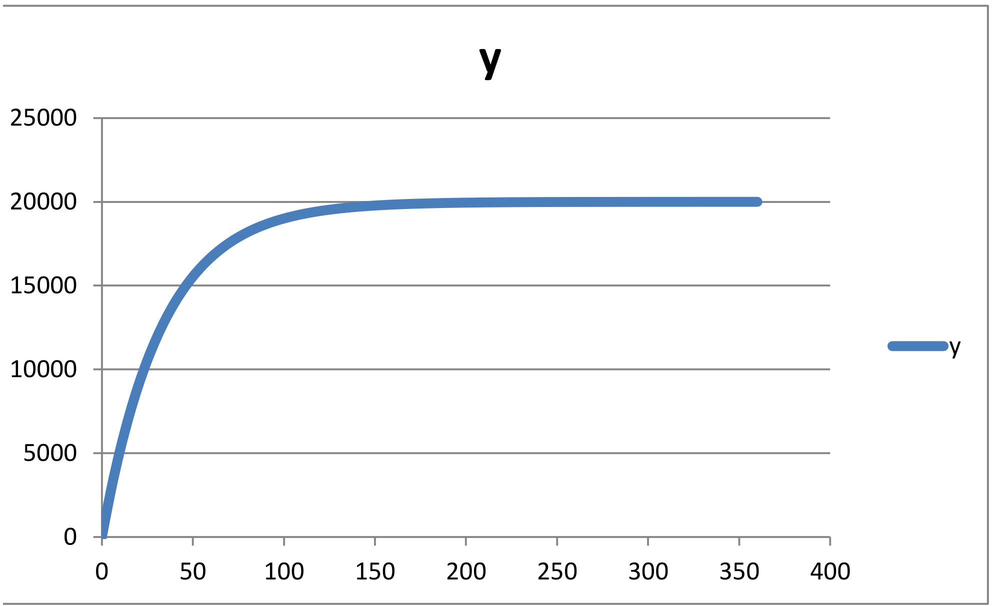
t	y
0	0
5	2785.84047
10	5183.63559
15	7247.43697
20	9023.76728
25	10552.6689
30	11868.6068
35	13001.245
40	13976.1158
45	14815.1948
50	15537.3968
55	16159.0018
60	16694.0222
65	17154.5186
70	17550.8714
75	17892.0155
80	18185.6409
85	18438.3667
90	18655.8897
95	18843.1136
100	19004.2586
105	19142.9575
110	19262.3367
115	19365.0873
120	19453.5256
125	19529.6451
130	19595.1618
135	19651.5525
140	19700.0885
145	19741.8637
150	19777.8201
155	19808.768
160	19835.4051
165	19858.3318
170	19878.0651
175	19895.0496
180	19909.6684
185	19922.2509
190	19933.0807
195	19942.402
200	19950.425
205	19957.3304
210	19963.2739

215	19968.3896
220	19972.7926
225	19976.5824
230	19979.8443
235	19982.6518
240	19985.0683
245	19987.1482
250	19988.9383
255	19990.4791
260	19991.8053
265	19992.9468
270	19993.9292
275	19994.7748
280	19995.5027
285	19996.1291
290	19996.6683
295	19997.1324
300	19997.5318
305	19997.8756
310	19998.1715
315	19998.4262
320	19998.6454
325	19998.8341
330	19998.9965
335	19999.1363
340	19999.2566
345	19999.3601
350	19999.4493
355	19999.526
360	19999.592



y
25000
20000
15000
10000
5000
0
0
50
100
150
200
250
300
350
400
y

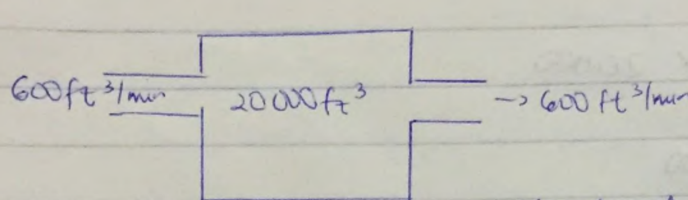
Ajaiyeoba Oyinkan Eloho
16/ENG06/006
Mechanical Engineering
ENG 282 Assignment solution

Using mixing problems,

initial air = $20000ft^3$

~~rate~~ inflow = $600ft^3/min$

rate of outflow = 600



Balance law : rate of accumulation of materials in a system = rate of inflow of materials − rate of outflow of materials.

Let amount of air = y

$\frac{dy}{dt}$ = amount of material of y

$\frac{dy}{dt} = y'in - y'out$

air coming out = $\frac{600}{20,000} = 0.03$

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

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

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

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

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

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

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

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

let $e^{c} = y_0$

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

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

if $t = 0$

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

$0 = 20000 + y_0$

$y_0 = -20000$

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

b 90% of fresh air $= \frac{90}{100} \times 20000$

$= 18000$

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

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

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

$0.1 = e^{-0.03t}$

$\ln 0.1 = -0.03t$

$-2.30 = -0.03t$

$t = 76.6$

$t \simeq 77$ min

d The steady-state value of the amount of fresh air in the room is 20000

e The result obtained in (d) indicates that no matter the increase in time, the amount of air at a particular time will remain constant.