

Bello for shade Shakti
17 March 1085

Chem Engineering

Math assignment 4

a) $\frac{dy}{dt} = \text{Air in flow rate} - \text{Air outflow rate}$

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

$$\frac{dy}{dt} = 600 \text{ ft}^3/\text{min} - \frac{600}{2000} y$$

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

$$z = 0.03(-2000y)$$

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

Integrating both sides

$$\int \frac{1}{y-20000} dy = \int (-0.03) dt$$

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

Divide by \ln

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

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

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

At time $t=0$, $y=20000$

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

$$y_0 - 20000 = y_0 \cdot 1$$

$$y_0 = -20000 \text{ pts/min}$$

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

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

b) 90% of 20000 cm³ of fresh air

$$= \frac{90}{100} \times 20000$$

= 18000 cm³ of fresh air

when $y = 18000$ fresh air

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

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

$$-2000 = - (2000 \cdot e^{-0.03t})$$

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

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

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

$$\ln 0.1 = -0.03t$$

$$-2.3 = -0.03t$$

$$t = \frac{-2.3}{-0.03}$$

$$t = 76.6 \text{ mins}$$

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d) Command window

clear

clc

close all

$$t = 0.5 : 3.60$$

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

plot(t, y)

-grid on

axis minor

x label ('time')

y label ('volume')

d) The steady value is 2x10⁴ ft³ at 180 mins.

e) At time $t = 180$ mins, the room is filled with 20000 ft³ of air and it is maintained until the 560 min (6th hr).