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17/ENG07/019
Petroleum Engineering
ENG 282 Assignment IV

Initially, there was no fresh air = $0 ft^3$ of air
Let $y(t)$ be the amount of fresh air inside in ft^3

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

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

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

$$\frac{dy(t)}{dt} = 0.03(20,000 - y(t))$$

$$\frac{dy(t)}{dt} = -0.03(y - 20,000)$$

$$y' = -0.03(y - 20,000).$$

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

$$\ln(y - 20,000) = -0.03t + C$$

$$y - 20,000 = e^{-0.03t} \cdot e^C$$

Let $e^C = B$.

$$y - 20,000 = Be^{-0.03t}$$

$$y(t) = 20,000 + Be^{-0.03t}$$

when $y(t) = 0$

$y(t)_{,0} = 20,000 + Be^{-0.03t}$

$= 0 = 20,000 + Be^{-0.03(0)}$

$0 = 20,000 + B$

$B = -20,000$

$\therefore y(t) = 20,000 - 20,000e^{-0.03t}$

b. when 90% of air when be fresh

$y = \frac{90}{100} \times 20,000 = 18,000$

$18000 = 20,000 = 20,000e^{-0.03t}$

$18,000 - 20,000 = -20,000e^{-0.03t}$

$-2,000 = -20,000e^{-0.03t}$

Divide both sides by -20000

$0.1 = e^{0.03t}$

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

$-2.30 = -0.03t$

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

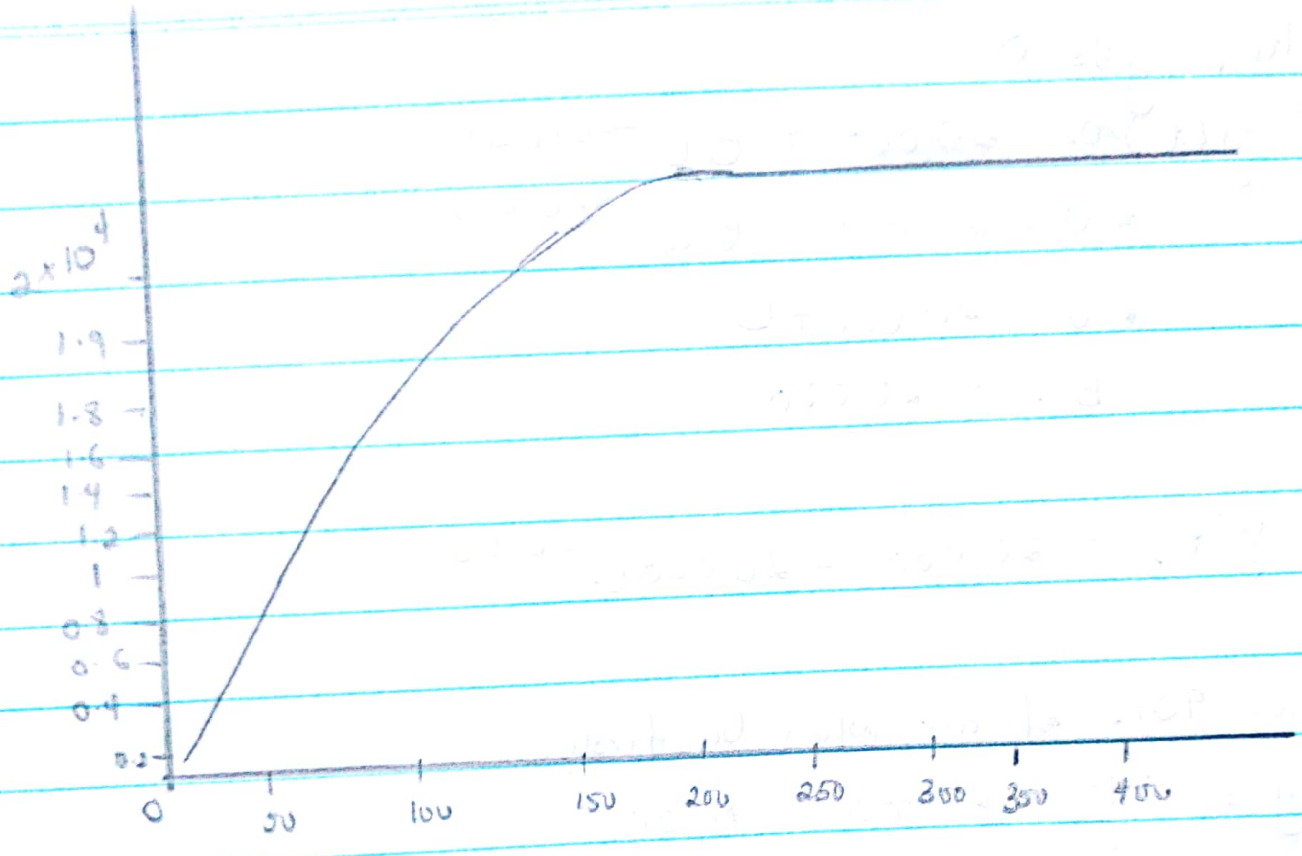
$t = 76.6$ mins

$t = 77$ mins.

6hours = 360mins

C: Command window

```
clear
clc
close all.
Syms t
t = [0:5:360]
y = 20,000 - 20,000*exp^(0.03t)
plot(t,y)
```



d. The steady state value of the amount of fresh air in the room is 20,000 ft

e. The result shows that at the 200 minutes y is going to infinity giving a steady state value.