

$t := 0, 1.. 35$

$I(t) := -15 \exp(-0.21972 \cdot t) + 25$

$I(t) =$

24.138
24.308
24.444
24.554
24.642
24.713
24.769
24.815
24.851
24.881
24.904
24.923
24.938
24.95
24.96
...

Calculator

sin cos tan ln log
nl i |x| √ √
e^x 1/x () x² x^y
π 7 8 9 /
1/4 4 5 6 ×
÷ 1 2 3 +
:= . 0 - =

Graph

Graphing tools and axes

Activate Windows
Go to Settings to activate Windows.

ITUA EMIAGHE E
18/ENGO1/012
CHEMICAL ENGI.

QUIZ.

T_0 of the environment is 25°C

$$\frac{dT}{dt} = k(T-25).$$

$$\int \frac{dT}{(T-25)} = \int dt k.$$

$$\ln(T-25) = kt + C.$$

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

$$T-25 = e^{kt} \cdot e^C$$

$$T-25 = T_0 e^{kt}$$

$$T = T_0 e^{kt} + 25$$

At $t=0$; $T=10^\circ\text{C}$

$$10 = T_0 e^{k \cdot 0} + 25.$$

$$10 = T_0 + 25$$

$$10 - 25 = T_0$$

$$\therefore T_0 = -15^\circ\text{C}.$$

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

but when $t=5$ mins, $T=20^\circ\text{C}$.

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

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

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

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

$$0.33 = e^{k \cdot 5}$$

$$\ln 0.33 = \frac{k \cdot 5}{5}$$

$$k = -0.21972 \approx -0.2197$$

$$\therefore T = -15e^{-0.2197t} + 25^\circ\text{C}$$

Then to find t at $T=24.9^\circ\text{C}$

$$24.9^\circ\text{C} = -15e^{-0.2197t} + 25^\circ\text{C}$$

$$24.9^\circ\text{C} - 25^\circ\text{C} = -15e^{-0.2197t}$$

$$-0.1 = -15e^{-0.2197t}$$

$$\frac{-0.1}{-15} = e^{-0.2197t}$$

$$6.67 \times 10^{-3} = e^{-0.2197t}$$

$$\ln 6.67 \times 10^{-3} = -0.2197t$$

$$\frac{-5.010}{-0.2197} = \frac{-0.2197t}{-0.2197}$$

$$t = 22.80 \text{ mins}$$

at $t = 20^\circ\text{C}$ $t = 5 \text{ mins}$

$$20^\circ\text{C} = 25e^{5k} - 25$$

$$45 = 35e^{5k}$$

$$e^{5k} = 45/35$$

$$5k = \ln\left(\frac{45}{35}\right)$$

$$k = \frac{0.281}{5} \quad k = 0.055$$

$$T = 35e^{0.055t} - 25$$

$$T = 24.9 \text{ at } t = ?$$

$$24.9 = 35e^{0.055t} - 25$$

$$49.9 = 35e^{0.055t}$$

$$e^{0.055t} = 49.9/35$$

$$e^{0.055t} = \ln(1.426)$$

$$0.055t = 0.055$$

$$t = 7.1 \text{ minutes}$$

Kabari Mepher

18/SC109/001

Mechatronics

Question 1

$$T_{\text{initial}} = 10^{\circ}\text{C}$$

$$T = 20^{\circ}\text{C} \text{ @ } 5 \text{ mins}$$

$$T_{\text{ambient}} = 25^{\circ}\text{C}$$

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

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

$$\frac{dT}{dt} = k(T - 25)$$

Collect like terms

$$\frac{dT}{T - 25} = k dt$$

Integrating both sides

$$\ln(T - 25) = t k + C$$

$$T - 25 = e^{tk + C}$$

$$T - 25 = e^{tk} \cdot e^C$$

$$T = A e^{tk} - 25$$

At Initial conditions $t = 0$ $T = 10^{\circ}\text{C}$

$$10 = A e^0 - 25$$

$$A = 35$$

~~$$T = 35 e^{tk} - 25$$~~

$$T = 35 e^{tk} - 25$$