Tanarami Kukuoritsela Adriel
17/ENG05/1038
Mechatronics

a. Mathematical Modelling is a mathetical 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 variable or as input variable is change from one values to another.

b. Methods of Obtaining a Model
- Differentiating
- Use of Balance Law

c. $T(0) = 10^{\circ}C$

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

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

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

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

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

Scanned by CamScanner

- Integrating both sides

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

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

Let e^{C} be A

$T - T_A = Ae^{kt}$

$T = Ae^{kt} + T_A$

When $T = 10$, $t = 0$

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

$10 = A + 25$

$A = 10 - 25$

$= -15$

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

At $t(5) = 20$

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

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

$15e^{5k} = 5$

$e^{5k} = 0.3333$

$5k = \ln 0.3333$

$5k = -1.0980$

$k = -0.22$

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

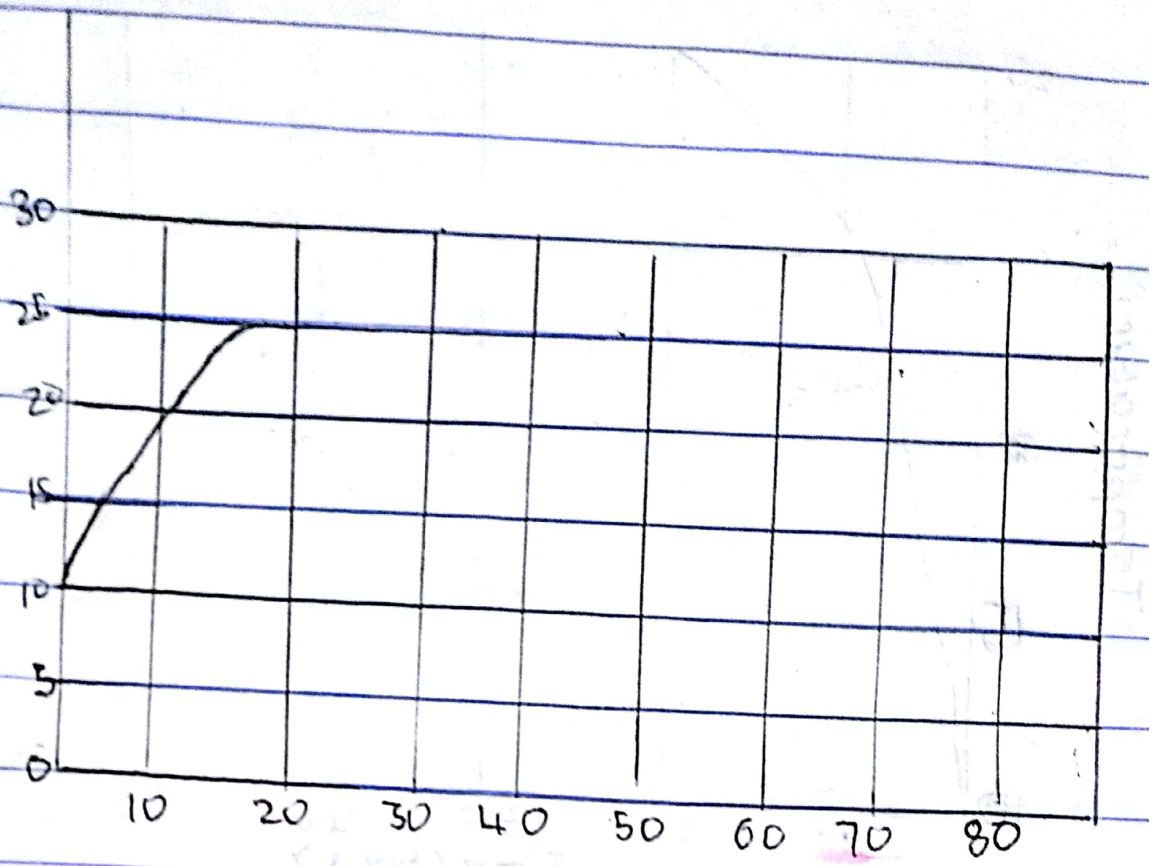
Scanned by CamScanner

ii. Using Microsoft Excel

- Pick a box insert (t)
- Pick another box insert (T)
- Under the already labelled box 1 (t)
- Insert a value of 0 in an empty box
- Go to Fill
- adjust to Click on Series
- Insert a Step Value of 4
- Change the Series to Columns
- Insert a Stop value of 60
- Under the already labelled box 2 (T)
- Pick a box
- Insert "$=25-(15*EXP(-022*A_2)$"
- Auto Fill
- Go to Insert
- Pick a graph of Choice
- Label the graph

Scanned by CamScanner

Output

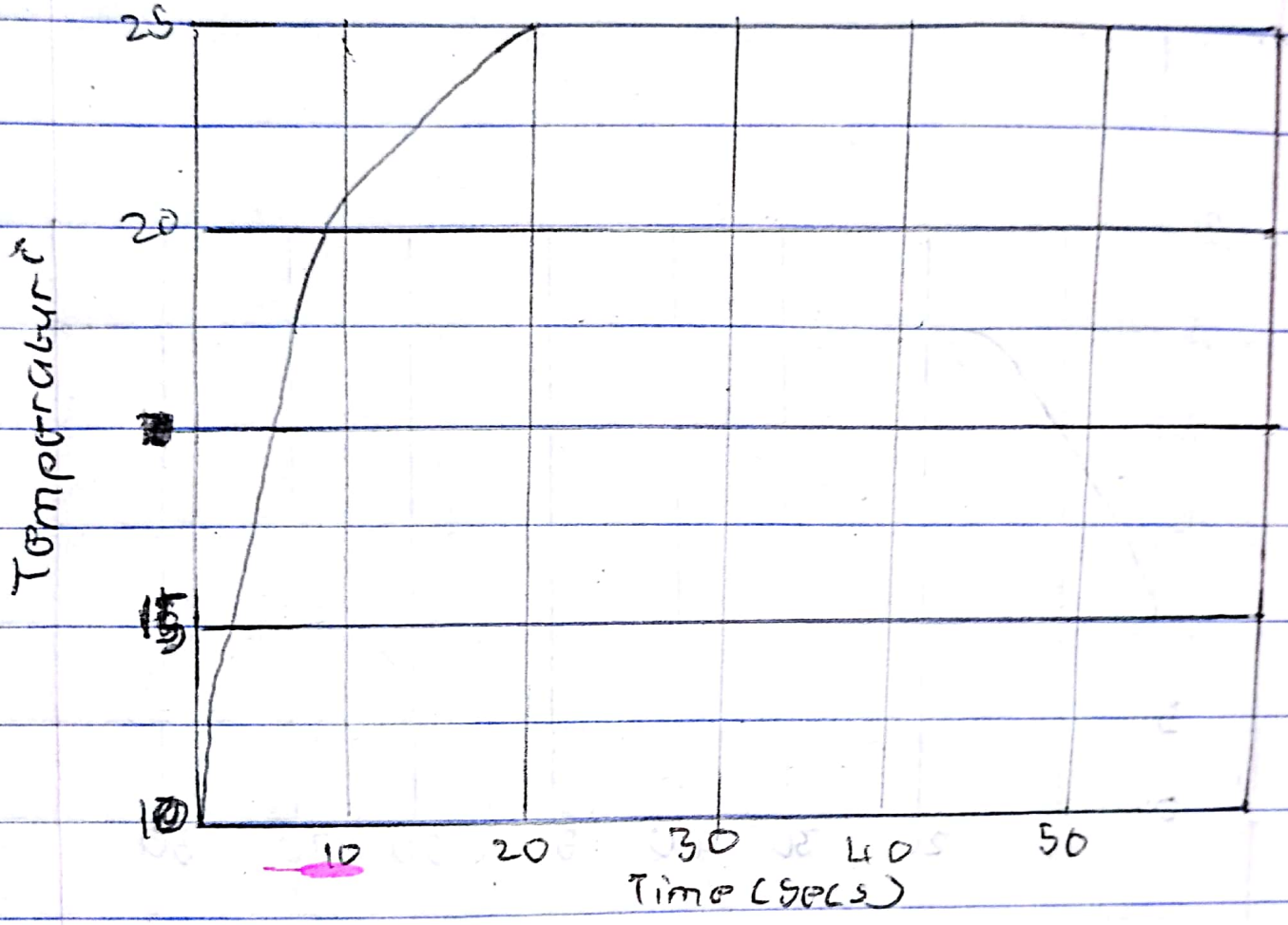


Using MatLab,

```
Command Window
Clear
CLC
CLOSEALL
t = 0:1:60
T = 25 - 15* exp(-0.22* t)
PLOT(t,T)
grid on
grid minor
xlabel ('Time(secs)')
Ylabel ('Temperature')
```

Scanned by CamScanner

Output



14. 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 = 0 will be 25°C

Scanned by CamScanner