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Biomedical Engineering :

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

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

$$= k(T - 25)$$

collect like terms

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

$$T - 25$$

$$\therefore \ln(T - 25) = tk + c$$

$$\therefore T - 25 = e^{tk+c}$$

$$= e^{tk} \cdot e^c$$

$$= A e^{tk}$$

where $e^c = A$

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

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

$$A = 35$$

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

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

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

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

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

$$5k = \ln \frac{45}{35}$$

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

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

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

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

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

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

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

$$0.05t = 0.353$$

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



