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18 | ENCO61072
Mechanical Engineering

Question 1

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

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

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

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

$T_A =$ Actual temperature

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

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

Collecting like terms

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

Integrating both sides

$$\ln(T - 25) = tK + C$$

$$\therefore T - 25 = e^{tK + C}$$

where $e^C = A$

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

$$T - 25 = Ae^{tK}$$

$$T = Ae^{tK} - 25$$

at initial conditions $t = 0$ $T = 10^{\circ}\text{C}$

$$10 = Ae^0 - 25$$

$$A = 35$$

$$\therefore T = 35e^{tK} - 25$$

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

$$20 = 35e^{5K} - 25$$

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

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

$$5K = \ln(45/35)$$

$$K = \frac{0.251}{5}$$

$$K = 0.05$$

$$T = 35e^{0.05t} - 25$$

~~Question~~

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

$$24.9 = 35e^{0.05t} - 25$$

$$49.9 = 35e^{0.05t}$$

$$e^{0.05t} = 49.9/35$$

$$e^{0.05t} = \ln(1.426)$$

$$0.05t = 0.355$$

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

Question 2

Sorry Sir My laptop is being fixed