$$\frac{5}{-15} = \frac{-15}{-15} e^{k(5)}$$

$$\Rightarrow \frac{1}{3} = e^{5k}$$

$$5k = \ln(0.333)$$

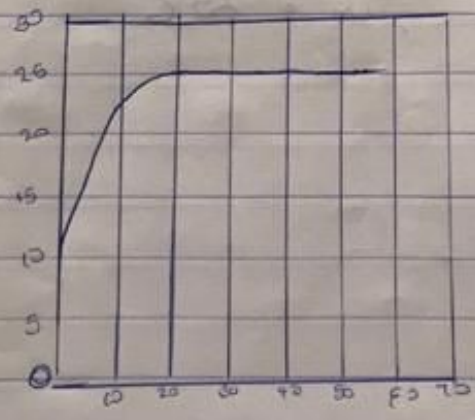
$$\frac{5k}{5} = \frac{\ln(0.333)}{5}$$

$$k = -0.22$$

$$\therefore T_0 = 25 - 15e^{-0.22t}$$

a Using Microsoft excel

- type in 't' for column 1
- type in 'T' for column 2
- ~~for~~ column 1, type '0' under t
- On home, Select fill under editing
- Select series, Choose columns, insert a Step value of 1 and a Stop value of 60 in enter
- Then in column 2 under T, type = 25 - 15 exp(-0.22) then enter
- Double Click the dot at the bottom right of the cell.
- Highlight columns 1 and 2.
- Go to insert and pick a graph type.



1. A mathematical model is a mathematical representation of a system in order to study its behavior

b. Methods of obtaining a model
- Differential equation
- Use of balance law

c. From Newton law of cooling.

$$dT/dt = K(T - T_m)$$

$$dT = K(T - T_m)dt$$

$$\frac{dT}{T - T_m} = Kdt$$

Integrating both sides

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

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

$$T - T_m = e^{kt} \cdot e^{C}$$

let $e^{C} = C$

$$T - T_m = e^{kt} \cdot C$$

$$T - T_m = Ce^{kt}$$

$$T = Ce^{ke} + T_m$$

at $t = 0$, $T = 10^{\circ}C$, $T_m = 25^{\circ}C$

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

$$10 = C + 25$$

$$C = 10 - 25$$

$$C = -15.$$

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

at $t = 5$, $T = 20^{\circ}C$.

$$20 = -15e^{k(5)} + 25.$$

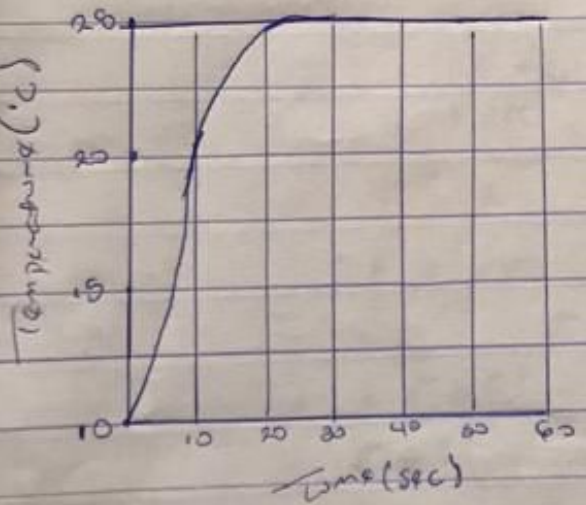
$$20 - 25 = -15e^{k(5)}$$

Using Matlab.

- Command.
- Clear

```
clc
clear all
t = (0:1:60)
T = 25 - 15*exp(-0.22*t)
Plot (t, T)
Grid on.
Grid minor
label ('Time (sec)')
```

```
label ['Temperature (°C)']
```



d. Letting the dynamic responses, the steady state is 25°C at 20 minutes.

- Using the developed model equation the temperature at the thermometer at $t \to 0 = 25°C$.