PH 222 - 2A

03/12/2012

RECITATION #9

Sol:- The resistors R_1 & R_3 are connected in series.

$$R_{13} = R_1 + R_3$$

$$= 10 + 30$$

$$= 40\ k\Omega$$

The resistors R_{13} and R_2 are connected in parallel.

$$R_{13eq} = \frac{R_{13} R_2}{R_{13} + R_2}$$

$$= \frac{10 \times 40}{10 + 40}$$

$$= 8\ k\Omega$$

The total equivalent resistance is :-

$$R_{eq} = R_{13\,eq} + R_4$$

$$= 8 + 30$$

$$= 38\ k\Omega$$

(a) The time constant is :-

$$\tau = RL$$
$$= 38 \times 10^3 \times 100 \times 10^{-3}$$
$$= 3800 s$$

(b) The voltage of battery is :-

$$V = 24 + 24$$
$$= 48V$$

The current is :- $V = IR$

$$I = \frac{V}{R}$$
$$= \frac{48}{38 \times 10^3}$$
$$= 1.26 \times 10^{-3}$$
$$= 1.26 mA$$

(c) The time is :-

$$I = I_0 \left(1 - e^{-\frac{t}{\tau}}\right)$$

$$\frac{I_0}{2} = I_0 \left(1 - e^{-\frac{t}{7400}}\right)$$

$$\frac{1}{2} = \left(1 - e^{-\frac{t}{3800}}\right)$$

$$\frac{1}{2} - 1 = -e^{-\frac{t}{3800}}$$

$$\frac{1}{2} = e^{-\frac{t}{3800}}$$

$$-\frac{t}{3800} = \ln\left(\frac{1}{2}\right)$$

$$\frac{-t}{3800} = -0.693$$

$$t = 2633.96 \text{ s}$$