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17/ENG02/029

COMPUTER ENGINEERING

Initial condition; no fresh air = 0 ft³ of air

Let $y(t)$ be the amount of fresh air inside in ft³

$$\text{Air in} = \frac{600 \text{ ft}^3}{\text{min}}$$

$$\text{Air out} = \frac{y(t) \text{ ft}^3}{20,000 \text{ ft}^3} \times \frac{600 \text{ ft}^3}{\text{min}} = 0.03 y(t) \frac{\text{ft}^3}{\text{min}}$$

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

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

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

$$y' = -0.03 (y - 20000)$$

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

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

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

$$\text{Let } e^C = B$$

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

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

$$\text{Let } e^C = B$$

$$y-20000 = Be^{-0.03t}$$

$$y(t) = 20000 + Be^{-0.03t}$$

when $y(t) = 0$

$$y_t = 0 = 20000 + Be^{-0.03t}$$

b) when 90% of air will be fresh
 $y = \frac{90}{100} \times 20000 = 18000$

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

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

$$-2000 = -20000 e^{-0.03t}$$

Divide both sides by -2000

$$\frac{+2000}{-2000} = \frac{-20000 e^{-0.03t}}{-20000}$$

$$-1 = e^{-0.03t}$$

$$\ln 0.1 = \ln(e^{-0.03t})$$

$$-2.30 = -0.03t$$

$$t = \frac{-2.30}{-0.03}$$

$t = 76.7 \approx 77$ mins
 6 hours = 360 mins

2 Demand Windows

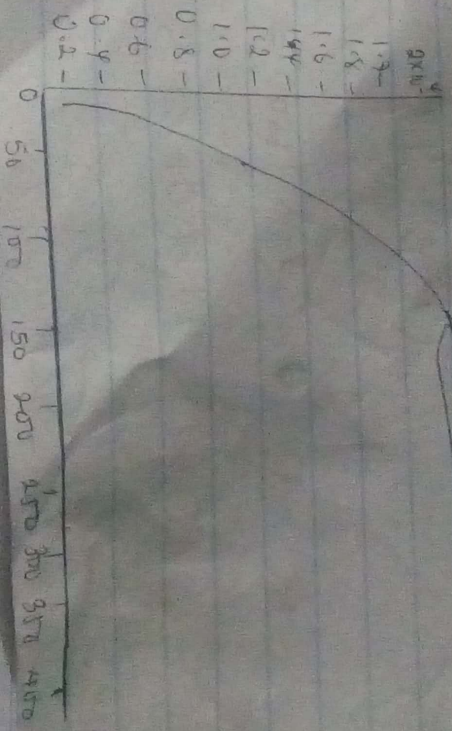
Close all

Syms t

$$t = [0:5:360]$$

$$y = 20000 - 20000 \exp(-0.03t)$$

plot (t,y)



(1) The steady state value of amount of fresh air in the room is 20000 ft.
 (2) From results at the room motion y is tending to infinity & doing a steady state value