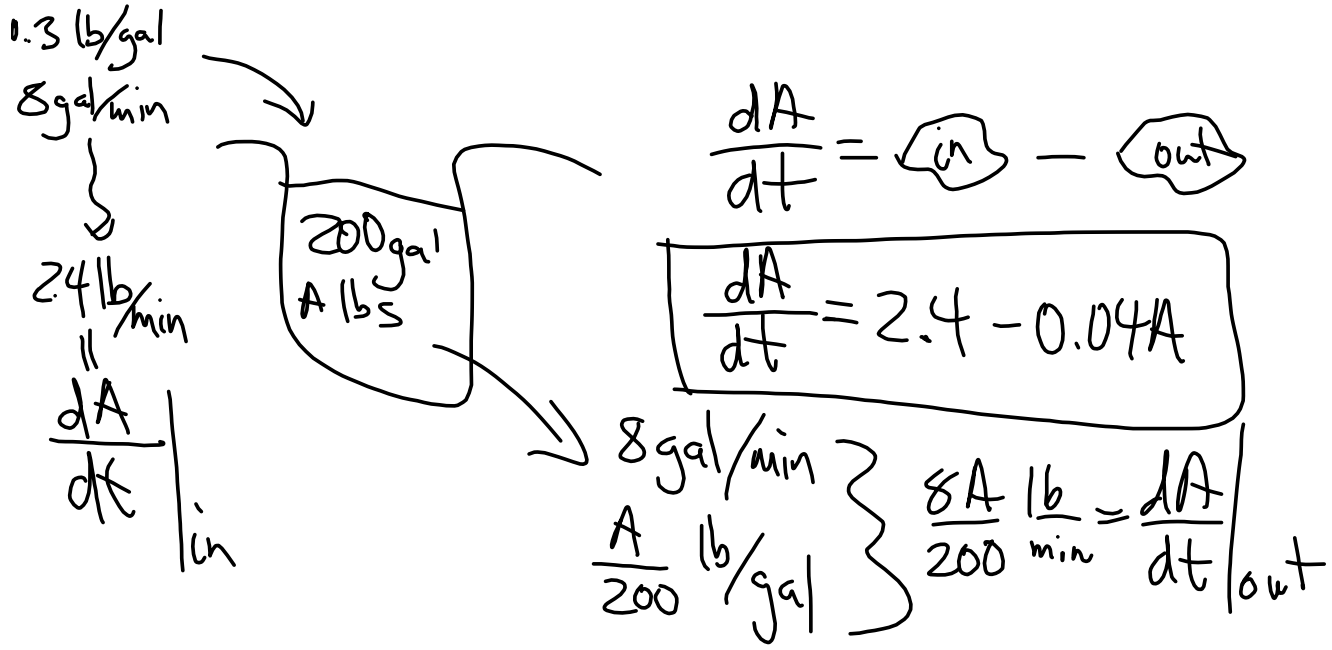

0.3 lb/gal
8 gal/min
2.4 lb/min
dA/dt |in
200 gal
A lbs
8 gal/min
A/200 lb/gal
8A/200 lb/min = dA/dt |out
dA/dt = in − out
dA/dt = 2.4 − 0.04A

$\frac{dA}{dt} = 2.4 - 0.04A$

$y'' + 3y' + 2y = 4e^{-2t}$

$\frac{dA}{dt} + 0.04A = 2.4$

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

$e^{0.04t}\frac{dA}{dt} + .04Ae^{0.04t} = 2.4e^{0.04t}$

$u = \int p(x)\,dx$

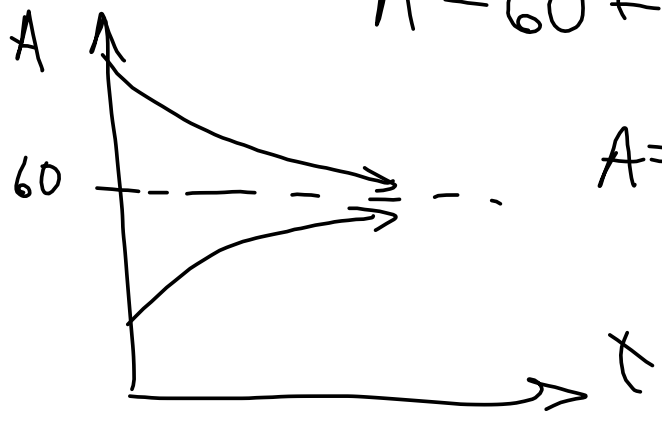
$u = \int 0.04\,dt = 0.04t$

$\frac{d(Ae^{0.04t})}{dt} = 2.4e^{0.04t}\,dt$

$Ae^{0.04t} = 60e^{0.04t} + C$

$e^{-0.04t}Ae^{0.04t} = 60 + Ce^{-0.04t}$

$A = 60 + Ce^{-0.04t}$



$A = 60$ is a stable equilibrium.

$A' + 0.04A = 2.4$

$A' + 0.04A = 0$

Guess $A = e^{rt}$

$r + 0.04 = 0$

$r = -0.04$

$A_h = C_1 e^{-0.04t}$

Guess $A_p = C$

$A_p' = 0$

$0 + 0.04C = 2.4$

$A_p = 60$ $C = 60$

$A = 60 + Ce^{-0.04t}$

$\frac{d^4y}{dx^4} = 24 \qquad y(0) = y(10) = y''(0) = y''(10) = 0$

$\vdots$

$\frac{d^2y}{dx^2} = 12x^2 + C_1x + \cancel{C_2}$ ($C_2 = 0$ because $y''(0) = 0$)

$y''(0) = 0 \Rightarrow C_1 = -120$

$\frac{d^2y}{dx^2} = 12x^2 - 120x$

$\vdots$

Solve $y'' + \lambda^2 y = 0$, $y'(0) = 0$, $y'(10) = 0$

$r^2 + \lambda^2 = 0$

$r^2 = -\lambda^2$

$r = \pm \lambda i$

$y = C_1 \sin \lambda x + C_2 \cos \lambda x$

$y' = C_1 \lambda \cos \lambda x - C_2 \lambda \sin \lambda x$

$0 = C_1 \lambda \cos 0 - C_2 \lambda \sin 0$ → 0

$C_1 = 0$

$y = C_2 \cos \lambda x$

$y' = -C_2 \lambda \sin \lambda x$

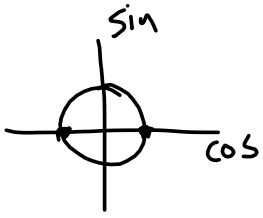
$y = C_2 \cos \lambda x$

$y' = -C_2 \lambda \sin \lambda x$

$0 = +C_2 \lambda \underbrace{\sin 10\lambda}_{\text{Must be zero}}$

$y'(10) = 0$

$\sin 10\lambda = 0$



$10\lambda = 0, \pi, 2\pi, 3\pi, \ldots$

$\lambda = 0, \frac{\pi}{10}, \frac{2\pi}{10}, \frac{3\pi}{10}, \ldots$

$y = C_2 \cos \frac{\pi}{10} x, C_2 \cos \frac{2\pi}{10} x, \ldots$