Name: Ukpai Chinenye Shalom
Department: Chemical Engineering
Matric No: 17/ENG01/028

It is discovered that 600ft³/min of fresh air flows into a room containing 20000ft³ of air. The mixture which is made partially uniform by circulating

Solutions

1) Let y(t) be the amount of air time t in (ft^3) in the room.

Fresh air inflow → 600ft^3/min

Fresh air outflow → Remember the amount flowing out of the room is a function of the amount in the room.

$\frac{600}{20000} = 0.03$mm

∴ 0.03mm in the fresh air inflow

$dy/dx = 600 - 0.03y$

$= -0.03y + 600$

$= -0.03(y - 20000)$

The equation can therefore be solved

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

Integrating both sides

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

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

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

Recall that $C = e^{0}$

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

$0 - 20000 = C$

$C = -20000$

$y = 20000 - 20000e^{-0.05t}$

$y = 20000(1 - e^{-0.03t})$

∴ The equation above is the model for the amount of fresh air on the room.

b) $90\% = \frac{90}{100} = 0.9$

$y = 0.9$ of 20000

$= 0.9 \times 20000$

$= 18000\ ft^3$

$y = 20000(1 - e^{-0.03t})$

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

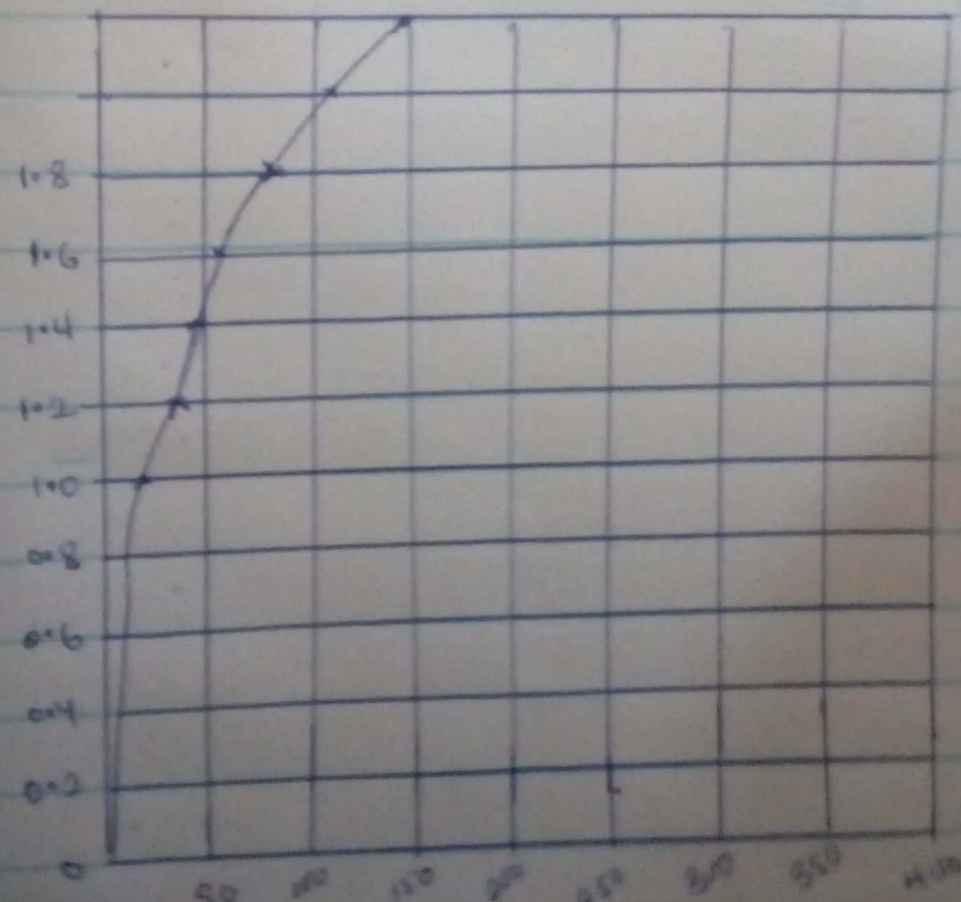
$= -0.03t = \ln(0.1)$

$= t = 77$ minutes

The air on the room will be 90% fresh at 77 minutes

(c) Command window

```
clear
clc
close all
Syms y, k, t
y = 20000 * (1 - exp(-0.03 * t))
t = 0:5:360
Yn = Subs(y)
Plot (t, Yn)
x label ('Time (mins)')
y label ('Flowrate of fresh air (ft^3/min)')
grid on
grid minor
```



d) The steady value is 2000 ft^3/min at 215 mins of exponential approach.

e) It shows that the effect of 2000 ft^3 of CO_2 increases each time. Also when the steady state value approaches 20000 ft^3 at 215 mins and continues till 860 minutes (1 hour). The model discussed becomes more realistic on Pneumatic technology although maybe because ~~mixing maybe~~ Problem may be Unexpect.