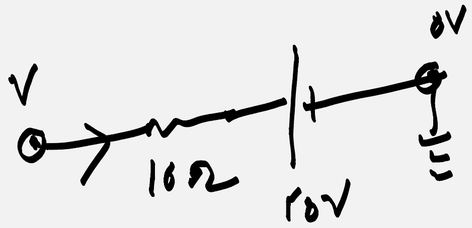
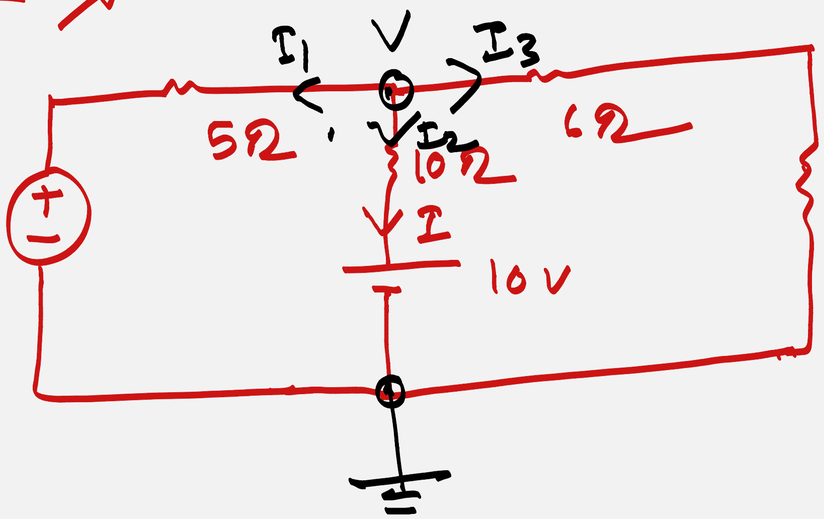
Nodal Analysis / Node Voltage method

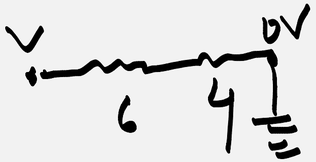


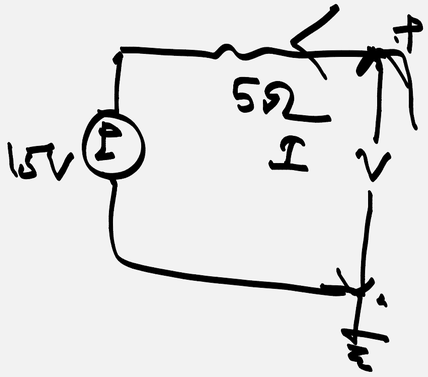
I_2

Ex : 1

Find $I_{10\Omega}$ using nodal analysis?







$$I_1 + I_2 + I_3 = 0$$

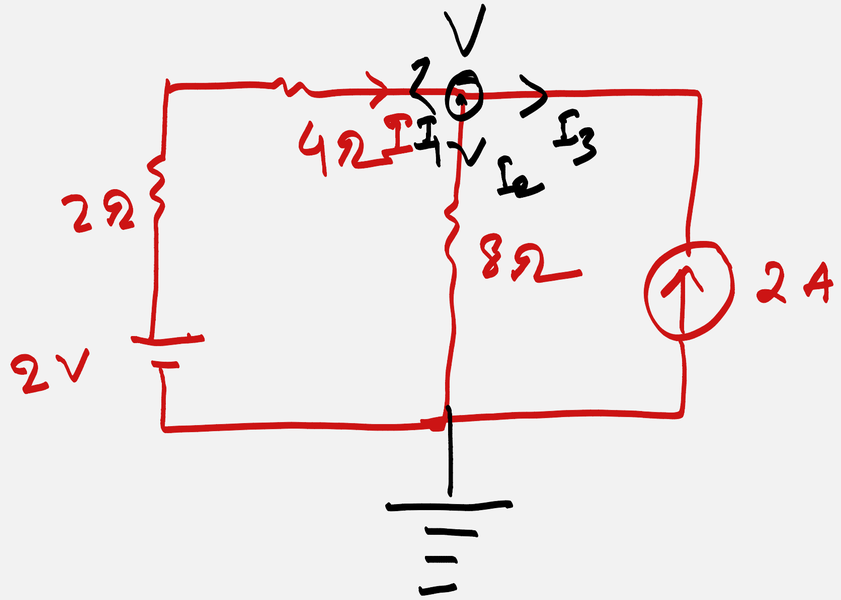
$$\frac{V-15}{5} + \frac{V-10}{10} + \frac{V}{10} = 0$$

$$\frac{2V-30+V-10+V}{10} = 0$$

$$V = 10V$$

$$I_{10\Omega} = \frac{V-10}{10} = 0A$$

Q.2.



Find $I_{4\Omega}$ using nodal analysis?

$$I_1 + I_2 + I_3 = 0$$

$$\Rightarrow \frac{V-2}{6} + \frac{V}{8} - 2 = 0$$

$$\Rightarrow \frac{4V - 8 + 3V - 48}{24} = 0$$

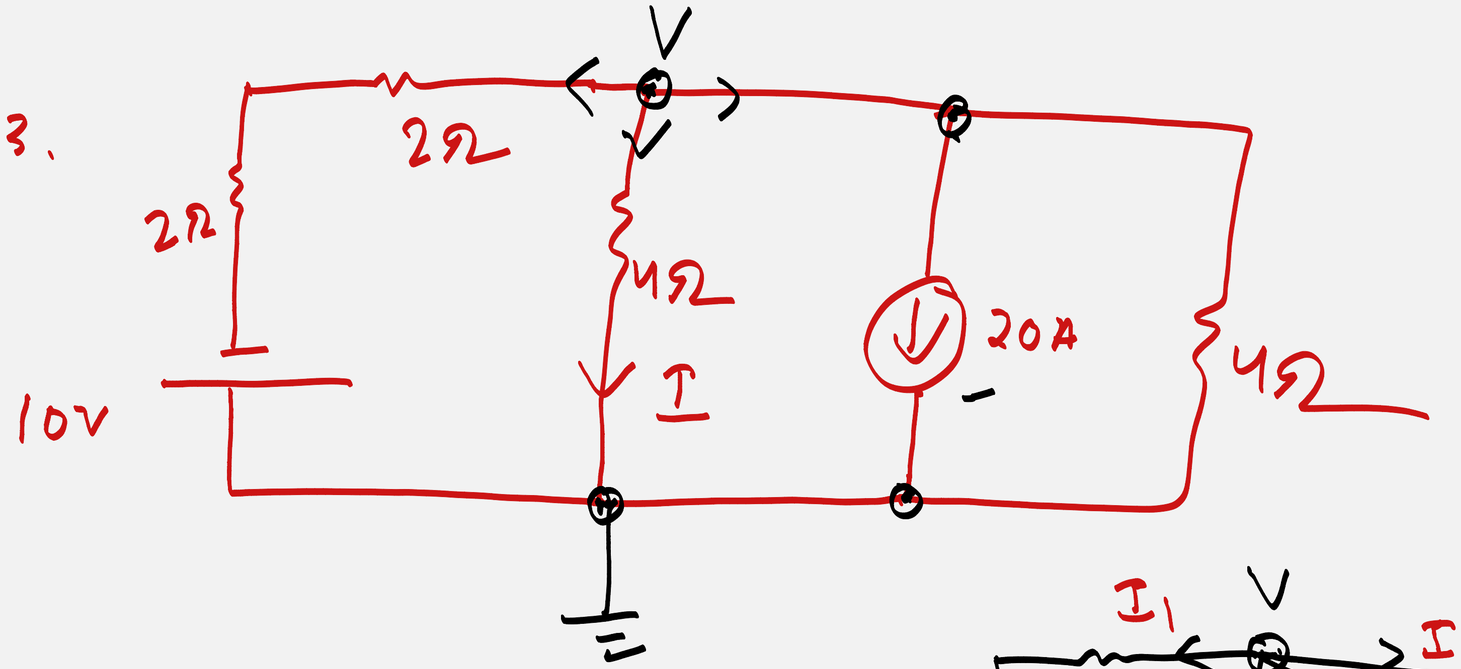
$$7V - 56 = 0$$

$$V = \frac{56}{7} = 8V$$

$$I_1 = \frac{V-2}{6} = 1A$$

$$I = -I_1 = -1A$$

Q.3.



Find I using nodal analysis?

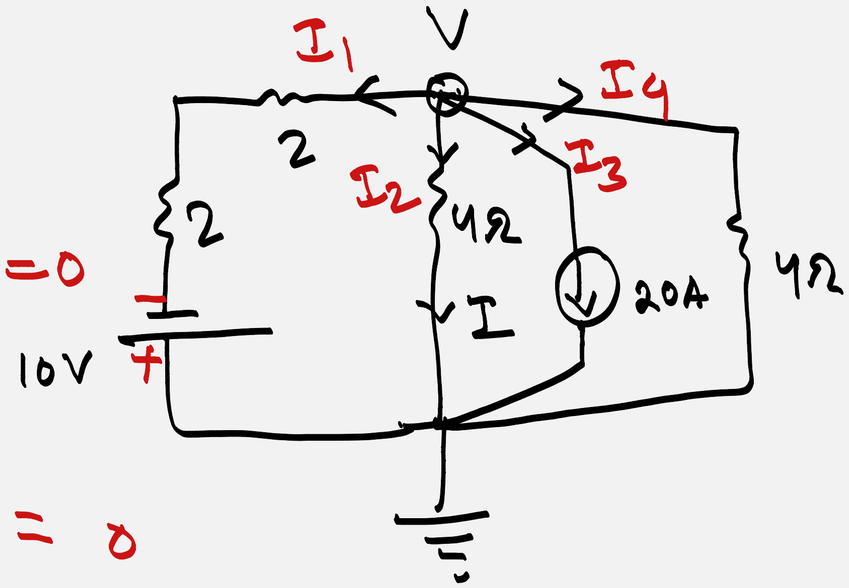
$$\frac{V+10}{4}+\frac{V}{4}+20+\frac{V}{4}=0$$

$$\frac{V+10+V+80+V}{4}=0$$

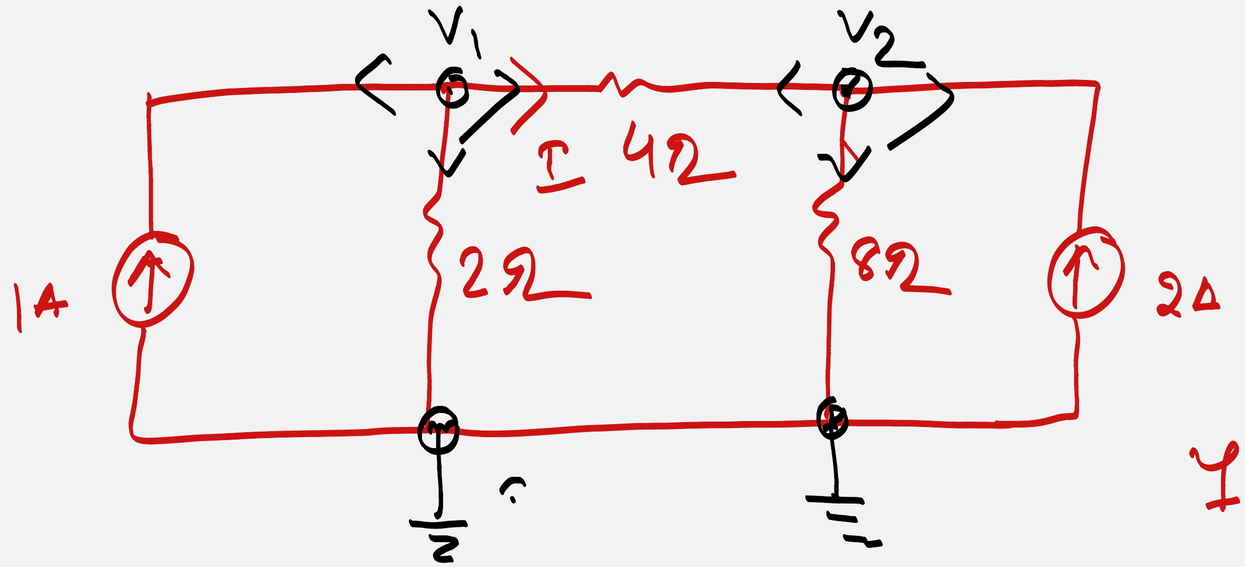
$$\frac{3V+90}{4}=0$$

$$V=-\frac{90}{3}=-30V$$

$$I=\frac{V}{4}=-\frac{30}{4}=-7.5A$$



Q.4.



Find $I_{4\Omega}$ using nodal analysis?

At junction 2

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

$$\Rightarrow \frac{2V_2 - 2V_1 + V_2 - 16}{8} = 0$$

$$\Rightarrow \boxed{-2V_1 + 3V_2 = 16} \quad \text{---(2)}$$

At junction 1

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

$$\Rightarrow \frac{-4 + 2V_1 + V_1 - V_2}{4} = 0$$

$$\Rightarrow \boxed{3V_1 - V_2 = 4} \quad \text{---(1)}$$

$$V_1 = \frac{\Delta_1}{\Delta}$$

$$\Delta = \begin{bmatrix} 4 & -1 \\ 16 & 3 \end{bmatrix}$$

$$3 \times [3V_1 - V_2 = 4] \quad \text{——} \quad (1)$$

$$-2V_1 + 3V_2 = 16 \quad \text{——} \quad (2)$$

$$V_1 = \begin{bmatrix} 3 & -1 \\ -2 & 3 \end{bmatrix}$$

$$7V_1 = 28\,V$$

$$\boxed{V_1 = 4V}$$

$$3V_1 - V_2 = 4V$$

$$12 - V_2 = 4$$

$$\boxed{V_2 = 8V}$$

$$V_2 = \frac{\Delta_2}{\Delta} = \frac{\begin{bmatrix} 3 & 4 \\ -2 & 16 \end{bmatrix}}{\begin{bmatrix} 3 & -1 \\ -2 & 3 \end{bmatrix}}$$

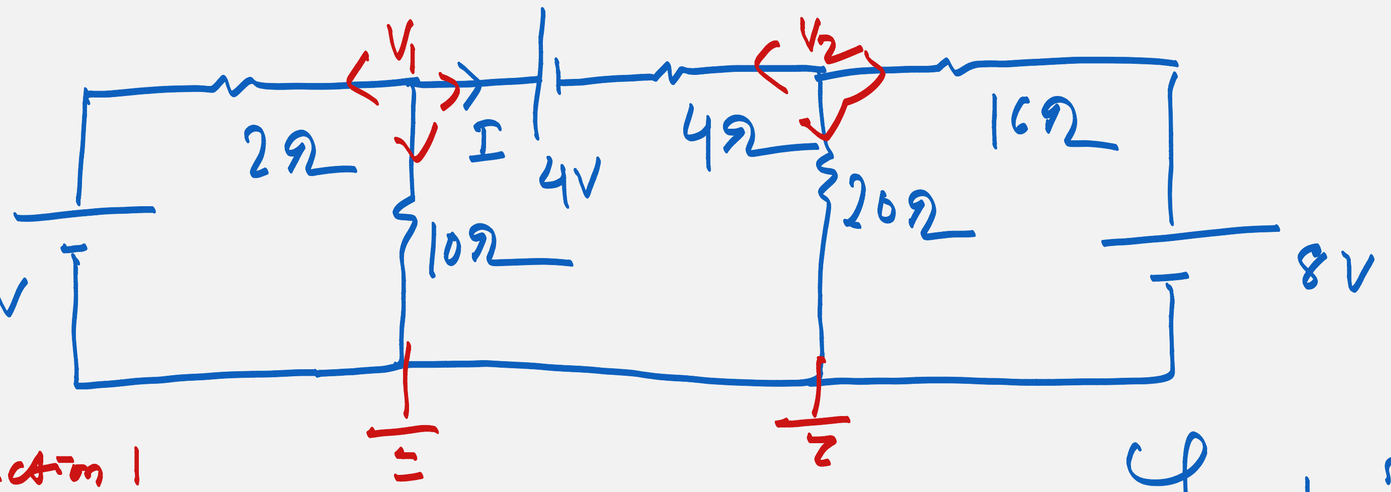
$$I = \frac{V_1 - V_2}{4}$$

$$\boxed{I = -1A}$$

$V_1 = 9.82V$

$V_2 = 5.39V$

Q.5



Find $I_{4\Omega}$ using nodal analysis?

4 | 20 | 16

4 | 5 | 4

4 | 1 | 5 | 4

$$I = \frac{V_1 - 4 - V_2}{4} = 0.105A$$

Junction 2'

$$\frac{V_2 + 4 - V_1}{4} + \frac{V_2}{20} + \frac{V_2 - 8}{16} = 0$$

$$20V_2 + 80 - 20V_1 + 4V_2 + 5V_2 - 40 = 0$$

80

$$-20V_1 + 29V_2 = -40$$

Junction 1

$$\frac{V_1 - 12}{2} + \frac{V_1}{10} + \frac{V_1 - V_2 - 4}{4} = 0$$

$$10V_1 - 120 + 2V_1 + 5V_1 - 5V_2 - 20 = 0$$

20

$$17V_1 - 5V_2 = 140 \quad \text{—— (1)}$$

2 | 2 | 10 | 4

1 | 5 | 2