OLEBOADE PHILKAYATH KILTAN
BIOMEDICAL ENGINEERING
17/ENG08/084

ENG 282 – ENGINEERING ASSIGNMENT 4

QUESTION 1.

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

fresh air inflow → $600 ft^3/m$

fresh air Outflow → Remember the amount flowing Out of the room is a function of the amount in the room

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

∴ 0.03mm in the fresh air Outflow

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

$$= -0.03y + 600$$

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

The equation can therefore be solved

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

Integrating both sides

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

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

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

Recall that $C = e^{c}$

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

$0 - 20000 = C$

$C = -20000$

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

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

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

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

$y = 0.9$ of 20000

0.9×20000

$18000 m^3$

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

$18000 = 20000(1 - e^{-0.03t})$

$e^{-0.03t} = 0.1$

$-0.03t = \ln(0.1)$

$t = 77$ mins

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

c. Command window

```
clear all
clc.
close all
Syms y, k, t.
y = 20000 * [1 - exp(0.03*t))
t = 0:5:360
```

```
yn = subs(y)
plot(t, yn)
xlabel('time (mins)')
ylabel('flow rate of fresh air (ft^3/min)')
Grid on
Grid minor
```

d. The steady value is 20000 ft^3 at 215 mins of exponential approach

e. It shows that the limit of 20000 ft^3 of y increases with time. After which the steady state value approaches 20000 ft^3 at 215 mins and continues till 360 minutes (1 hour). The graph decreases because