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Civ. C

Question 2

$$T_1 \text{ of thermometer} = 10^\circ\text{C}$$

$$T_2 \text{ " " " " } = 20^\circ\text{C}$$

$$\text{Time taken} = 5 \text{ minutes} = 300 \text{ sec}$$

$$\Delta T = 20 - 10 = 10^\circ\text{C}$$

$$\text{Find } i = 24.9^\circ\text{C}, \Delta T_C = 24.9 - 10 = 14.9^\circ\text{C}$$

$$\log 14.9 = 2$$

$$\log = 2$$

$$\log = 300 \times 14.9$$

$$\log = 4470$$

$$y = 447$$

$$y = 447 \text{ sec}$$

$$y = 7 \text{ minutes } 27 \text{ seconds}$$

Question 1

$$T_{\text{true}} = 10^\circ\text{C}, T = 20^\circ\text{C} \text{ (at } 5 \text{ min)}$$

$$T_{\text{actual}} = 22.5^\circ\text{C}$$

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

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

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

Collector 1/1

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

Integrating both sides

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

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

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

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

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

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

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

$$A = 35$$

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

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

$$20^\circ\text{C} = 35 e^{5k} - 25$$

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

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

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

$$k = \frac{0.251}{5} \quad k = 0.05$$

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

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

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

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

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

$$0.05t = 0.855$$

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