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Mechanical Eng.

$$T_1 = 10^\circ \quad T = 20^\circ \text{ @ } 5 \text{ mins}$$

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

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

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

Collect like terms

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

Integrate both sides

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

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

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

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

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

$$10 = A e^{0} + 25$$

$$A = -15$$

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

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

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

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

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

$$35$$

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

$$k = \frac{0.25}{5} = 0.05$$

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

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

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

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

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

$$t = \frac{\ln\left(\frac{49.9}{35}\right)}{0.05} = 7.1 \text{ minutes}$$



