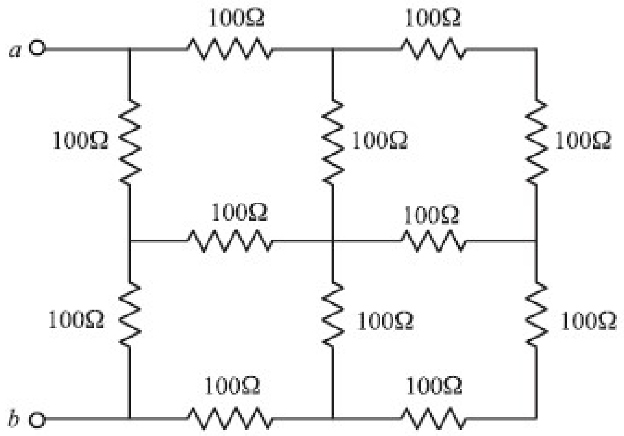
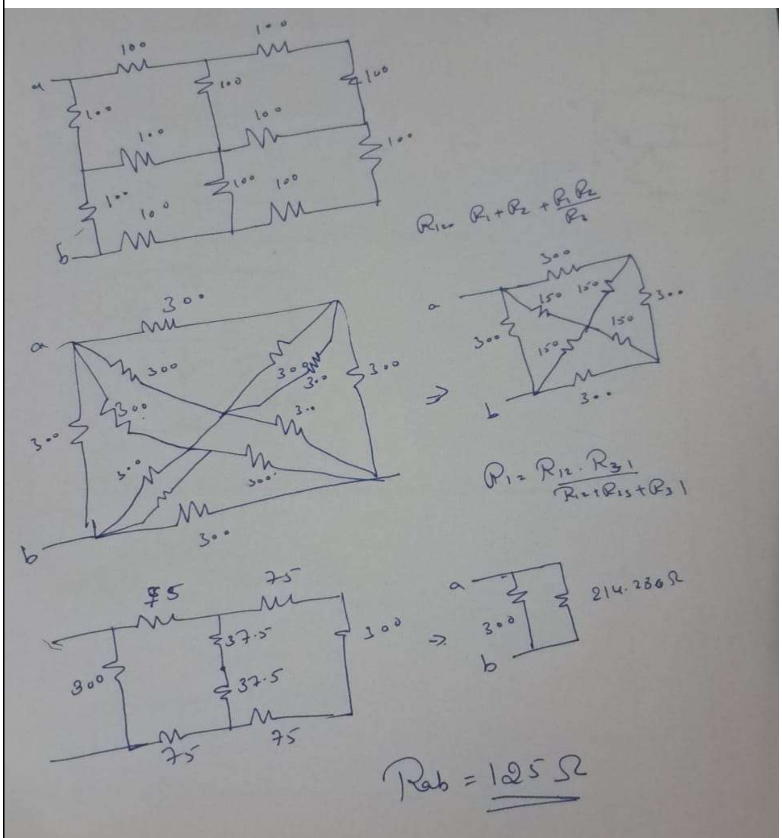
CMR
INSTITUTE OF
TECHNOLOGY

Sub:	Network Analysis	Code:BEC304

	Scheme and solution	Marks
1.	Find the equivalent resistance R_{ab} for the circuit shown.	[10]

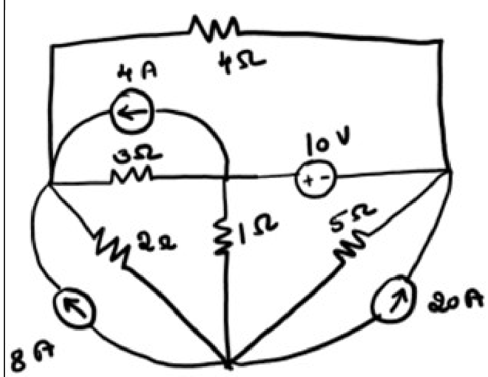


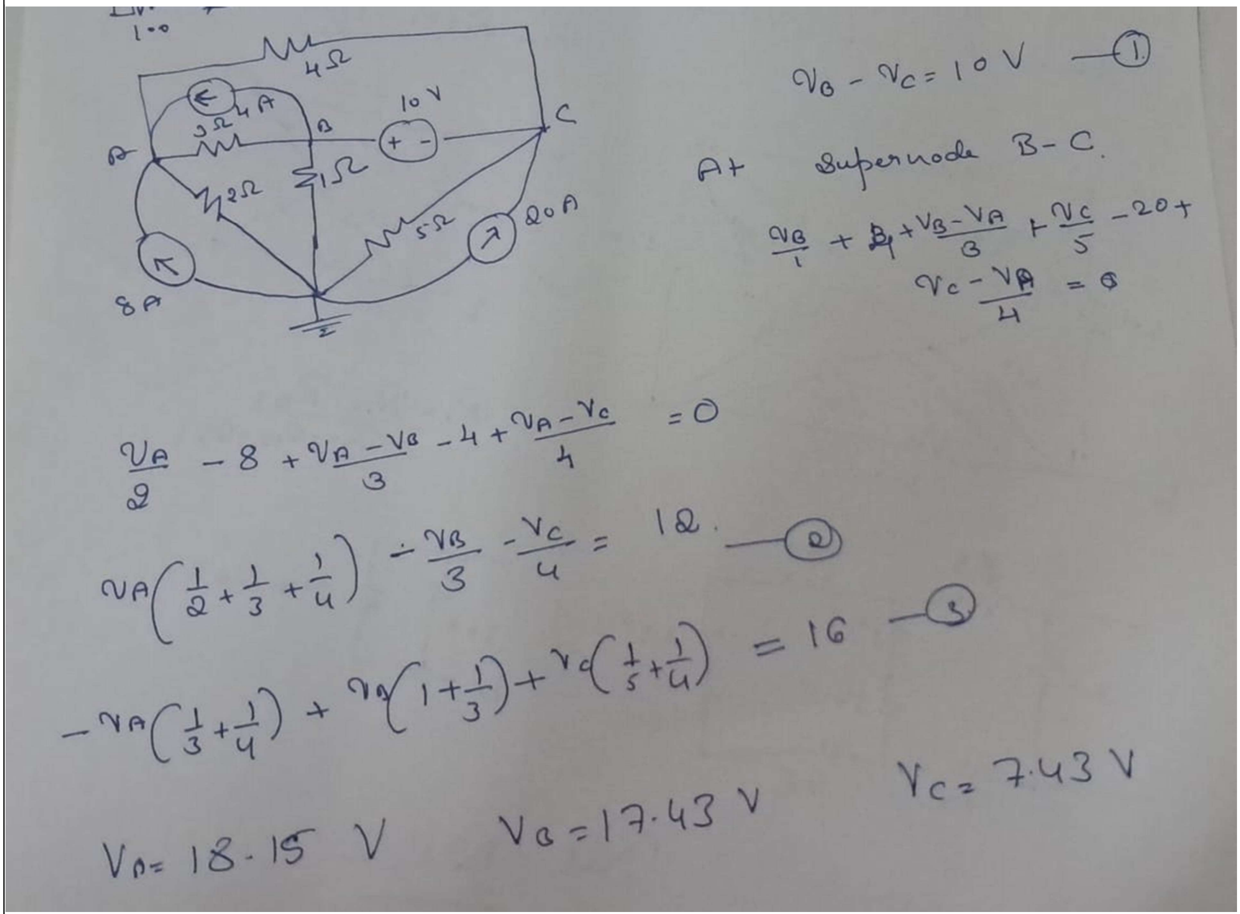


Each step: 2*4=8 Marks

Correct answer:2 Marks

2.	Determine all the node voltages in the circuit using nodal analysis.	[10]





$V_B - V_C = 10\,V$ — (1)

At Supernode B-C.

$\frac{V_B}{1} + 4 + \frac{V_B - V_A}{3} + \frac{V_C}{5} - 20 + \frac{V_C - V_A}{4} = 0$

$\frac{V_A}{2} - 8 + \frac{V_A - V_B}{3} - 4 + \frac{V_A - V_C}{4} = 0$

$V_A\left(\frac{1}{2} + \frac{1}{3} + \frac{1}{4}\right) - \frac{V_B}{3} - \frac{V_C}{4} = 12$ — (2)

$-V_A\left(\frac{1}{3} + \frac{1}{4}\right) + V_B\left(1 + \frac{1}{3}\right) + V_C\left(\frac{1}{5} + \frac{1}{4}\right) = 16$ — (3)

$V_A = 18.15\,V$ $V_B = 17.43\,V$ $V_C = 7.43\,V$

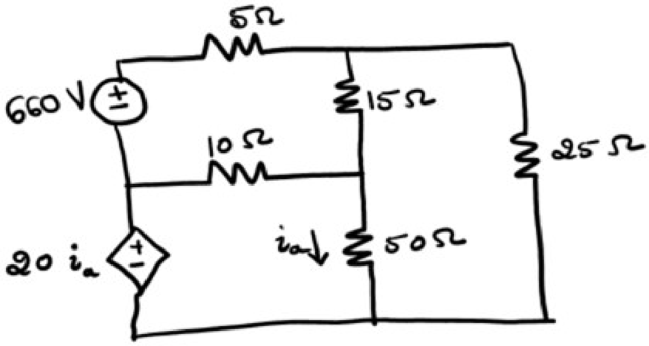
Identifying supernode:2Marks

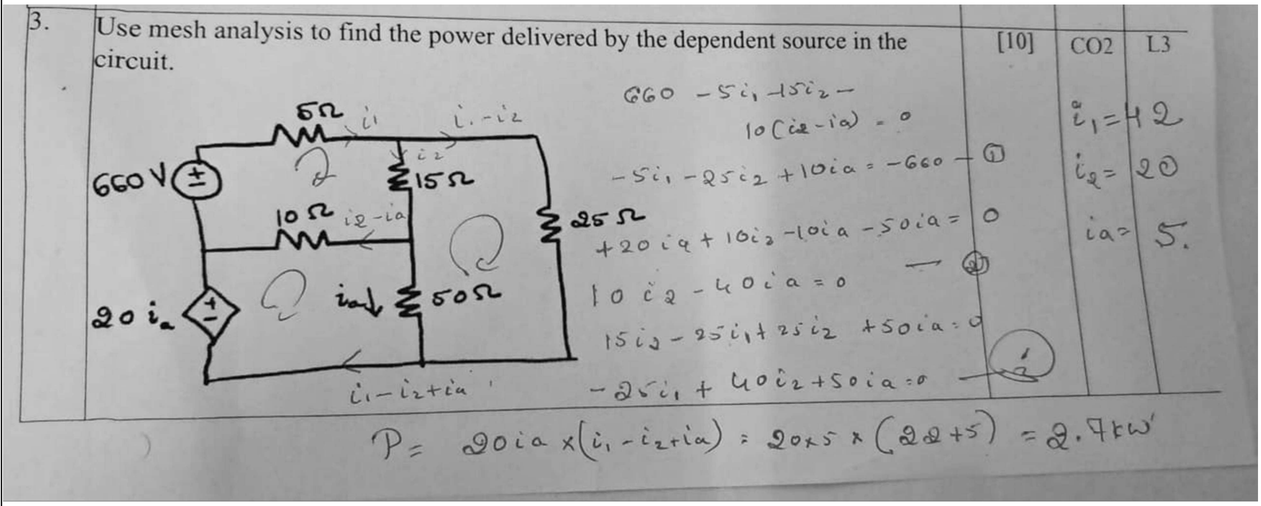
Nodal analysis equation:3Marks

Solution:3Marks

Correct answer: 2Marks

3.	Use mesh analysis to find the power delivered by the dependent source in the circuit.	[10]





3.	Use mesh analysis to find the power delivered by the dependent source in the circuit.	[10]	CO2	L3

$660 - 5i_1 - 15i_2 - 10(i_2 - i_a) = 0$

$-5i_1 - 25i_2 + 10i_a = -660$ — ①

$+20i_a + 10i_2 - 10i_a - 50i_a = 0$ — ②

$10i_2 - 40i_a = 0$

$15i_2 - 25i_1 + 25i_2 + 50i_a = 0$

$-25i_1 + 40i_2 + 50i_a = 0$ — ③

$i_1 = 42$

$i_2 = 20$

$i_a = 5.$

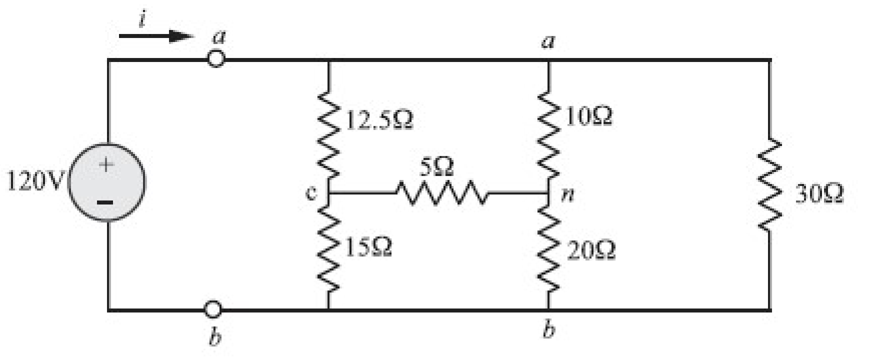
$P = 20i_a \times (i_1 - i_2 + i_a) = 20 \times 5 \times (22 + 5) = 2.7kW$

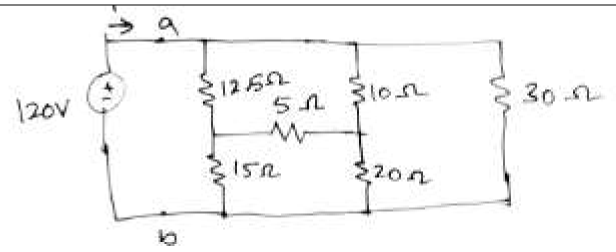
KVL:2Marks

Solution to get current values: 6 Marks

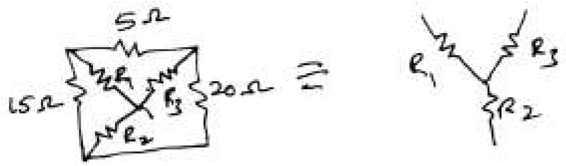
Power: 2Marks

4. Obtain the equivalent resistance R_{ab} for the circuit and hence find i. [10]





15Ω, 5Ω, 20Ω Delta network is converted into Star network as

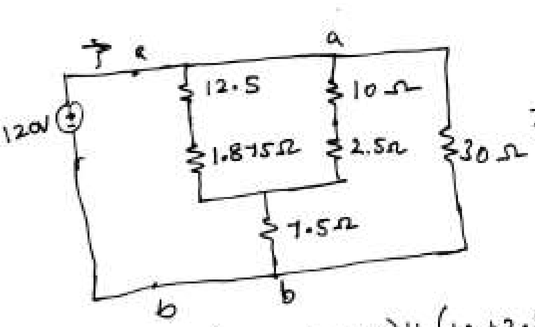


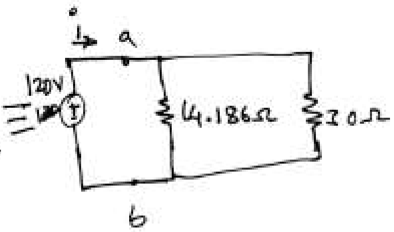
$$R_1 = \frac{15 \times 5}{15+5+20} = \frac{75}{40} = 1.875\,\Omega$$

$$R_2 = \frac{15 \times 20}{15+5+20} = 7.5\,\Omega$$

$$R_3 = \frac{20 \times 5}{15+5+20} = 2.5\,\Omega$$

……………4Marks



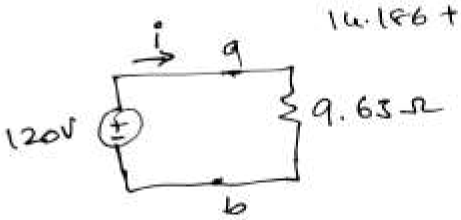
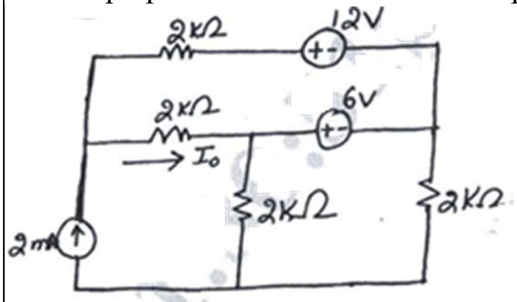


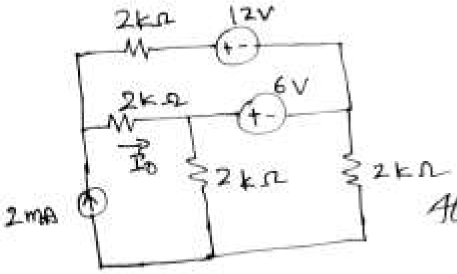
$$(12.5+1.875) \parallel (10+2.5) = \frac{14.375 \times 12.5}{14.375+12.5}$$

$$= 6.686\,\Omega$$

6.686 in series with 7.5Ω = 6.686 + 7.5 = 14.186 Ω

…………..4Marks

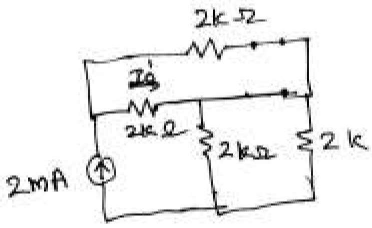
	14.186Ω is in parallel with 30Ω $(14.186 \parallel 30) = \dfrac{14.186 \times 30}{14.186 + 30} = 9.63\Omega$  Equivalent resistance between terminals a&b is $R_{ab} = 9.63\Omega$ Then $\boxed{i = \dfrac{120V}{9.63V} = 12.46A.}$ ……………2 Marks	
5.	State superposition theorem. Use the superposition theorem to find I_0 in the circuit shown below:  	[3]



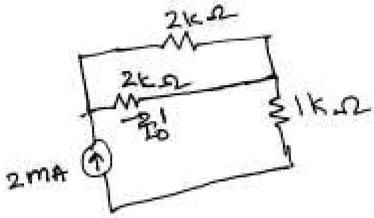
There are three sources
Hence I_o can be found using.
activating each source alone.
using superposition theorem

Hence $I_o = I_o' + I_o'' + I_o'''$

Deactivate 6V and 12V source to find current I_o'



$$2k \| 2k = \frac{2k \times 2k}{2k + 2k} = 1k\Omega$$

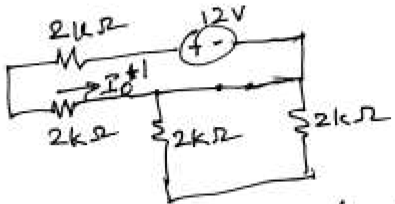


Using current divider formula

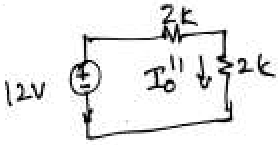
$$I_o' = \frac{2mA \times 2k\Omega}{(2k + 2k)\Omega}$$

$$\boxed{I_o' = \frac{4}{4k\Omega} = 1mA}$$

Deactivate 6V and 2mA source to find I_o''

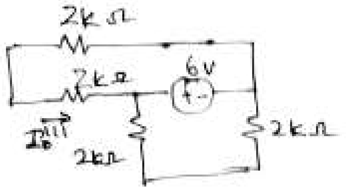


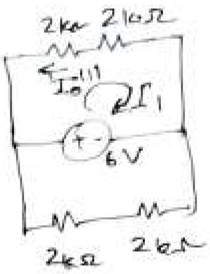
The above circuit can be further simplified as



$$\boxed{I_o'' = \frac{12V}{4k\Omega} = 3mA.}$$

Deactivate 2mA and 12V source to find I_o''' circuit will be.





$I_1 = -I_0'''$

Applying KVL to mesh containing current I_1

$-6+(2k+2k)I_1=0$

$4kI_1=6$

$I_1=\frac{6}{4k}=1.5mA$

$I_1=-I_0'''=1.5mA$

Hence $\boxed{I_0'''=-1.5mA}$

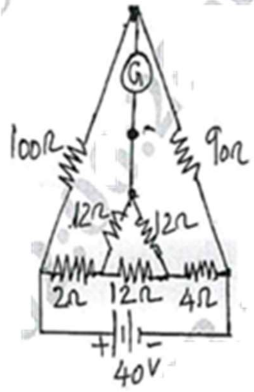
So current $I_0=I_0'+I_0''+I_0'''$

$=1m+3m-1.5m$

$\boxed{I_0=2.5mA}$

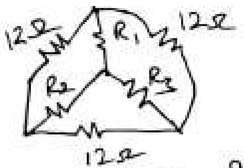
Each case: 3*3=9 marks
Final current 1Mark

6. Find current through galvanometer of 50Ω using thevinins theorem for the circuit shown below: [10]



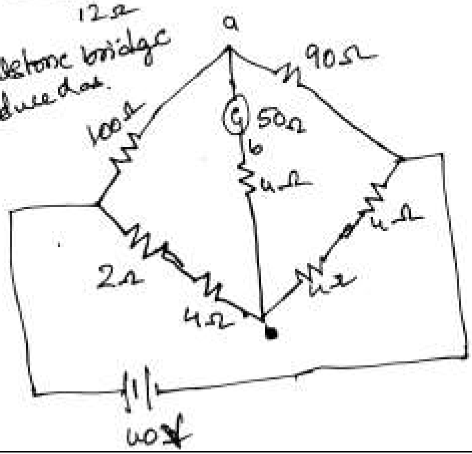
~~12Ω~~ Three 12Ω resistors can be reduced to a star network as.

$$R_1 = R_2 = R_3 = \frac{12 \times 12}{12+12+12}$$



$$\boxed{R_1 = R_2 = R_3 = 4\,\Omega}$$

above wheatstone bridge can be reduced as.



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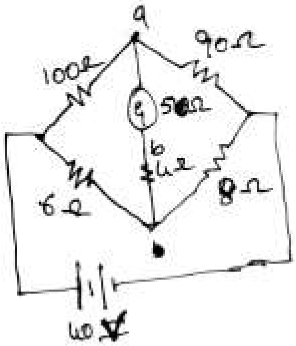
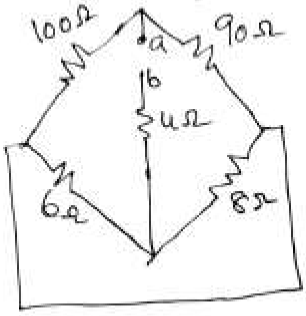
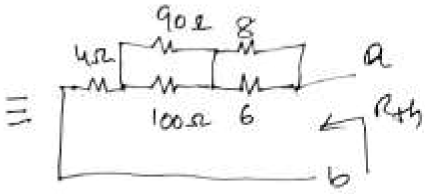


Let us remove part B of the circuit and finding thevinins equivalent resistance R_{th} by deactivating 40V voltage source.

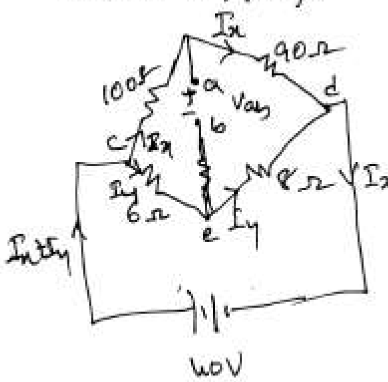




$$(90 \| 100) + (8 \| 6) + 4\Omega = (47.38 + 3.42 + 4)\Omega$$

$$\boxed{R_{th} = 54.8\Omega}$$

To find V_{th} (V_{ab}):



Apply KVL to caba loop

$100I_x + V_{ab} - 6I_y = 0 \to (1)$

Apply KVL to adba loop

$90I_x - 8I_y - V_{ab} = 0 \to (2)$

Apply KVL to cedc loop

$-40 + 6I_y + 8I_y = 0$

$I_y = 40 = 2.857A$

Rth calculation:4 marks
Vth : 4 marks
I:2 Marks

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