Eng282 Assignment 5.

(a) What is mathematical modelling

Mathematical modelling can be defined as a description of System using mathematical concepts and languages. mathematical models are used in the natural Sciences and engineering disciplines as well as the Social Sciences.

(b) Methods of Obtaining a model

→ Differentiating

→ Use of Basic laws

(c) Solution

$T_{(0)} = 10^\circ C$

$T_{(t)} = 20^\circ C$

Actual temp $= 25^\circ C : T_A$

$\frac{dT}{dt} = k(T - T_a)$

$dT = k(T - T_a)dt$

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

Integrating both sides

$\ln(T - T_A) = kt + c$

$T - T_A = e^{kt} + e^c$

let e^c be A.

$T - T_A = e^{kt}\ A$

$T - T_A = Ae^{kt}$

$T = Ae^{kt} + T_A$

When $T = 10$

$10 = Ae^{k(20)} + 25$

$10 = A + 25$

$A = 10 - 25$

$A = -15$

$T = 25 - 15e^{At}$

At $t = 5$: and $T = 20$

$20 - 25 = -15e^{5k}$

$20 - 25 = -15e^{5k}$

$15e^{5k} - 5 = -15e^{5k}$

$15e^{5k} = 5$

$e^{5k} = 5/15$

$e^{5k} = 0.3333$

$\ln e^{5k} = \ln 0.3333$

$5k = -1.0987$

$k = \frac{-1.0987}{5}$

$k = -0.22$

$[T(t) = 25 - 15e^{-0.22t}]$ -> Model equation

Using Microsoft Excel.

-> Picking a cell labeled 't'

-> Picking another cell labeled 'T'

-> Under the already labeled cell 't'

-> Insert a value at 0 in an empty cell

-> Click on Series

-> Insert a Step Value of 1

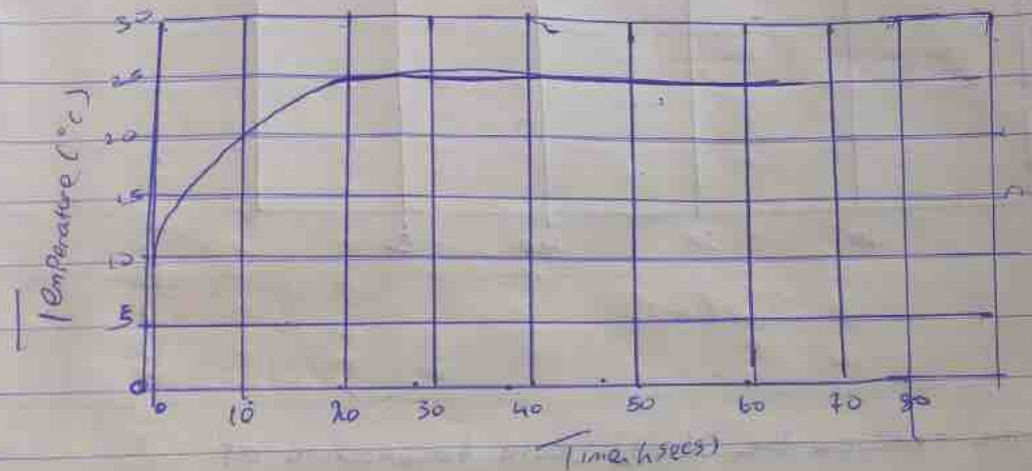
-> Change the Series into columns

-> Insert a Step value of 60

=>

-> Under the already labelled cell 2 'T'
-> Press a cell
-> Insert "= 25 (15" exp (-0.22" A2))
-> Auto fill
-> Go to insert
-> Press a graph of choice
-> Label the graph

Output



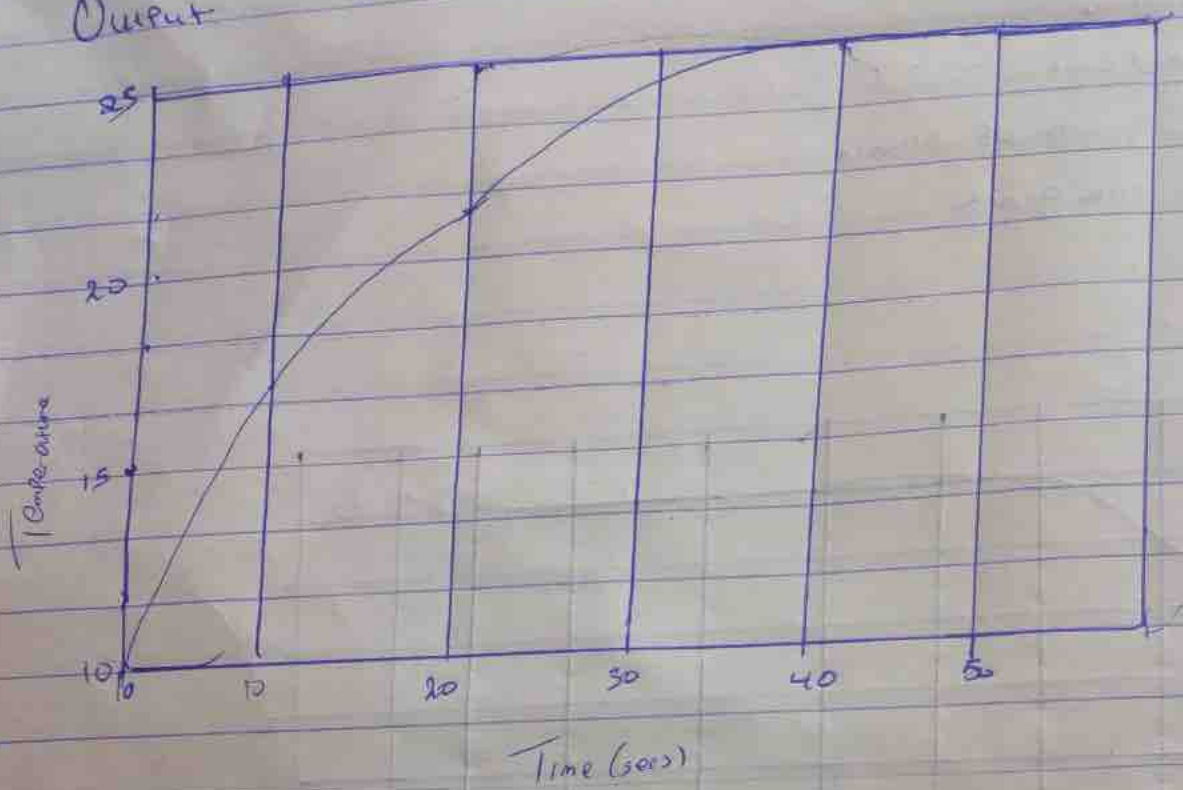
Using MatLab

Command Window

```
Clear
clc
Close all
t = 0:1:60
T = 25-15*exp(-0.22*t)
Plot (t, T)
grid on
grid minor
xlabel ('Time (secs)')
ylabel ('Temperature')
grid on
```

grid mirror

Output



(a) Using Grid dynamic response the Steady State temperature of the system would be 25°C to 20mins

(b) Using developed model eqn, the temperature of the thermometre at t=∞ will be 25°C