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Elect / Elect

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1) $T_{\text{initial}} = 10^\circ\text{C}$ $T = 20^\circ\text{C}$ @ 5 mins

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

$\frac{dT}{dt} \propto (T - T_A)$ $T_A = \text{Actual temperature}$

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

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

collecting like terms

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

$(T - 25)$

Integrating both sides $\therefore \ln(T - 25) = kt + C$

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

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

$T - 25 = Ae^{kt}$

$T = Ae^{kt} - 25$

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

$10 = Ae^{0} - 25 = A - 25$

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

at $T=20^\circ\text{C}$ $t=5\text{mins}$: $20 = 35e^{5k} - 25$

$45 = 35e^{5k}$

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

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

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

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

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

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

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

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

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

$$0.05t = 0.355$$

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

Mathcad - [Untitled2]

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$t := 0..1..35$

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

T(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

Graph

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