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

At $t(5) = 20$

$20 = 25 - 15e$

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

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

$15e^{5k} = 5$

$e^{5k} = 0.3333$

$5k = \ln 0.3333$

$5k = -1.0986$

$k = -0.22$

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

ii) Using microsoft Excel

- Pick a box insert 't'
- Pick another box insert 'T'
- Under the already labelled bal 't'
- Insert a value of 0 in an empty box
- Go to.
- Click on Series
- Insert a step value of 1
- Change the Series in to columns
- Insert a stop value of 60
- Under the already labelled box
- Pick a box
- Insert = 25 - (15 * Exp(-0.22 * A2))
- Auto fill
- Go to insert
- Pick a graph of choice
- Label the graph

(a) Define Mathematical modelling

Mathematical modelling is a mathematical representation of a system and simulation of system which involves the model and obtain it's output. Variable for different values or it's input variable or as input variable is changed from one values to another.

(b) Methods of obtaining a model

- Differentiating
- Use of balance law

(c) Solution

$T(0) = 10^\circ C$

$T(5) = 20^\circ C$

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

$$\frac{dT}{dt} = K(T - T_A)$$

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

Integrate both sides

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

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

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

let e^C be A

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

$$T - T_A = Ae^{kt}$$

$$T = Ae^{kt} + T_A$$

When $T = 10$

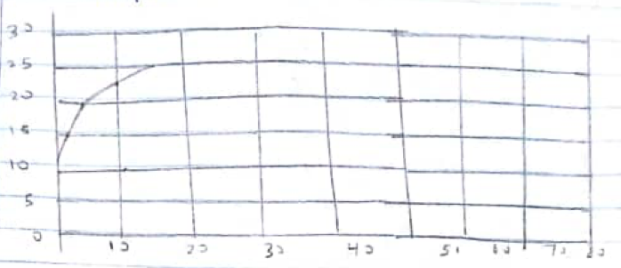
$$10 = Ae^{k(0)} + 25$$

$$10 = A + 25$$

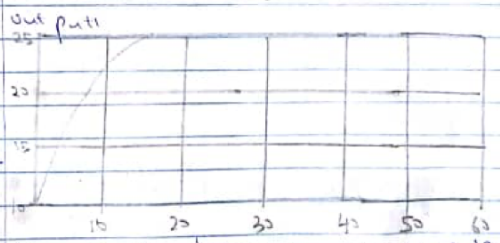
$$A = 10 - 25$$

$$A = -15$$

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



(iv) Using Excel's dynamic response. State temperature of the system would be 25 °C at 20 minutes

(v) Using the developed model equation, the temperature of the thermometer at t will be 25°C