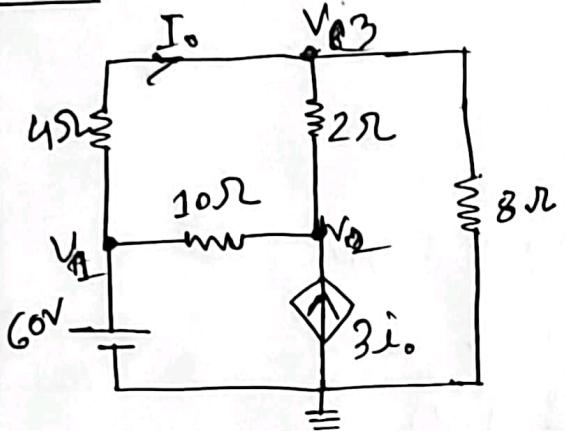


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CSE 250 sec: 02

Assignment : 01

1



$$\text{here } V_A = 60V$$

$$I_o = \frac{V_1 - V_3}{4}$$

at node V_2

$$\frac{V_1 - V_2}{10} + 3 \left(\frac{V_1 - V_3}{4} \right) = \frac{V_2 - V_3}{2}$$

$$\frac{60 - V_2}{10} + 3 \left(\frac{60 - V_3}{4} \right) - \frac{V_2}{2} + \frac{V_3}{2} = 0$$

$$-\frac{V_2}{10} + 45 + 6 - \frac{3V_3}{4} - \frac{V_2}{2} + \frac{V_3}{2} = 0$$

$$-\frac{V_2}{10} - \frac{3V_3}{4} - \frac{V_2}{2} + \frac{V_3}{2} = -51 \quad \text{--- (1)}$$

at node V_3 :

$$\frac{60 - V_3}{4} + \frac{V_2 - V_3}{2} - \frac{V_3}{8} = 0$$

$$15 - \frac{V_3}{4} + \frac{V_2}{2} - \frac{V_3}{2} - \frac{V_3}{8} = 0$$

$$\therefore -\frac{V_3}{4} + \frac{V_2}{2} - \frac{V_3}{2} - \frac{V_3}{8} = -15 \quad \text{--- (11)}$$

Solving eqn (1), (11), \Rightarrow

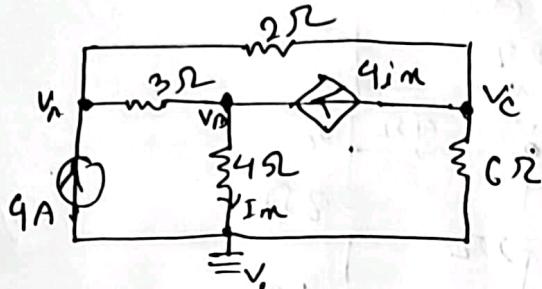
$$V_2 = 62.88V$$

$$V_3 = 53.07V$$

$$\therefore I_o = \frac{60 - 53.07}{4}$$

$$= 1.7325 A \text{ (Ans)}$$

2.



$$i_m = \frac{V_B}{4}$$

$$-4 + \frac{V_A - V_B}{3} + \frac{V_A - V_C}{2} = 0$$

$$\frac{V_A}{3} - \frac{V_B}{3} + \frac{V_A}{2} - \frac{V_C}{2} = 4 \quad \text{--- (1)}$$

$$\frac{V_B - V_A}{3} + \frac{V_B}{4} - 4i_m = 0$$

$$\frac{V_B}{3} - \frac{V_A}{3} + \frac{V_B}{4} - 4 \frac{V_B}{4} = 0$$

$$\therefore \frac{V_B}{3} - \frac{V_A}{3} + \frac{V_B}{4} - V_B = 0 \quad \text{--- (11)}$$

$$4i_m + \frac{V_C - V_A}{2} + \frac{V_C}{6} = 0$$

$$V_B + \frac{V_C}{2} - \frac{V_A}{2} + \frac{V_C}{6} = 0 \quad \text{--- (111)}$$

\therefore solving eqn (1), (11), (111) \Rightarrow

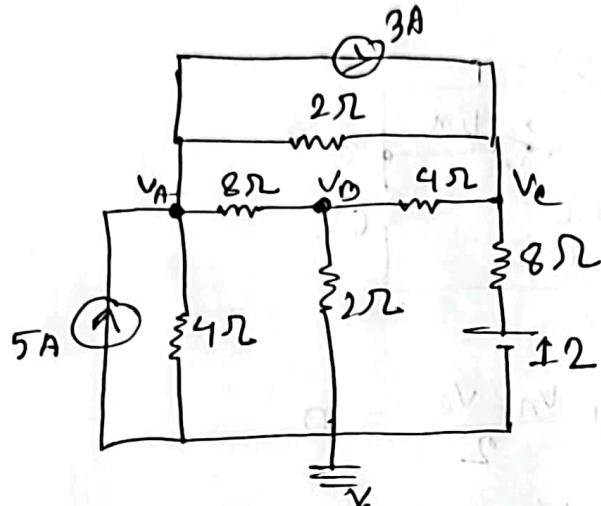
$$V_A = 32V$$

$$V_B = -25.6V$$

$$V_C = 2.4V$$

$$V_o = 0V \quad (\text{Ans})$$

3



$$-5 + \frac{V_A}{4} + \frac{V_A - V_B}{8} + 3 + \frac{V_A - V_C}{2} = 0$$

$$\frac{V_A}{4} + \frac{V_A}{8} + \frac{V_A}{2} - \frac{V_B}{8} - \frac{V_C}{2} = 2 \quad \text{--- (I)}$$

$$\frac{V_B - V_A}{8} + \frac{V_B}{2} + \frac{V_B - V_C}{4} = 0$$

$$\frac{V_B}{8} - \frac{V_A}{8} + \frac{V_B}{2} + \frac{V_B}{4} - \frac{V_C}{4} = 0 \quad \text{--- (II)}$$

$$-3 + \frac{V_C - V_A}{2} + \frac{V_C - V_B}{4} + \frac{V_C - 12}{8} = 0$$

$$\frac{V_C}{2} - \frac{V_A}{2} + \frac{V_C}{4} - \frac{V_B}{4} + \frac{V_C}{8} = \frac{9}{2} \quad \text{--- (III)}$$

Solving eqn (I), (II), (III) \Rightarrow

$$V_A = 10V$$

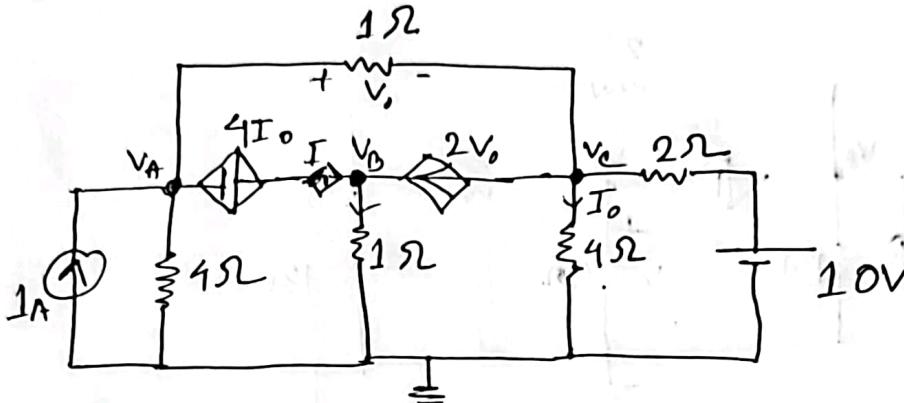
$$V_B = 4.933V$$

$$V_C = 12.27V$$

Voltage across the 3A source = $\frac{V_A - V_C}{2}$
 $= 2.27V$

(Ans)

4



$$\text{at } V_A + \frac{V_A - 4I_o}{1} + V_B = 0$$

here,

$$V_B - V_A = 4I_o \quad I_o = \frac{V_C}{4}$$

$$V_B - V_A = 4 \cdot \frac{V_C}{4} \quad \text{--- (I)}$$

At Node V_C :

$$\Rightarrow V_B - V_A - V_C = 0 \quad \text{--- (I)}$$

$$\frac{V_C}{4} + \frac{V_C - 10}{2} + \frac{V_C - V_A}{1} + 2V_o = 0$$

here,

$$V_o = \frac{V_A - V_C}{1}$$

$$\frac{V_C}{4} + \frac{V_C}{2} - 5 + V_C - V_A + 2V_A - 2V_C = 0$$

$$\frac{V_C}{4} + \frac{V_C}{2} - V_C + V_A = 5 \quad \text{--- (II)}$$

At supernode V_A, V_B :

$$-1 + \frac{V_A}{1} + \frac{V_A - V_C}{1} + \frac{V_B}{1} - 2V_o = 0$$

$$-1 + \frac{V_A}{1} + V_A - V_C + V_B - 2V_A + 2V_C = 0$$

$$\frac{V_A}{1} + V_A - 2V_A + V_B + V_C = 1 \quad \text{--- (III)}$$

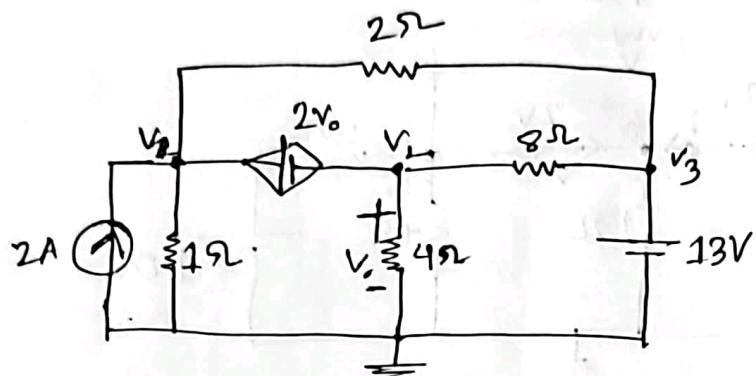
Solving $\text{--- (I), (II) and (III)}$

$$\begin{aligned} V_A &= 4.969V \\ V_B &= 4.848V \\ V_C &= -0.121V \end{aligned}$$

(Ans)

here,
dependent voltage source $= 4I_o$
 $I = \frac{V_B - 2V_o}{1} \quad I + 2V_o = V_B$
 $I = 4.848 + 2(V_A - V_C)$
 $= 4.848 + 2(4.969 + 0.12)$
 $= -5.33A \quad (\text{Ans})$

5



$$V_1 - V_2 = 2V_0 \quad [V_0 = \frac{V_2}{2}]$$

$$\Rightarrow V_1 - V_2 = \cancel{2}V_0$$

$$\Rightarrow V_1 - V_2 - \frac{2V_2}{2} = 0$$

$$= \cancel{2}V_1 - 2V_2 - V_2 = 0$$

$$= 3V_1 - 3V_2 = 0 \quad \text{---(1)}$$

At Node V_3 :

$$V_3 = 13V$$

At superNode V_1, V_2 :

$$-2 + \frac{V_A}{1} + \frac{V_2}{4} + \frac{V_1 - 13}{2} + \frac{V_2 - 13}{8} = 0$$

$$-2 + \frac{V_1}{1} + \frac{V_2}{4} + \frac{V_1}{2} - \frac{13}{2} + \frac{V_2}{8} - \frac{13}{8} = 0$$

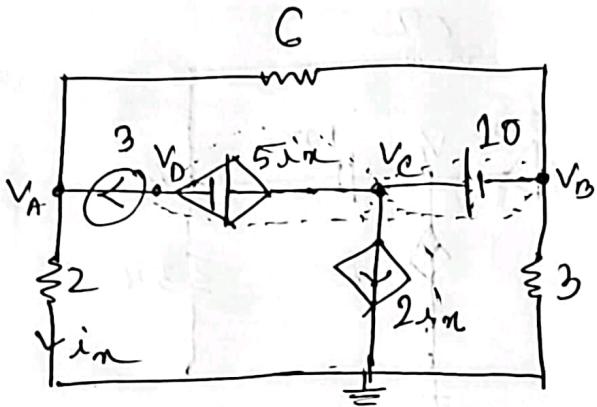
$$\Rightarrow \frac{V_1}{1} + \frac{V_2}{4} + \frac{V_1}{2} - \cancel{\frac{13}{2}} + \frac{V_2}{8} = 8\frac{1}{8} \quad \text{---(11)}$$

Solving equ. (1), (11), (11) \Rightarrow

$$V_1 = 6.23V$$

$$V_2 = 2.0709V \quad (\text{Ans})$$

G



$$V_C - V_B = 10 \quad \text{--- (I)}$$

$$V_C - V_D = 5 \text{ in}$$

$$\Rightarrow V_C - V_D = 5 \cdot \frac{V_A}{2}$$

$$\Rightarrow -2.5 V_A + V_C - V_B = 0 \quad \text{--- (II)}$$

At node V_A :

$$\frac{V_A}{2} + \frac{V_A - V_B}{C} = 6$$

$$\Rightarrow V_A \left(\frac{1}{C} + \frac{1}{2} \right) - \frac{V_B}{C} = 3 \quad \text{--- (III)}$$

At supernode V_D, V_C, V_B :

$$\frac{V_B - V_A}{C} + \frac{V_B}{3} + 3 + 2i_m = 0$$

$$\frac{V_B}{C} - \frac{V_A}{C} + \frac{V_B}{3} + 3 + 2 \cdot \frac{V_B}{2} = 0$$

$$\Rightarrow V_B \left(\frac{1}{C} + \frac{1}{3} \right) - \frac{V_A}{C} + V_A = -3 \quad \text{--- (IV)}$$

Solving (I), (II), (III), (IV) \Rightarrow

$$V_A = 2.117 \text{ V}$$

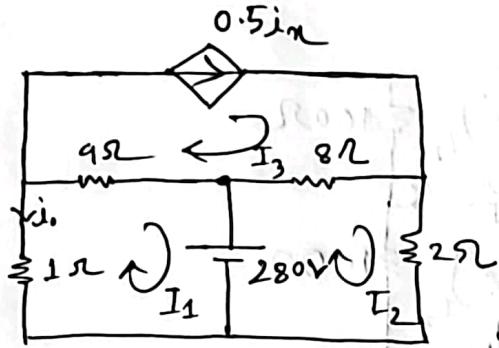
$$V_B = -9.529 \text{ V}$$

$$V_C = 0.47 \text{ V}$$

$$V_B = -4.823 \text{ V}$$

here,
 $i_m = \frac{V_A}{2}$
 $= 1.0585 \text{ A}$
 (Ans)

7



here,

$$I_3 = 0.5 \text{ in} \quad \text{and} \quad I_{in} = -I_1$$

$$\therefore I_3 = -0.5 I_1$$

$$\Rightarrow I_3 + 0.5 I_1 = 0 \quad \text{--- (1)}$$

at loop 1

$$4I_1 - 4I_3 + 280 + I_1 = 0 \quad \text{--- (2)}$$

$$5I_1 - 4I_3 = -280 \quad \text{--- (3)}$$

at loop 2

$$8I_2 - 8I_3 + 2I_2 = 280 \quad \text{--- (4)}$$

$$\therefore I_2 = -40 \text{ A}$$

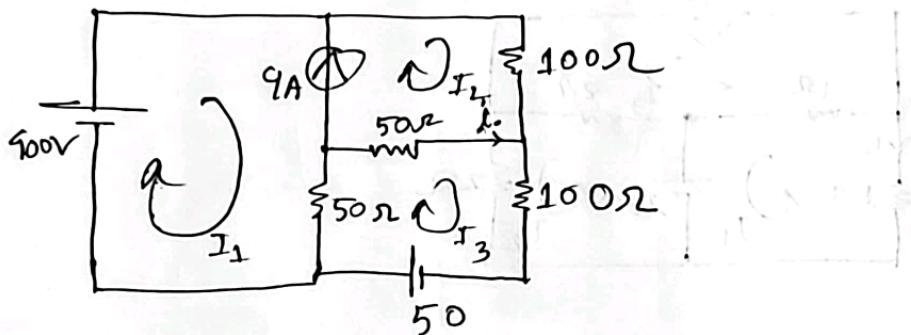
$$I_2 = 44 \text{ A}$$

$$I_3 = 20 \text{ A}$$

$$\therefore I_0 = -I_1$$

$$= 40 \text{ A} \quad (\text{Ans})$$

8



From supernode I_1 and I_2 :

$$I_2 - I_1 = 4 \quad \text{--- (1)}$$

loop at supernode I_1 and I_2 :

$$50I_1 - 50I_3 - 400 + 100I_2 + 50I_2 - 50I_3 = 0$$

$$50I_1 + 150I_2 - 100I_3 = 400 \quad \text{--- (II)}$$

at loop 3

$$50I_3 - 50I_2 + 100I_3 - 50 + 50I_3 - 50I_1 = 0$$

$$-50I_1 - 50I_2 + 200I_3 = 50 \quad \text{--- (III)}$$

solving equation ①, ②, ③ \Rightarrow

$$I_1 = -0.5 \text{ A}$$

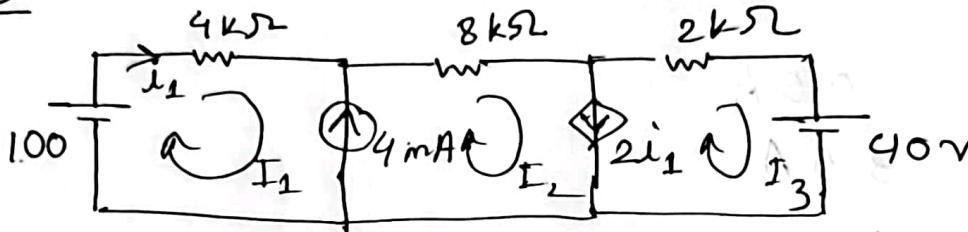
$$I_2 = 3.5 \text{ A}$$

$$I_3 = 1 \text{ A}$$

here, $i_o = I_3 - I_2$

$$\begin{aligned} &= (1 - 3.5) \text{ A} \\ &= -2.5 \text{ A} \quad (\text{Ans}) \end{aligned}$$

Q



$$I_2 - I_1 = 4 \quad \text{--- (1)}$$

$$I_2 - I_3 = 2i_1$$

here,

$$i_1 = I_1$$

$$\therefore I_2 - I_3 = 2I_1$$

$$\Rightarrow -2I_1 + I_2 - I_3 = 0 \quad \text{--- (II)}$$

Supermesh at loop 1, 2, 3 \Rightarrow

$$9I_1 + 8I_2 + 2I_3 + 40 - 100 = 0$$

$$\Rightarrow 9I_1 + 8I_2 + 2I_3 = 60 \quad \text{--- (III)}$$

Solving equation (1), (II), (III) \Rightarrow

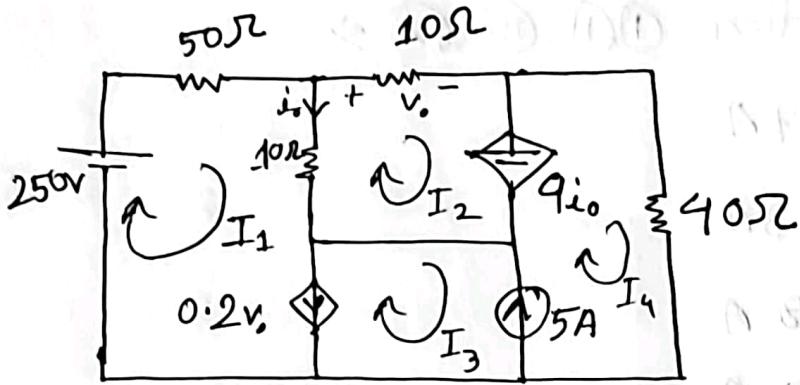
$$I_1 = 2 \text{ mA}$$

$$I_2 = 6 \text{ mA}$$

$$I_3 = 2 \text{ mA}$$

(Ans)

10



$$I_4 - I_3 = 5 \quad \text{--- (1)}$$

$$I_1 - I_3 = 0.2V_o \quad [V_o = 10I_2] \quad \text{--- (2)}$$

$$\Rightarrow I_1 - I_3 = 0.2 \times 10I_2 \quad \text{--- (3)}$$

$$\Rightarrow I_1 - 2I_2 - I_3 = 0 \quad \text{--- (4)} \quad \text{here, } i_o = I_1 - I_2$$

at loop 2

$$10I_2 + 4i_o + 10I_2 - 10I_1 = 0$$

$$10I_2 + 4(I_1 - I_2) + 10I_2 - 10I_1 = 0$$

$$10I_2 + 4I_1 - 4I_2 + 10I_2 - 10I_1 = 0$$

$$-6I_1 + 16I_2 = 0 \quad \text{--- (5)}$$

supermesh at loop ~~4~~, 1, 3, 4 \Rightarrow

$$50I_1 + 10I_4 - 10I_3 + 40I_4 = 250$$

$$60I_1 - 10I_2 + 40I_4 = 250 \quad \text{--- (6)}$$

Solving equation ① ⑪, ⑬, ⑭ \Rightarrow

$$I_1 = 0.754 A$$

$$I_2 = 0.283 A$$

$$I_3 = 0.188 A$$

$$I_9 = 5.188 A$$

Now,

$$V_6 = 10 \times I_2$$

$$= (10 \times 0.283) V$$

$$= 2.83 V$$

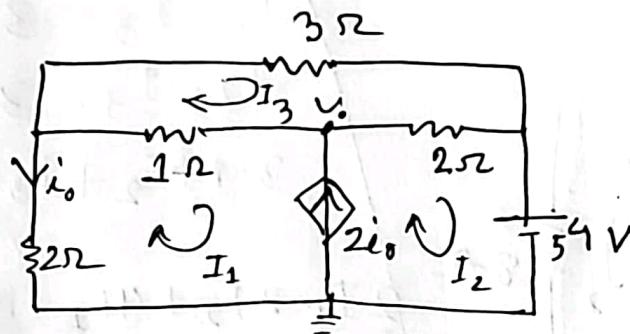
$$\therefore i_6 = I_1 - I_2$$

$$= (0.754 - 0.283) A$$

$$= 0.471 A$$

(Ans)

11.



$$I_2 - I_1 = 2i_0 \quad [\because i_0 = -I_1]$$

$$I_2 - I_1 = -2I_1$$

$$I_2 - I_1 + 2I_1 = 0$$

$$\therefore I_1 + I_2 = 0 \quad \text{--- (1)}$$

at loop 3

$$3I_3 + 1I_3 - 1I_1 + 2I_3 - 2I_2 = 0$$

$$-I_1 - 2I_2 + 6I_3 = 0 \quad \text{--- (II)}$$

applying supermesh at loop 1,2 \Rightarrow

$$I_1 - I_3 + 2I_2 - 2I_3 + 54 + 2I_1 = 0$$

$$3I_1 + 2I_2 - 3I_3 = -54 \quad \text{--- (III)}$$

Solving equation (1), (II), (III) \Rightarrow

$$I_2 = -36A$$

where,

$$I_2 = 36A$$

$$i_0 = -I_1$$

$$I_3 = 6A$$

$$\therefore i_0 = 36A$$

(Ans)