(1) Mathematical modelling is a mathematical representation on of a system and simulation of a system which involves solving the model and obtaining its output variable for different values of its output variable or as input variable is changed from one value to another

(2) Use of balance law.
Differentiation.

c) T at 0s = $10^\circ C$
T at 5s = $20^\circ C$
Let $T_A = 25^\circ C$.

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

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

$$\int k\,dt = \int \frac{1}{T - T_a}\,dT$$

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

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

$$T - T_a = e^{kt} \cdot e^{c}$$

Let $T_0 = e^{c}$

$$T - T_a = T_0 e^{kt}$$

$$T = T_A + T_0 e^{kt}$$

where $T = 10$

$$10 = T_0 e^{k(0)} + 25 \quad \text{at } t = 0$$

$$10 = T_0 + 25$$

$$T_0 = 10 - 25$$

$$T_0 = -15$$

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

At time $t = 5s$ and $T = 20^\circ C$

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

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

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

$$e^{5k} = \frac{5}{15}$$

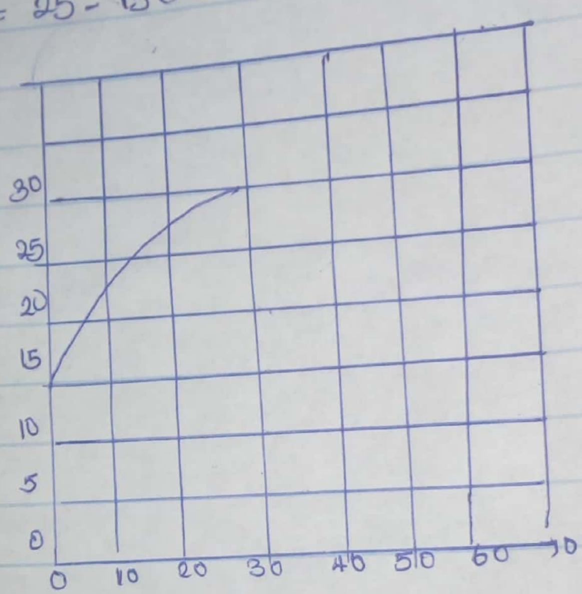
$e^{5k} = 0.333$

$5k = \ln 0.333$

$5k = -0.0986$

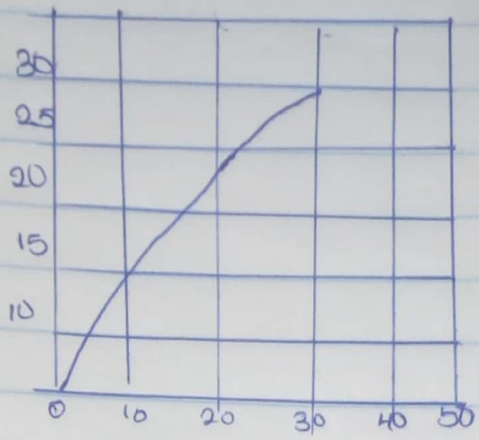
$k = -0.22$

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



Command window

```
clear
clc
close all
t=0:1:6
y=25-15*exp(-0.22*t)
Plot (t,y)
Grid on
Grid minor
```



(iv) Using ms Excel's dynamic response, the steady state temperature of the system would be, $25°$ at 20 seconds.

(v) Using the developed equation, the temperature of the thermometer as $t \to \infty = 25\,°C$