

CUME WELSAID ADOGU
17HEN 603/1005
CUMC ENGINEERING

a. Mathematical modelling is a mathematical representation of a system and simulation of a system which involves solving the model and obtaining its output variable for different values of its input variables.

b. - Differentiating
- Use of Balance law

c. $T(0) = 15^\circ\text{C}$

$$T(5) = 20^\circ\text{C}$$

$$\text{Actual temp.} = 25^\circ\text{C} = T_A$$

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

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

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

$$(\int - T_A)$$

Integrating both sides

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

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

$$\text{Let } e^C \text{ be } A$$

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

$$T - T_A = A e^{Kt}$$

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

when $T=10$

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

$$10 = A + 25$$

$$A = 10 - 25$$

$$A = -15$$

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

$$At \quad t(5) = 20$$

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

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

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

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

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

$$5k = \ln 0.3333$$

$$5k = -1.0986$$

$$k = -0.22$$

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

- ∴
- Using Microsoft Excel
 - Pick a box insert 't'
 - Pick another box insert 'T'
 - Under the already labelled box 't'

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
```

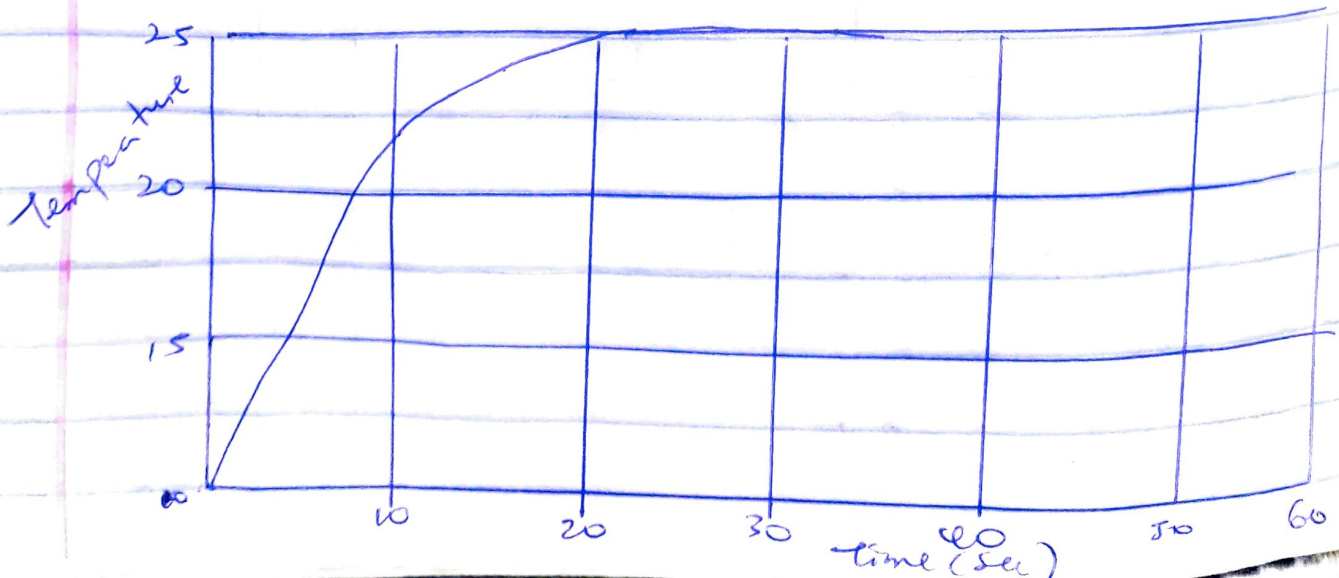
```
x label ('Time (secs)')
```

```
y label ('Temperature')
```

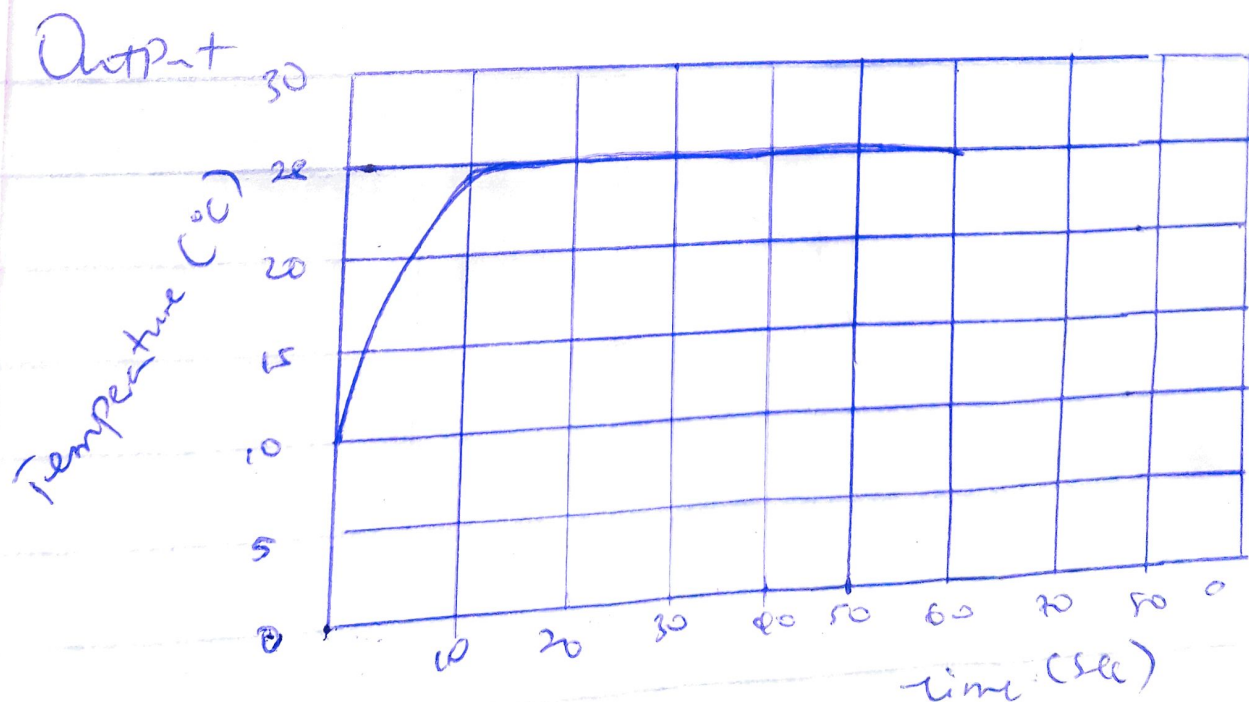
```
grid on
```

```
grid minor
```

Output



- Insert a value of 0 in an empty box
- Go to fill
- ~~Adjust~~ 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 2
- Pick a box
- Insert $= 25 - (15 * \text{Exp}(-0.22 * A2))$
- Auto fill
- Go to insert
- Pick a graph of choice
- Label the graph



w) Using Excel's dynamic response the steady 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 .