PVPP College of Engineering, Mumbai

Department of General Engineering

Mid-Semester Test SH-2015

Sem-1 All Branches Sub: BEEE Max. Marks: 20
Time: 9-30AM to 11AM Date: Sept. 08, 2015

Note: *(1) Q.1 is Compulsory, (2) Attempt any three questions from Q.2 to Q.5.*

(3) Each question carry 5 Marks. (4) Assume suitable data wherever required with proper justification

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Q1 What voltage should be applied to the circuit given below through the adjustable source E?

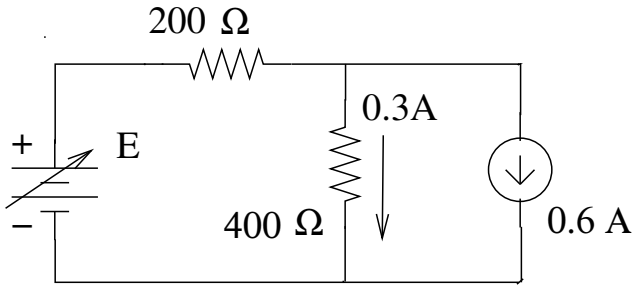

Figure 1: Q.1

Q2 Find the current through 4Ω resistor by source conversion technique.

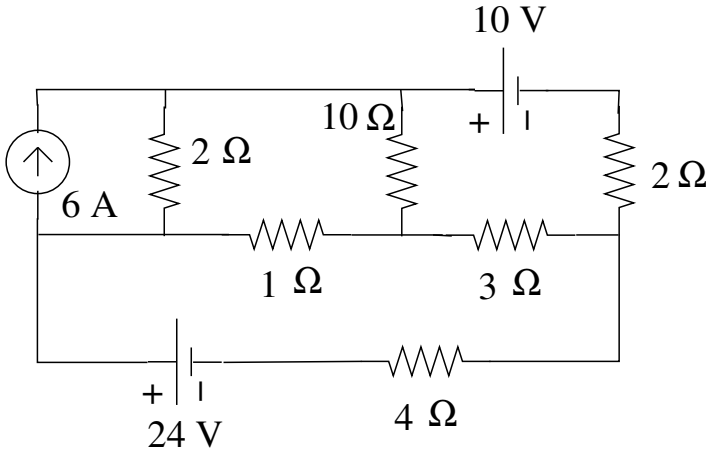

Figure 2: Q.2

Q3 For the circuit given below, find the power dissipated in 1Ω resistor by nodal analysis

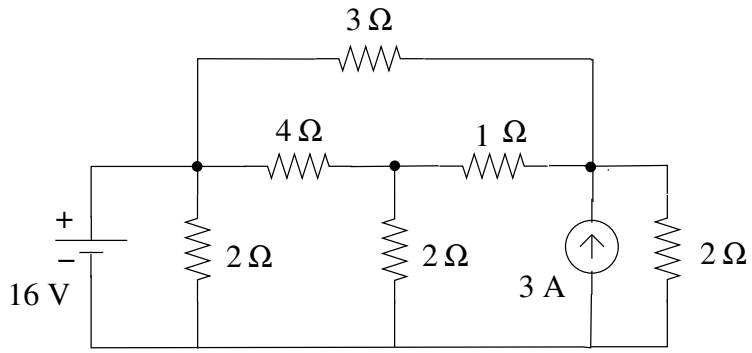

Figure 3: Q.3

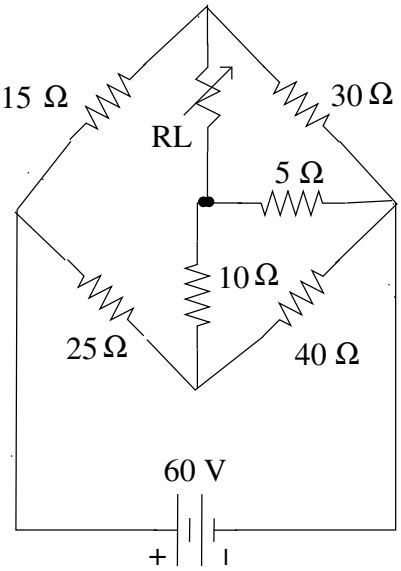

Fig. Q.4

Q4 Find the value of resistor R_L so that maximum power will be transferred to it. Also find maximum power transferred to R_L.

Q5 Find the current through 10Ω resistor by using superposition theorem.

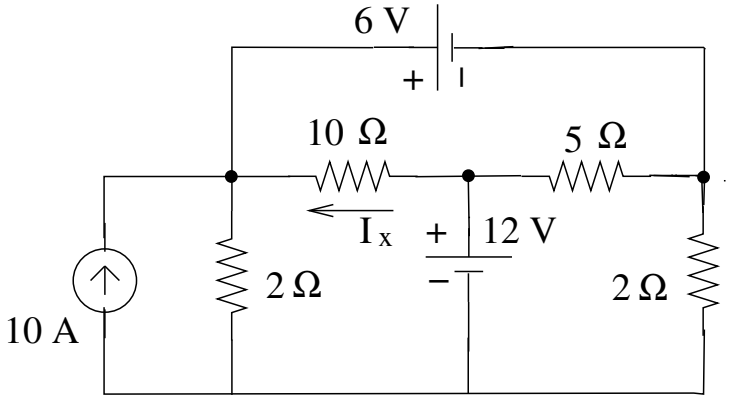

Figure 4: Q.5

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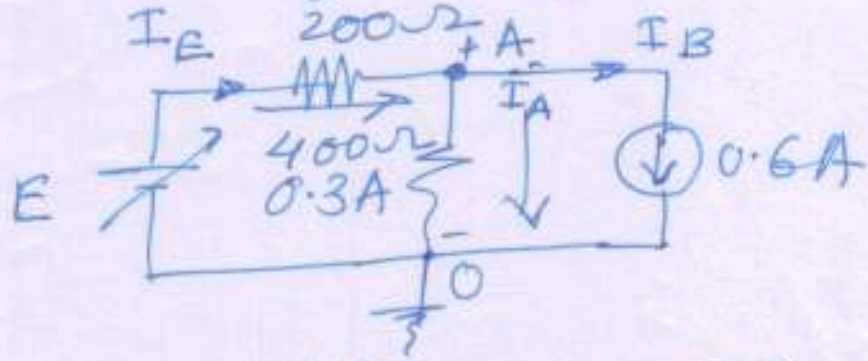
Answers to the Mid-Sem Test for SH-2015

Q.1 Redrawing the given figure



The voltage $V_{AO} = 400 \times 0.3 = 120\,V$

By KCL $I_E = I_A + I_B$

$= 0.3 + 0.6 = 0.9\,A$

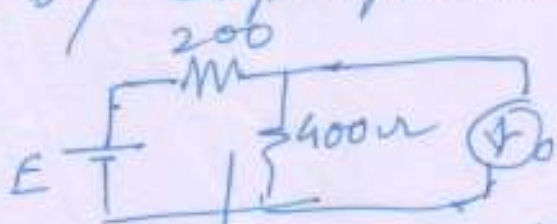
∴ By Applying KVL around the loop containing E

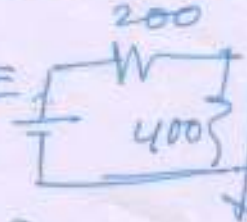
$$E - I_E \times 200 - I_A \times 400 = 0$$

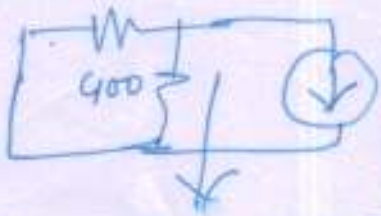
$$\therefore E - 0.9 \times 200 - 0.3 \times 400 = 0$$

$$E = 180 + 120 = 300 \text{ Volt}$$

The Problem Can also be Solved by Superposition Theorem



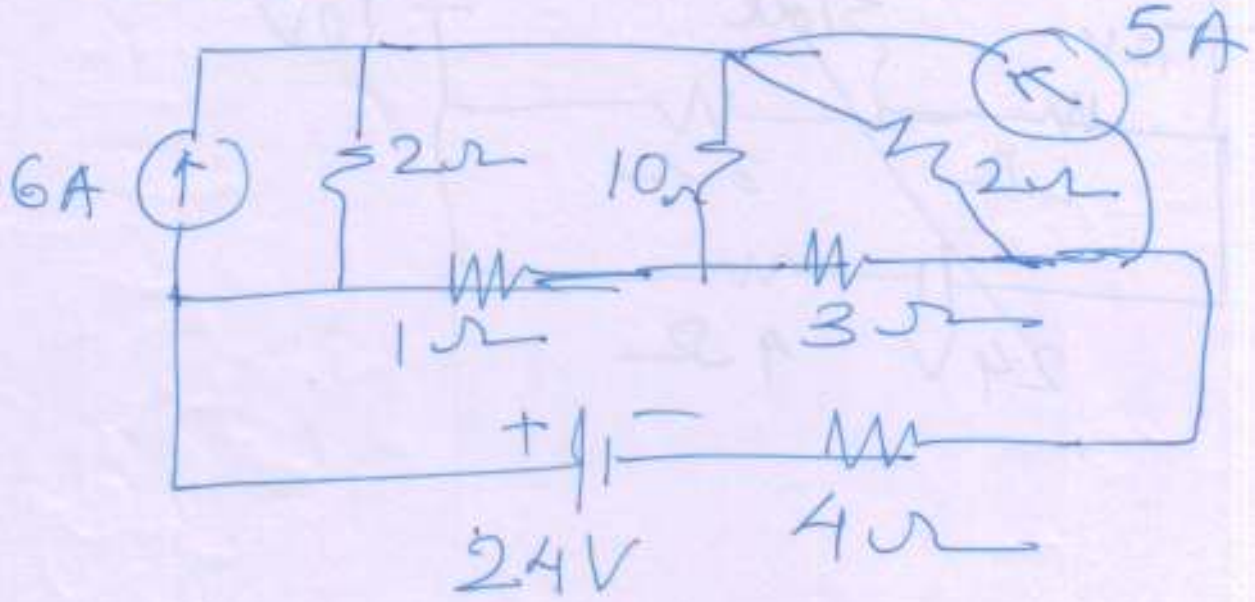




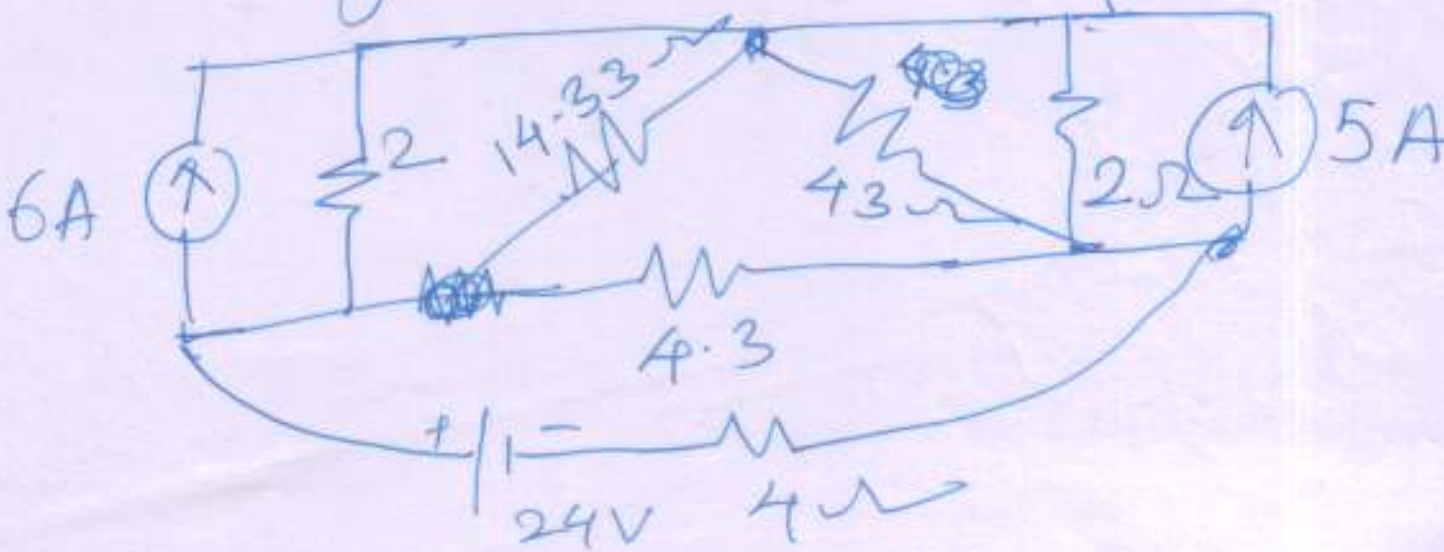
$0.3 = (E/600) - 0.6 \times \frac{200}{600} \Rightarrow E/600 = 0.3 +$

Q.2. Solving the problem by Source Conversion technique

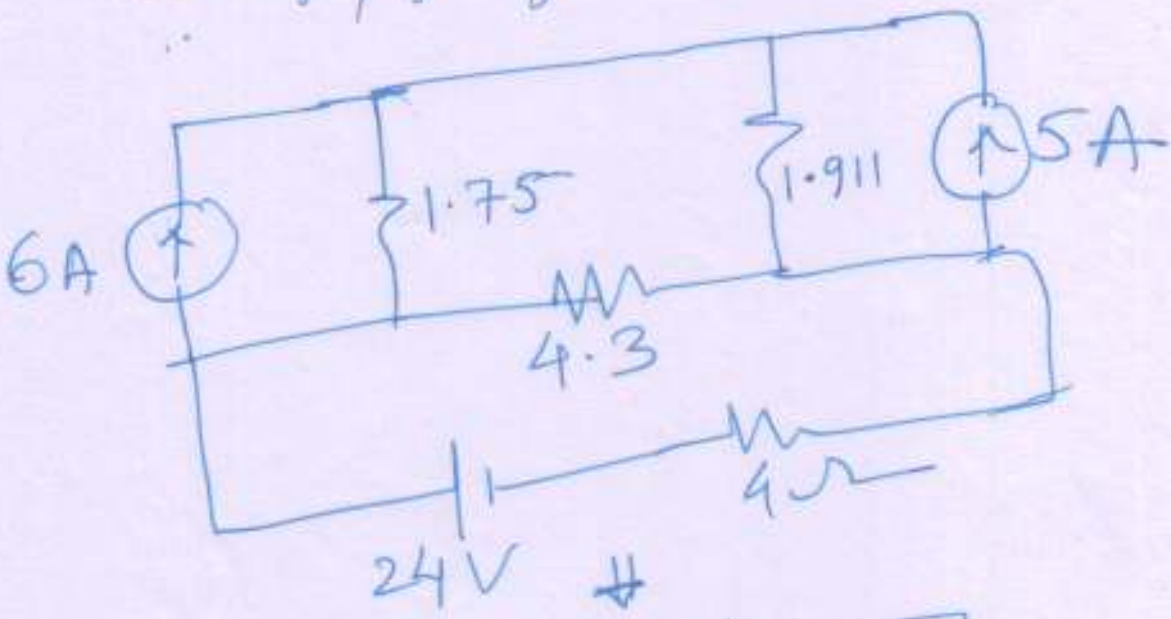
Converting 10V Source into Current Source

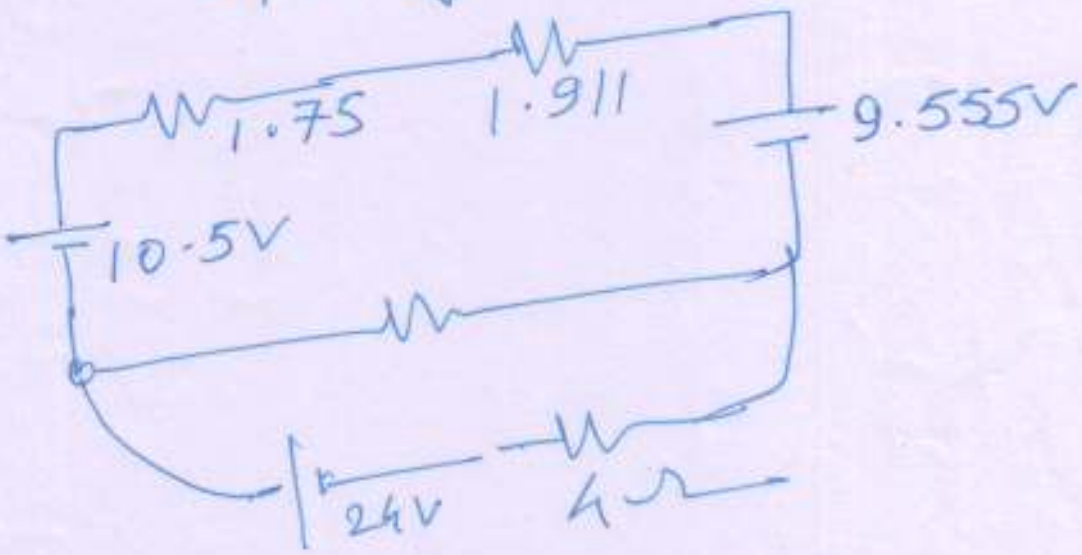


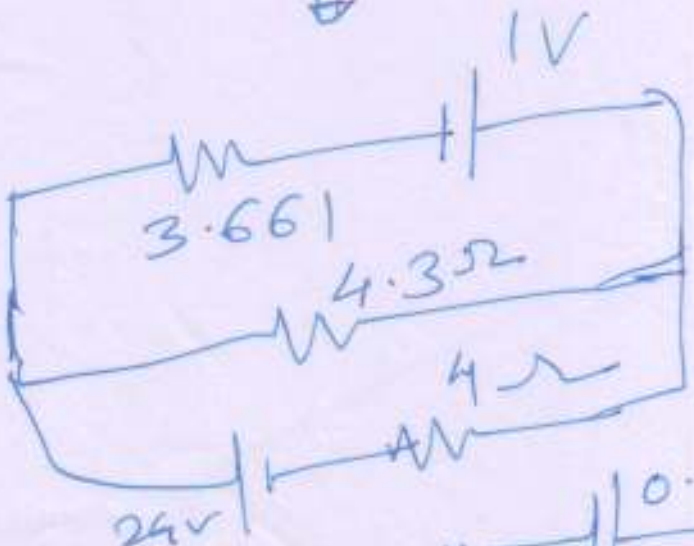
A star network is formed with 10, 1 and 3Ω resistors. Converting Y to Δ transformation

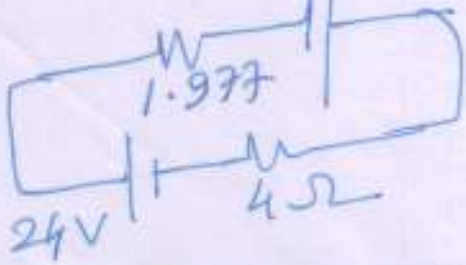


Simplifying the ckt further



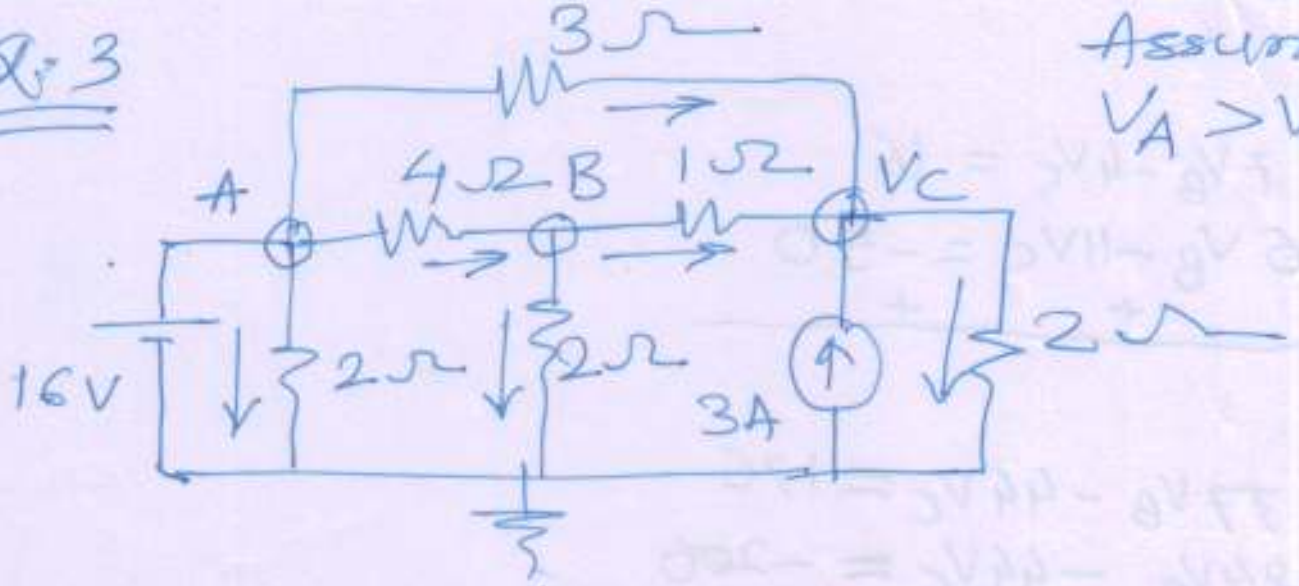






$I_4 = 4.1$ Amp

④ Q: 3



Assume $V_A > V_B > V$

Node A has 16V battery directly Connected to the node A and grou

∴ we can write

$$\boxed{V_A = 16V} \quad \text{—— (1)}$$

★ Writing KCL around Node B

$$\frac{V_A - V_B}{4} = \frac{V_B}{2} + \frac{V_B - V_C}{1}$$

$$\therefore \quad V_A - V_B = 2V_B + 4V_B - 4V_C$$

$$\therefore \quad \boxed{7V_B - 4V_C = 16} \quad \text{—— (2)}$$

★ Writing KCL eqn. at node C

$$\frac{V_B - V_C}{1} + \frac{V_A - V_C}{3} + 3 = \frac{V_C}{2}$$

$$6V_B - 6V_C + 2V_A - 2V_C + 18 = 3V_C$$

$$6V_B - 11V_C = -18 - 32 = -50$$

$$\boxed{6V_B - 11V_C = -50} \quad (3$$

$$7V_B - 4V_C = 16$$
$$6V_B - 11V_C = -50$$
$$- \quad + \quad +$$

$$77V_B - 44V_C = 176$$
$$24V_B - 44V_C = -200$$
$$- \quad + \quad +$$

$$53V_B = 376$$

$$V_B = 7.09 \text{ Volts.}$$
$$V_C = 8.41 \text{ Volts.}$$

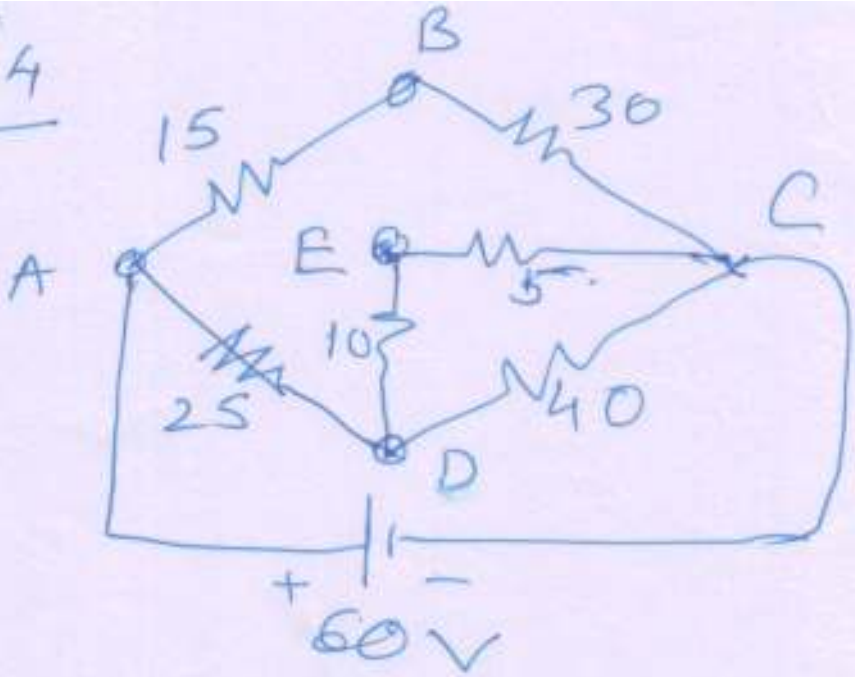
Current through 1 Ω resistor

$$\therefore I_1 = \frac{V_C - V_B}{1} = 1.325 \text{ Amp.}$$

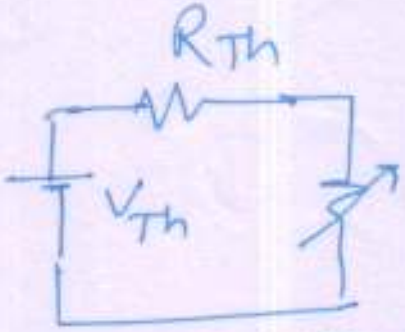
$\therefore$ Power dissipated $= (1.325)^2$

$$P = 1.755 \text{ watt}$$

Q. 4



Opening the ckt from R Branch

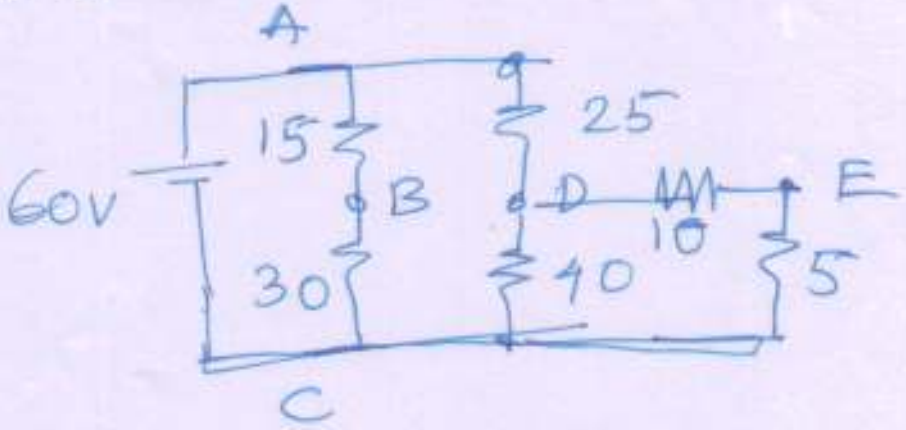


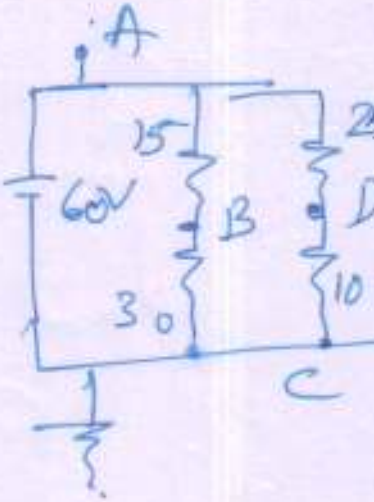
Therenin's equ circuit

Applying Therenin's Theorem.

a) To find $R_{Th.} = V_{BE}$

The equivalent ckt is drawn as.





$V_{Th} = V_{BE} = V_{BC} - V_{EC}$

$V_{BC} = 60 \times \frac{30}{45} = 40$ Volts

[∵ By Potential Divide Rule]

$V_{EC} = V_{DC} \times \frac{5}{15}$ $\quad V_{DC} = 60 \times \frac{10.9}{35.9}$

$= 6.07$ Volts $\quad = 18.21$ V

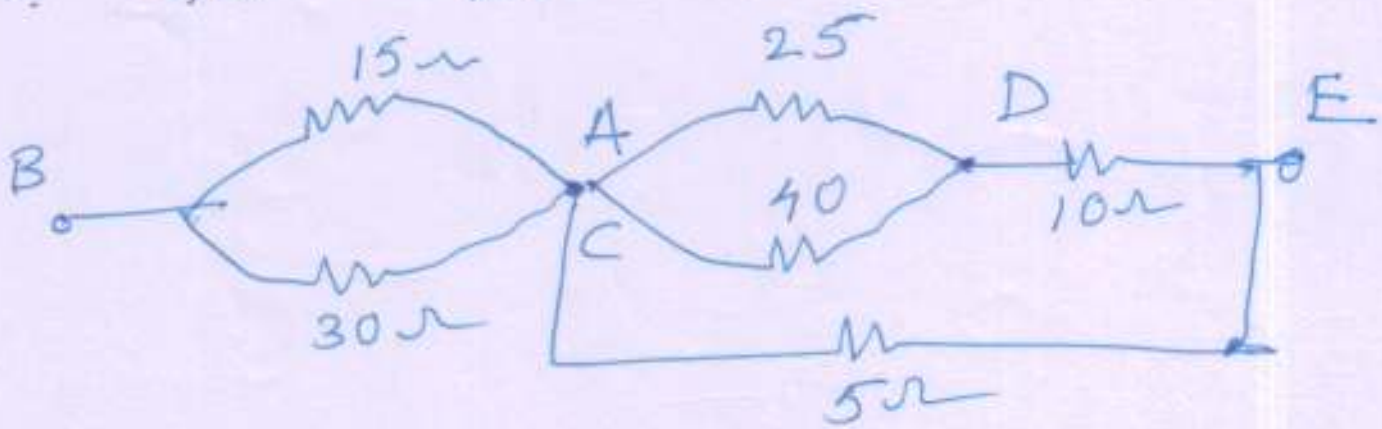
$\therefore V_{BE} = 40 - 6.07 = 33.93$ Volts

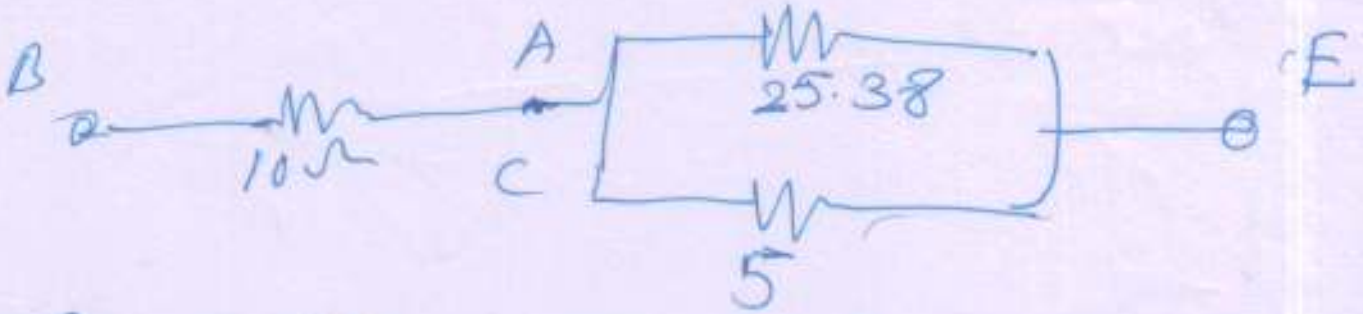
Q.4 ... Continued ...

To find R_{Th}.

- A and C terminals are shorted
- These nodes are joined together to find an equivalent resistance looking from B and E. The developed diagram is as follows:

$\therefore R_{Th} = R_{BE}$



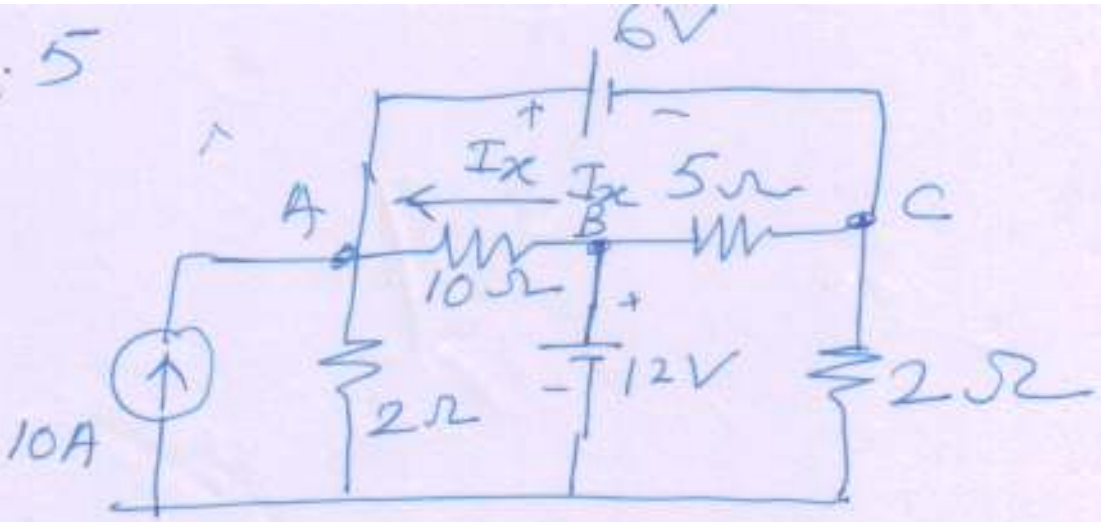


$R_{BE} = V_{Th} = 14.17\ \Omega$

∴ The resistor R_L has value equals to R_{BE} or V_{Th} to draw Maximum power from the source in R_L. $\boxed{R_L = 14.17\ \Omega}$

$$P_{max} = \frac{V_{Th}^2}{4R_L} = \frac{(33.93)^2}{4 \times 14.17} = \boxed{20.31\ \text{Watt}}$$

Q.5



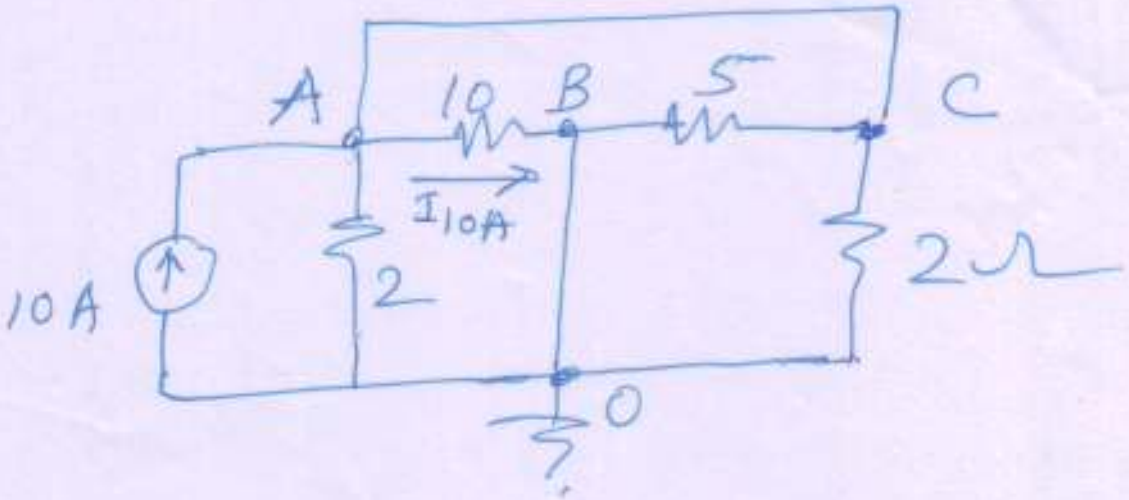
To find I_x by using superposition theorem, we will have to solve three circuits to find three current I_{10A}; I_{12V} and I_{6V} by considering individual sources only, replacing meanwhile all other sources by their internal resistances. Finally

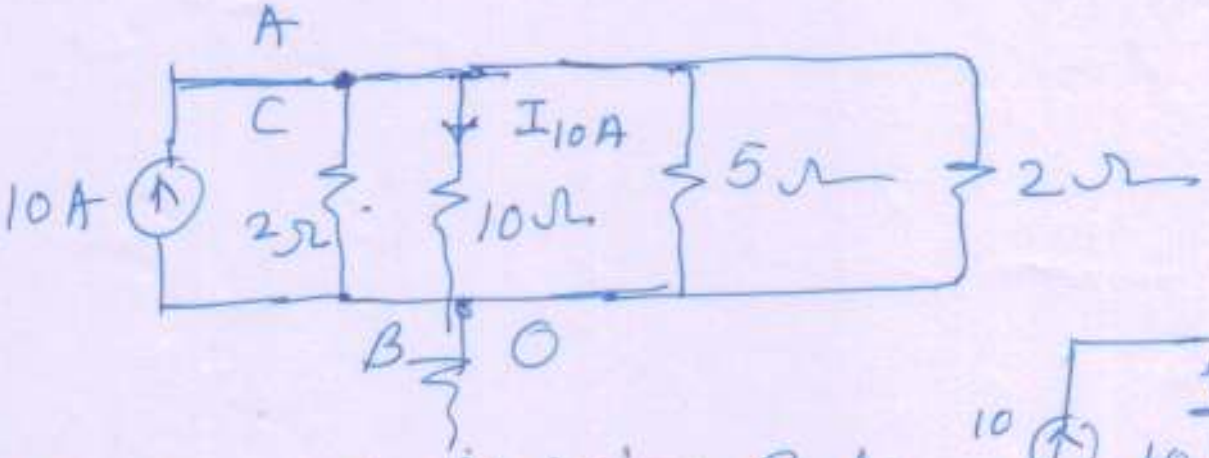
$$I_x = I_{10A} + I_{12V} + I_{6V}$$

with appropriate sign-convention for the currents.

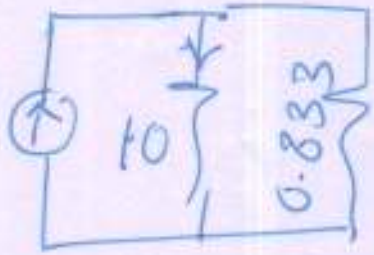
If the individual current is in the same direction with I_x assumed the current is considered as positive, otherwise, the current is taken as negative

a) Circuit with 10A Source only





By Current division Rule.



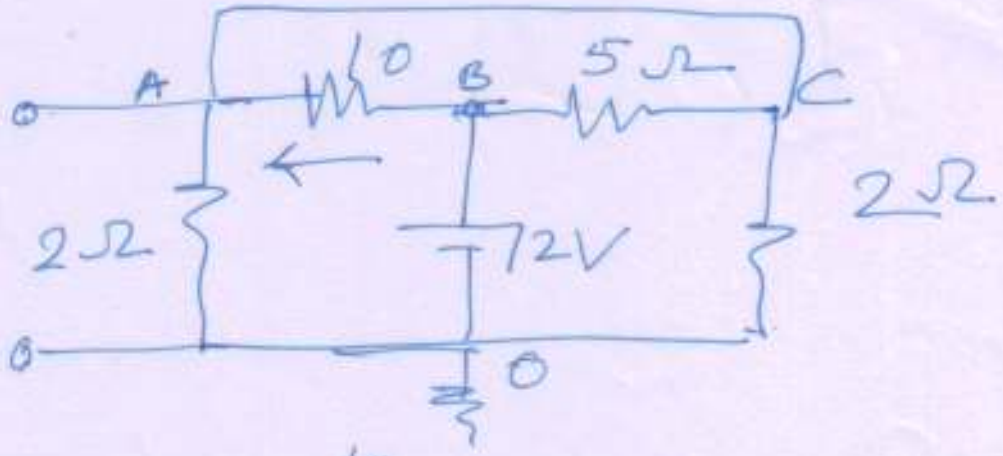
$$I_{10A} = 10 \times \frac{0.833}{10 + 0.833} = 0.769\ A$$
$$\simeq 0.77\ A.$$

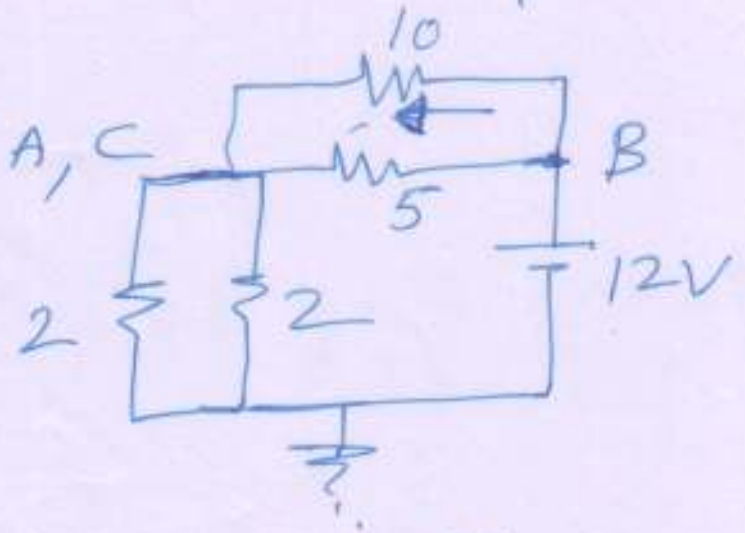
I_{10A} has Opposite Polarity $\therefore I_{10A} = -0.77A$

$$I_{10A} = -0.77\ A$$ — (1)

Pg 10

b) Circuit with the 12V Source only





$$V_{BA} = 12 \times \frac{10 \parallel}{10 \parallel 5 +}$$

$$\therefore V_{BA} = 12 \times \frac{3.33}{4.33} = 9.23V$$

$$\therefore I_{12V} = \frac{9.23}{10} = \underline{0.923 \text{ Amp}}$$

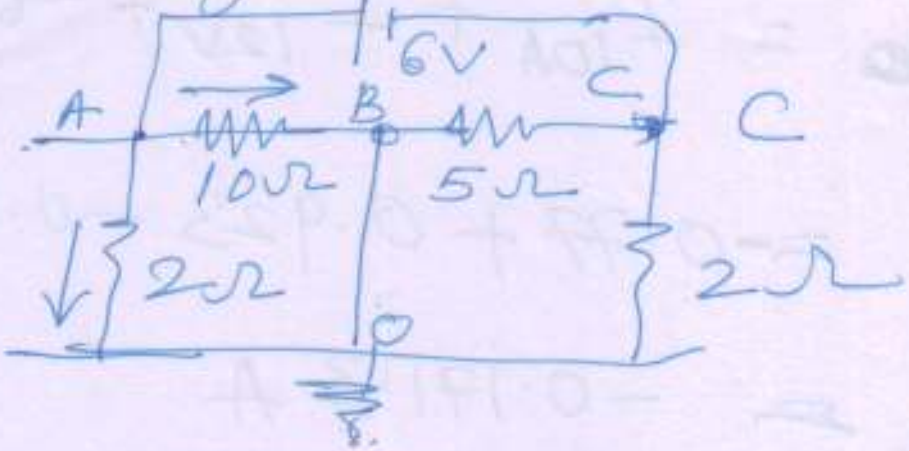
I_{12V} ←

Since I_{12V} is having the same ~~opposite~~ sign to that of I_x (assumed)

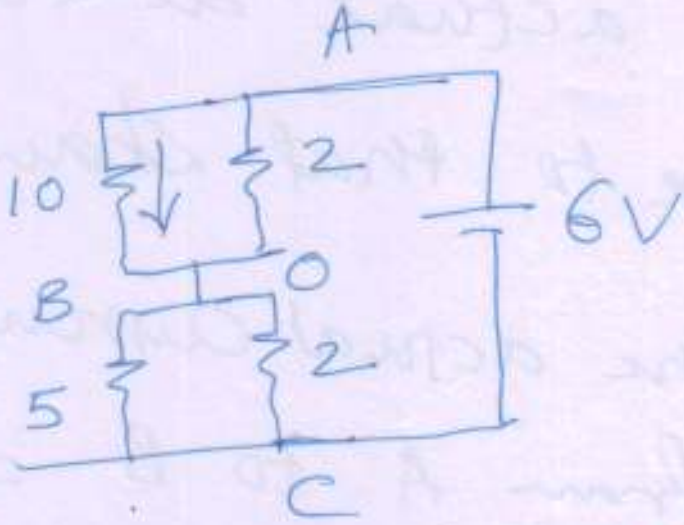
$\therefore I_{12V}$ is positive

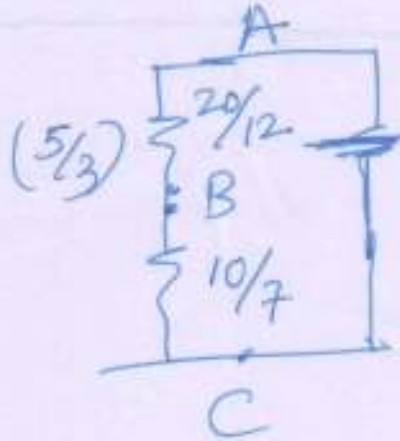
$$\boxed{I_{12V} = 0.923 A}$$

c) Considering the Source 6V only



Equivalent CKt





$$\therefore V_{AB} = 6 \times \frac{5/3}{5/3 + \frac{10}{7}}$$

$$= 6 \times \frac{1.67}{1.67 + 1.4285}$$

$$= 3.243\,V$$

$$\therefore \overrightarrow{I_{6V}} = \frac{3.243}{10} = 0.3243$$

since the direction (sign) I_{6V} is negative.

$$\therefore I_{6V} = -0.3243.$$

Thus By Superposition theorem

$I_{xx} = I_{10A} + I_{12V} + I_{6V}$

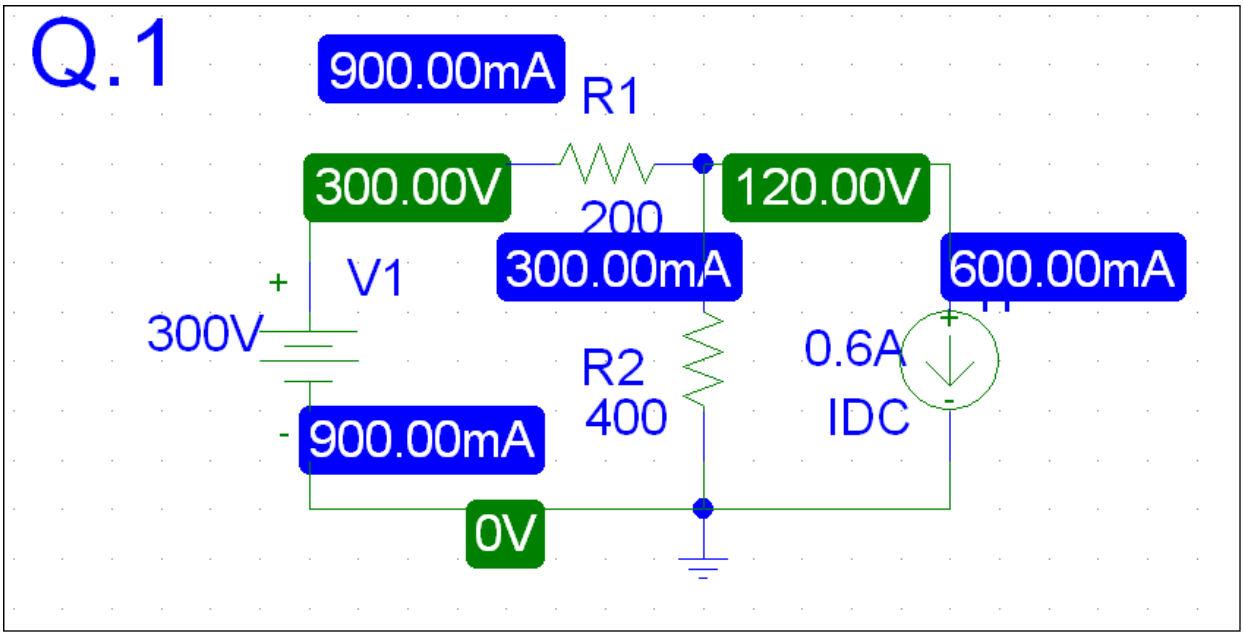
$= -0.77 + 0.923 - 0.3243$

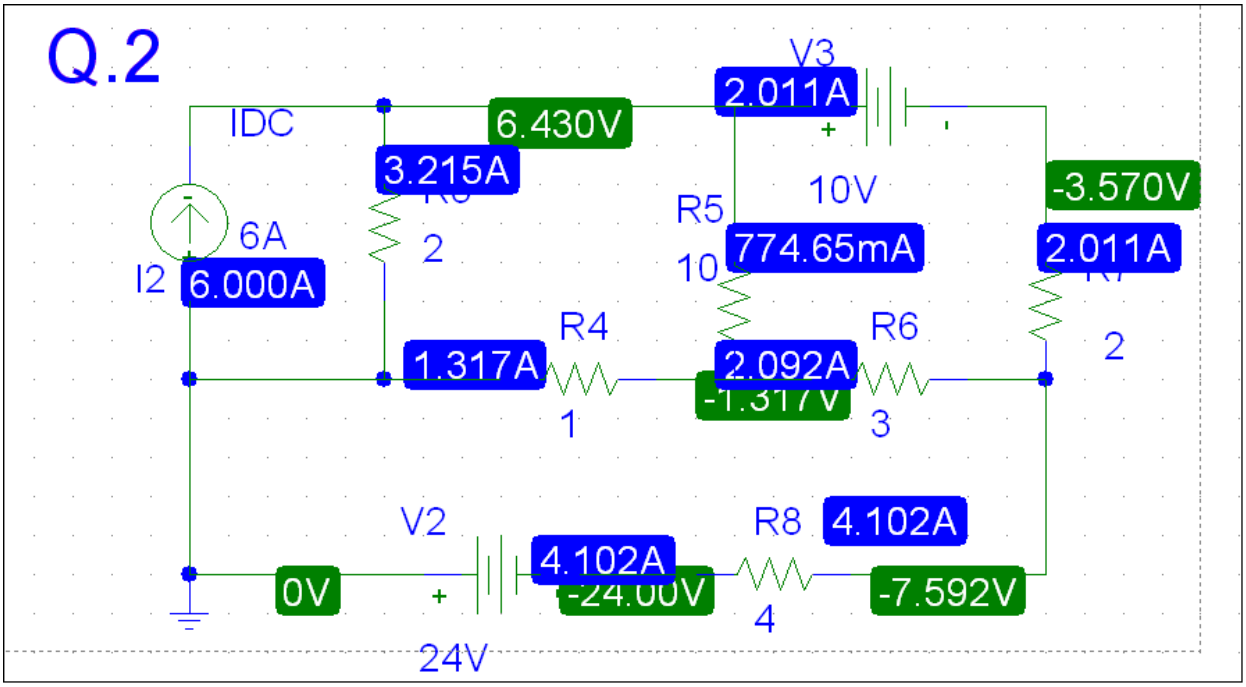
$I_{xx} = -0.17113\ A$

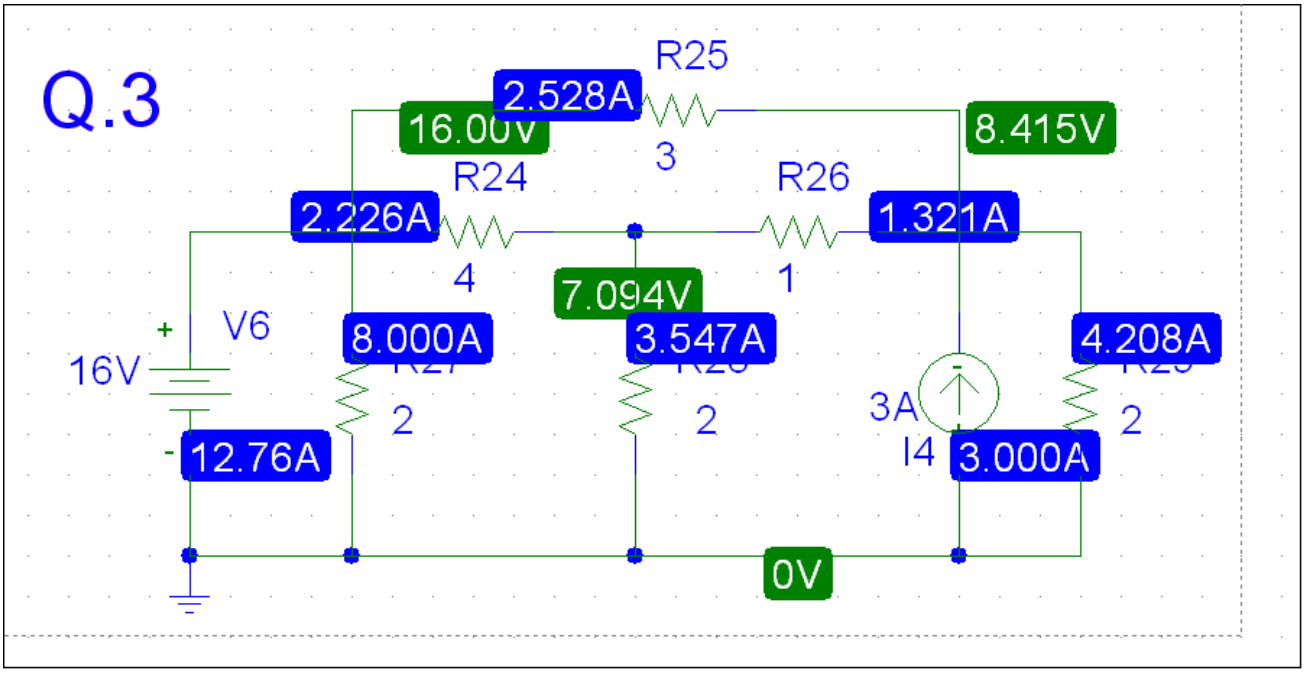
∴ the actual direction is opposite to that shown.

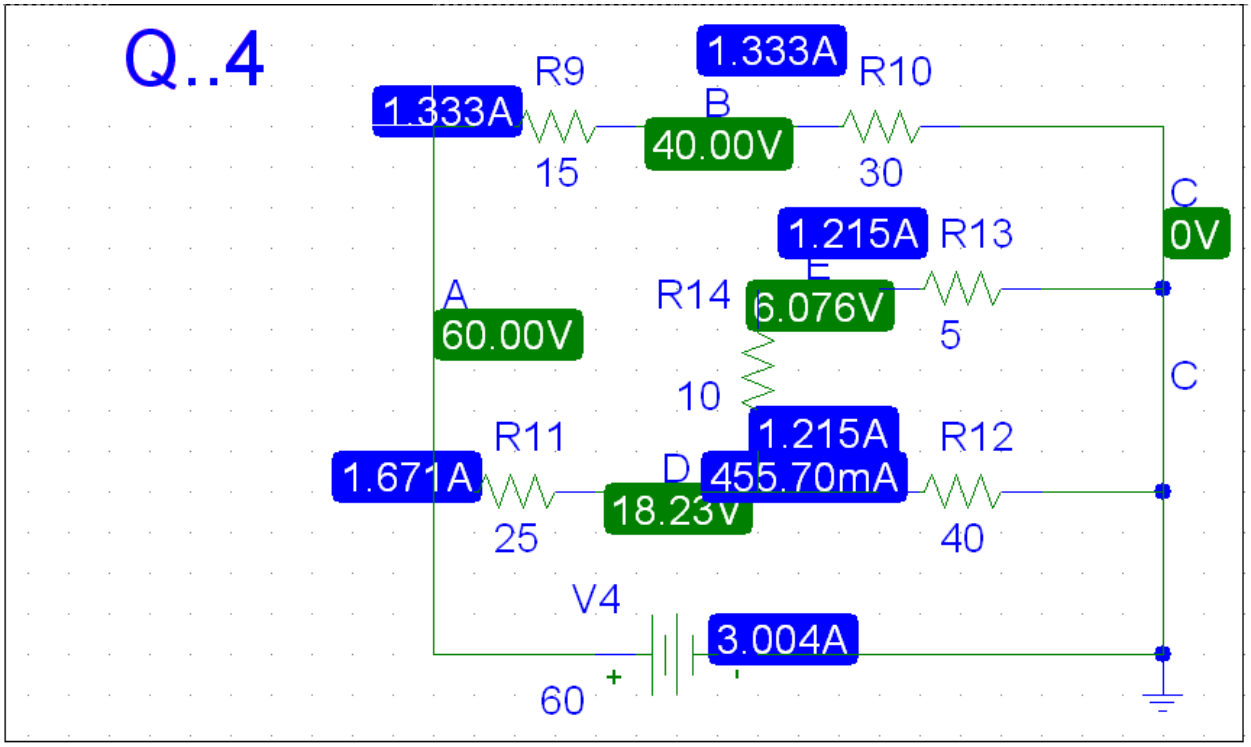
∴ the actual current direction from A to B = 0.1713 A

BEEE Simulation Results Midsem Test Paper SH2015

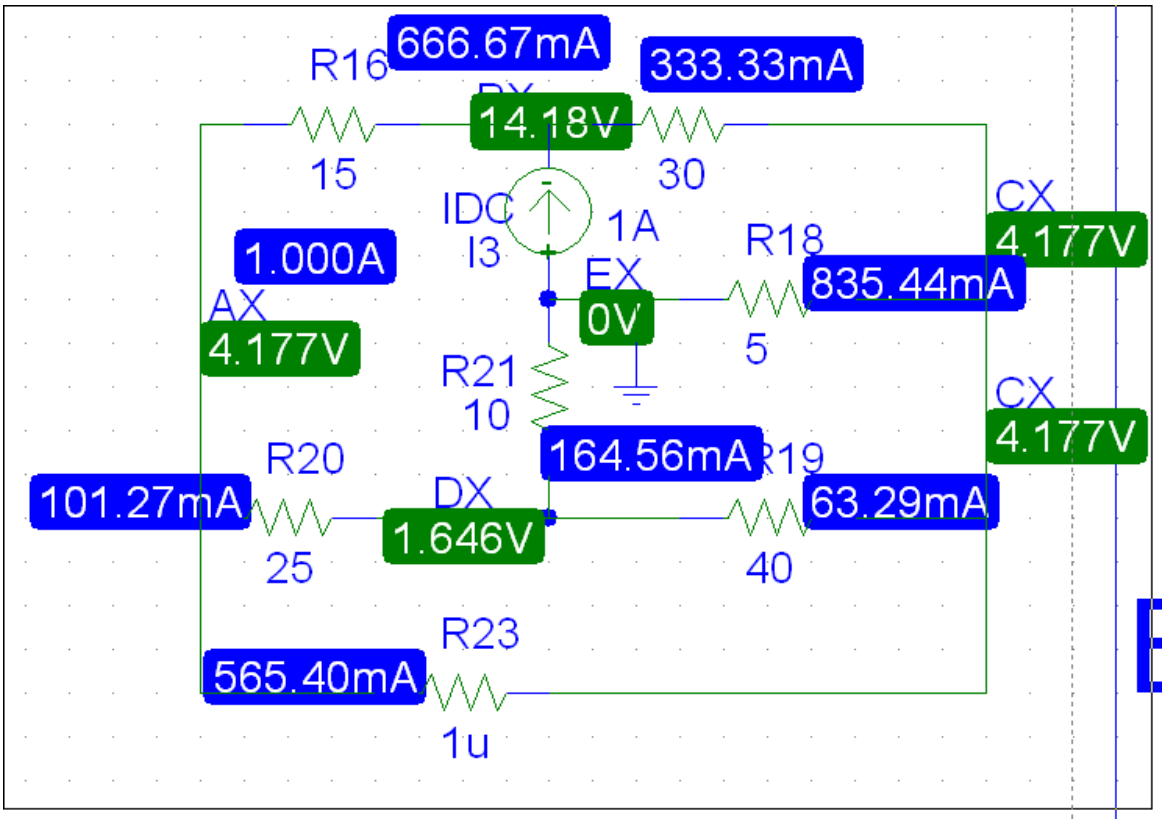




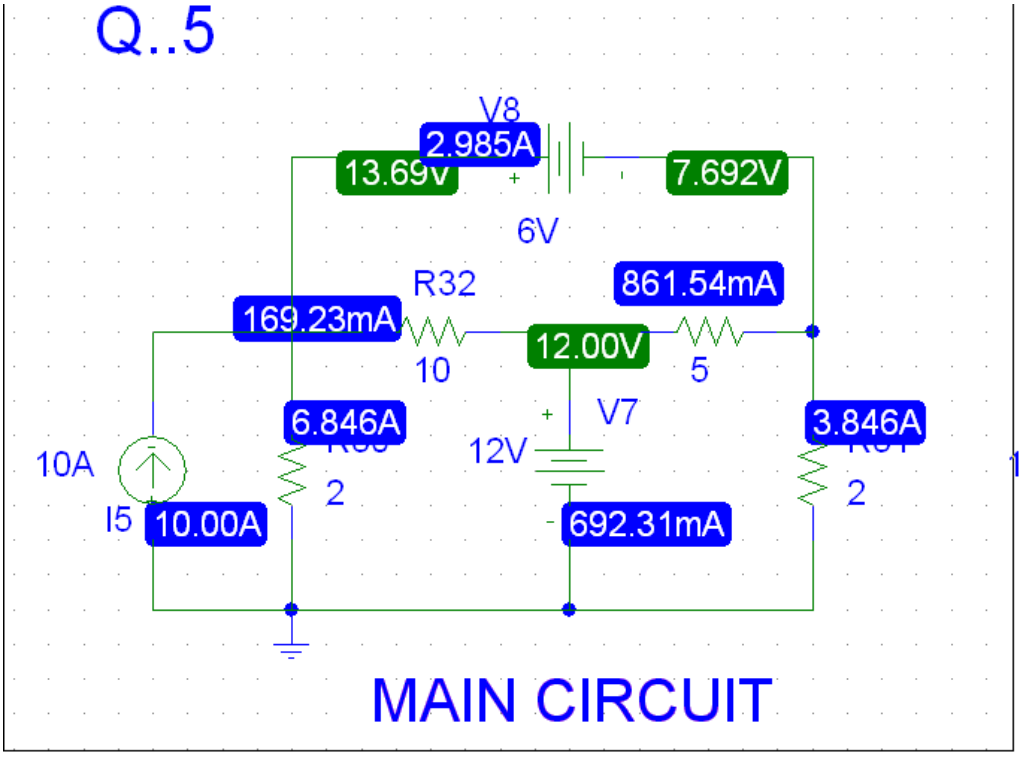

Q.3
R25
2.528A
16.00V
8.415V
3
R24
R26
2.226A
1.321A
4
1
7.094V
V6
8.000A
3.547A
4.208A
16V
2
2
2
3A
I4
12.76A
3.000A
0V

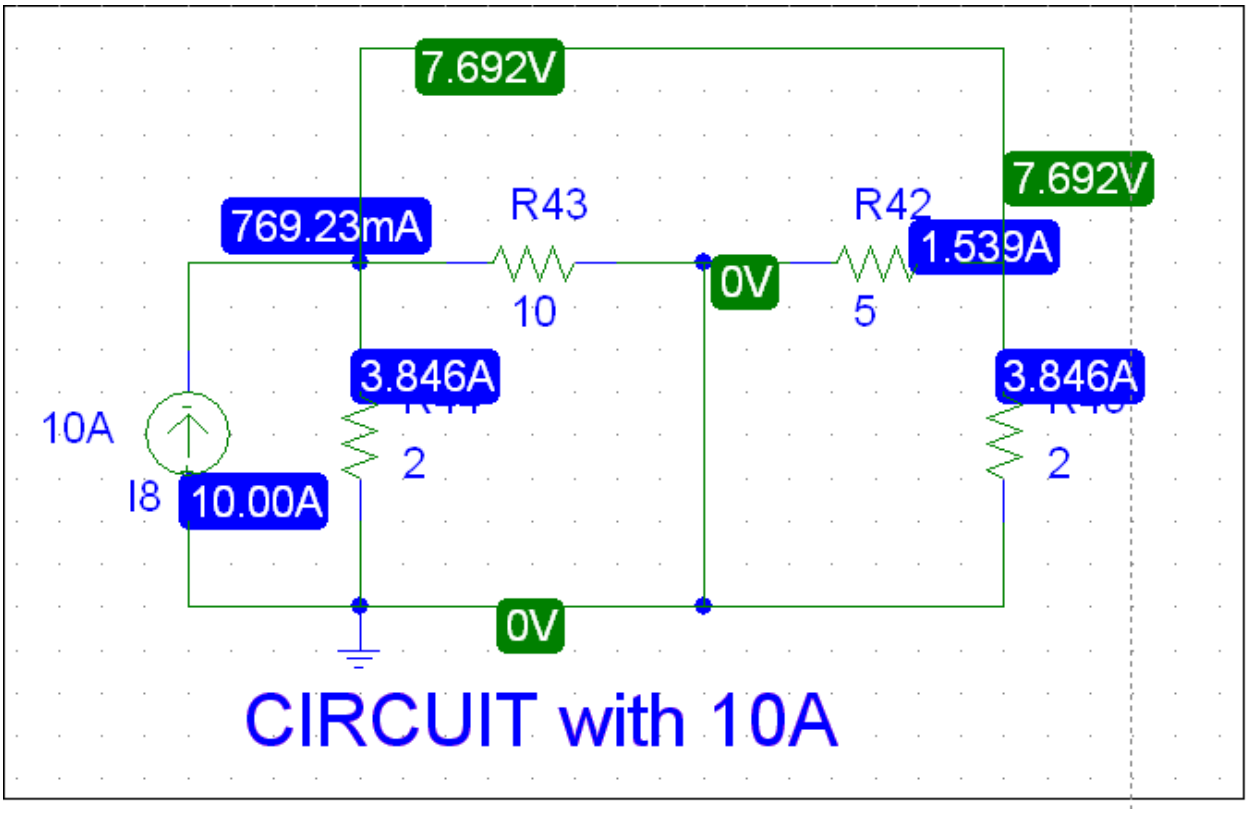


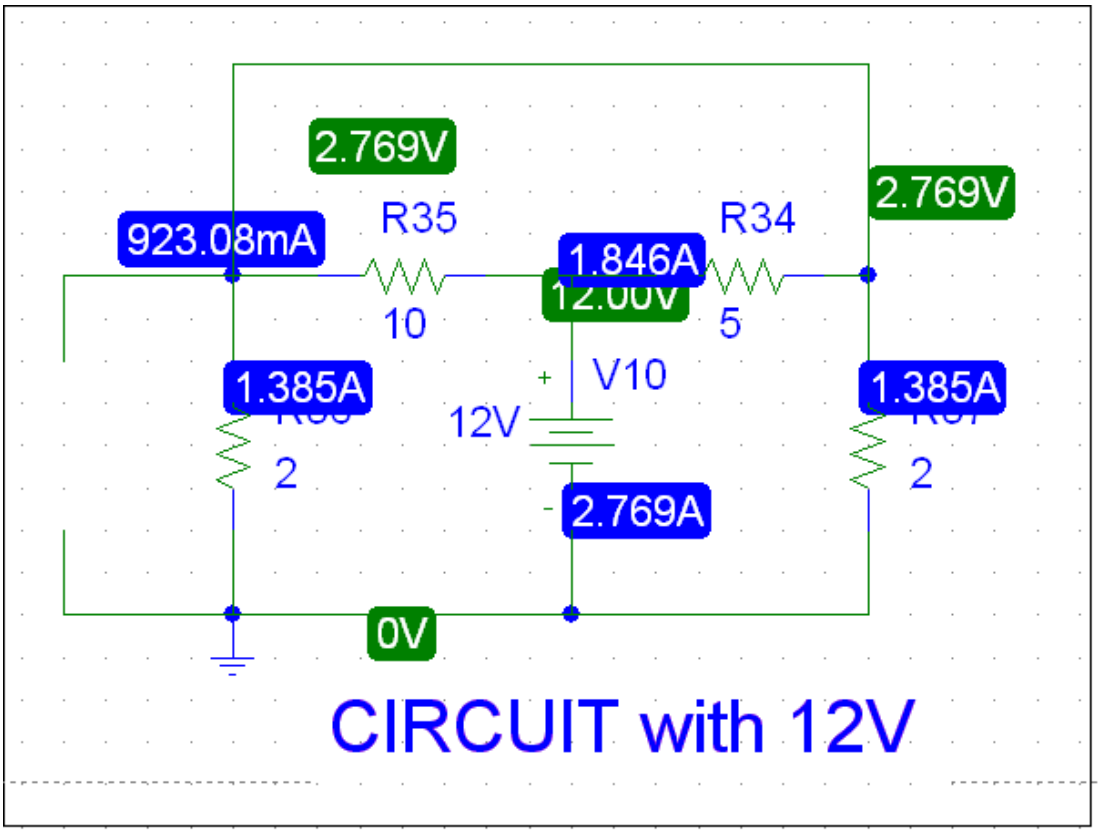
Upper Circuit for VTH Calculation

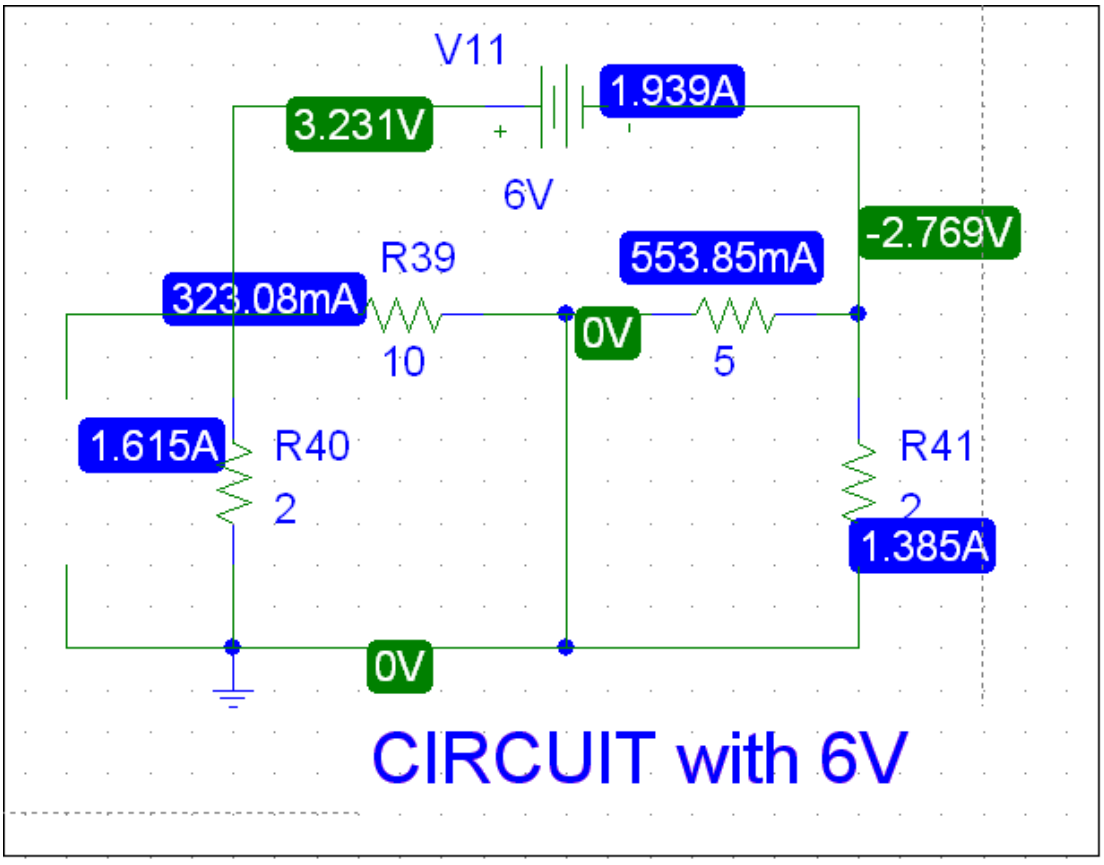


The Circuit for RTH Calculation


Q..5
V8
2.985A
13.69V
7.692V
6V
R32
861.54mA
169.23mA
10
12.00V
5
V7
6.846A
3.846A
10A
12V
2
2
I5
10.00A
692.31mA
MAIN CIRCUIT


7.692V
7.692V
769.23mA
R43
R42
1.539A
10
0V
5
3.846A
3.846A
10A
2
2
I8
10.00A
0V
CIRCUIT with 10A


2.769V
923.08mA
R35
10
1.846A
12.00V
R34
5
2.769V
1.385A
V10
12V
2
2.769A
1.385A
2
0V
CIRCUIT with 12V


V11
3.231V
1.939A
6V
-2.769V
R39
553.85mA
323.08mA
10
0V
5
1.615A
R40
2
R41
2
1.385A
0V
CIRCUIT with 6V