USN

CMRIT

Internal Assessment Test 1 – Sept. 2019

Sub:	NETWORK THEORY			Sub Code:	18EC32	Branch:	ECE
Date:	06/09/2019	Duration:	90 min's	Max Marks:	50	Sem / Sec:	III

Answer any FIVE FULL Questions

		MARKS	CO	RBT
1 (a)	Use source shifting and transformation techniques to find voltage across 2Ω resistor shown in **Fig 1(a)**. All resistor values are in ohms	[05]	CO1	L3
(b)	Find the current i_0 using **Mesh analysis** in the circuit shown in **Fig. 1(b)**.	[05]	CO1	L3
2.	Find the power supplied by dependent source in the circuit of **Fig.2**	[10]	CO1	L3
3.	Use nodal analysis to find v_o in the network of **Fig.3**.	[10]	CO1	L3

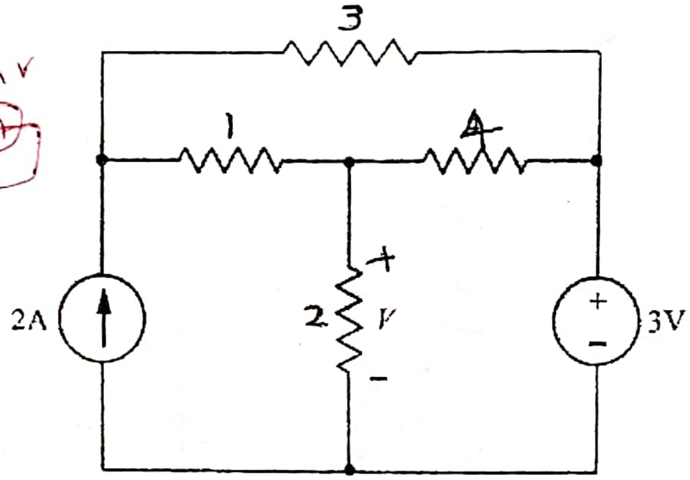


Fig. 1(a)

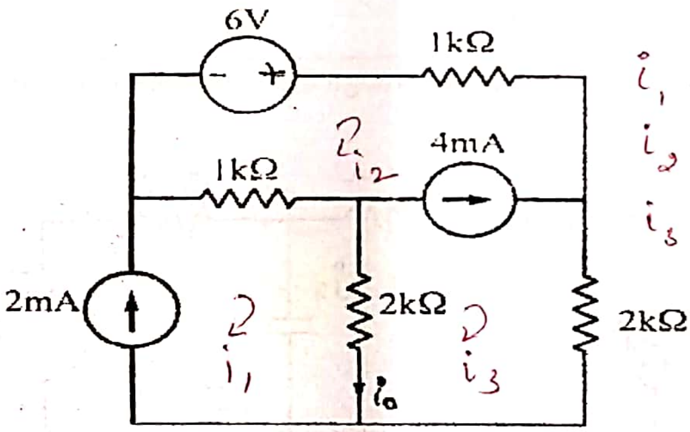


Fig. 1(b).

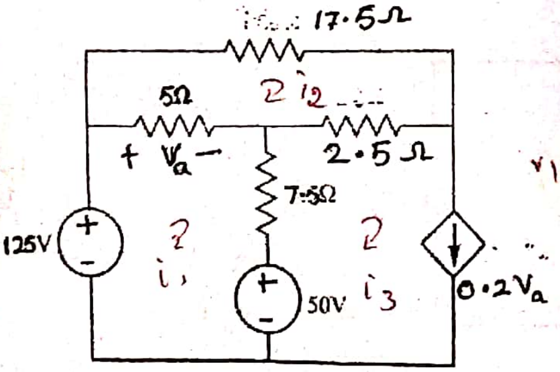


Fig. 2

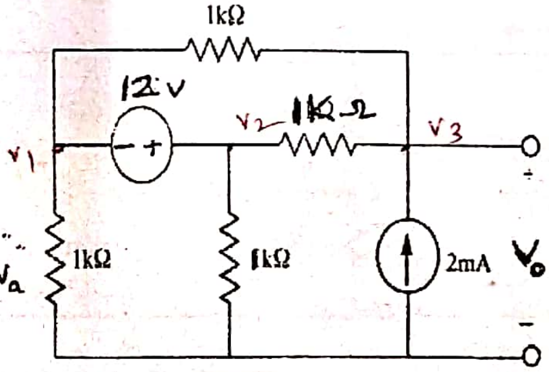


Fig. 3

4.	Use the principle of superposition to solve for v_x for the circuit shown in Fig.4. Find the power delivered by 4A current source.	[10]	CO2	L3

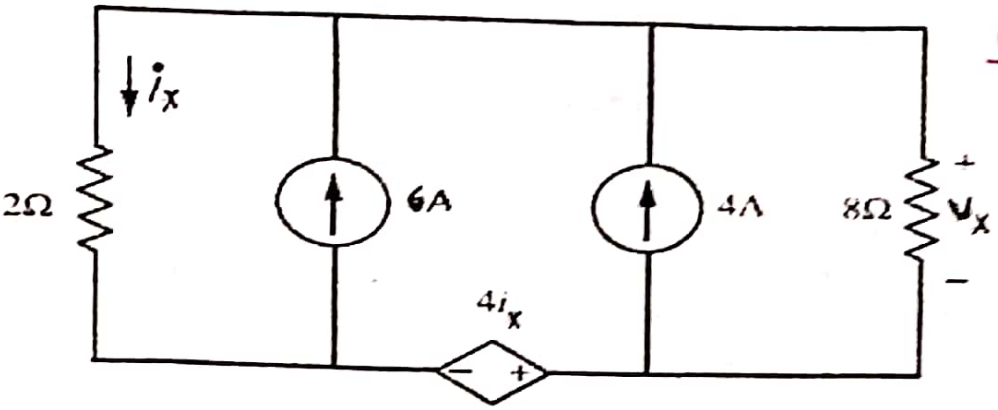


Fig.4

5.	Find the voltage V_1 using the superposition principle. Refer the circuit shown in Fig. 5.	[10]	CO2	L3

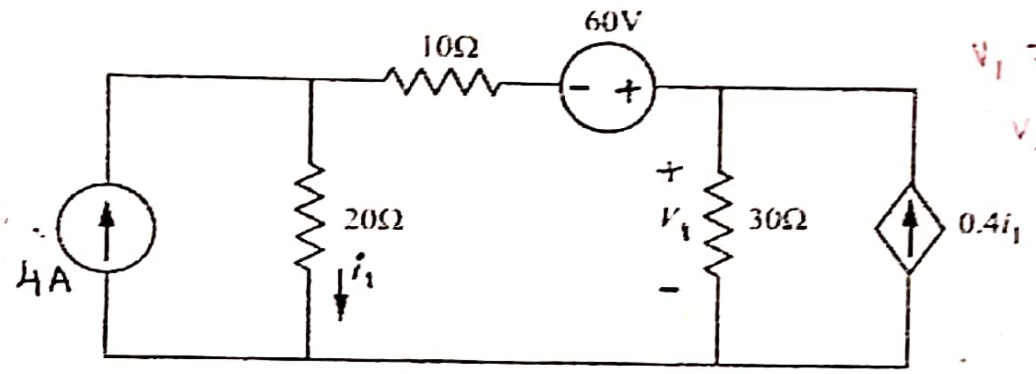


Fig. 5

6.	Determine the value of V_2 such that the current through the impedance (3+j4) ohm is Zero.	[10]	CO1	L3

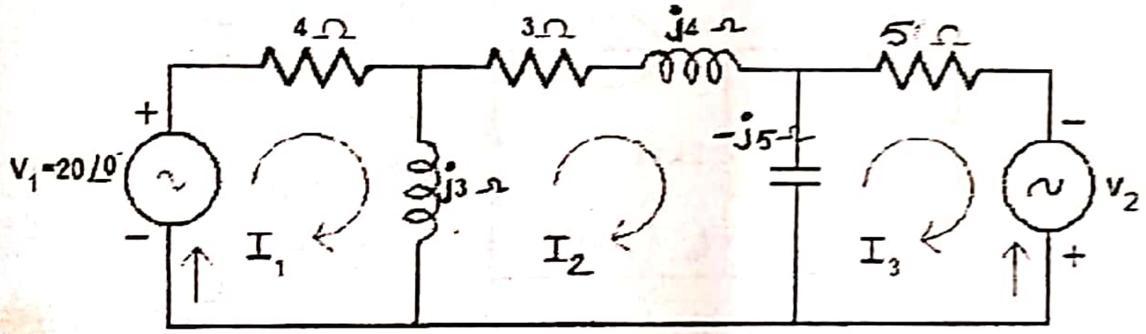


Fig. 6

7	Obtain the equivalent resistance R_{ab} for the circuit of Fig. 7 and hence find i.	[10]	CO1	L3

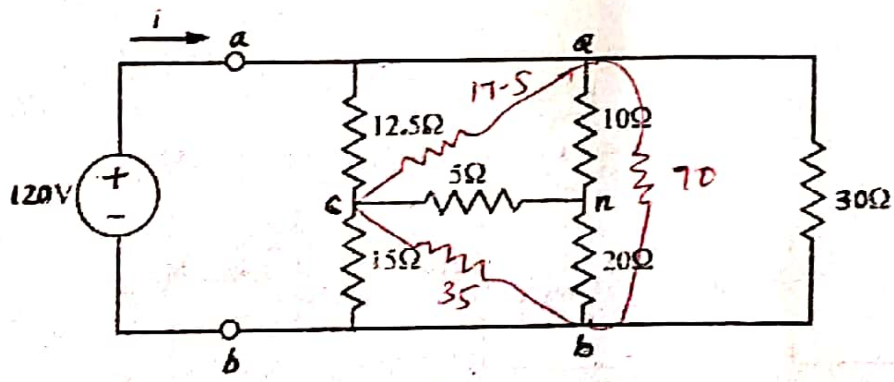
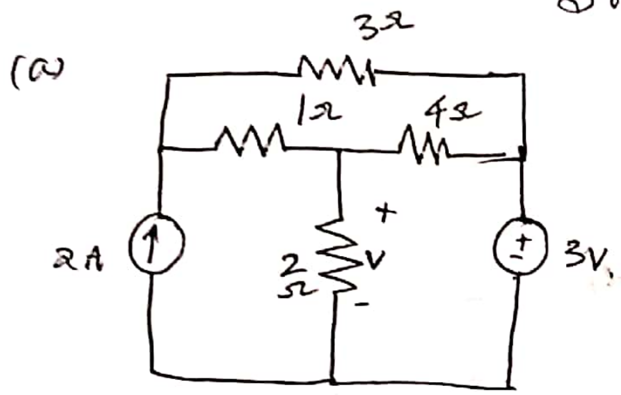


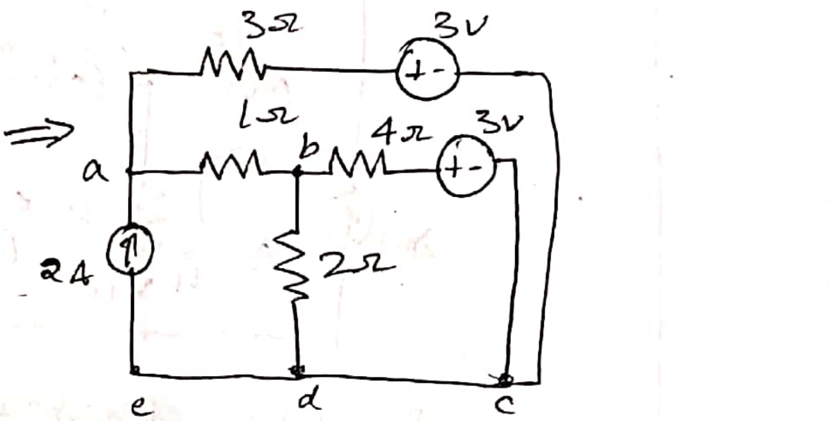
Fig. 7

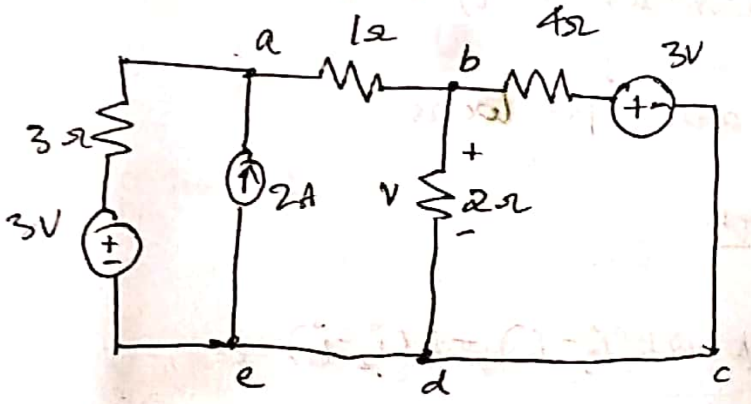
Network Theory IAT 1

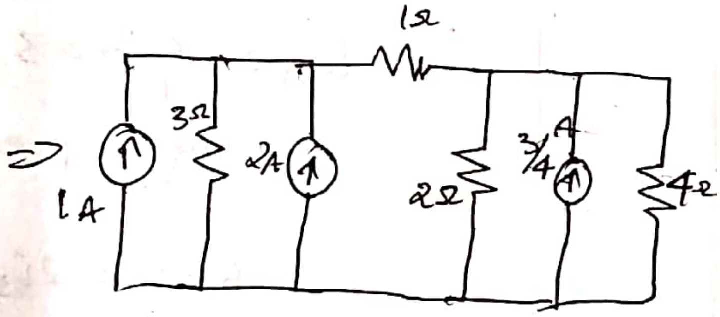
Solution

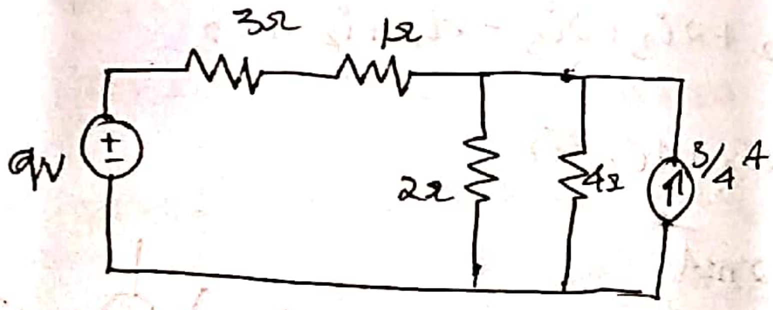
(a)

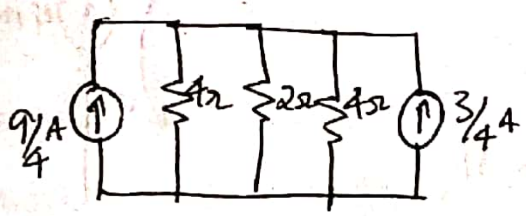


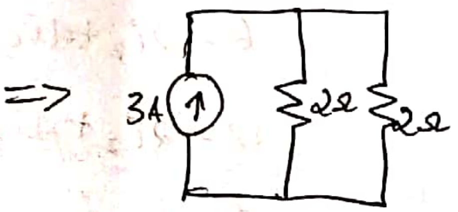


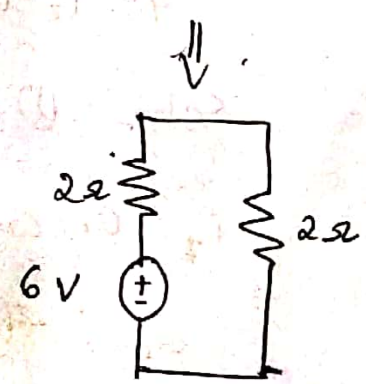








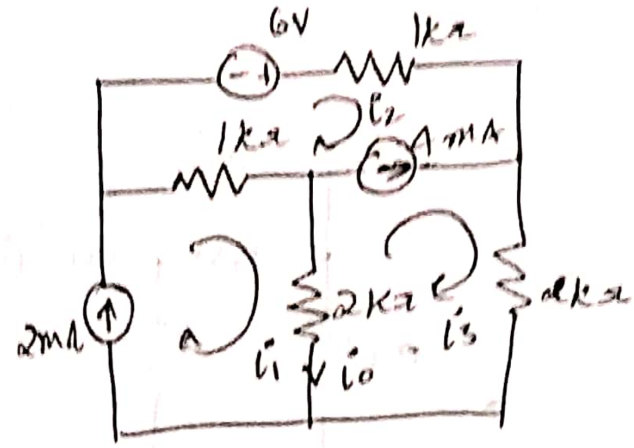




Across 2Ω

$\Rightarrow \frac{6\times 2}{3} = 3V$

b.



By direct observation ⟹ $i_1 = 2mA$

loop2 & loop 3 are super loops.

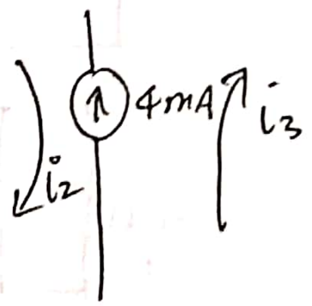
superloop eqn.

$6 - i_2 k - 2i_3 k - 2k(i_3 - i_1) - k(i_2 - i_1) = 0$

$6 = i_2 + 2i_3 + 2i_3 - 2i_1 + i_2 - i_1 = 0$

$6 = (2i_2 + 4i_3 - 3i_1)$

$i_1 = 2mA$



$6 = 2i_2 + 4i_3 - 6$

$12 = 2i_2 + 4i_3$ — ①

$4 = i_3 - i_2$ - ②

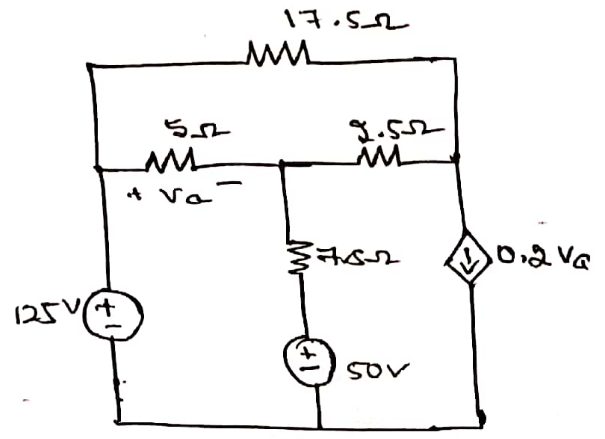
Solve ① and ②

$i_2 = 0.66mA$ $i_3 = 3.34mA$

$I_0 = i_1 - i_3$

$I_0 = (2 - 3.34)mA$

9) Find the power supplied by dependent source in the circuit



By direct observation

$i_3 = 0.2V_a$ A → ①

KVL for loop1 and loop2

Loop-1

$125 = 5(i_1 - i_2) + 7.5(i_1 - i_3) + 50$

$125 - 50 = 5i_1 - 5i_2 + 7.5i_1 - 7.5i_3$

$75 = 12.5i_1 - 5i_2 - 7.5i_3$ → ②

$i_1 = 13.2$ A

$i_2 = 3.6$ A

$i_3 = 9.6$ A

Loop-2

$0 = 17.5i_2 + 2.5(i_2 - i_3) + 5(i_2 - i_1)$

$0 = 25i_2 - 5i_1 - 2.5i_3$ → ③

$V_a = 5(i_1 - i_2)$ → ④

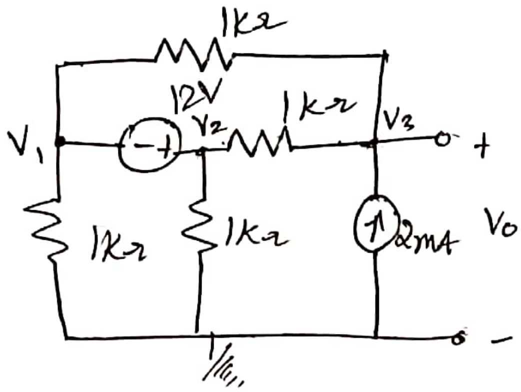
V_a in ①

$i_3 = 0.2(5i_1 - 5i_2)$

$i_3 = i_1 - i_2$

$i_1 - i_2 - i_3 = 0$

3.



V_2 and V_2 are super node.

$$\frac{V_2-V_3}{1} + \frac{V_2-0}{1} + \frac{V_1-0}{1} + \frac{V_1-V_3}{1} = 0 \quad -①$$

Super node eqn:

$$\frac{V_1}{1K} + \frac{V_2}{1K} + \frac{V_2-V_3}{1K} + \frac{V_1-V_3}{1K} = 0$$

At V_3-

$$\frac{V_3-V_1}{1} + \frac{V_3-V_2}{1} = 2. \quad -②$$

@ node V_3

$$\frac{V_3-V_1}{1K} + \frac{V_3-V_3}{1K} = 2mA$$

We know- $V_2-V_1 = 0$ 12V

$V_2 = V_1$

By solving

$V_1 = -\frac{5}{2}V$

$V_2 = 7V$

$V_3 = 2V = V_0$

$V_2-V_3+V_2+V_2+V_2-V_3=0 \quad -①$

$4V_2-2V_3=0 \quad -ⓐ$

$V_3-V_2+V_3-V_2=2 \quad -②$

$2V_3-2V_2=2 \quad -ⓑ$

$V_3=V_0=2V$

Solve ⓐ and ⓑ.

$V_2 = 1V$

$V_3 = 2V.$

$V_2 = V_1$

$\therefore V = 1V.$

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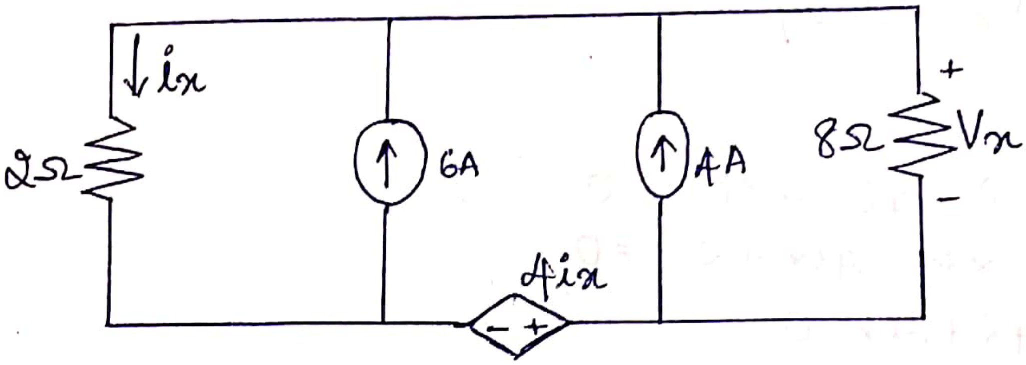
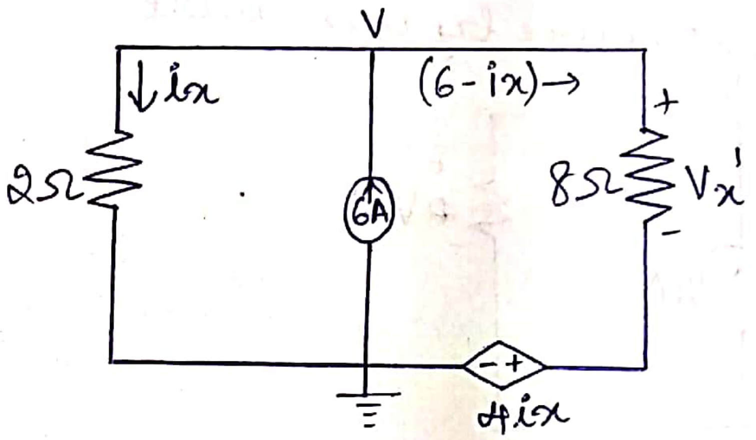
NETWORK THEORY

4th Soln



Case 1: Considering 6A current source alone,
Replace 4A current source with open circuit.



By nodal analysis

$$\frac{V_x}{2} + \frac{V - 4i_x}{8} = 6$$

$$4V + V - 4i_x = 48$$

$$5V - 4i_x = 48$$

$$i_x = \frac{V}{2}$$

$$\Rightarrow 5V - 4\left(V/2\right) = 48 \Rightarrow 3V = 48 \Rightarrow V = \frac{48}{3}$$

$$\Rightarrow V = 16V$$

$$i_x = \frac{V}{2} = \frac{16}{2} = 8A \quad ; \quad \boxed{i_x = 8A}$$

P.T.O

By KVL : $V - V_x' - 4i_x = 0$

$V_x' = V - 4i_x = 16 - 32 = -16V$

$\boxed{V_x' = -16V}$

i_x by KVL :

$-8(6 - i_x) - 4i_x + 2i_x = 0$

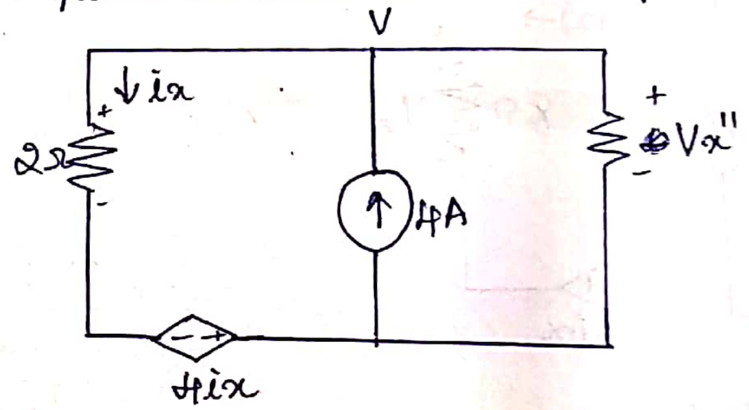
$-48 - 8i_x - 4i_x + 2i_x = 0$

$-48 + 6i_x = 0$

$\Rightarrow i_x = \frac{48}{6}$

$\therefore \boxed{i_x = 8A}$

Case 2: Consider 4A current source alone, Replace 6A current source by open circuit



By KVL : $-8(4 - I_x) - 4i_x + 2i_x = 0$

$-32 + 8I_x - 4i_x + 2i_x = 0$

$6I_x = 32$

$I_x = \frac{32}{6} \Rightarrow I_x = 5.33A$

$V_x'' = 8(4 - i_x) = 8(4 - 5.33)$

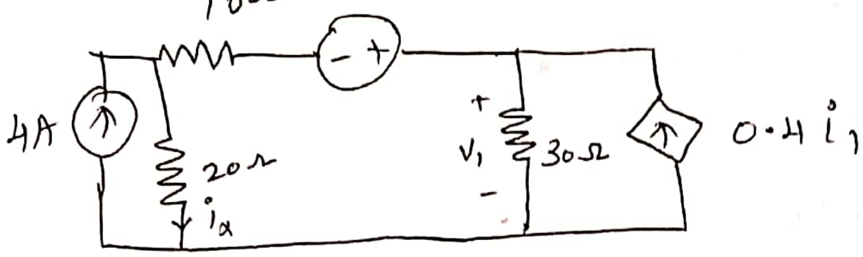
$\boxed{V_x'' = -10.64V}$

By SPT,

$V_x = V_x' + V_x'' = -16 - 10.64$

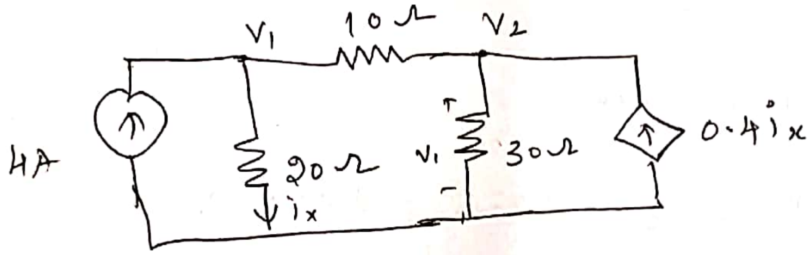
$\Rightarrow \boxed{V_x = -26.64V}$

2)



Case 1 ::

Consider 4A source acting alone.



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

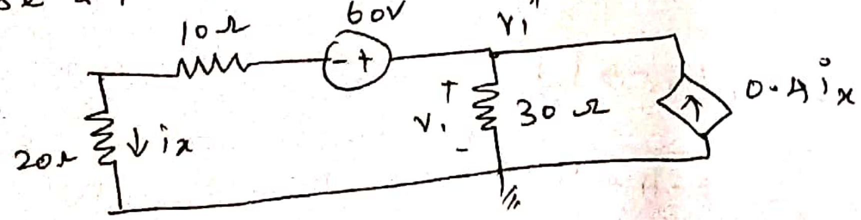
$$3V_1 - 2V_2 = 80$$

$$\frac{V_2 - V_1}{10} + \frac{V_2}{30} - 0.4\left(\frac{V_1}{20}\right) = 0$$

$$20V_2 - 18V_1 = 0$$

$$\boxed{V_1' = 60\,V}$$

Case 2 : Consider 60V source acting alone.



$$\frac{V_1'' - 60}{30} + \frac{V_1''}{30} = 0.4\, i_x$$

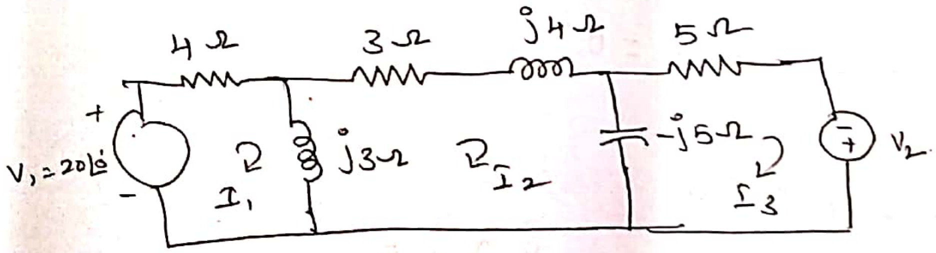
$$i_x = \frac{V_1'' - 60}{30}$$

$$\boxed{V_1'' = 22.5\ V}$$

O/P = case 1 + case 2

$V = V' + V_1'' = 60 + 22.5 = 82.5\ V$

eg: 6



Loop 1: $I_1 = \frac{20}{4+3j}$

Loop 2 : $I_2 = 0$

$-3j\, i_1 + 0 + 5j\, i_3 = 0$

$i_3 = 1.92 - 1.44j\ A$

Loop 3: $V_2 = i_3 (5 - 5j)$

$$\boxed{V_2 = 2.4 - 16.8j\ V}$$

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(7) Obtain the equivalent resistance R_{ab} for the circuit of fig. 7 & hence find i :- [10 marks]

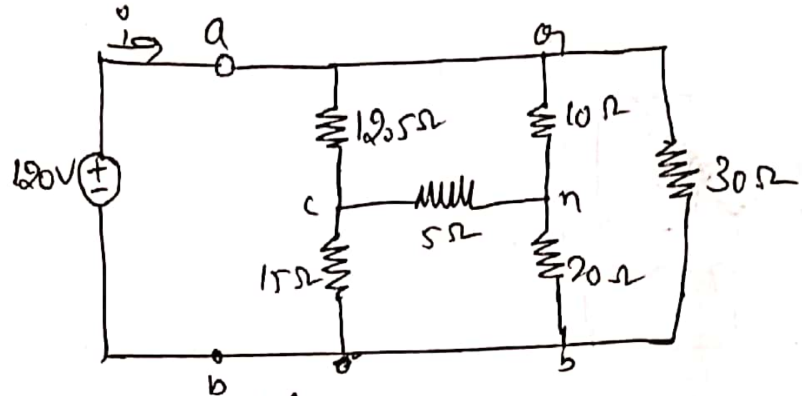
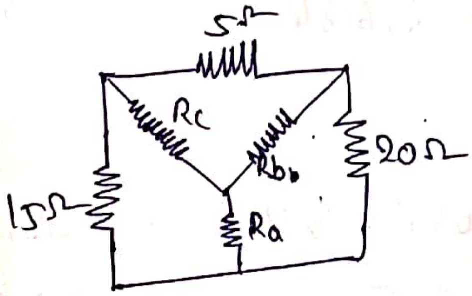


fig. 7

Sol :- Consider a Δ connection part.

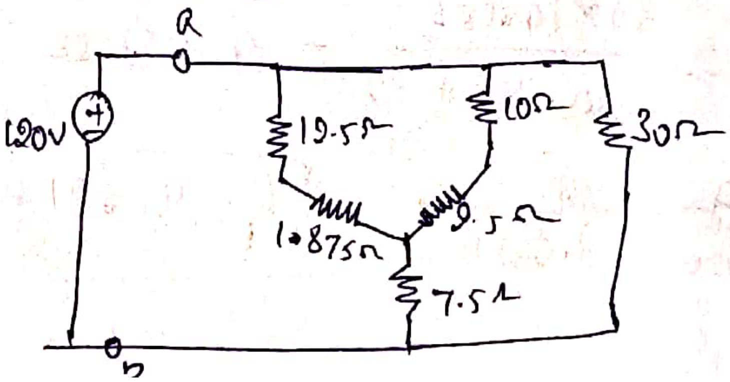


$$R_a = \frac{15 \times 20}{15+20+5} = 7.5\,\Omega$$

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

$$R_c = \frac{5 \times 15}{15+20+5} = 1.875\,\Omega$$

Now circuit diagram is,

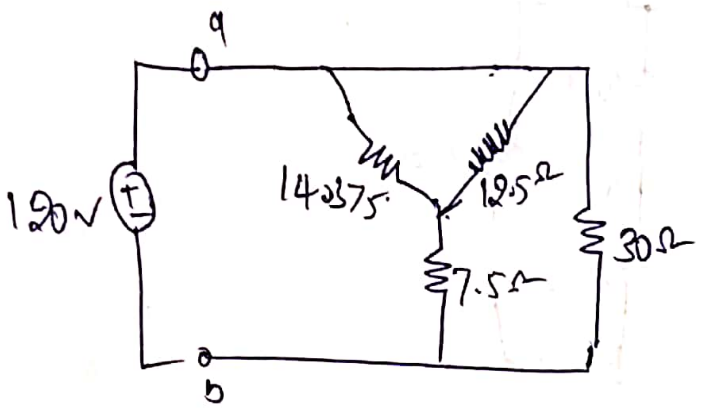


10Ω & 2.5 Ω are in series

$10 + 2.5 = 12.5\,\Omega$

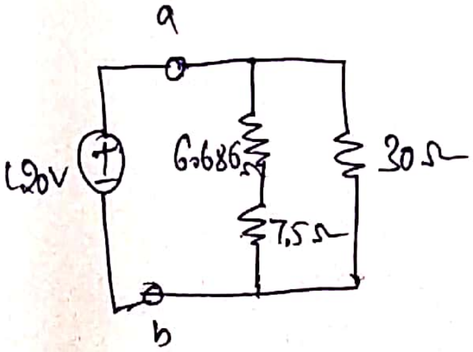
12.5Ω & 1.875Ω are in series

$12.5 + 1.875 = 14.375\,\Omega$



12.5 & 14.375Ω are in parallel.

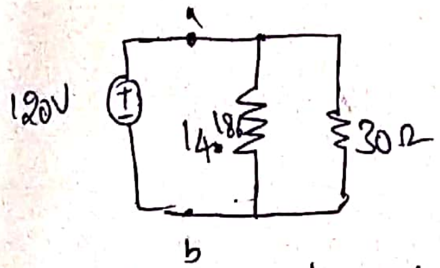
$$\frac{12.5 \times 14.375}{12.5 + 14.375} = 6.686$$

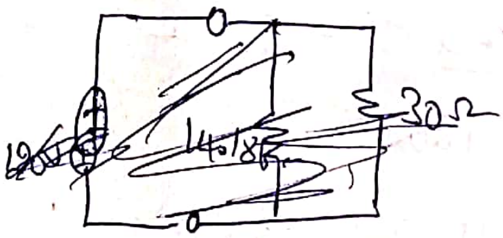


6.686Ω & 7.5 are in series

~~6.68~~ ~~6.68~~ $6.686 + 7.5$

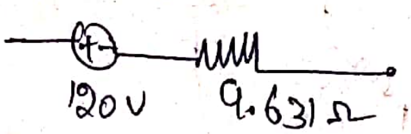
$= 14.186\,\Omega$





14.186Ω & 30Ω are in parallel

$$R_{Eq} = \frac{30 \times 14.186}{14.186 + 30} = 9.631\,\Omega$$



$R_{Eq} = 9.631\,\Omega$

$$I = \frac{V}{R}$$

$$= \frac{120}{9.631}$$

$$I = 12.4597 \text{ A}$$