BEE

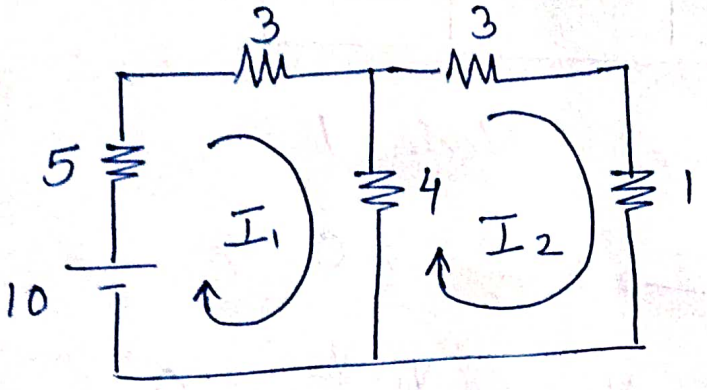
FE- 1A-1

[Mech/ Auto/ ECS, EXTC]

16/12/2022

Q1

a)



KVL in mesh I

$$-3I_1 - 4(I_1 - I_2) + 10 - 5I_1 = 0$$

$$-12I_1 + 4I_2 = -10 \quad \text{— (1)}$$

KVL in mesh II

$$-3I_2 - 1I_2 - 4(I_2 - I_1) = 0$$

$$4I_1 - 8I_2 = 0 \quad \text{— (2)}$$

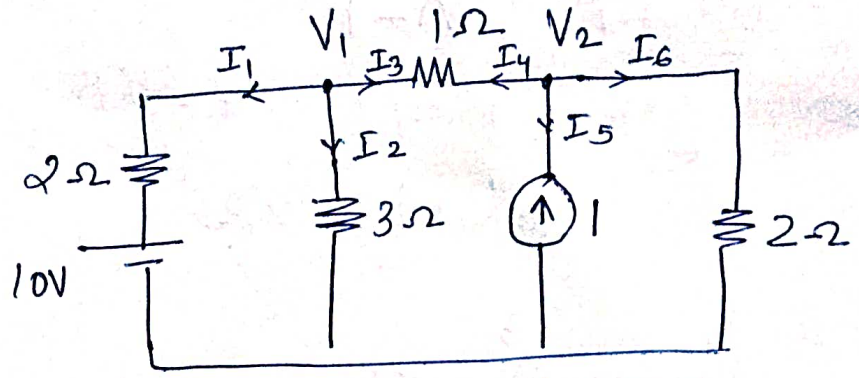
$$I_1 = \cancel{0.5}\,A \quad 1\,A$$

$$I_2 = 0.5\,A$$

Current through $1\Omega = \underline{0.5\,A}$

Q1

a)



Apply KCL at Node-1

$$I_1 + I_2 + I_3 = 0$$

$$\frac{V_1 - 10}{2} + \frac{V_1}{3} + \frac{V_1 - V_2}{1} = 0$$

$$V_1\left[\frac{1}{2} + \frac{1}{3} + 1\right] + V_2\left[-1\right] = 5 \quad \text{— (1)}$$

Apply KCL at Node 2

$$I_4 + I_5 + I_6 = 0$$

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

$$V_1\left[-1\right] + V_2\left[1 + \frac{1}{2}\right] = 1 \quad \text{— (2)}$$

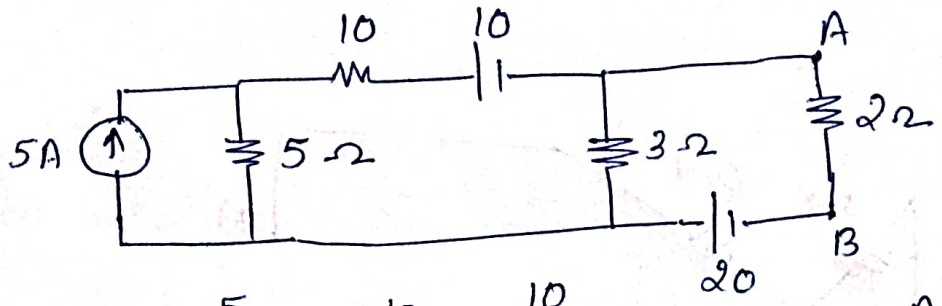
$$V_1 = 4.86\ V$$

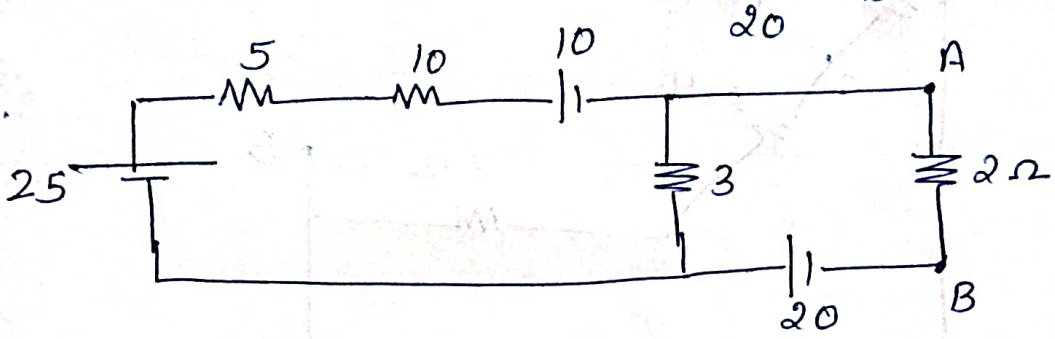
$$V_2 = 3.9\ V$$

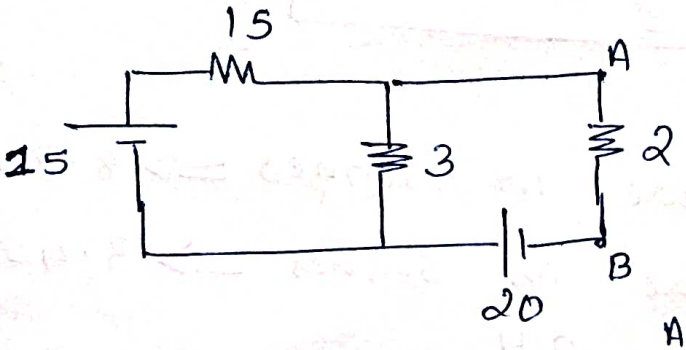
Current through $1\Omega = \frac{V_1 - V_2}{1}$

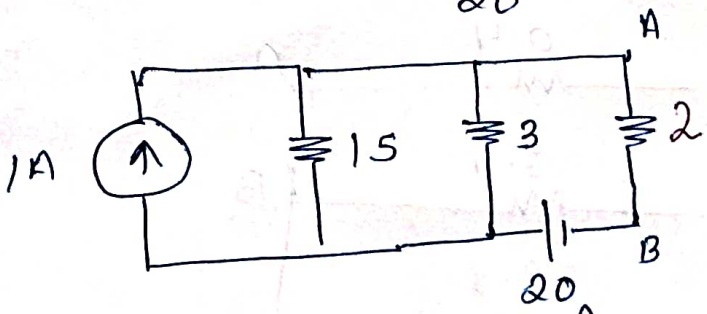
$$= \underline{\underline{0.96A}}$$

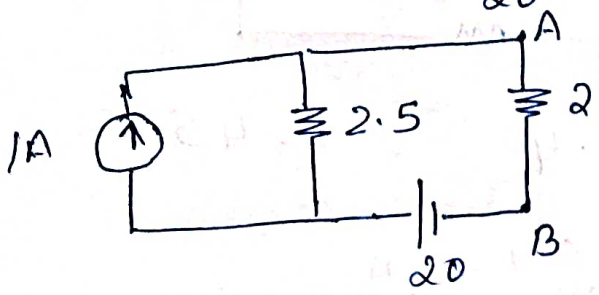
Q1
c











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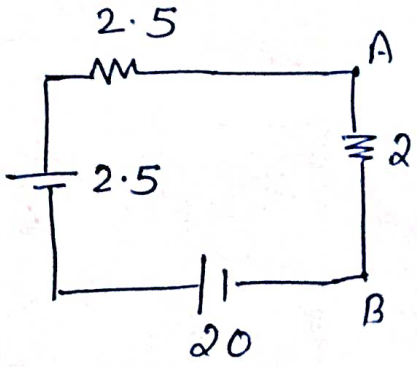
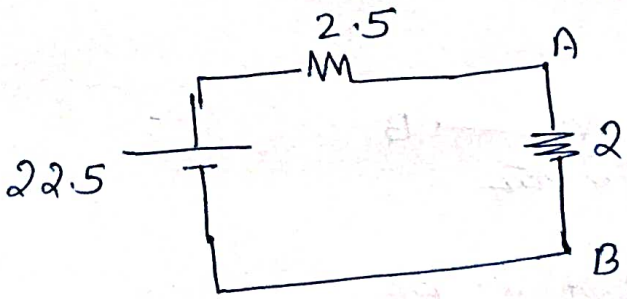
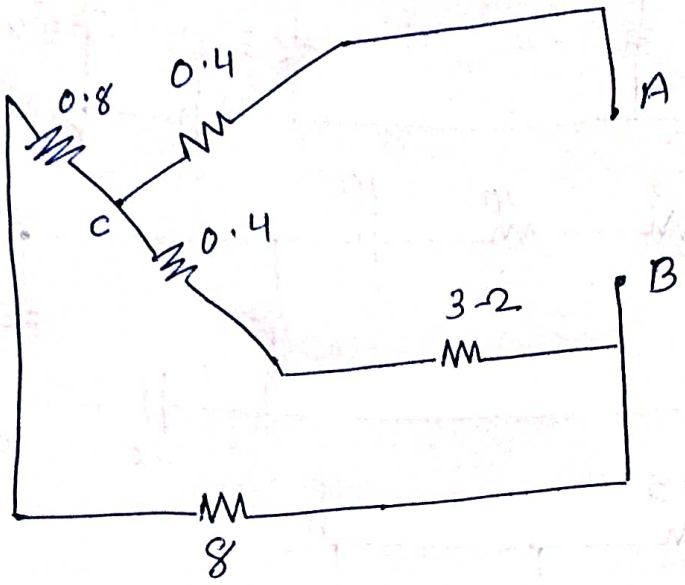




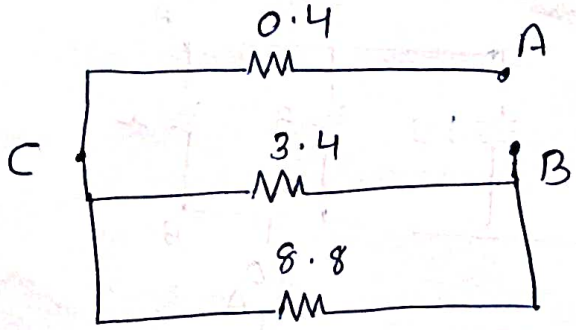
$$I_{2\Omega} = \frac{22.5}{2.5+2} = \underline{\underline{5\ A}}$$

Q1
f

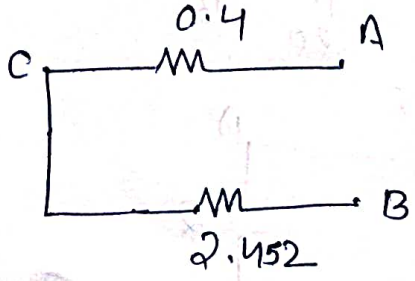


0.8 & 8 are in series $\Rightarrow 8.8\,\Omega$ (B&C)

0.4 & 3 are in series $\Rightarrow 3.4\,\Omega$ (B&C)



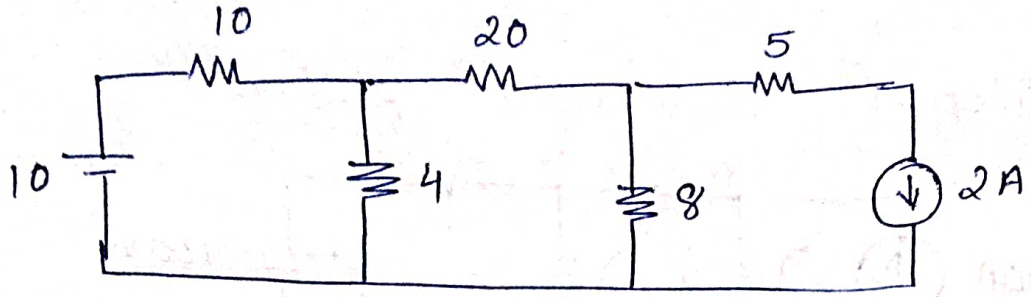
$8.8 \,||\, 3.4 = 2.45$



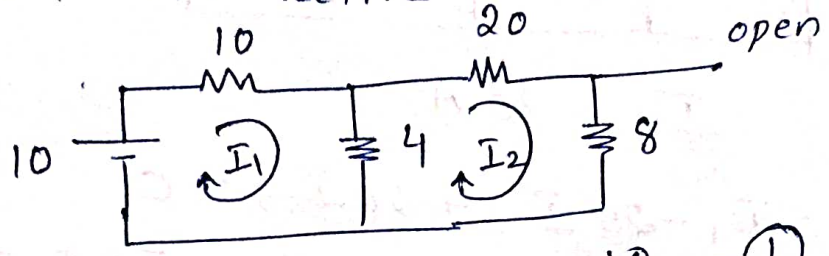
$R_{AB} = 0.4 + 2.452$

$= \underline{2.852}$

Q2
a



Step-1 10V active



$$-14 I_1 + 4 I_2 = -10 \quad -(1)$$

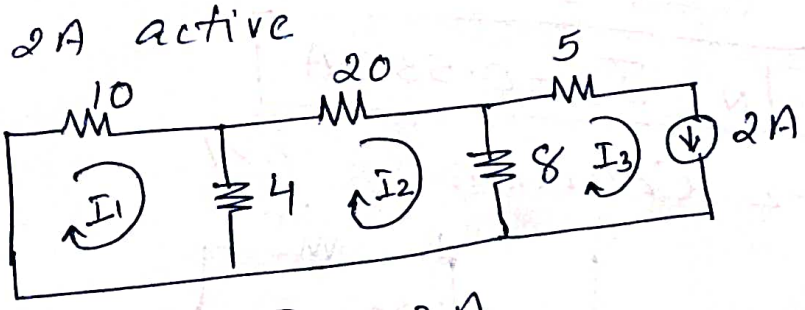
$$4 I_1 - 32 I_2 = 0 \quad -(2)$$

$I_1 = 0.741$

$I_2 = 0.093$

$I'_{20} = I_2 = \underline{0.093 (\rightarrow)}$

Step-2 2A active



$I_3 = 2A$

$$-14 I_1 + 4 I_2 = 0 \quad -(1)$$

$$4 I_1 - 32 I_2 + 8 I_3 = 0$$

$$4 I_1 - 32 I_2 = -16 \quad -(2)$$

$I_1 = 0.15 A$

$I_2 = 0.52 A$

$I''_{20} = 0.52 A (\rightarrow)$

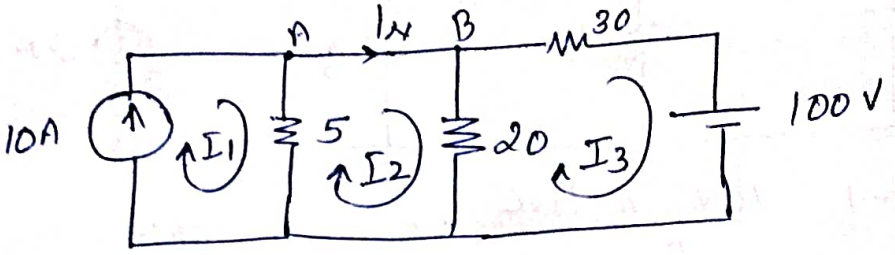
$I_{20} = I'_{20} + I''_{20}$

$= 0.093 + 0.52$

$= \underline{0.613 A (\rightarrow)}$

Q2 C

Step-1 Calculation of I_N



$I_1 = 10\ A$

$5I_1 - 25I_2 + 20I_3 = 0$

$-25I_2 + 20I_3 = -50$ — (1)

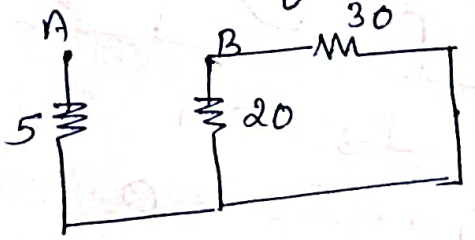
$20I_2 - 50I_3 = 100$ — (2)

$I_2 = 0.588\ A = I_N$

$I_3 = -1.765A$

$\boxed{I_N = I_2 = 0.588A}$

Step-2 Calculation of R_N

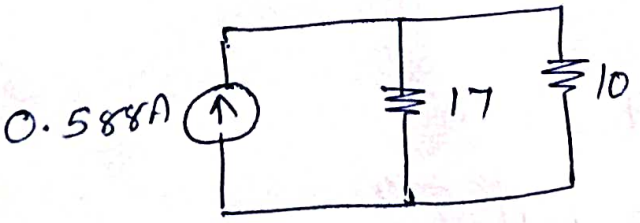


$30 \parallel 20 = 12$

$R_{AB} = 12 + 5 = 17$

$\boxed{R_{AB} = 17\ \Omega}$

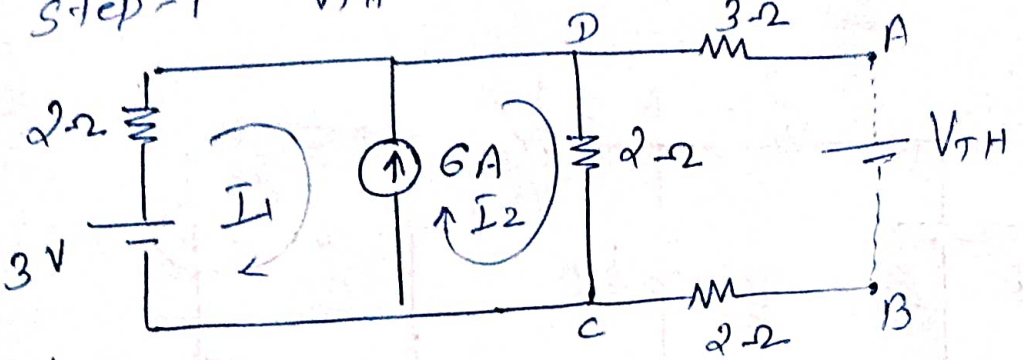
Step-3 Calculation of I_L



$I_{10} = \frac{0.588 \times 17}{17+10}$

$\boxed{I_{10} = 0.37\ A}$

Step-1 V_{TH}



Sol:

$$I_2 - I_1 = 6 \quad \text{— (1)}$$

$$-2I_1 - 2I_2 = -3 \quad \text{— (2)}$$

$$I_1 = -2.25\ A$$

$$I_2 = 3.75\ A$$

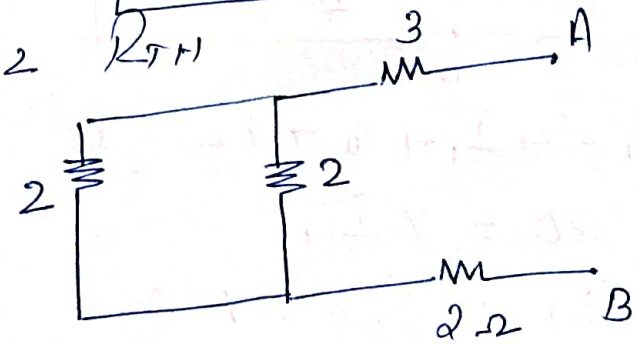
Apply KVL to ABCD

$$-V_{TH} + 2I_2 = 0$$

$$-V_{TH} = -2 \times 3.75$$

$$\boxed{V_{TH} = 7.5\ V}$$

Step-2 R_{TH}



$(2||2)+3+2$

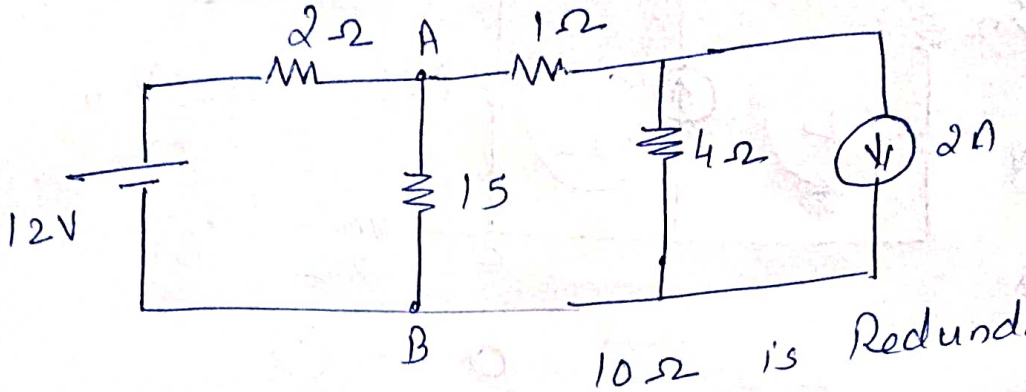
$$R_{AB} = 6\ \Omega$$

$$\boxed{R_L = R_{TH} = 6\ \Omega}$$

$$P_{max} = \frac{V_{TH}^2}{4R_{TH}} = \frac{7.5^2}{4 \times 6} = 2.344$$

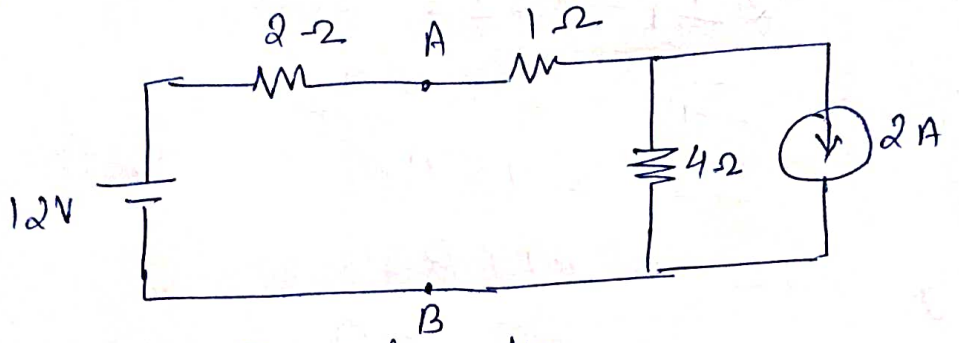
$$\boxed{P_{max} = 2.344\ \text{Watts}}$$

Q_{3_b}

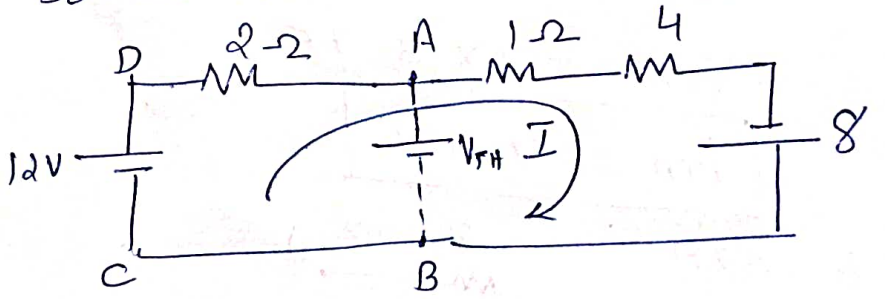


10Ω is Redundant

Step-1 V_{TH}



By some Transformation,



$$-2I_1 - 1I_1 - 4I_1 + 8 + 12 = 0$$

$$20 = 7I_1$$

$$I_1 = 2.857\ A$$

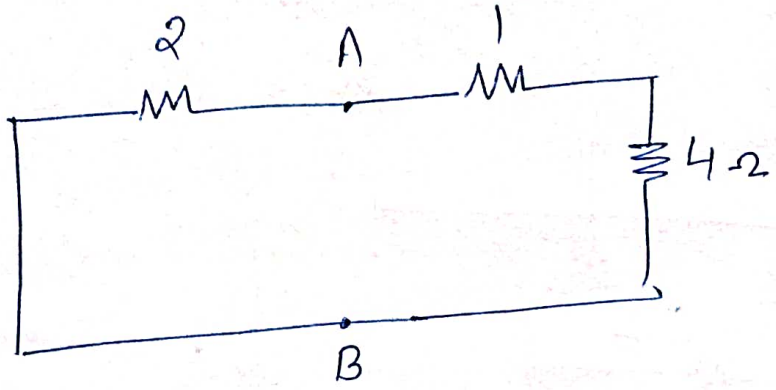
Apply KVL to ABCD

$$-2I_1 - V_{TH} + 12 = 0$$

$$-V_{TH} = -12 + 2 \times 2.857$$

$$\boxed{V_{TH} = 6.2857\ V}$$

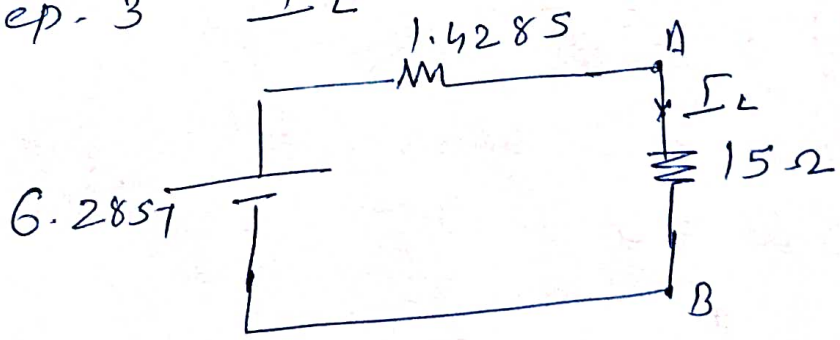
Step - 2 R_{TH}



$$(1+4) \,||\, 2 = \left[\frac{1}{5} + \frac{1}{2}\right]^{-1}$$

$$\boxed{R_{AB} = R_{TH} = 1.4285\ \Omega}$$

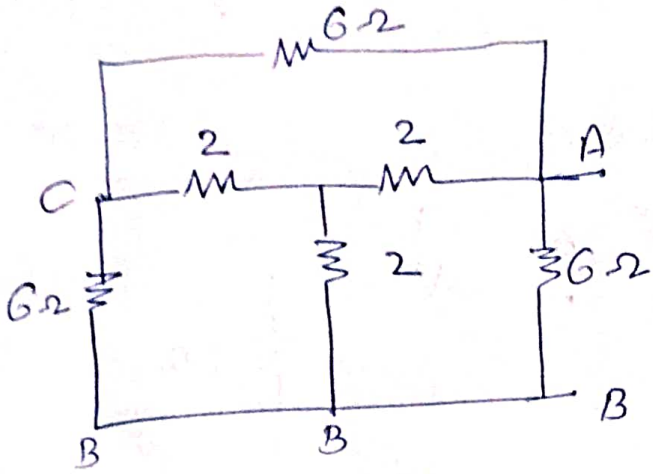
Step - 3 I_L

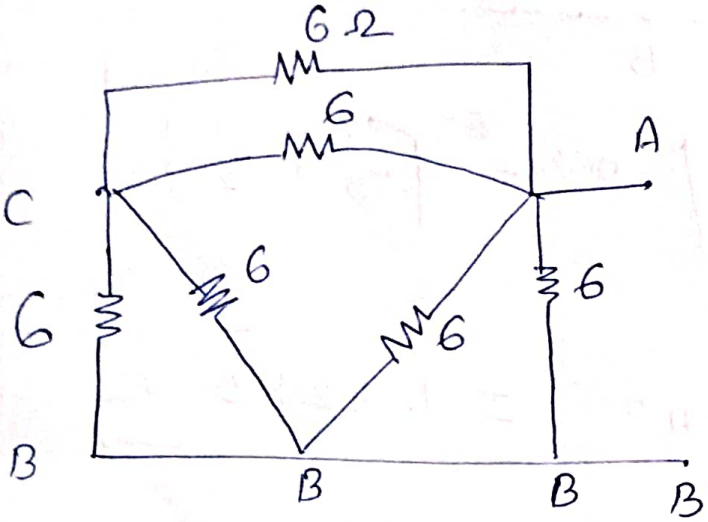


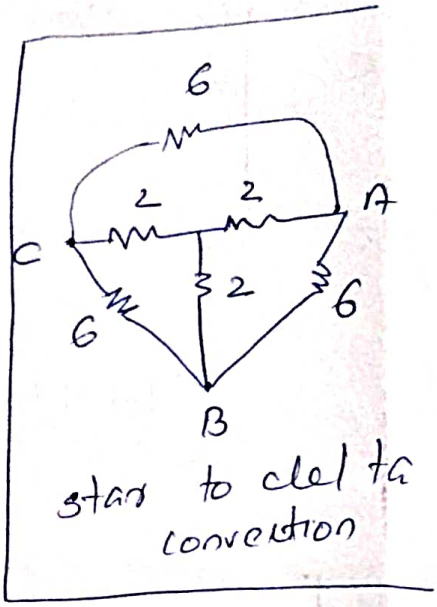
$$I_{15\Omega} = \frac{6.2857}{1.4285+15}$$

$$= 0.3826\ A$$

Q 3 C







$6 \,||\, 6 = 3$ (between A & C)

$6 \,||\, 6 = 3$ (between C & B)

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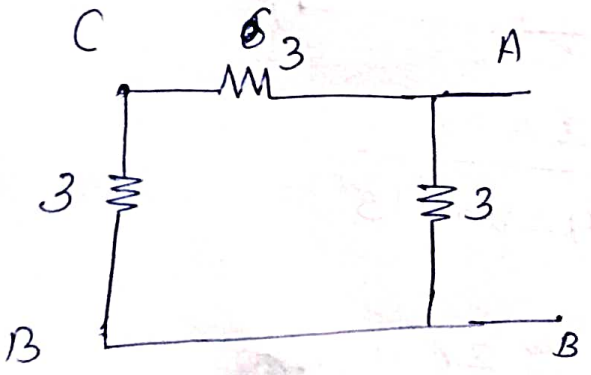

$(3+3) \,||\, 3 = 6 \,||\, 3$

$$R_{AB} = 2\,\Omega$$