin t) = (1+\sin(1)) = 1.84 \simeq 1.02$.

∴ amount of salt entering the tank.
$= 50 \times 1.02 = 51$ lb/min

the tank contains 1200 gal of water with dissolved salt while 30 gal of the solution goes out of the tank per minute.

$\therefore \frac{30\text{ gal}}{1200\text{ gal}} = 0.025 = 0.025 \times 100\% = 2.5\%$

2.5% of the salt is present.
$\therefore y_{out} = 2.5\%$ of y

(a) dy/dt lb/min $=$ 51 lb/min $-$ 2.5% of y lb/min

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

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

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

Seperating variables.

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

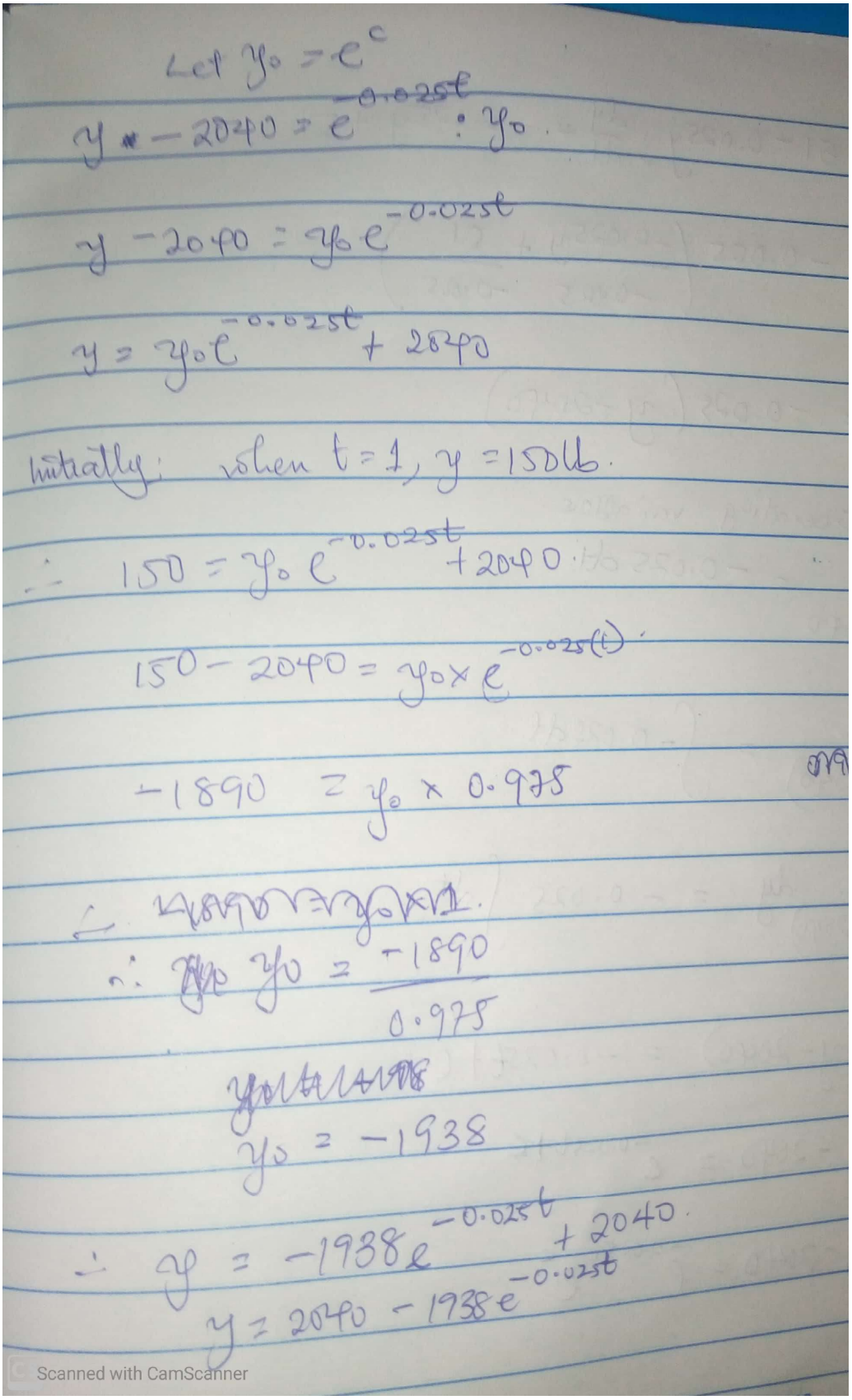
$$\int \frac{dy}{(y-2040)} = \int -0.025\,dt$$

$$\int \frac{1}{(y-2040)}\,dy = -0.025 \int dt$$

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

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

$$y - 2040 = e^{-0.025t}\, e^{C}$$



Let $y_0 = e^{c}$

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

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

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

Initially: when $t = 1$, $y = 150$lb.

$\therefore 150 = y_0 e^{-0.025t} + 2040$

$150 - 2040 = y_0 \times e^{-0.025(t)}$

$-1890 = y_0 \times 0.975$

$\therefore y_0 = \frac{-1890}{0.975}$

$y_0 = -1938$

$\therefore y = -1938 e^{-0.025t} + 2040$

$y = 2040 - 1938 e^{-0.025t}$

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