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M/ENG03/032

CIVIL ENGINEERING.

QUIZ

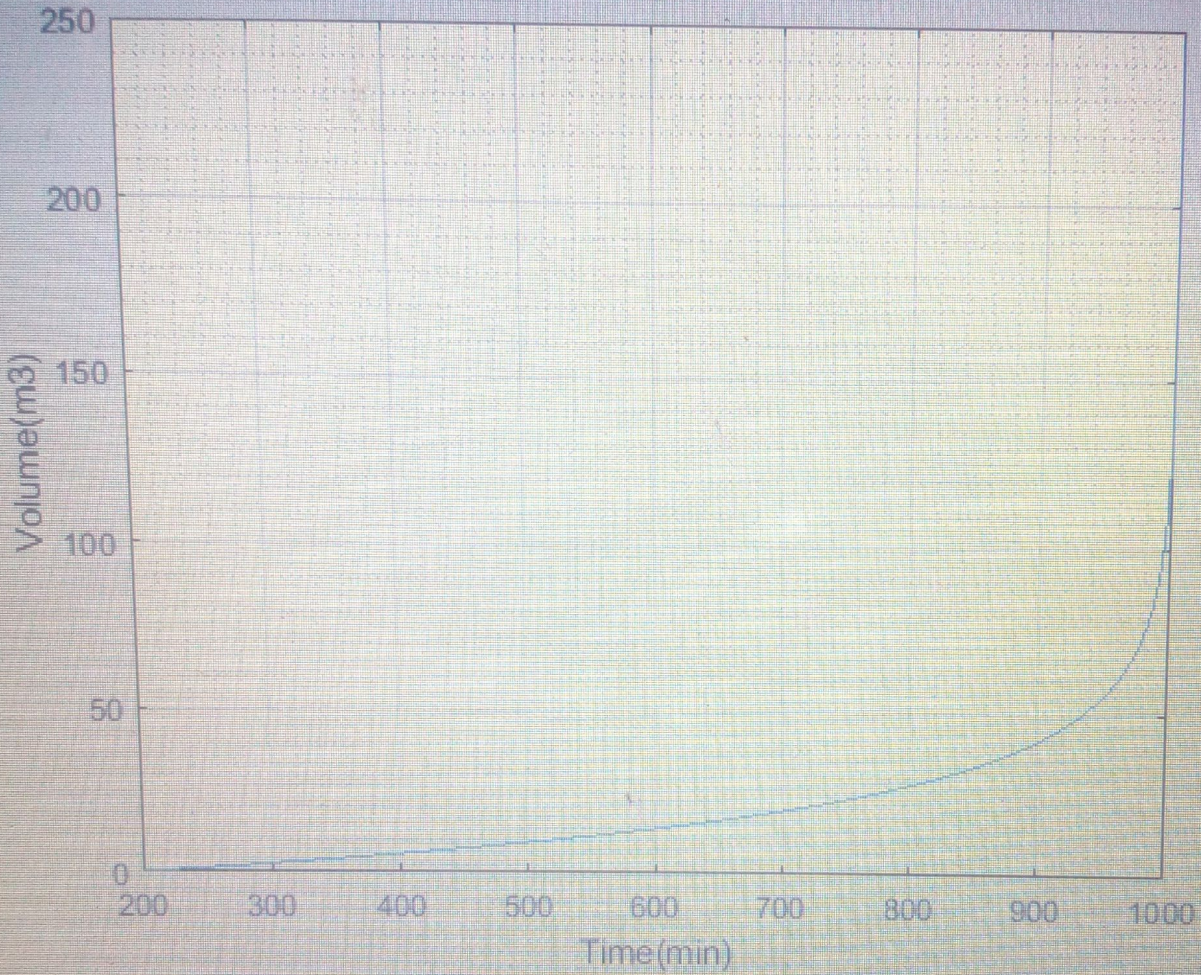
Question 2.

1. Command window
2. clear
3. clc
4. close all
5. mdata = xlsread ('onlinequizdata', 'fluiddata')
6. t = mdata (~~1:2:250~~) (1:2:250, 1)
7. V = mdata (~~1:2:250~~) (1:2:250, 2)
8. plot (V, t)
9. grid on
10. grid minor
11. xlabel ('Time (min)')
12. ylabel ('Volume (m³)')

Figure 1

File Edit View Insert Tools Desktop Window Help

Maximize



```
999.9940  
999.9946  
999.9951  
999.9956  
999.9960  
999.9964  
999.9967
```

fx >>

Question 1

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

$$\text{At } t=0, T = 10^\circ\text{C}$$

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

Using the formula.

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

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

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

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

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

$$e^{\ln(T - 25)} = e^{(kt + C)}$$

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

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

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

at $t=0, T=10$

$$10 = T_0 e^0 + 25$$

$$T_0 = -15^\circ\text{C}$$

∴ The general equation is

$$T = -15e^{kt} + 25$$

Time required for thermometer to reach the system temperature 24.9°C .

$$24.9^\circ\text{C} =$$

To obtain value of k .

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

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

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

$$1 = e^{5k}$$

$$\ln(1) = \ln(e^{5k})$$

$$\ln(1) = 5k$$

$$k = \frac{\ln(1)}{5} \quad k = \frac{\ln(1)}{5}$$

$$k = 0.$$

ERRORS.

The equation becomes.

To obtain value for k .

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

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

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

$$1 = 3e^{5k}$$

$$0.33 = e^{5k}$$

$$\ln(0.33) = \ln(e^{5k})$$

$$\ln(0.33) = 5k.$$

$$k = \frac{\ln(0.33)}{5}$$

$$k = -0.22$$

$$k = -0.22$$

The equation becomes:

$$T = -15e^{-0.22t} + 25$$

Time required for the thermometer to reach the temperature 24.9°C .

$$24.9 = -15e^{-0.22t} + 25$$

$$-0.1 = -15e^{-0.22t}$$

$$6.67 \times 10^{-3} = e^{-0.22t}$$

$$\ln(6.67 \times 10^{-3}) = -0.22t$$

$$t = \frac{\ln(6.67 \times 10^{-3})}{-0.22}$$

$$t = 22.76 \text{ minutes}$$