

Q2

Using Newton's cooling equation

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

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

$$T_a = 25^\circ\text{C}$$

$$\frac{dT}{dt} = k(T - 25^\circ\text{C})$$

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

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

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

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

$$T - 25 = T_0 e^{kt}$$

$$T = T_0 e^{kt} + 25$$

when $t = 0$ $T = 10$

$$10 = T_0 e^{k(0)} + 25$$

$$-15 = T_0(1)$$

$$T_0 = -15$$

When $t = 5$ minutes $T = 20$

$$20 = -15e^{k(5)} + 25$$

$$-5 = -15e^{k(5)}$$

$$\ln\left(\frac{1}{3}\right) = k(5)$$

$$-1.099 = 5k$$

$$k = \frac{-1.099}{5}$$

$$k = -0.2197$$

The full dynamic equation

$$T = -15e^{t(-0.2197)} + 25$$

Find t when $T = 24.9^\circ\text{C}$

$$24.9^\circ\text{C} = -15e^{t(-0.2197)} + 25$$

$$-0.1 = -15e^{t(-0.2197)}$$

$$\frac{1}{150} = e^{t(-0.2197)}$$

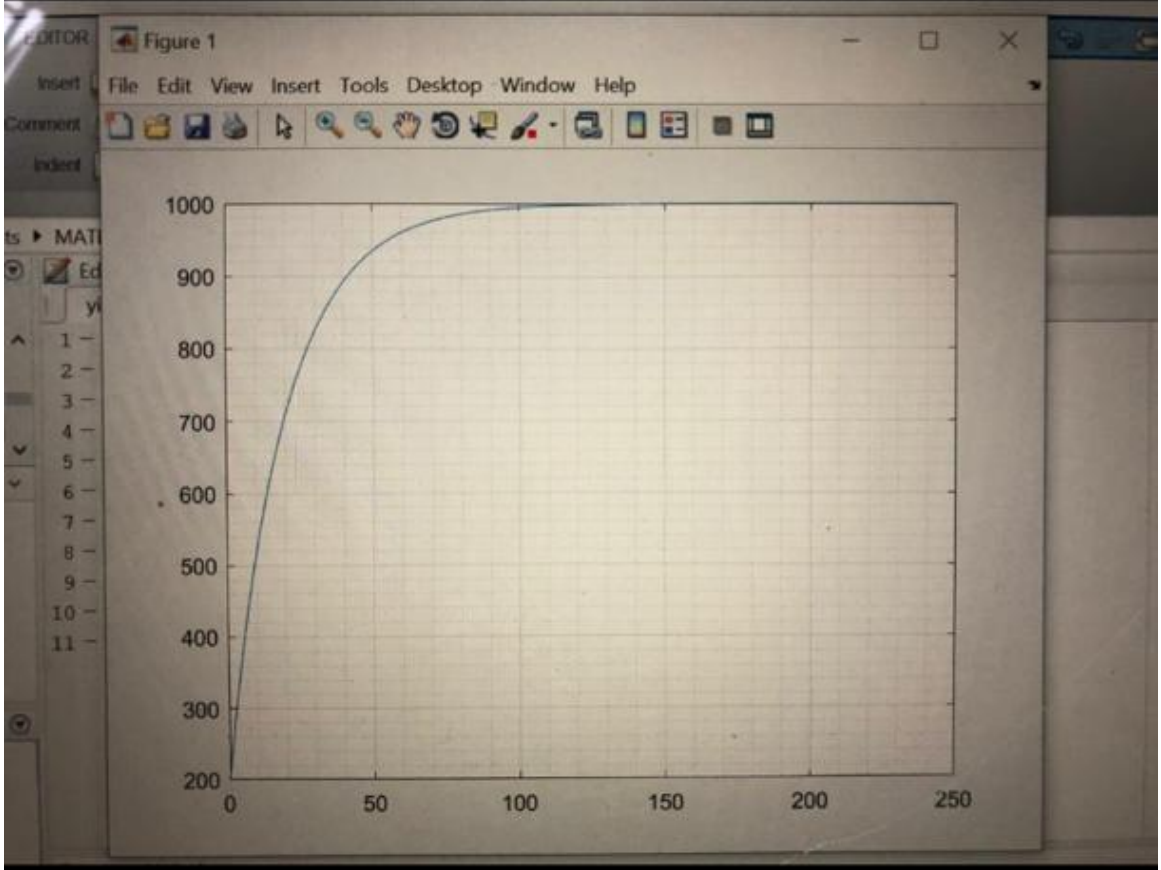
$$\ln\left(\frac{1}{150}\right) = t(-0.2197)$$

$$-5.011 = t(-0.2197)$$

$$t = \frac{-5.011}{-0.2197}$$

$$= 22.8 \text{ minutes}$$

$$t = 22.8 \text{ minutes}$$



```
editor - C:\Users\ymat\Documents\MATLAB\ymaquiz2.m
ymaquiz2.m
- commandwindow
- clear
- clc
- close all
- format short g
- mdata=xlread('onlinequirdata','fluiddata')
- xmdata(1:2:250,1)
- ymdata(1:2:250,2)
- plot(x,y)
- grid on
- grid minor

I

Command Window
88
89
90
92
94
96
98
100
102

script In 11 Col 11
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