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17/ENG06/066

A) Modelling is the mathematical representation and simulation of a system which involves solving the model and obtaining output variable for different values of input variables

B) i) Differentiating
ii) Balance law
iii) Analysis

c) $\frac{dT}{dt} = K(T - T_A)$ (Newton's law of cooling)

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

$\int \frac{dT}{(T - T_A)} = \int K\,dt \quad = \quad \ln(T - T_A) = Kt + C$

$T - T_A = e^{KT + C} \quad \Rightarrow T - T_A = e^{Kt} \cdot e^{C}$

$T = 10^{\circ}C$

$T_A = 25^{\circ}C \qquad t = 0$

$T - T_A = Ce^{Kt}$

$10 - 25 = Ce^{K(0)}$

$-15 = C$

After 5 minutes $T = 20 \qquad t = 5$

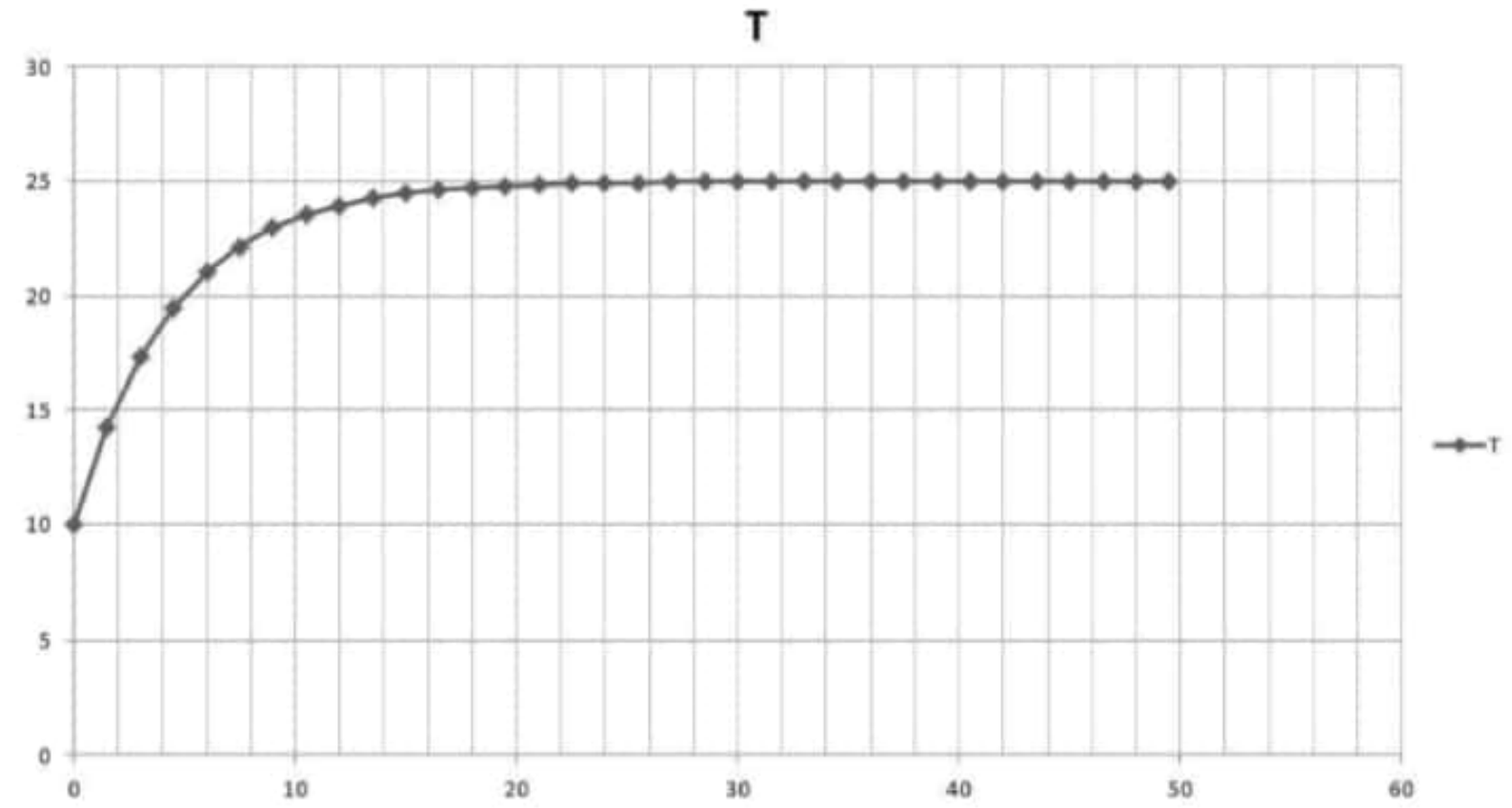
$T - T_A = -15e^{K(5)}$

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

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

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

$K = 0.222$



$T - T_A = Ce^{Kt}$

$T = T_A + Ce^{Kt}$

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

ii) $t = 1 \rightarrow 50$

$\Delta t = 1.5$

$T = 25 - 15 * \exp(-0.222) * t)$

iii) MATLAB simulation

code

```
command window
clear
clc
close all
syms t
t = 0:0.5:50
T = 25.15*(exp(-0.222*t))
T_t = subs(T)
plot(t, T_t)
x label('Time (min)')
y label('Temperature')
axis tight
grid on
grid minor
```