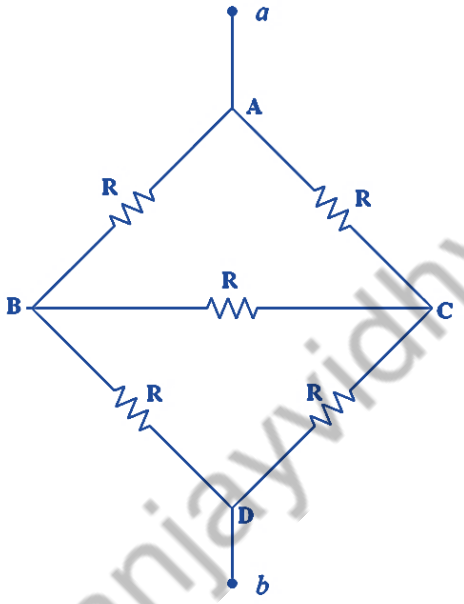
Electrical Science: 2021-22
Tutorial 2
Mesh and Node Analysis

By Dr. Sanjay Vidhyadharan

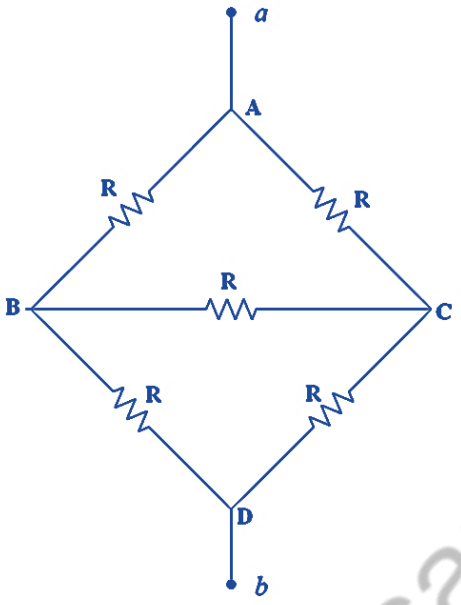
Problem 1

Find the equivalent resistance

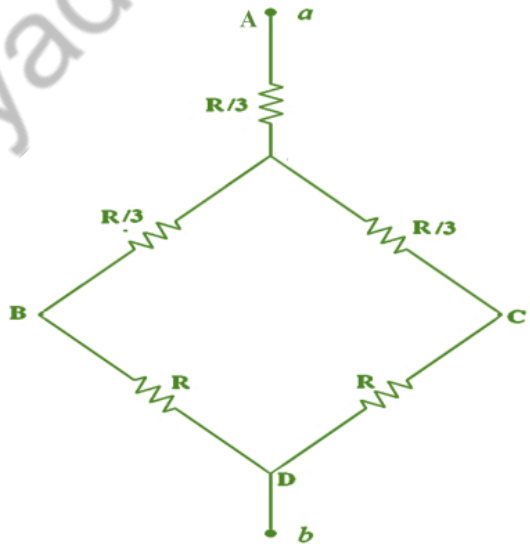


Problem 1

Find the equivalent resistance

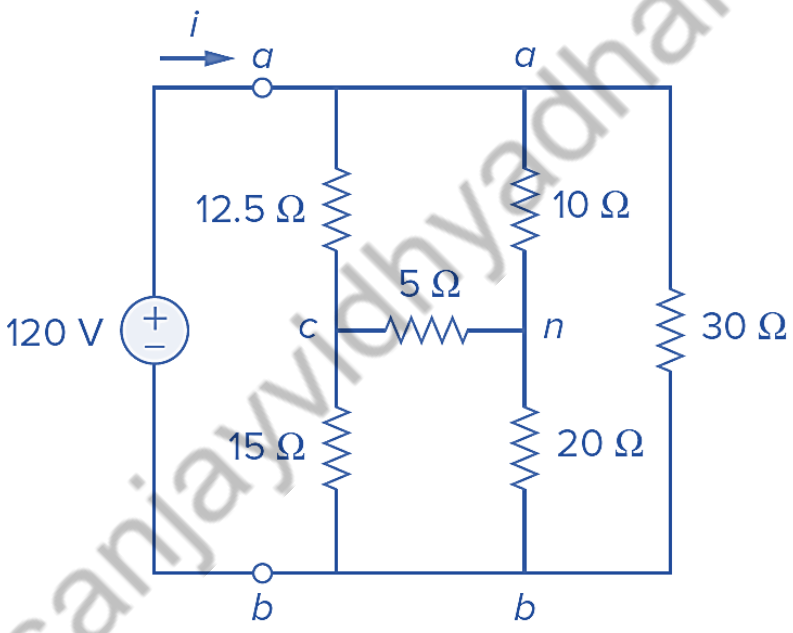


$$R_Y = \frac{R \times R}{R + R + R} = R/3$$



Problem 2

Obtain the equivalent resistance R_{ab} for the circuit and use it to find current i.

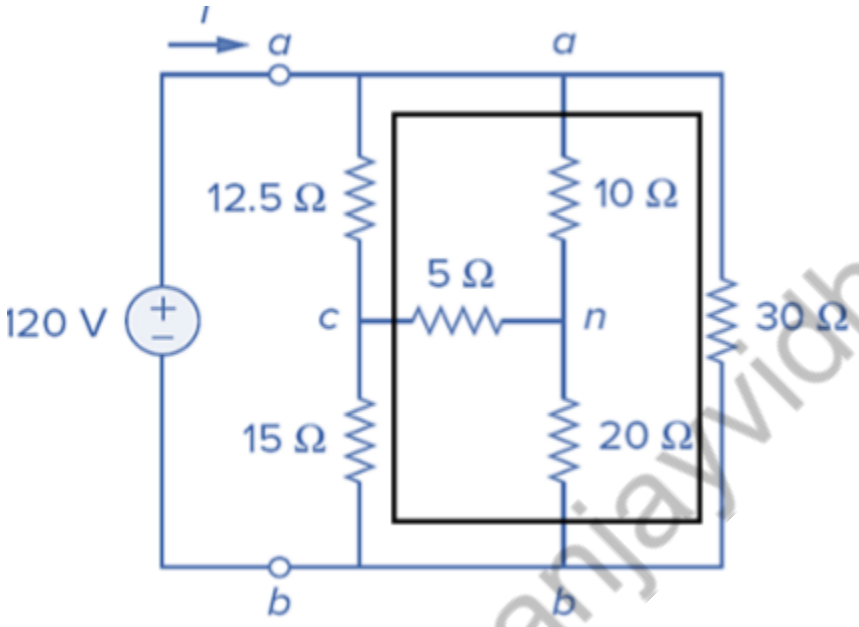


Problem 2

Three ways in which star connection may appear in a circuit.

Problem 2

Obtain the equivalent resistance R_{ab} for the circuit and use it to find current i.



$$R_1 = 5 + 10 + \frac{5 \times 10}{20} = 17.5 \ ohms$$

(comes in parallel with 12.5 Ω)

$$R_2 = 5 + 20 + \frac{5 \times 20}{10} = 35 \ ohms$$

(comes in parallel with 15 Ω)

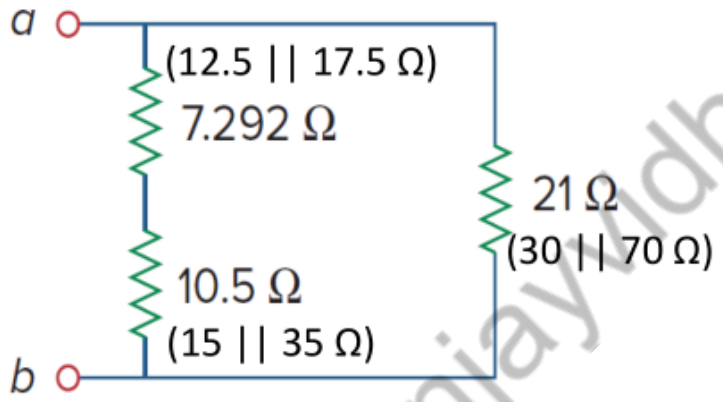
$$R_3 = 10 + 20 + \frac{10 \times 20}{5} = 70 \ ohms$$

(comes in parallel with 30 Ω)

Problem 2

Obtain the equivalent resistance R_{ab} for the circuit and use it to find current i.

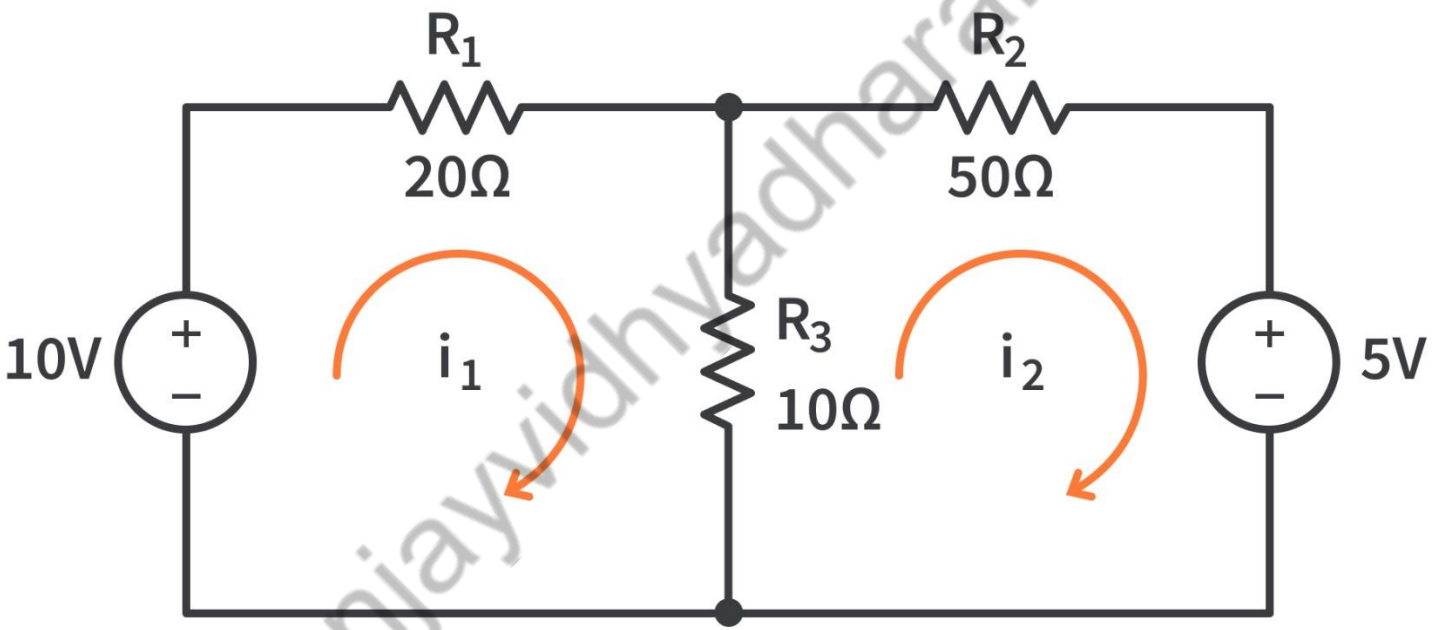
Combining the three pairs of resistors in parallel, we obtain.



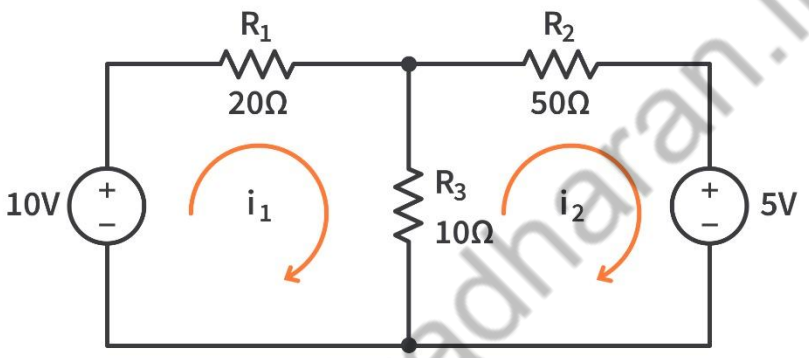
$$R_{ab} = (7.292 + 10.5) \prod 21 = \frac{17.792 \times 21}{17.792 + 21} = 9.632 \text{ ohms}$$

$$i = \frac{v_s}{R_{ab}} = \frac{120}{9.632} = 12.458A$$

Problem 3



Problem 3



$$10\text{V} = \text{i}_1(20) + (\text{i}_1 - \text{i}_2)(10)$$

$$10\text{V} + 10\text{i}_2 = 30\text{i}_1$$

$$\text{i}_1 = \frac{1}{3}\text{V} + \frac{1}{3}\text{i}_2$$

$$-5\text{V} = (\text{i}_2 - \text{i}_1)(10) + \text{i}_2(50)$$

$$-60\text{i}_2 + 10\text{i}_1 = 5$$

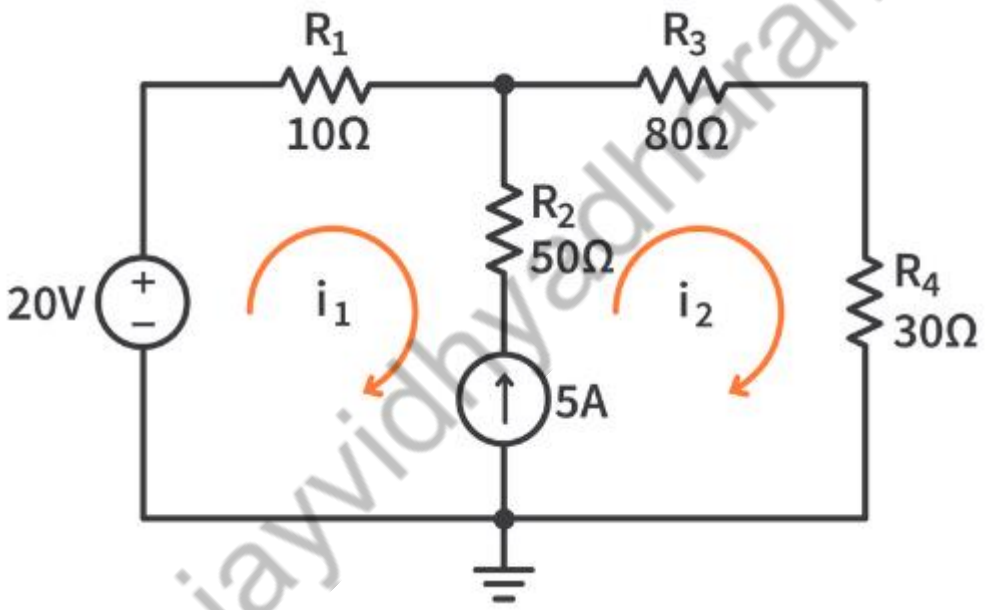
$$-60\text{i}_2 + 10(\frac{1}{3} + \frac{1}{3}\text{i}_2) = 5$$

$$\text{i}_2 = -\frac{5}{170} = -\frac{1}{34} = -0.0294\text{A}$$

$$\text{i}_1 = \frac{1}{3} + \frac{1}{3}(-0.0294) = 0.324$$

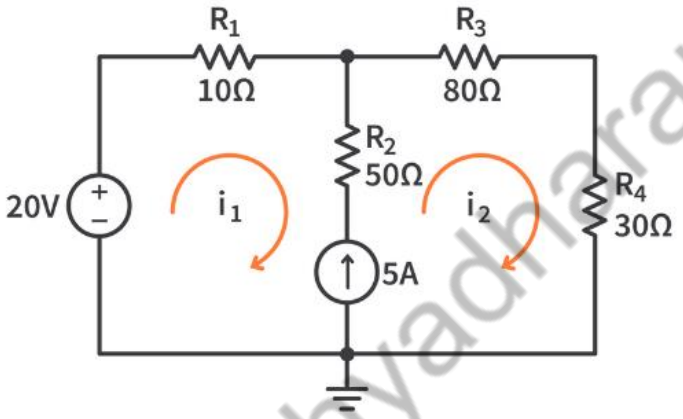
Problem 4

Supermesh



Problem 4

Supermesh



$$+20\text{V} - 10\text{i}_1 - 80\text{i}_2 - 30\text{i}_2 = 0$$

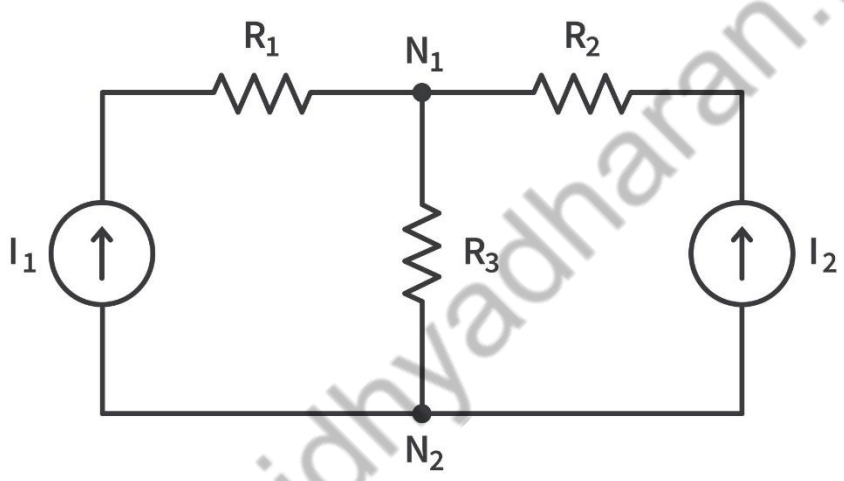
$$20 = 10\text{i}_1 + 110\text{i}_2$$

$$5 + \text{i}_1 - \text{i}_2 = 0$$

$$\text{i}_1 = -\frac{53}{12}\text{A}$$

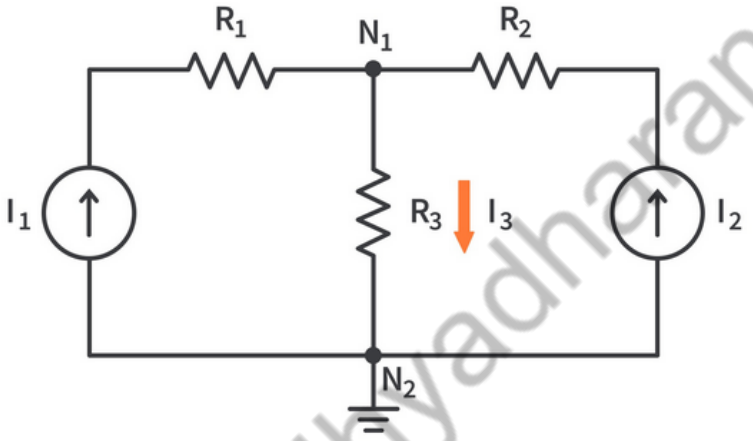
$$\text{i}_2 = \frac{7}{12}\text{A}$$

Problem 5



$R_1 = 10 \quad R_2 = 20 \quad R_3 = 30 \quad I_1 = 1A \quad I_2 = 2A$

Problem 5

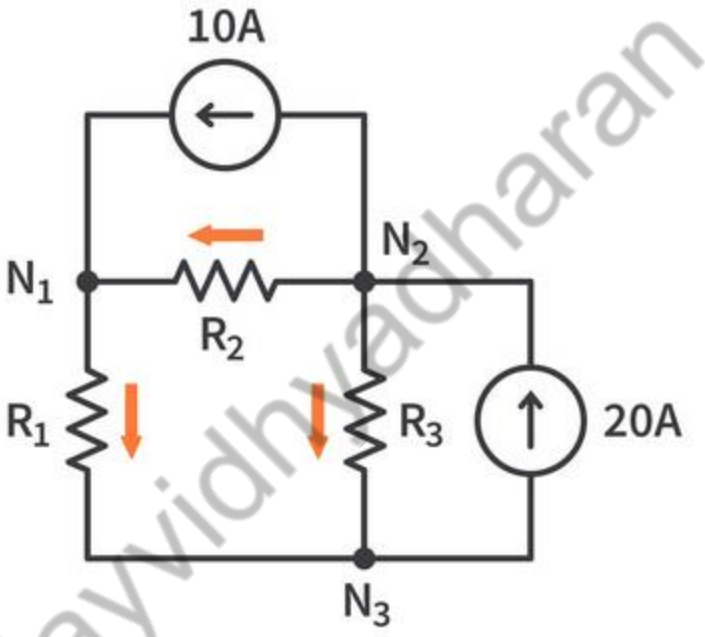


$R_1 = 10 \quad R_2 = 20 \quad R_3 = 30 \quad I_1 = 1A \quad I_2 = 2A$

$$I_1 + I_2 = I_3$$

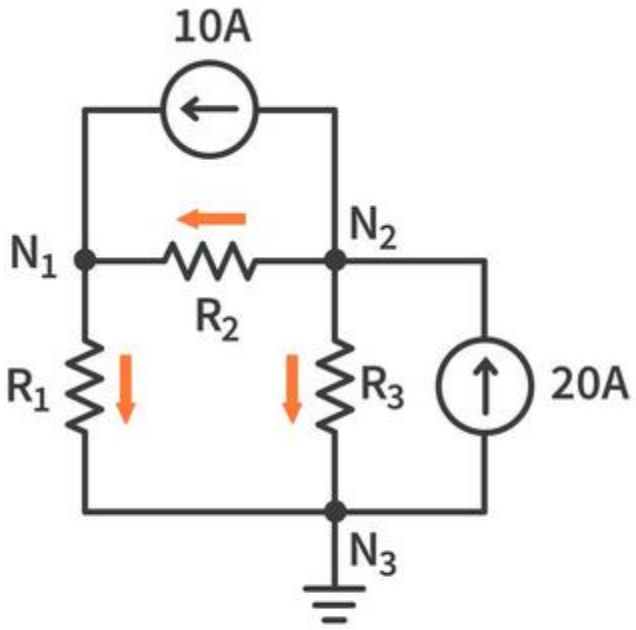
$$V_1 = 90$$

Problem 6



$R_1 = 10 \quad R_2 = 20 \quad R_3 = 30$

Problem 6



$R_1 = 10 \quad R_2 = 20 \quad R_3 = 30$

At Node1:

$$10A + \frac{(V_2 - V_1)}{20} - \frac{V_1}{10} = 0$$

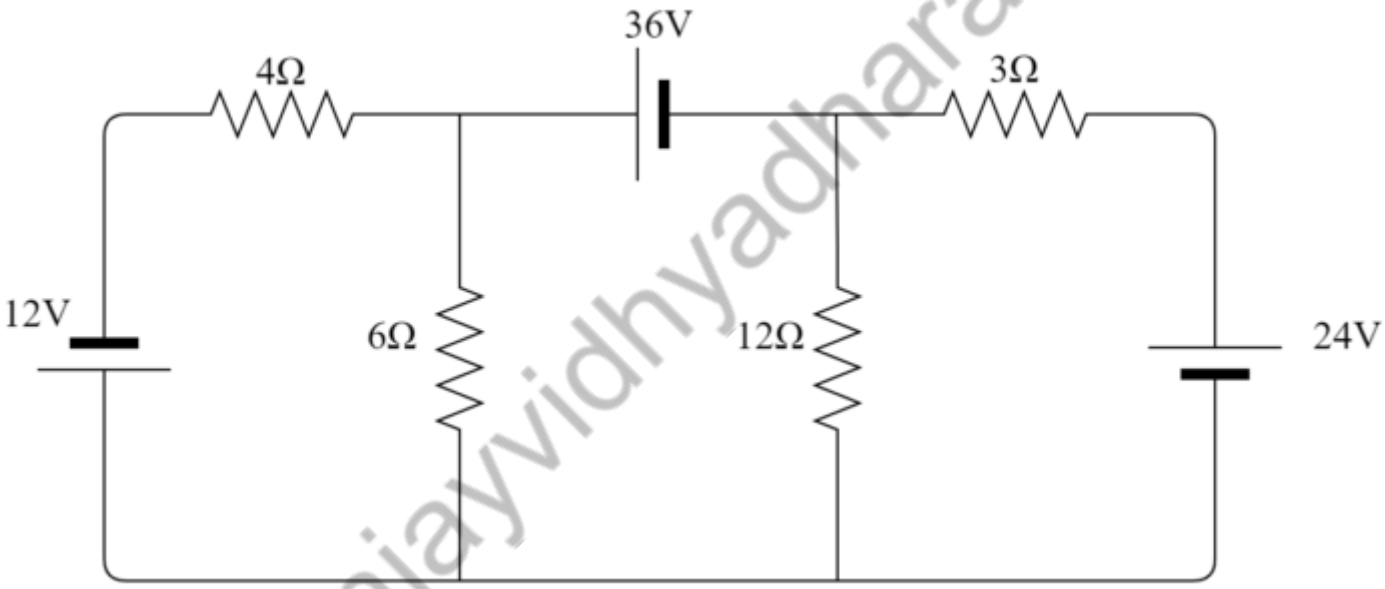
At Node2:

$$20A - 10A - \frac{(V_2 - V_1)}{20} - \frac{V_2}{30} = 0$$

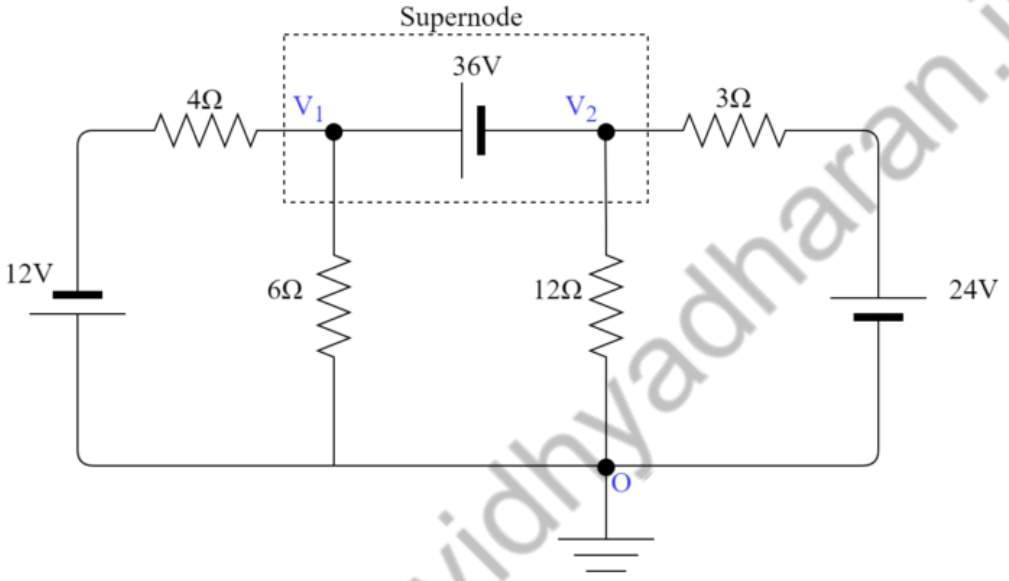
$$V_1 = \frac{400}{3}$$

$$V_2 = 200$$

Problem 7



Problem 7



$$V_1 - V_2 = 36 \ldots (i)$$

$$I_1 + I_2 + I_3 + I_4 = 0$$

$$or, \frac{V_1 + 12}{4} + \frac{V_1}{6} + \frac{V_2}{12} + \frac{V_2 - 24}{3} = 0 \ldots (ii)$$

$$V_1 = 24\, Volts$$

$$V_2 = -12\, Volts$$

Thank you