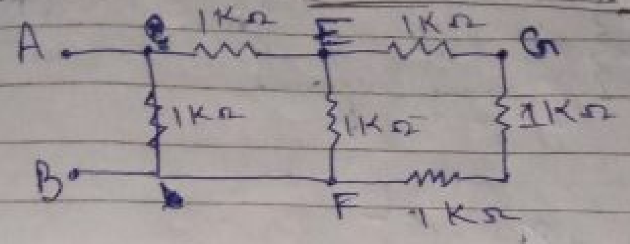
Anmol Baranwal --2820208

BEE Assignment No. 1

Ans1.

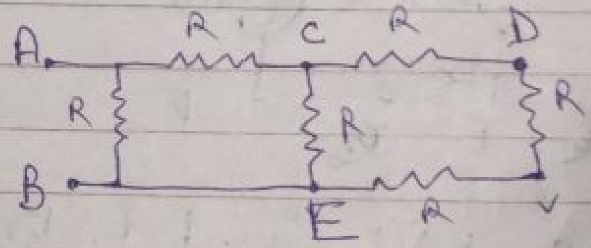


(i) $R_{AB} = ?$

$R_{EF} \Rightarrow \frac{3 \times 1}{4} K\Omega$

$R_{AB} \Rightarrow \frac{1 \times \left(\frac{3}{4} + 1\right)}{1 + \left(\frac{3}{4} + 1\right)} \Rightarrow \frac{7}{11} K\Omega$

(ii) ~~$R_{EG} = ?$~~ $R_{CD} = ?$



$(R = 1K\Omega)$

~~$R_{CE} \Rightarrow$~~

calculating effective resistance b/w terminals C and E

$R_{CE} \Rightarrow \frac{2}{3} K\Omega$

now effective resistance b/w C and D

$R_{CD} \Rightarrow \frac{1 \times \left(\frac{2}{3} + 2\right)}{1 + \left(\frac{2}{3} + 2\right)} \Rightarrow \frac{8}{11} K\Omega$

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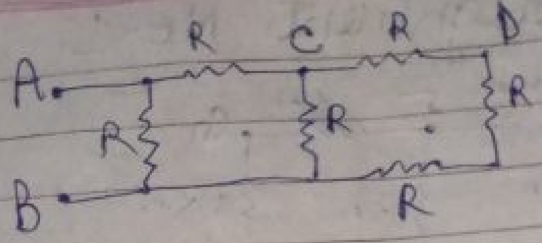
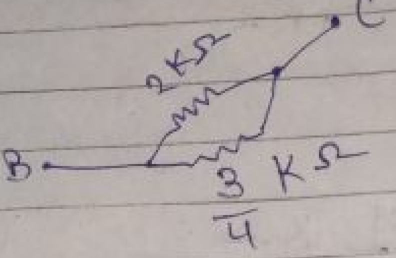
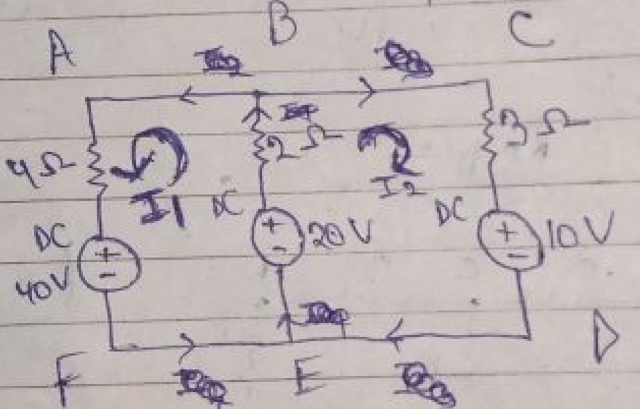
(iii) $(R = 1\,k\Omega)$





$$R_{BC} \Rightarrow \frac{2 \times \frac{3}{4}}{2 + \frac{3}{4}} \Rightarrow \frac{6}{11}\,k\Omega$$

Ans2.



applying KVL in FEBAF

$$\cancel{-20 + 2I_1 + 4I_2 + 40 = 0}$$

$$\cancel{I_1 + 2I_2 + 10 = 0}$$

~~applying~~

$$-20 + 2(I_1 + I_2) + 4I_1 + 40 = 0$$

$$6I_1 + 2I_2 = -20$$

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$$3I_1 + I_2 = -10 \quad -(1)$$

applying KVL in DEBCD

$$-20 + 2(I_1 + I_2) + 3I_2 + 10 = 0$$

$$2I_1 + 5I_2 = 10 \quad -(2)$$

solving (1) and (2)

$$15I_2 - 2I_2 = 30 + 20$$

$$13I_2 = 50$$

$$I_2 \Rightarrow \frac{50}{13} \text{ A}$$

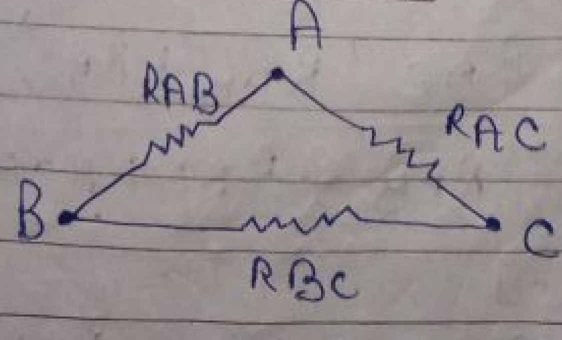
$$I_1 = \left(-10 - \frac{50}{13}\right) \times \frac{1}{3}$$

$$\Rightarrow -\frac{60}{13} \text{ A}$$

$\therefore$ current in 2Ω

$$I_1 + I_2 \Rightarrow -\frac{10}{13} \text{ A}$$

Ans 3. Delta to star $\Rightarrow$



$\rightarrow$ Delta

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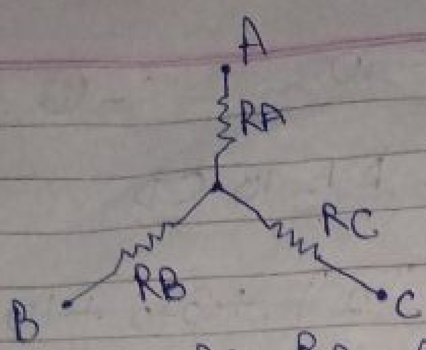

→ Star

here R_A, R_B, R_C ~~is~~ are in terms of R_{AB}, R_{BC}, R_{CA}

Equivalent resistance b/w terminal A and B for delta connection

$$\frac{1}{R} = \frac{1}{R_{AB}} + \frac{1}{R_{BC}+R_{AC}}$$

$$R_\Delta \Rightarrow \frac{R_{AB}\cdot(R_{BC}+R_{AC})}{R_{AB}+R_{BC}+R_{AC}}$$

Resistance b/w terminal A and B for star connection $\Rightarrow R_A+R_B$

$$R_A+R_B = \frac{R_{AB}(R_{BC}+R_{AC})}{R_{AB}+R_{BC}+R_{CA}} \quad -(1)$$

similarly, $$R_B+R_C = \frac{R_{BC}(R_{AB}+R_{CA})}{R_{AB}+R_{BC}+R_{CA}} \quad -(2)$$

$$R_A+R_C = \frac{R_{AC}(R_{AB}+R_{BC})}{R_{AB}+R_{BC}+R_{CA}} \quad -(3)$$

(3) − (2) + (1)

$$2R_A = \frac{-R_{BC}\cdot R_{AB} + R_{AC}\cdot R_{AB} + R_{BC}\cdot R_{AB} + R_{AC}\cdot R_{AB}}{R_{AB}+R_{BC}+R_{CA}}$$

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$$\left(\therefore R_A = \frac{R_{AB} \cdot R_{CA}}{R_{AB}+R_{BC}+R_{CA}}\right)$$

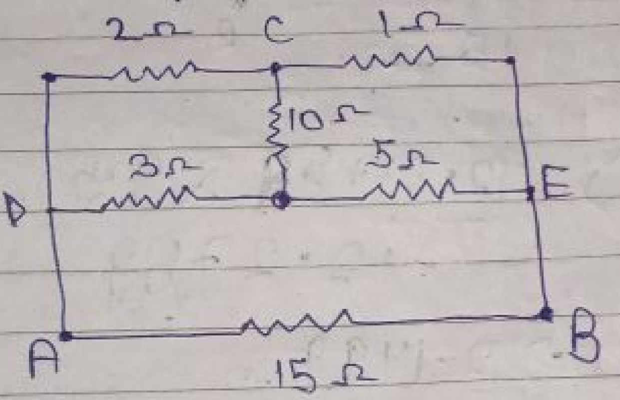
similarly,

$$R_B = \frac{R_{AB} \cdot R_{BC}}{R_{AB}+R_{BC}+R_{CA}}$$

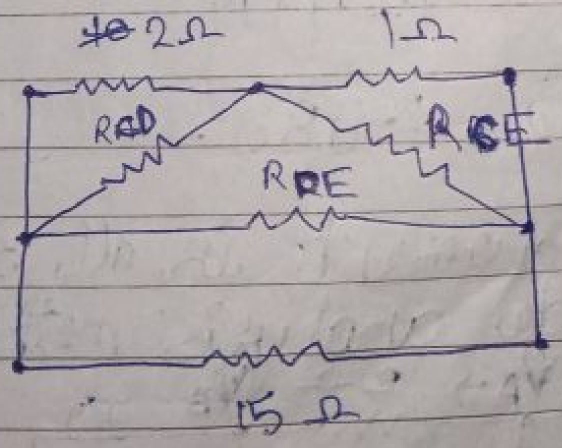
$$R_C = \frac{R_{BC} \cdot R_{CA}}{R_{AB}+R_{BC}+R_{CA}}$$

$R_A = R_B = R_C \Rightarrow R/3$

Ans 4. $R_{AB} \Rightarrow ?$



converting ~~delta CD~~ star CDE to delta



$R_{CE} \Rightarrow 10+5+\frac{10\times5}{3}$

$\Rightarrow \frac{95}{3}\,\Omega$

, $R_{DE} \Rightarrow 3+5+\frac{\cancel{15}\,3}{\cancel{10}\,2}$

$\Rightarrow \frac{19}{2}\,\Omega$

$R_{CD} \Rightarrow 10+3+\frac{10\times3}{5} \Rightarrow 19\,\Omega$

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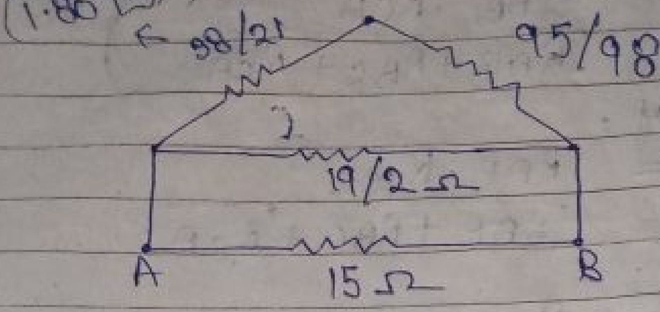
$\dfrac{\frac{95}{3}\times 1}{\frac{95}{3}+1}$

$\Rightarrow 2.7789$

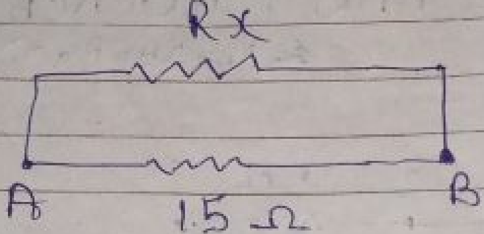
$+$

(0.9693)

(1.8095)



$\frac{19\times 2}{21}$



9.5

$$R_x \Rightarrow \frac{2.7789 \times 9.5}{12.2789}$$

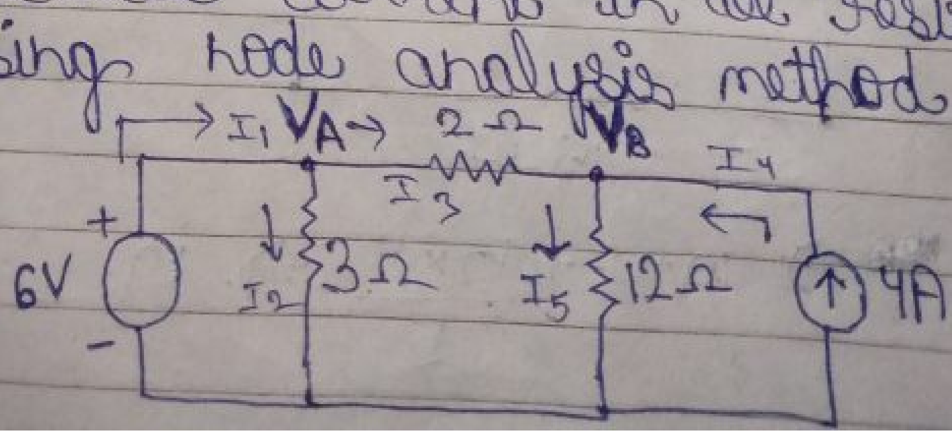
$$\Rightarrow 2.1499\ \Omega$$

$$R_{AB} \Rightarrow \frac{15 \times 2.1499}{17.1499}$$

$$\Rightarrow 1.880\ \Omega$$

<u>Ans 5.</u> Calculate current in all resistances using node analysis method

$\Rightarrow$



$$48 + 36 = 84$$

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using KCL around VA

$\cancel{I_1 = I_2 + I_g}$ $V_A = 6V$

$\cancel{6 = V_A}$

using KCL around V_B

$$I_3 + I_4 = I_5$$

$$\frac{6 - V_B}{2} + 4 = \frac{V_B}{12}$$

$$6(6 - V_B) + 48 = V_B$$

$$36 + 48 = 7V_B$$

$$V_B \Rightarrow \frac{84}{7} \Rightarrow 12V$$

$$I_2 \Rightarrow 2A$$

$$I_3 \Rightarrow -3A \quad , I_5 \Rightarrow 1A$$

... Applying Mesh anal... find current

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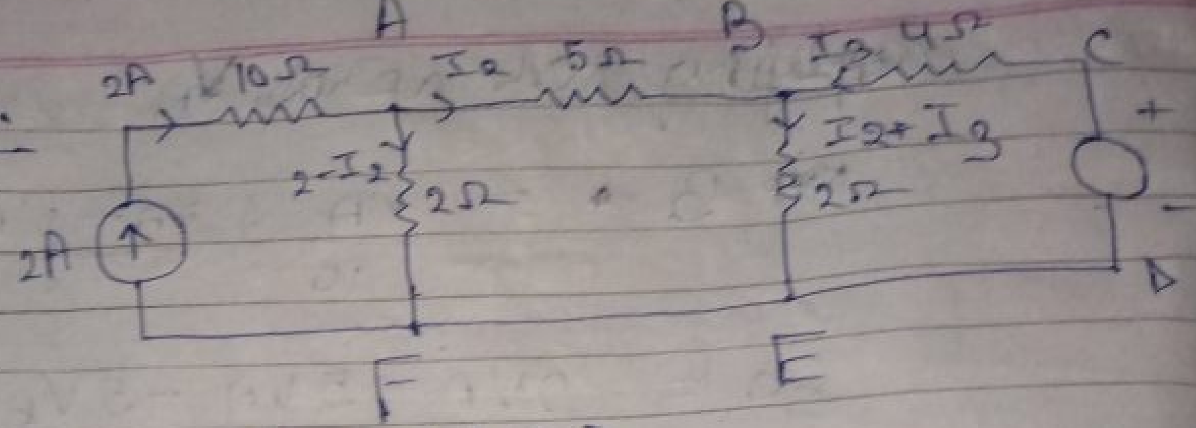
Ans6.



In mesh BCDEB

$$2(I_2+I_3)+4I_3-100=0$$

$$2I_2+6I_3=100$$

$$I_2+3I_3=50 \quad -(1)$$

In mesh ABEFA

$$2(2-I_2)-5I_2-2(I_2+I_3)=0$$

$$\cancel{2 I_2 + 6I_3 =}$$

$$9I_2+2I_3=4 \quad -(2)$$

Solving (1) and (2)

$$(1)\times 2 - 3\times(2)$$

$$-25I_2=88$$

$$I_2 \Rightarrow \frac{-88}{25} A$$

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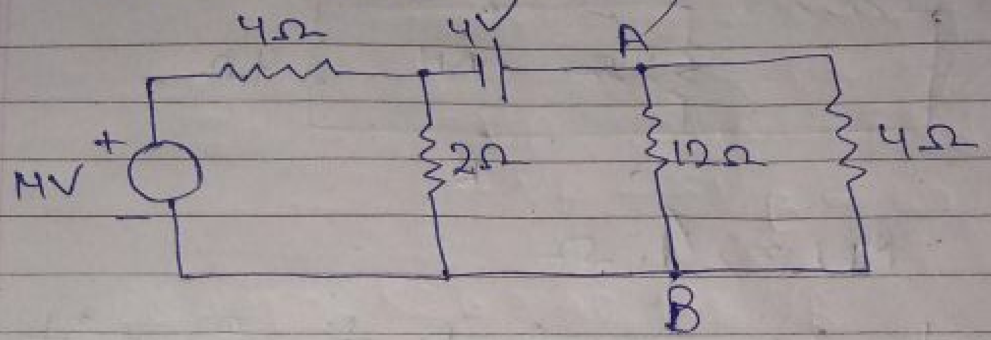
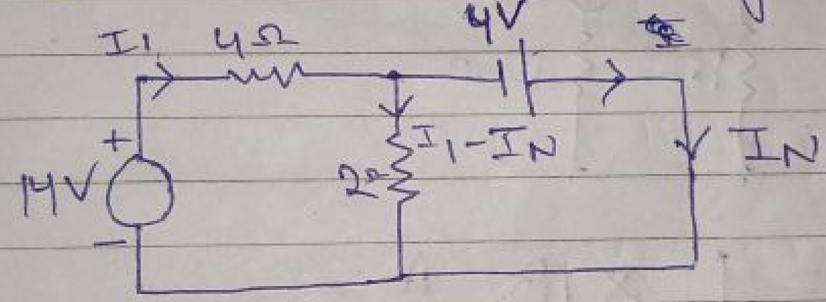
Ans 7. voltage drop across 12 Ω using Norton's theorem ⟹



1. short-circuit terminals across 12Ω and calculating I_N.



applying KVL

$$4I_1 + 2(I_1 - I_N) - 14 = 0$$

$$2(I_1 - I_N) + 4 = 0$$

$$I_N - I_1 = 2$$

$$6I_1 - 2I_N = 14$$

$$I_N = \frac{13}{2} \text{ A}$$

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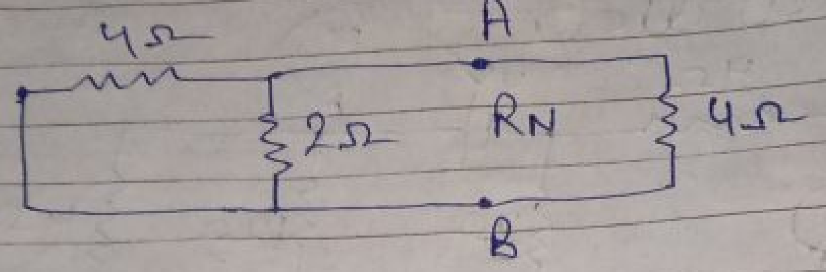
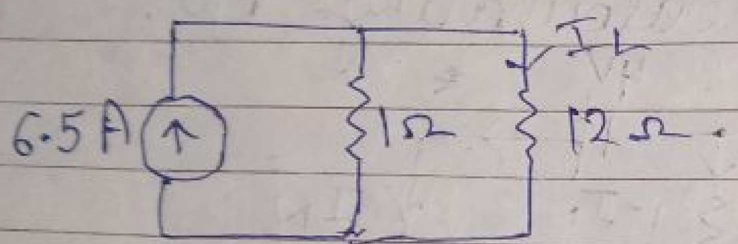
2. effective resistance across 12Ω



$R_N \Rightarrow 1\ \Omega$

3. Norton's equivalent circuit



$I_L = \frac{1}{12} \times \frac{13}{2}$ A

$V_{AB} \Rightarrow \frac{13}{2} \times 12 \times \frac{1}{12} \Rightarrow \underline{\underline{6.5\ V}}$

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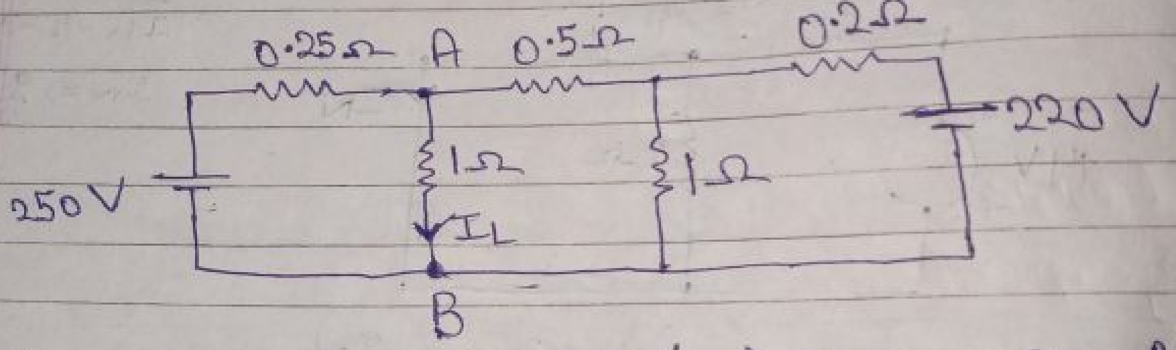
~~voltage drop across 12Ω~~

$\Rightarrow I_L \times 12\Omega$

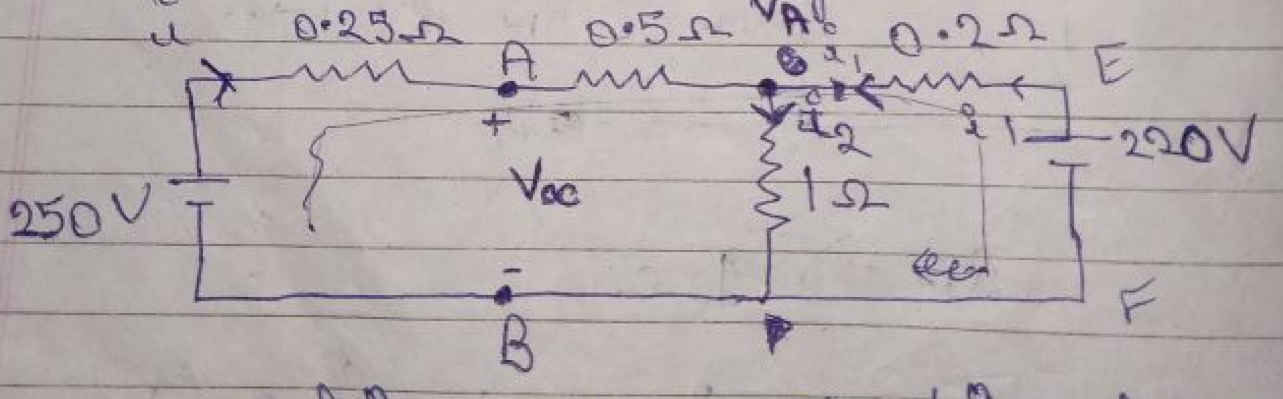
$\Rightarrow \left(\frac{1}{1+12} \times \frac{9}{2}\right) \times 12$

$\Rightarrow \frac{4.5 \times 12}{13} \Rightarrow \frac{54}{13}$ ✓

<u>Ans8.</u> Find I_L using Thevenin's theorem $\Rightarrow$



1. remove resistance (R_L) from circuit and calculating Voc.



~~applying KVL across big loop~~

~~$-250 + V_{oc} + 0.95i + 220 = 0$~~

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~~Voc + 0.95i = 30~~

using nodal analysis

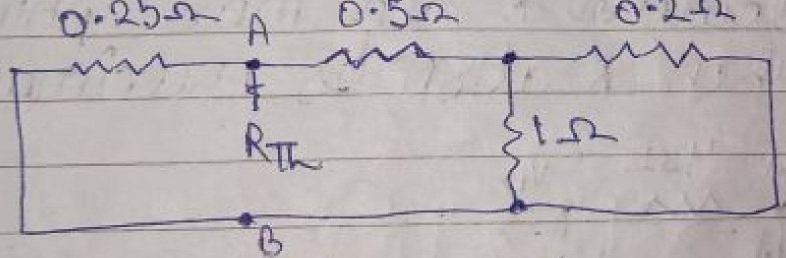
~~applying~~ $\frac{250-V_A}{0.75} + \frac{220-V_A}{0.2} = \frac{V_A}{1}$

on solving $V_A \Rightarrow \frac{215}{1.1}$ V

$V_{oc} \Rightarrow \left(\frac{250-\frac{215}{1.1}}{\cancel{0.75}_{3}}\right) \times \cancel{0.25}$

$\Rightarrow \frac{60}{1.1\times 3} \Rightarrow \frac{20}{1.1}$ V

2. calculate Req across R_L



$\Rightarrow \frac{0.\cancel{2}+0.5}{\cancel{1.2}_6}$

$\frac{1}{6}+\frac{1}{2}$

$R_{Th} \Rightarrow \frac{\frac{1}{4}\times\frac{2}{3}}{\frac{1}{4}+\frac{2}{3}} \Rightarrow \frac{2}{11}\ \Omega$

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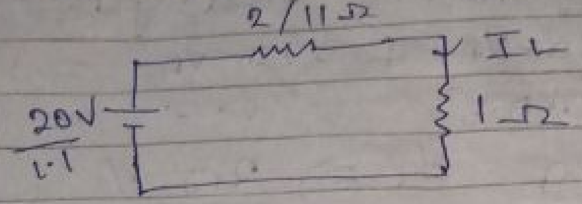
Thevenin's equivalent circuit

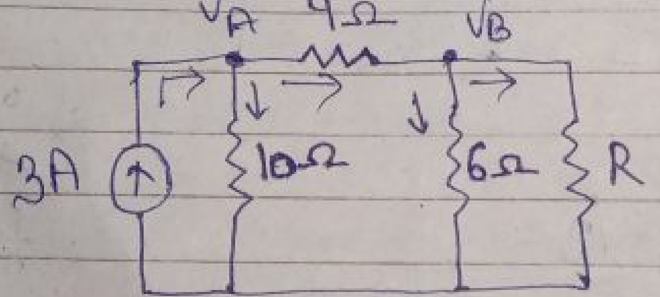


$$I_L \Rightarrow \frac{(20/1.1)}{\left(\frac{2}{11}+1\right)}$$

$$\Rightarrow \frac{200}{11} \times \frac{11}{13}$$

$$\Rightarrow \frac{200}{13} A$$

Ans 9. Calculate R and max^m power when R absorbs maximum power.



∵ R absorbs max^m power

∴ R is equivalent to

$$\Rightarrow \frac{\cancel{14}^{7} \times \cancel{6}^{3}}{\cancel{20}_{\cancel{10}\,5}} \Rightarrow \frac{21}{5} \Omega$$

(Here current source is taken 3A so resultant × 100 will be ans)

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applying KCL across V_A

$$3 = \frac{V_A}{10} + \frac{V_A - V_B}{4}$$

$$60 = 2V_A + 5V_A - 5V_B$$

$$7V_A - 5V_B = 60 \quad -(1)$$

applying KCL across V_B

$$\frac{V_A - V_B}{4} = \frac{V_B}{6} + \frac{V_B}{21} \times 5$$

$$21(V_A - V_B) = 14(V_B) + 4V_B \times 5$$

$$21V_A - 21V_B = 14V_B + 20V_B$$

$$55V_B - 21V_A = 0 \quad -(2)$$

solving (1) and (2)

$$77V_A - 21V_A = 60 \times 11$$

$$56V_A = 11 \times 60$$

$$V_A \Rightarrow \frac{15 \times 11}{14}\ V$$

$$V_B \Rightarrow \frac{21}{55} \times \frac{15 \times 11}{14} \Rightarrow \frac{9}{2}\ V$$

$$\therefore P_{max} \Rightarrow \frac{\left(\frac{9}{2}\right)^2}{21/5} \Rightarrow \frac{9 \times 9 \times 5}{4 \times 21} \Rightarrow \frac{135}{28}$$