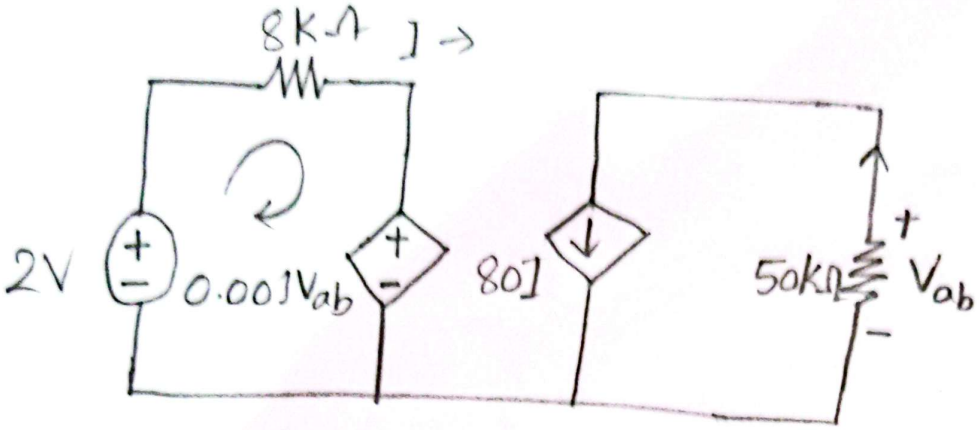
EEE101

Assignment 1 a

Name: Souvik Barman Ratul

ID : 24121205

Ans to the Q. NO-1



Applying KVL law,

$$-2+8000I+0.001V_{ab}=0 \quad \ldots\ldots (i)$$

Applying ohm's law,

$$V_{ab}=R.I = 500\times1000\times(-80I)$$

$$=-4000000I \quad \ldots (ii)$$

now, (i) $\Rightarrow$

$$-2+8000I+0.001(-4000000I)=0$$

$$\Rightarrow -2+8000I-4000I=0$$

$$\Rightarrow 4000I=2$$

$$\therefore I=\frac{1}{2000}$$

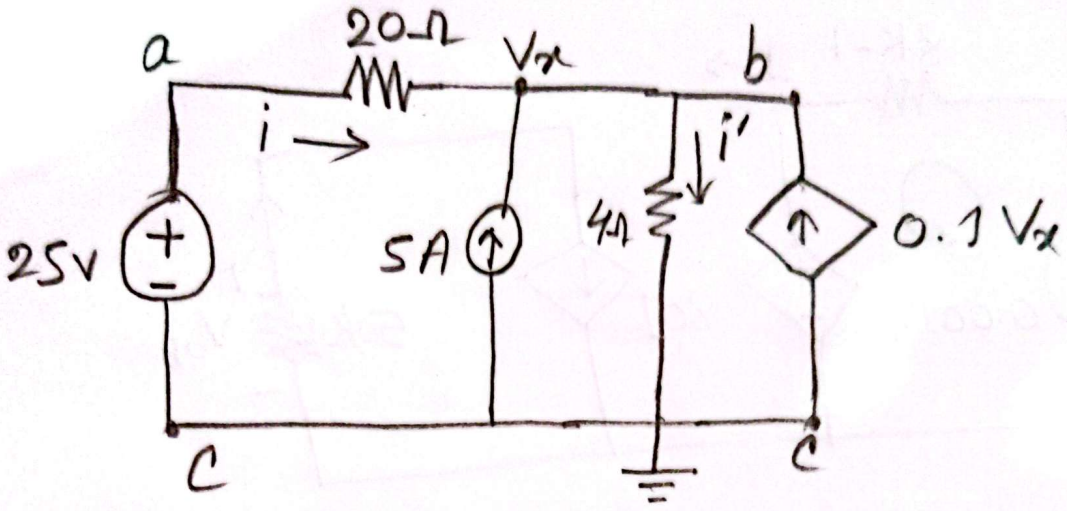
(ii) $\Rightarrow$ $V_{ab}=-4000000\times\frac{I}{2000}$

$$=-2000V$$

$$=-2KV$$

And

Ans to the Q. No-2



Applying ohm's law,

$$i = \frac{25 - V_x}{20}, \quad i' = \frac{V_x - 0}{4} = \frac{V_x}{4}$$

Applying KCL law, (b node)

$$i + 5 + 0.1V_x = i'$$

$$\Rightarrow \frac{25 - V_x}{20} + 5 + 0.1V_x = \frac{V_x}{4}$$

$$\Rightarrow \frac{25 - V_x + 100 + 2V_x}{20} = \frac{V_x}{4}$$

$$\Rightarrow 125 + V_x = 5V_x$$

$$\Rightarrow 4V_x = 125$$

$$V_x = 31.25 \text{ V}$$ Ans

Ans to the Q.No-5

Given that,

$$q(t) = 100(1+e^{-2.5t}) \text{ coulomb}$$

$$V(t) = 20\, e^{1.2t} \text{ V}$$

a] we know,

$$i = \frac{dq}{dt}$$

$$\Rightarrow i = \frac{d}{dt}\left\{100(1+e^{-2.5t})\right\}$$

$$\Rightarrow i = 100\left\{\frac{d}{dt}(1) + \frac{d}{dt}(e^{-2.5t})\right\}$$

$$\Rightarrow i = 100\left\{0 + -2.5\, e^{-2.5t}\right\}$$

$$\Rightarrow i = -250\, e^{-2.5t}$$

$$\therefore i(t) = -250\, e^{-2.5t} \text{ A} \quad \text{Ans}$$

b] At $t = 1$ s,

$$i = -250 \cdot e^{-2.5(1)} = -20.52 \text{ A}$$

$$V = 20 \cdot e^{1.2(1)} = 66.402 \text{ V}$$

} Ans

c] From 'b',

$i = -20.52A$, $V = 66.402\ V$

The power at $t = 1S$,

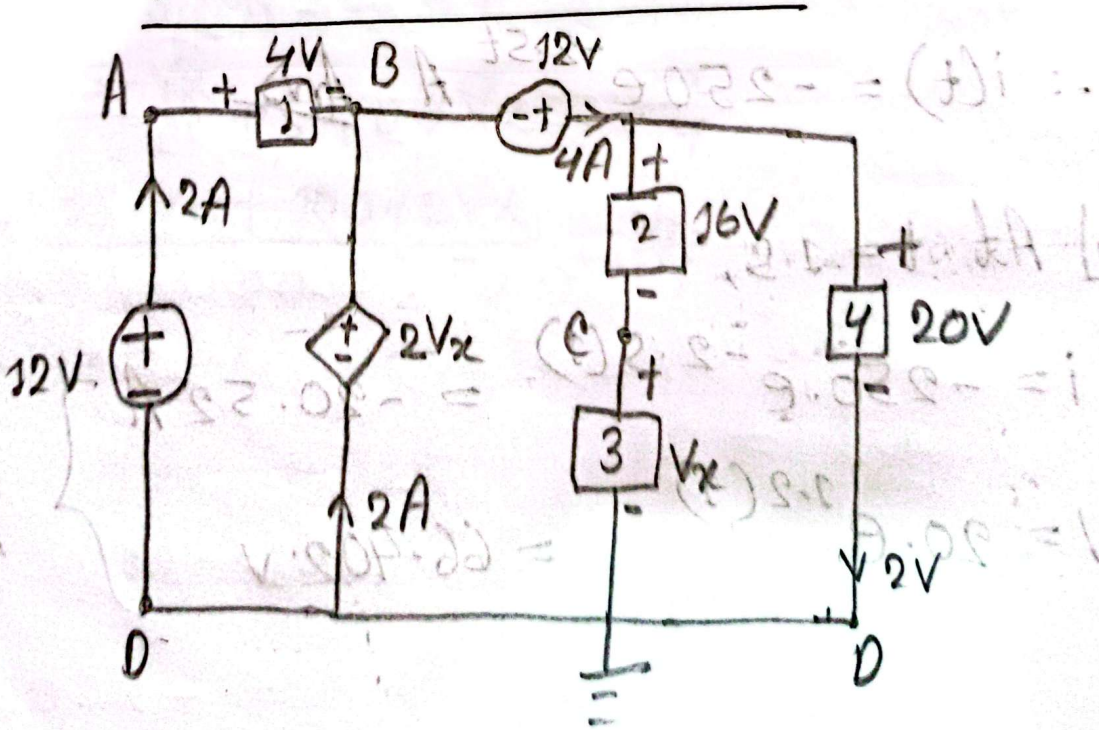
$P = VI$

$= (66.402)(-20.52)$

$= -1362.569\ W$

∴ The power is negative. So, the device is delivering power at $t = 1\ S$.

Ans to the Q. NO-6



For element 1.

$$V_1 = V_a - V_b$$

$$\Rightarrow 4 = 12 - V_b$$

$$V_b = 12 - 4 = 8 \text{ V}$$

now,

$$2V_x = 8 - 0$$

$$\therefore V_x = 4 \text{ V}$$

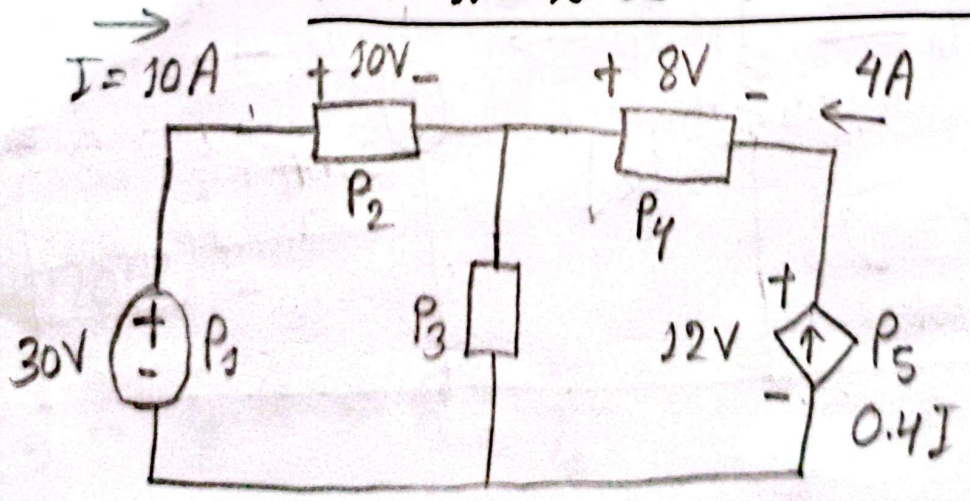
For element 3,

$$P = V_x I = (4 \times 2)\text{ W}$$

$$= 8 \text{ W}.$$

The power is positive, so element 3 is absorbing the power. Ans

Ans to the Q. NO-7



We know that,

$$\Sigma P = 0$$

$$\Rightarrow P_1 + P_2 + P_3 + P_4 + P_5 = 0$$

$$\Rightarrow (-30 \times 10) + (10 \times 10) + (P_3 - (4 \times 8) - (2 \times 4) = 0$$

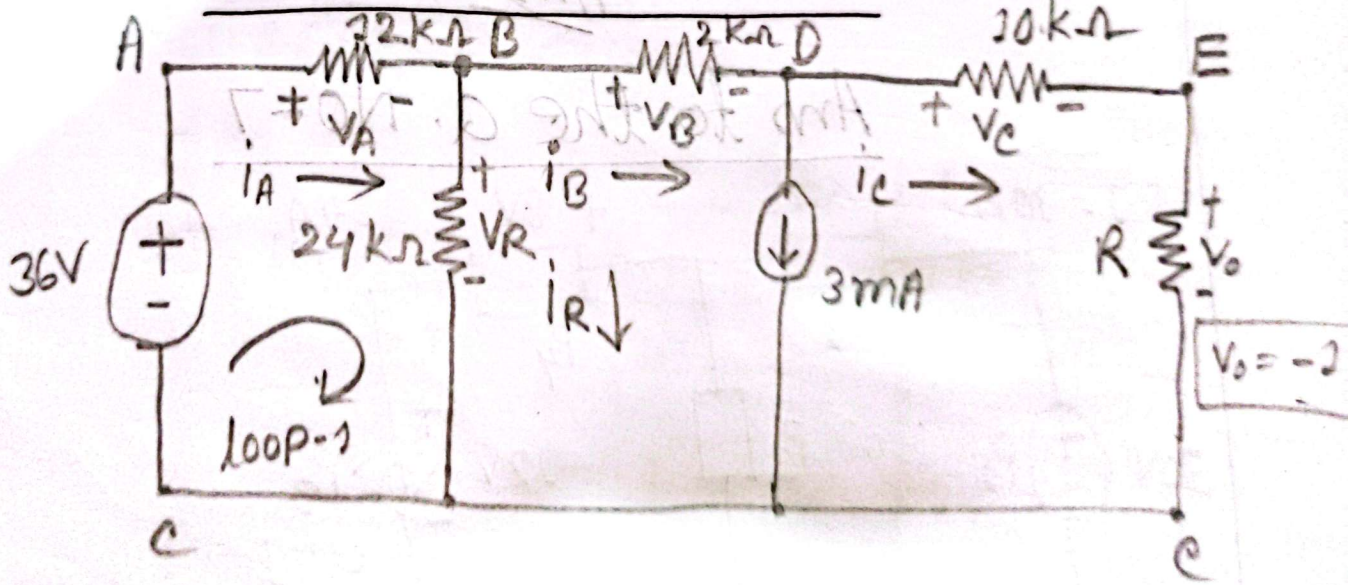
$$\Rightarrow -300 + 100 + P_3 - 32 - 48 = 0$$

$$\Rightarrow P_3 - 280 = 0$$

$$\therefore P_3 = 280\ w$$

The power of P_3 is positive, So the ~~power~~ element 3 is absorbing the power.

Ans to the Q. No-3



Applying ohm's law,

$V_A = 12 i_A$, $V_R = 24 i_R$, $V_B = 2 i_B$, $V_C = 10 i_C$

Applying KCL to node B, $i_A = i_B + i_R$ ... (i)

Applying KCL to node D, $i_B = 3 + i_C$ ... (ii)

Applying KVL to loop-1,

$$-36 + V_a + V_R = 0$$

$$\Rightarrow -36 + 12 i_A + 24 i_R = 0$$

$$\therefore i_A + 2 i_R = 3 \quad \text{... (iii)}$$

Applying KVL to around the loop,

$$-36 + V_A + V_B + V_C + V_0 = 0$$

$$\Rightarrow -36 + 12 i_A + 2 i_B + 10 i_C + 1 = 0$$

$$\therefore 12 i_A + 2 i_B + 10 i_C = 37 \quad \text{... (iv)}$$

from, (i), (ii), (iii), (iv) $\Rightarrow$ $i_A = \frac{17}{6}$ mA , $i_B = \frac{11}{4}$ mA

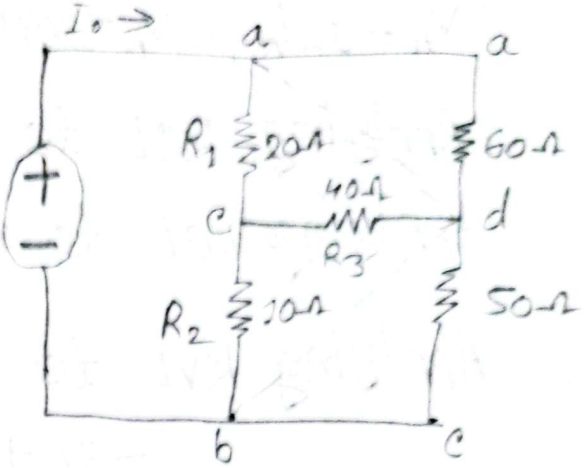
$i_C = -\frac{1}{4}$ mA, $i_R = \frac{1}{12}$ mA

now,

$$V_0 = i_C \cdot R \Rightarrow R = \frac{V_0}{i_C} = \frac{-1}{-1/4} = 4\,k\Omega$$ AND

Ans to the q. No-4

Using wye-Delta trans



$$R_a = \frac{(10\times20)+(10\times40)+(20\times40)}{20}$$

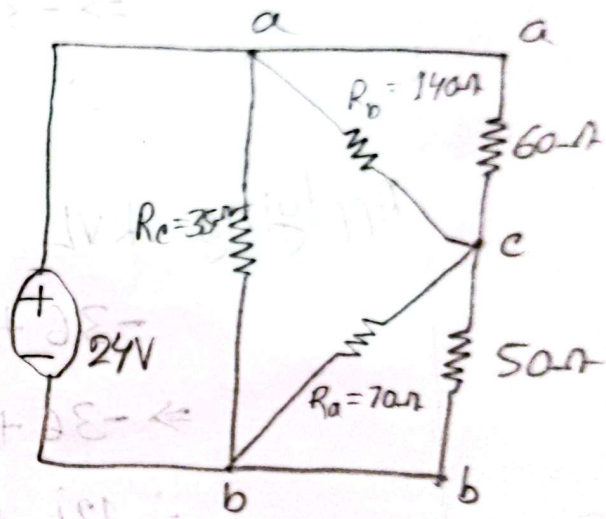
$$= 70\,\Omega$$

$$R_b = \frac{(10\times20)+(10\times40)+(20\times40)}{10}$$

$$= 140\,\Omega$$

$$R_c = \frac{(10\times20)+(10\times40)+(20\times40)}{40}$$

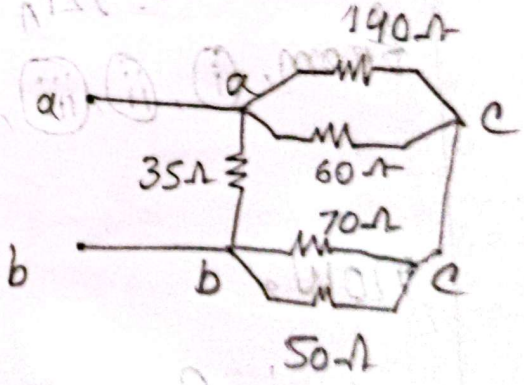
$$= 35\,\Omega$$



$$R_{eq} = 35 \,||\, \{(140\,||\,60)+(70\,||\,60)\}$$

$$= 35 \,||\, \frac{427}{6}$$

$$= 23.46\,\Omega$$



now,

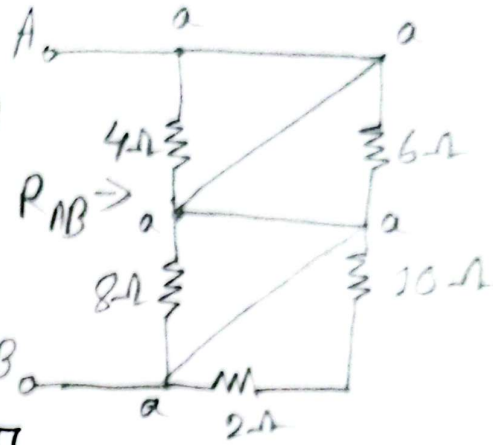
$$I_o = \frac{V}{R_{eq}}$$

$$= \frac{24}{23.46}$$

$$= 1.02 \approx 1\,A \quad \text{Ans}$$

Ans to the Q. No-10

a) A resistor works if there is a voltage difference between its two terminal. In here the resistor ends are connected to same node, the voltage difference across the resistor is 0. So, no current flows through any of the resistor. So, R_{AB} at terminal A-B is 0.

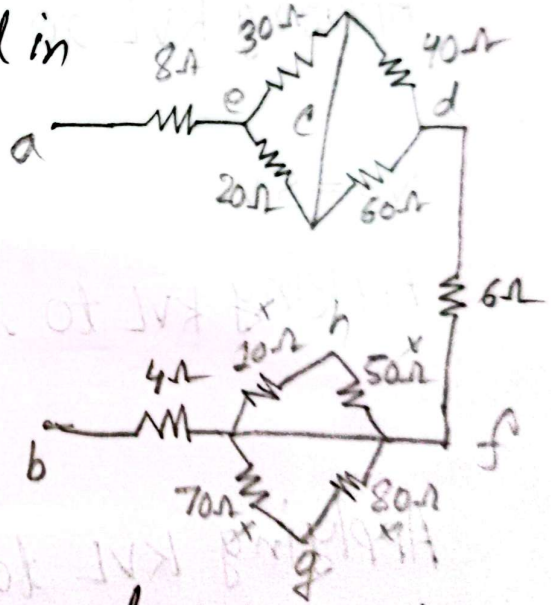


b) 30Ω and 20Ω are connected in parallel.

$$\therefore \frac{1}{R_{P_1}} = \frac{1}{30} + \frac{1}{20} \quad \therefore R_{P_1} = 12\Omega$$

40Ω and 60Ω are connected in parallel,

$$\frac{1}{R_{P_2}} = \frac{1}{40} + \frac{1}{60} \quad \therefore R_{P_2} = 24\Omega$$

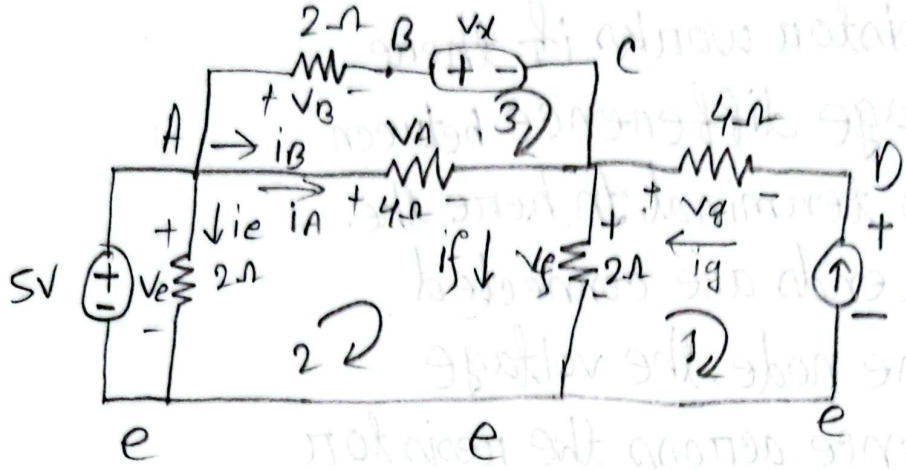


R_{P_1}, R_{P_2}, 8Ω, 6Ω, 4Ω are connected in series.

$$R_S = 8 + 12 + 24 + 6 + 4$$

$$= 54\Omega$$ Ans

Ans to the Q. NO-8



For, 5A current source, $V = \frac{50}{5} = 10V$.

$\therefore V_g = -5 \times 4 = -20V$.

Applying KVL to loop 1, $-V_f + V_g + 10 = 0$

$\Rightarrow V_f = V_g + 10 = -20 + 10 = -10V$

$V_e = 5V$

Applying KVL to loop 2, $-V_e + V_A + V_f = 0$

$\Rightarrow -5 + V_A - 10 = 0$

$\therefore V_A = 15V$.

Applying KVL to loop 3, $V_B + V_x - V_A = 0$

$\Rightarrow V_B + V_x = V_A$

$\Rightarrow V_B + V_x = 15$ ... (i)

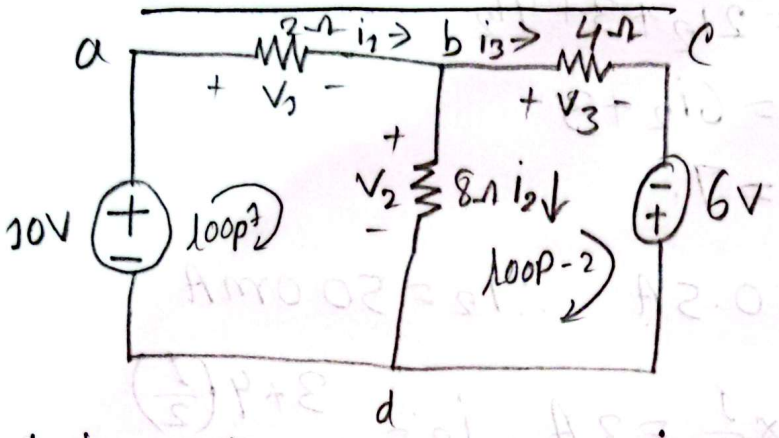
Applying KCL to node c, $i_B + 5 + i_A = i_f$

$\Rightarrow i_B + 5 + \frac{15}{4} = -\frac{10}{2}$ $\therefore i_B = -13.75$ A

$\therefore V_B = -13.75 \times 2 = -27.5\,V$

$\therefore V_x = 15 - V_B = 15 + 27.5 = 42.5\,V$ Ans

Ans to the Q. NO- 9



Applying ohm's law, $V_1 = 2i_1$, $V_2 = 8i_2$, $V_3 = 4i_3$

Applying KCL to node, $i_1 = i_2 + i_3$ ... (i)

Applying KVL to loop-1, $-10 + V_1 + V_2 = 0$

$\Rightarrow V_1 + V_2 = 10$

$\Rightarrow 2i_1 + 8i_2 = 10$

$\Rightarrow i_1 + 4i_2 = 5$ ... (ii)

Applying KVL to loop-2, $V_3 - 6 - V_2 = 0$

$\Rightarrow V_3 - V_2 = 6$

$\Rightarrow 4i_3 - 8i_2 = 6$

$\Rightarrow 2i_3 - 4i_2 = 3$ ... (iii)

from (ii), (iii) $\Rightarrow$

$i_1 = 5 - 4i_2$

$i_3 = \frac{3 + 4i_2}{2}$

(i) ⇒

$i_1 = i_2 + i_3$

$\Rightarrow 5 - 4i_2 = i_2 + \frac{3+4i_2}{2}$

$\Rightarrow 10 - 8i_2 = 2i_2 + 3 + 4i_2$

$\Rightarrow 10 - 8i_2 = 6i_2 + 3$

$\Rightarrow 14i_2 = 7.$

$\therefore i_2 = 0.5A \quad \therefore i_2 = 500mA$

$\therefore i_1 = 5 - 4 \times \frac{1}{2} = 3A, \quad i_3 = \frac{3+4\left(\frac{1}{2}\right)}{2} = 2.5A.$

$\therefore V_1 = 2 \times 3 = 6V, \quad V_2 = 8 \times \frac{1}{2} = 4V, \quad V_3 = 2.5 \times 4 = 10V$ And