① Do this ⟶

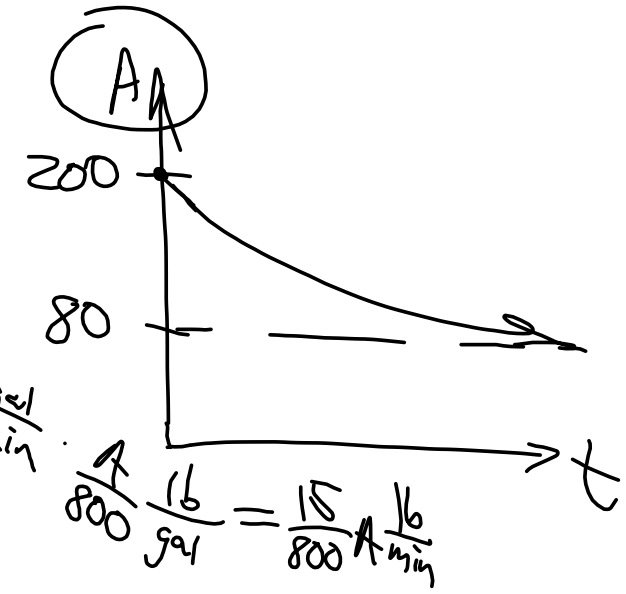
② If you get done early, solve

$$y' - 2xe^{-y} = e^{-y}, \quad y(0) = 0.$$

Solve for y in the end.

15 gal/min
0.1 lb/gal

$1.5 \frac{lb}{min} = \left.\frac{dA}{dt}\right|_{in}$



800 gal
A lb salt

$\left.\frac{dA}{dt}\right|_{out} = 15 \frac{gal}{min} \cdot \frac{A}{800} \frac{lb}{gal} = \frac{15}{800} A \frac{lb}{min}$

$$\frac{dA}{dt} = 1.5 - \frac{15}{800}A$$

$$\frac{dy}{dx} + p(x)y = q(x)$$

$$\frac{dA}{dt} + \frac{15}{800}A = 1.5$$

$$\frac{dA}{dt} = 1.5 - \frac{15}{800}A$$

$$\frac{dA}{1.5 - \frac{15}{800}A} = dt$$

$$-\frac{800}{15}\ln\left|1.5 - \frac{15}{800}A\right| = t + C$$ not the same C

$$\ln\left|1.5 - \frac{15}{800}A\right| = -\frac{15}{800}t + C$$

$$\left|1.5 - \frac{15}{800}A\right| = e^{-\frac{15}{800}t + C}$$

$$1.5 - \frac{15}{800}A = Ce^{-\frac{3}{160}t}$$

$$-\frac{15}{800}A = Ce^{-\frac{3}{160}t} - 1.5$$

$$\frac{3}{160}A = 1.5 + Ce^{-\frac{3}{160}t}$$

$$A = 80 + Ce^{-\frac{3}{160}t}$$

$$A(0) = 200 \longrightarrow 200 = 80 + C$$

$$C = 120$$

$$A = 80 + 120e^{-\frac{3}{160}t}$$

steady state solution

transient solution

$$i = \underbrace{\frac{100}{101}\sin 2t - \frac{10}{101}\cos 2t}_{\text{steady-state}} - \underbrace{\frac{10}{101}e^{-20t}}_{\text{transient}}$$

$$\frac{dA}{dt} = \left.\frac{dA}{dt}\right|_{in} - \left.\frac{dA}{dt}\right|_{out}$$