(a) Mathematical Modelling is the act of translating problems from an application area into tractable mathematical formulations whose theoretical and numerical analysis provides insight, answers and guidance useful for originating application.

(b) The two methods are:
- Differentiating method.
- Use of balance law.

(c) (i) $T(0) = 10t$.
$T(1) = 20^\circ c$
Actual Temperature $= 25^\circ c = T_h$
$\frac{dT}{dt} = k(T - T_0)$.
$dT = k(T - T_0)\,dt$.
$\frac{dT}{(T - T_A)} = kt + c$
$\lim (T - T_A) = kt + c$.
$T - T_A = e^{kt} + e^c$
let $e^c = A$.
$T - T_A = Ae^{kt}$.
$T = T_A + Ae^{kt}$
$T = T_A + Ae^{kt}$
$T = Ae^{kt} + T_A$.
when $T = 0$
$10 = Ae^{k(0)} + 25$.
$10 = A + 25$.
$A = -15$.
$T = 25 - 15e^{kt}$.
at $t(5) = 20$.
$20 = 25 - 15e^{k(5)}$.
$15e^{5k} = 25 - 20$.
$15e^{5k} = 5$.

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

$e^{5k} = 0.3333$.

$5k = \ln 0.3333$.

$5k = -1.0986$.

$k = \frac{-1.0986}{5}$.

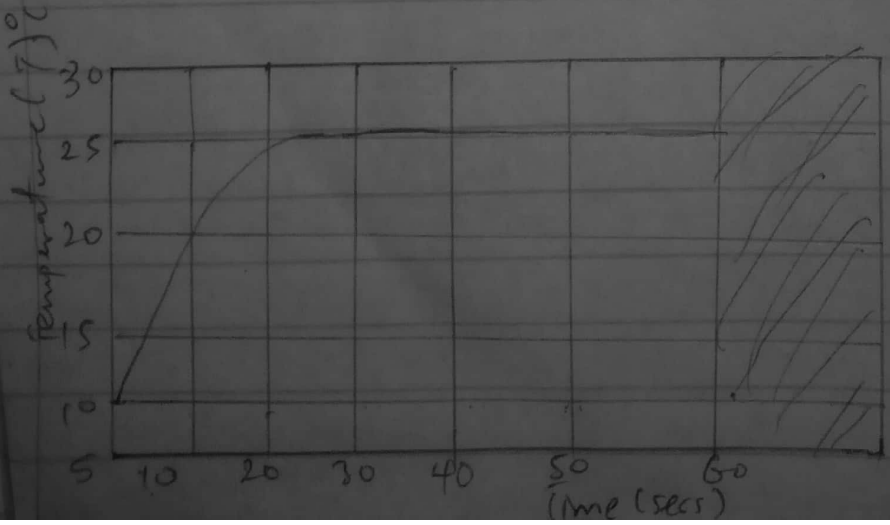
$k = 0.22$.

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

ii) Using Microsoft Excel.

* put a box and insert "t"
* put another box and insert "T"
* under the already labelled box 't'
* Insert '0' in an empty box.
* insert a step value of 1
* Arrange the series in 10 Columns.
* Under the labelled box 't'
* Select a box and insert =[25-(15*Exp(-0.22*A2))]
* Auto fill it.
* Go to insert.
* plot a graph of choice (xc and y scatter property).
* label the graph.

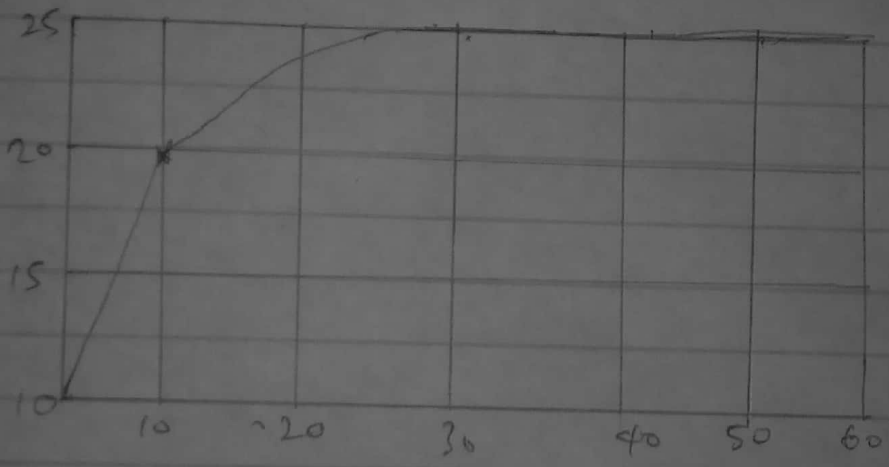
Output



(iii) Using MatLab:

```
clear
clc
clear all
t = 0:1:60
T = 25-150 exp(-0.22 * t)
plot (t, T)
Grid On
Grid minor
X label ('Time (secs)')
Y label ('Temperature')
Grid on
Grid minor
```

Output:



(iv) The steady state temperature of the system would be at 25°C at 20 min

(v) Using the developed model equation, the temperature of the thermom at $t \to \infty$ will be 25°C.