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17/ENG/02/040
COMPUTER ENGR.
ENG 282.

a) Mathematical Modelling is a process of setting up models, solving it mathematically and interpreting the results in physical and other terms

b) Methods of obtaining a model
- By use Torricelli's law e.g leaking tank, outflow of water through a hole
- By Newton's law of cooling eg heating an office building

c) Solving
$T(0) = 10°C$, $TA = 25°C$
$T(t) = 20°C$.
$\frac{dT}{dt} = k(T - TA)$ $\therefore dT = K(T - TA)dt$

$\int \frac{dT}{T-TA} = \int k\,dt$

$= \ln(T - TA) = kt + C$
$T - TA = e^{kt} + e^{c}$
$T = Ae^{kt} + TA$
When $t = 10$
$10 = A + 25$
$A = 10 - 25 = -15$ //

$T = 25 - 15e^{kt}$.
at $t(5) = 20$
$20 = 25 - 15e^{k(5)}$
$20 = 25 - 15e^{5k}$
$15e^{5k} = 25 - 20 = 5$
$15e^{5k} = 5$

$15e^{5k} = 5$

$e^{5k} = 0.3333$

$5k = \ln 0.3333$

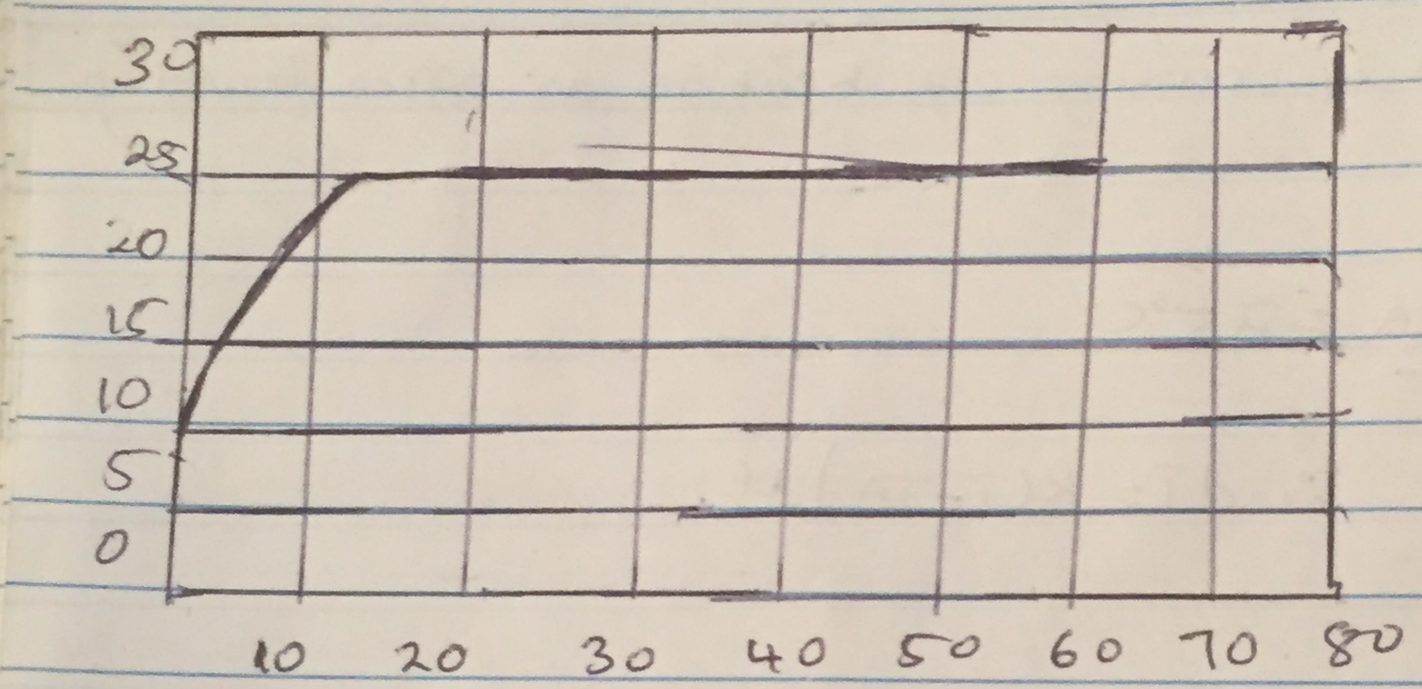
$5k = -1.0986$

$k = -0.22$

$T(t) = 25 - 15e^{0.22t}$

b) Using excel

Using the equation $T(t) = 25 - 15e^{0.22t}$, x t and at time 0:1: 60. and graph of Temperature (°C) against Time (t)



c) Using Matlab

Command window

clear

cls

close all

t = 0:1:60

T = 25 - 15 * exp (-0.22 * t)

Plot (t, T)

grid on

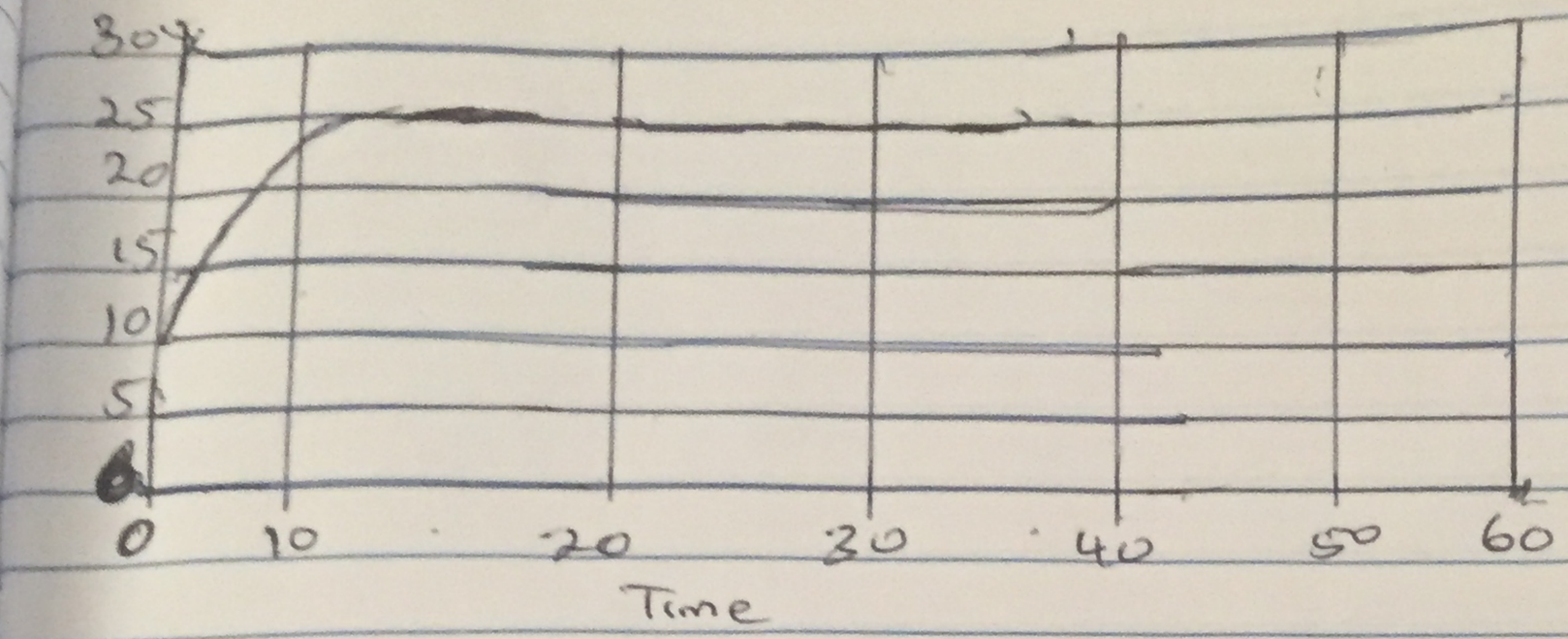
grid minor

x label ('Time(secs)')

y label ('Temperature('C)')

grid on

grid minor



d) The steady state value of the system is at 25°C at 20mins

e) Using the model eqn, the temperature of the diameter at $t = 20$ is $\geq 25°C$