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Matric no: 17HENEGG1075

Rate of change of temperature = $\frac{dT}{dt}$

From Newton's cooling law $\frac{dT}{dt} = k(T - T_0)$

$$\frac{dT}{dt} =$$

$$\frac{dT}{T - T_0} = k dt$$

$$\int \frac{dT}{T - T_0} = \int k dt$$

$$\ln(T - T_0) = kt + C$$

$$T - T_0 = e^{kt} + e^C \quad \text{let } e^C = A$$

$$T - T_0 = e^{kt} + A$$

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

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

Initially $10 = A e^{kt} + 25$

$$10 - 25 = A e^{k(0)}$$

$$A = -15$$

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

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

@ $T = 20^\circ$

$$t = 5$$

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

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

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

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

$$\ln\left(\frac{1}{3}\right) = 5k$$

$$5k = -1.099$$

$$k = \frac{-1.099}{5}$$

$$k = -0.22$$

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

Using MATLAB

Command window

clear

clc

close all

$$t = 0:1:60$$

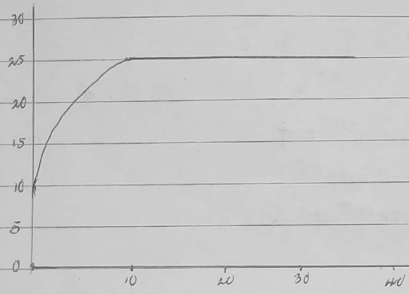
$$k = 0.22$$

$$T = 25 - 15 * \exp(-k * t)$$

plot (T, t)

Steady state value = 25

Using EXCEL



As $t \rightarrow \infty$

$$T = 25 - 15e^{-0.22 \cdot \infty}$$

$$T = 25 - 0$$

$$T = 25$$

Mathematical modeling is the process of using mathematical concept to solve real-life problems

Methods

- i) Theoretical
- ii) Experimental