Abdulsamad Bakamasi
Civil Engineering
18/Eng03/059

Engr 282 (5)

1) Defining of a mathematical modelling
This is a mathematical representation of a system in order to study its behaviour

b) methods of obtaining a model
a) Differential equation
b) Use of boundary law

c) From newton law of cooling

$$\frac{dT}{dt} = k_2(T - T_m)$$

$$dT = k_2(T - T_m)\,dt$$

$$\frac{dT}{T - T_m} = k\,dt$$

Integrating both side

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

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

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

Let $e^C = C$

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

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

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

at $t = 0$, $T = 10°C$, $T_m = 25°$

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

$$10 = C + 25$$

$$C = 10 - 25$$

$$C = -15$$

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

at $t = 5$, $T = 20°C$

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

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

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

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

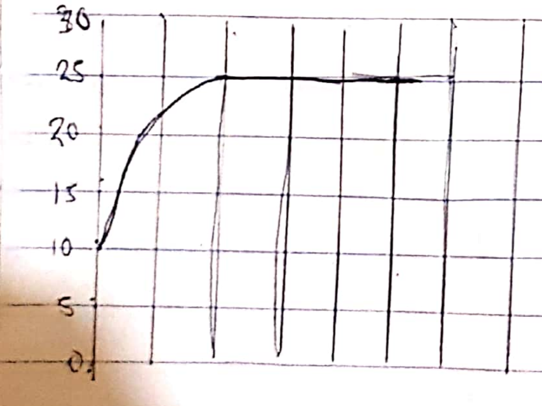
$5k = \ln(0.3333)$

$\frac{5k}{5} = \frac{\ln(0.3333)}{5}$

$k = -0.22$

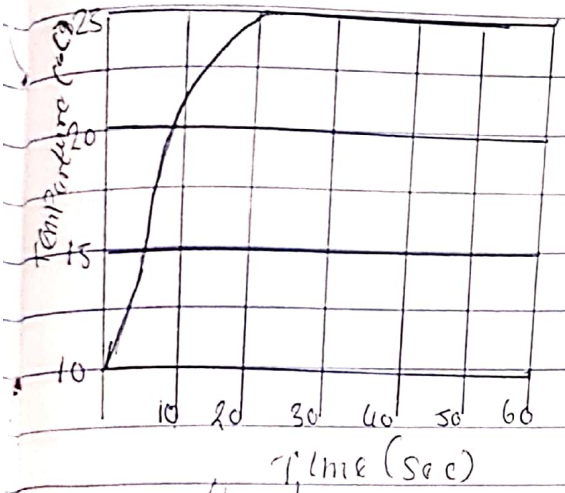
$\therefore T_{60} = 25 - 15e^{-0.22t}$

c) Using microsoft Excel
- type in "t" for columns 1
- type in "T" from column 2
the column 1, type '0' under t
on the home, select Fill order editing
select series, change colums, insert "step value of radar
step value of 60 in enter
then in column 2 under T type = 25 - 15 exp (-0.22*t) then enter
Double click the dot at the bottom right
Highlight columes 1 and 2
Go to insert and pick a graph type



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
Label (Time (sec))
    Graph Y label ( : Temperture ( °C) )
```



- Using the dynamic represses the steady state temperature in 25°C at 20 minutes
- Using the developed model equation to temperature at the thermometer at $t \to \infty = 25$ °C.