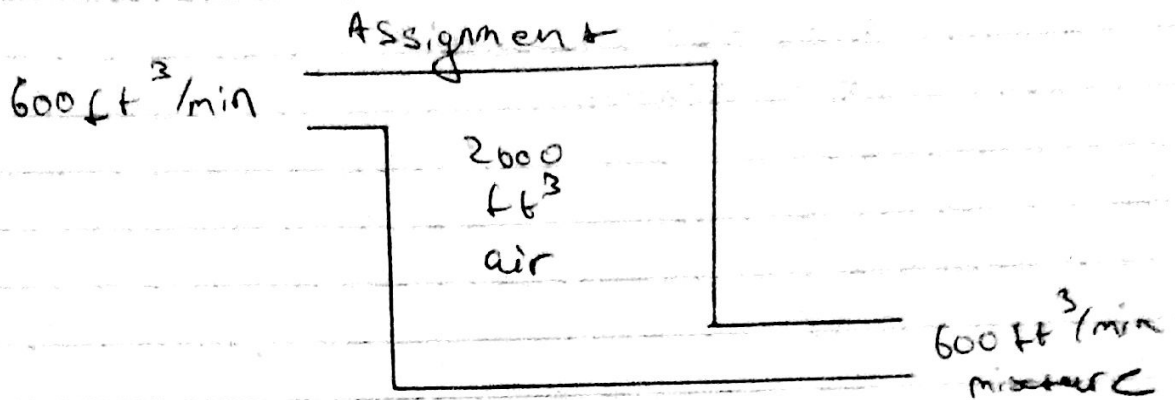


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Mechanical

18/ENGR 06/043

ENGR 282



$$\frac{dy}{dt} = y_{in} - y_{out}$$

$$y_{in} = 600$$

$$y_{out} = \frac{600}{20000} = 0.03y$$

$$\frac{dy}{dt} = 600 - 0.03y$$

$$\frac{dy}{dt} = -0.03(y - 20000)$$

$$\int \frac{dy}{(y-20000)} = \int -0.03 dt$$

$$\ln(y-20000) = -0.03t + C$$

$$y-20000 = e^{-0.03t+C}$$

$$y-20000 = y_0 \cdot e^{-0.03t}$$

$$y = y_0 e^{-0.03t} + 20000$$

a) At $t=0$, $y=0$

$$y = y_0 e^{-0.03t} + 20000$$

$$0 = y_0 e^{-0.03(0)} + 20000$$

$$\therefore y_0 = -20000$$

$$y = -20000 e^{-0.03t} + 20000 \dots \text{model}$$

b.) 90% of 20000 = 18000

$$y = 18000$$

$$18000 = -20000 e^{-0.03t} + 20000$$

$$18000 - 20000 = -20000e^{-0.03t}$$

$$0.1 = e^{-0.03t}$$

$$\ln(0.1) = -0.03t$$

$$t = -2.301 / -0.03$$

$$t = 76.8 \text{ min}$$