d) The steady state value is 200 min = 3hrs 20min

e) This result shows that at 200 minutes y → infinity, giving a steady plot.

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

$-0.03t = -2.3$

$t = 76.6$

$t \simeq 77$ minutes

6hr = 360 min

c) commandwindow

clear

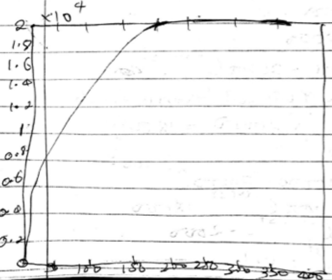
clc

close all

syms t

t = [0 : 5 : 360]

y = 20000 - 20000*exp(-0.03*t)



ENG282 Assignment 4

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17/ENG07/010
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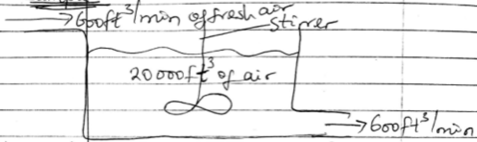
Assignment 4

Sample



Initially, no fresh air = 0ft³ of air

let y(t) be the amount of fresh air present in ft³

$\frac{dy(t)}{dt}$ = Air in − Air Out

Air in = $600ft^3/min$

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

Air Out = $0.03y(t)ft^3/min$

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

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

$\frac{dy(t)}{dt} = -0.03(y-20000)$, $y' = -0.03(y-20000)$

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

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

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

$e^{c} = b$

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

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

~~At~~ initial condition $y(0)$ $be^{-0.03t} = b$

$y(0) = 0 = 20000 + be^{-0.03t}$

$20000 + be^{-0.03t} = 0$

$b + 20000 = 0$

$b = -20000$

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

b) when 90% of air will become fresh

when $y = \frac{90}{100} \times 20000 = 18000$

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

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

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

$e^{-0.03t} = 0.1$