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17/ENG02/068
COMPUTER ENGINEERING

A. Modelling can be defined as a mathematical simulation of a system.

B. Methods
i. Use of Differenciation
ii. Balance method

C.
$$\frac{dT}{dt} = k(T - T_A)$$

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

integrate both sides

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

$$\ln(T - T_A) = kt + C$$
$$T - T_A = e^{kt + c} \quad => \quad e^{kt} e^c$$
$$\therefore \quad T - T_A = Ce^{kt}$$

where T is the thermometers initial reading $10°C$ and T_A, the actual temperature of the system $25°C$ all at time $(t) = 0$.

$$\therefore \quad T - T_A = Ce^{kt}$$
$$10 - 25 = Ce^{k(0)}$$
$$10 - 25 = C$$
$$C = -15$$

After 5min, temperature of the thermometer $T = 20°C$ and $t = 5$

$$T - T_A = Ce^{kt}$$
$$20 - 25 = -15e^{k(5)}$$
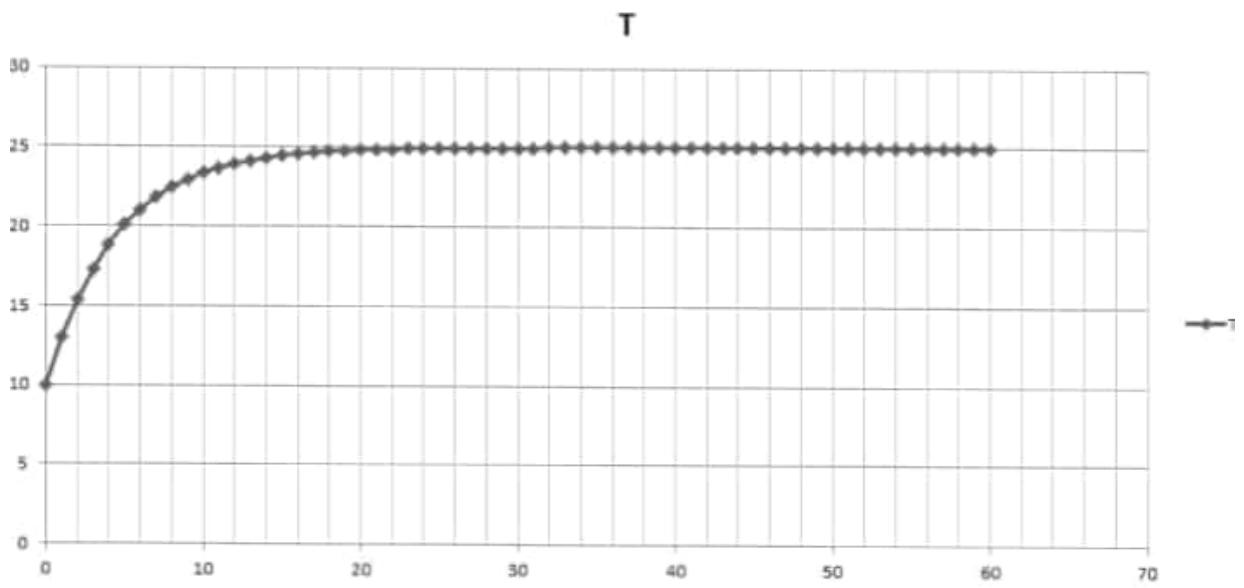$$\frac{-5}{-15} = e^{5k}$$

$$\ln(0.33) = 5k$$
$$k = \div 0.222$$

Therefore the model of the system is

$$T = T_A + Ce^{kt}$$

$$T = 25 - 15e^{-0.222t}$$

ii) Simulation using microsoft Excel
Some selection from the table t(1-60)

t	T
0	10
6	21.986
12	23.955
18	24.72
24	24.92
30	24.98
36	24.99
42	24.99
48	24.99
54	24.99
60	24.99

T

MATLAB CODE

Command Window

```
Clear
clc
Close all
Syms t
t = 0:1:60
T = 25 - 15 * (exp (-0.222 * t) )
Tb = Subs T
Plot (t, tb)
X label ('Time (min)')
y label ('Temperature')
axis tight
grid on
grid minor
```