USN										

CMR INSTITUTE OF TECHNOLOGY

Internal Assesment Test - II

Sub:	**Electric Circuit Analysis**							Code:	18EE32
Date:	02/11/2020	Duration:	90 mins	Max Marks:	50	Sem:	3rd	Branch:	EEE
Answer Any FIVE FULL Questions									

Marks/CO/RBT

1. (a) Derive expression for Delta-Star Transformation. (5)(CO2)(L2)

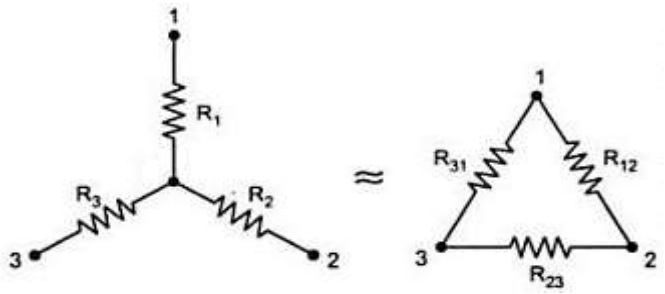
When a circuit cannot be simplified in normal series parallel reduction technique, the star delta transformation technique is used.

Equations for star-delta transformation:

$$R_{12} = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_3}$$

$$R_{23} = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_1}$$

$$R_{31} = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_2}$$

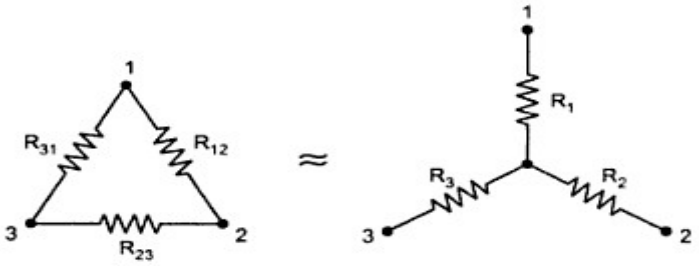


Equations for delta-star transformation:

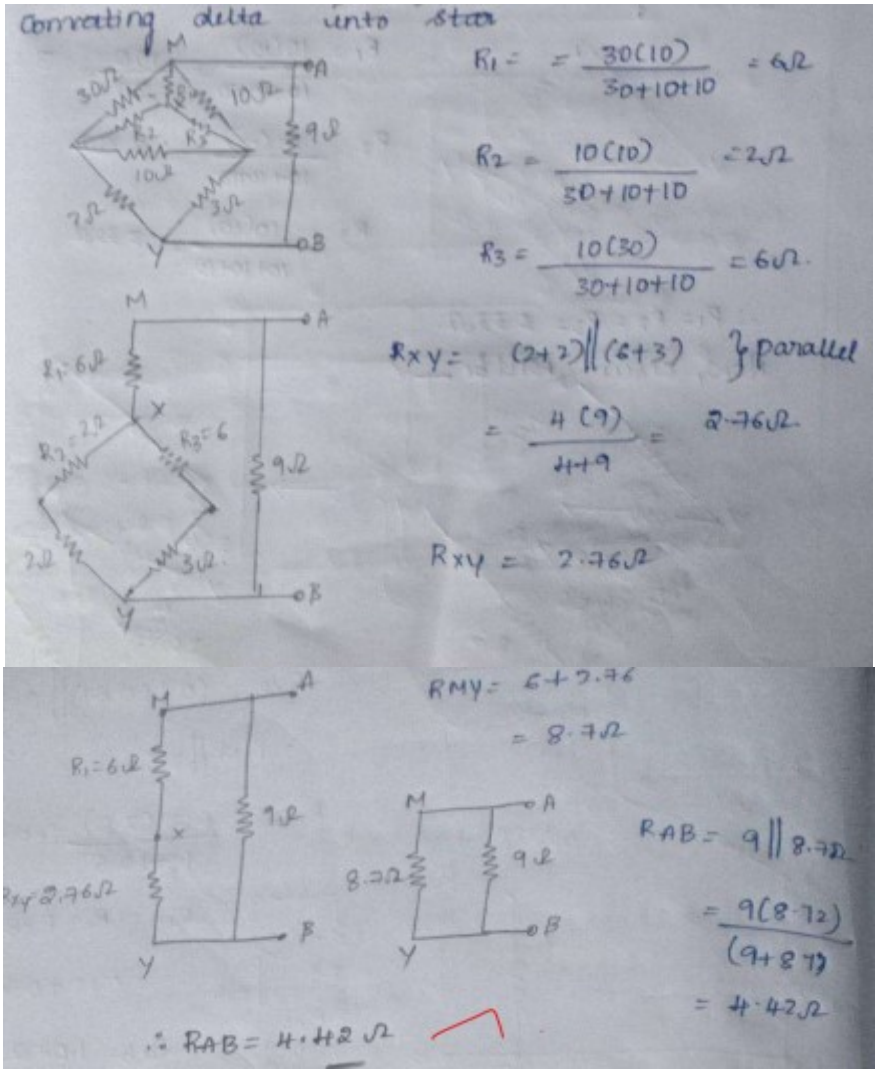
$$R_1 = \frac{R_{12}R_{31}}{R_{12} + R_{23} + R_{31}}$$

$$R_2 = \frac{R_{23}R_{12}}{R_{12} + R_{23} + R_{31}}$$

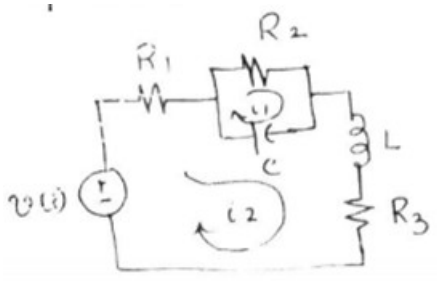
$$R_3 = \frac{R_{31}R_{23}}{R_{12} + R_{23} + R_{31}}$$



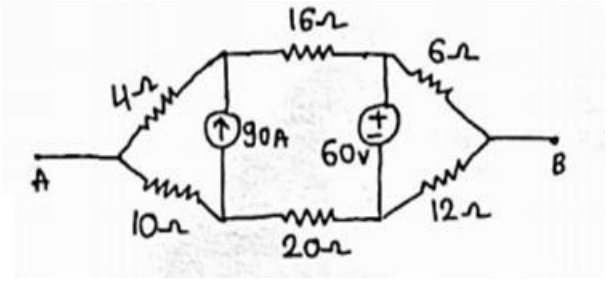
(b) Find the equivalent resistance R_{AB} using Delta-Star Transformation. (5)(CO2)(L3)

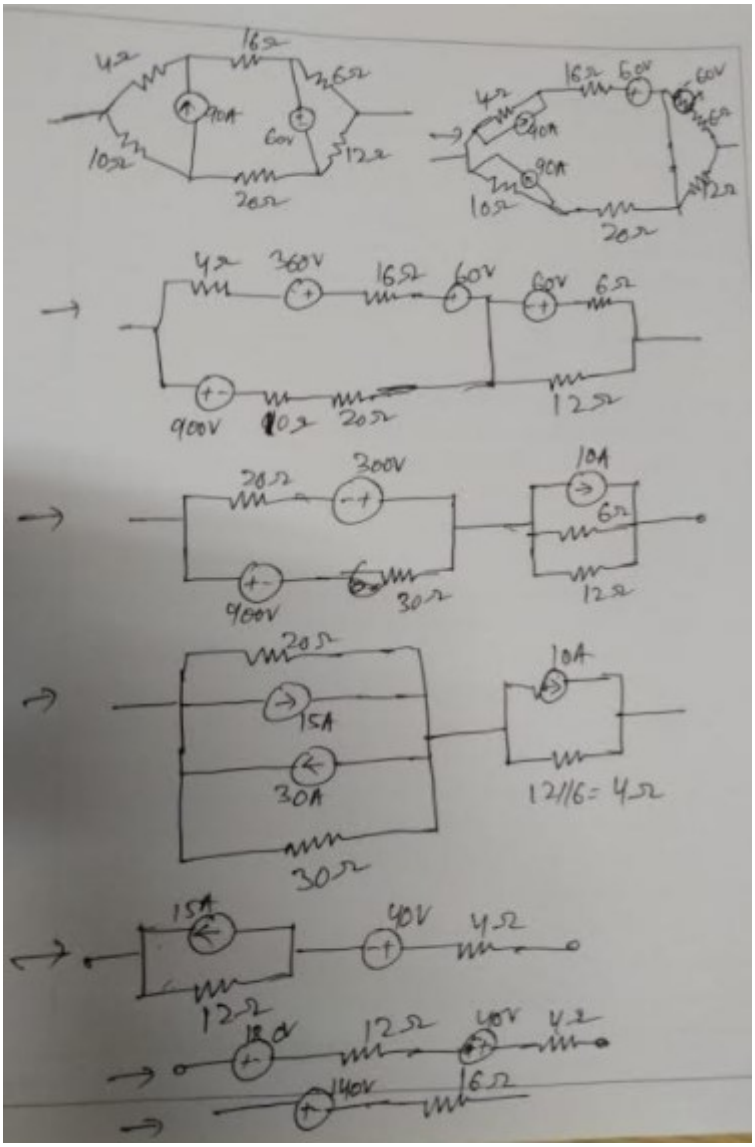


2. (a) Draw the dual of the following circuit. (4)(CO2) (L3)

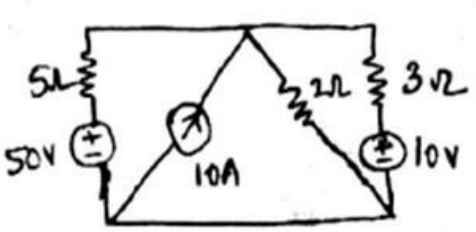


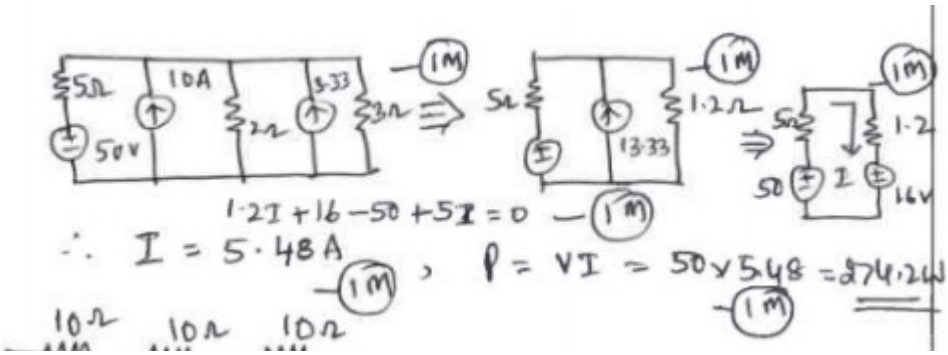
(b) Convert the given circuit into a single voltage source in series with a single resistance using source transformation & shifting. (6)(CO2) (L3)



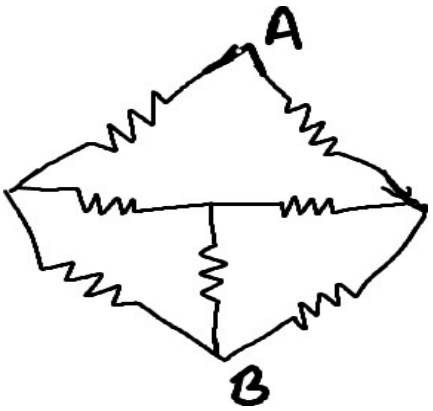


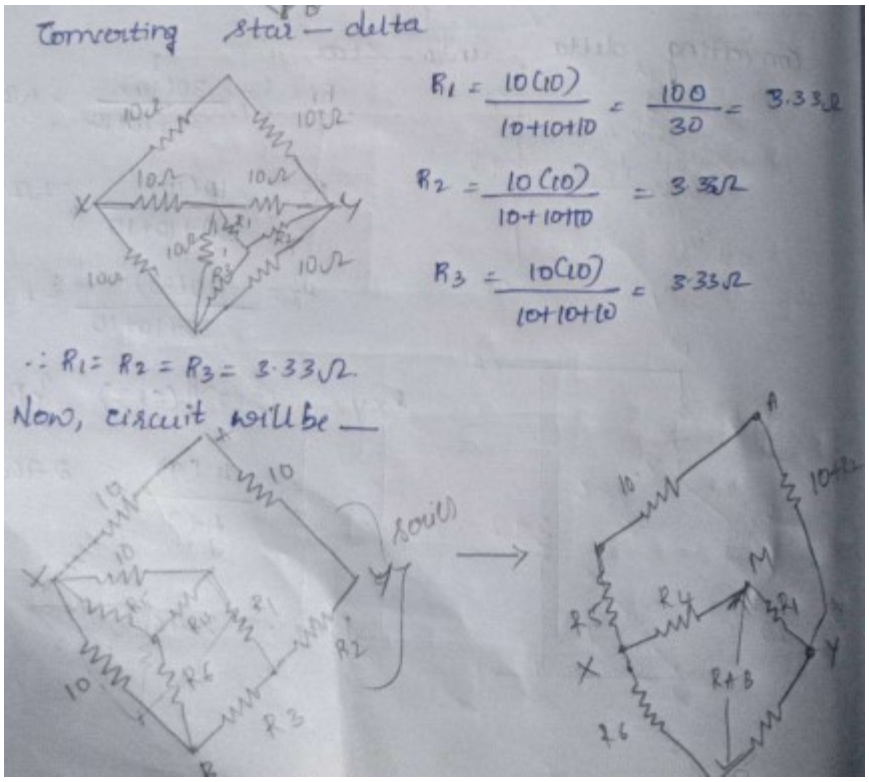
3. (a) Find power delivered by 50V source using source transformation. (5)(CO2) (L3)

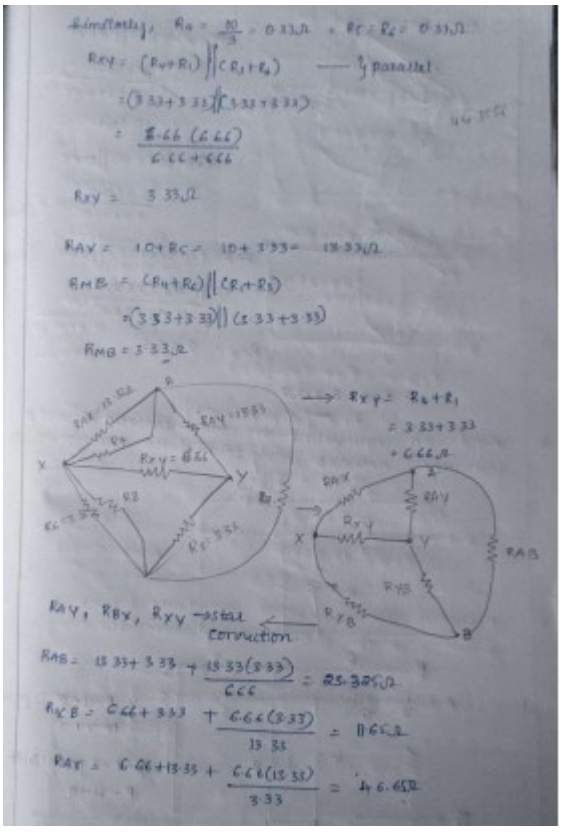


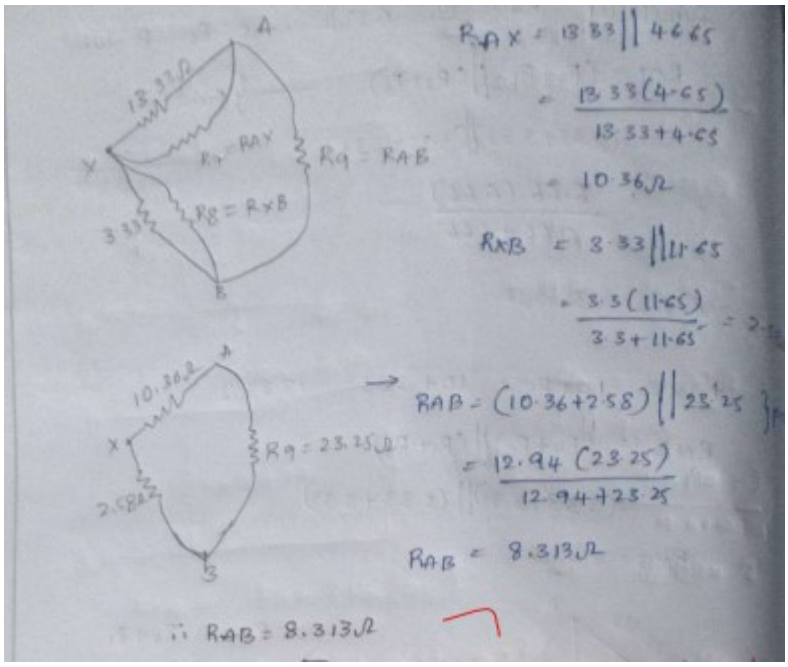


(b) Find R_{ab} using Delta-Star Transformation. All resistances are of same value 10Ω. (5)(CO2) (L3)

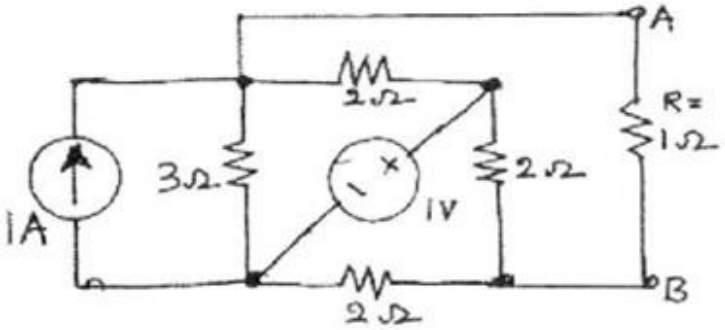




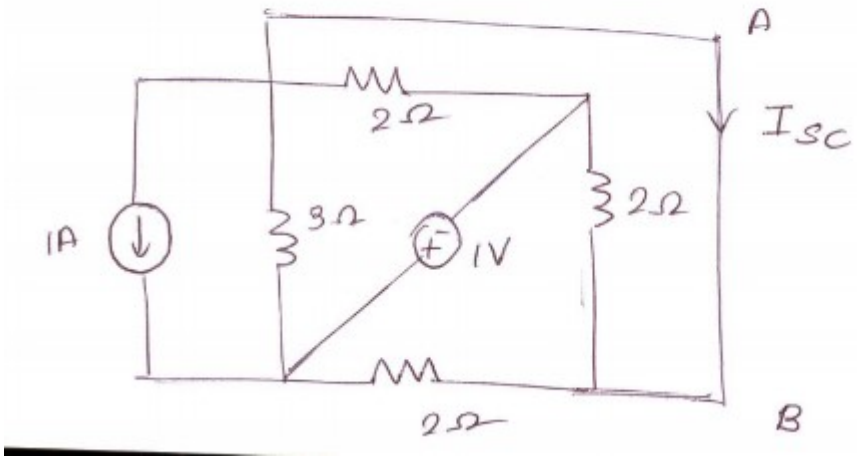




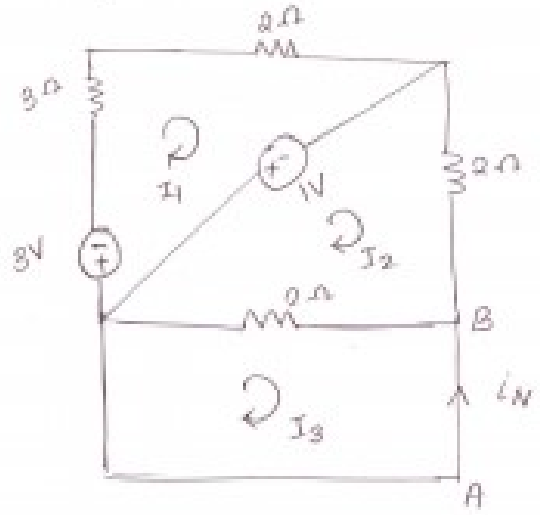
4. Find current in 1Ω resistor using Thevenin's & Superposition Theorem simultaneously. (10)(CO3)(L3)



∴ shorting terminals A & B



Using source transformation.



Applying mesh analysis in loop 1

$$-3 - 3I_1 - 2I_1 + 1 = 0$$

$$-5I_1 - 2 = 0$$

$$I_1 = -2/5\ A$$

Applying mesh analysis in loop 2

$$-1 - 2I_2 - 2(I_2 - I_3) = 0$$

$$-1 - 4I_2 + 2I_3 = 0 \quad \rightarrow (2)$$

Applying mesh analysis in loop 3.

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

$$-2I_3 + 2I_2 = 0$$

$$I_3 = I_2$$

Substituting in $-1 - 4I_2 + 2I_2 = 0$

$$-1 - 4I_2 + 2I_2 = 0$$

$$-1 - 2I_2 = 0$$

$$-1 = 2I_2$$

$$I_2 = \frac{-1}{2} = -0.5A$$

As I know $I_N = -I_2$

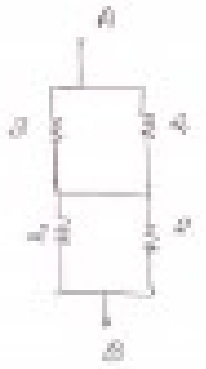
$$I_N = 0.5A$$

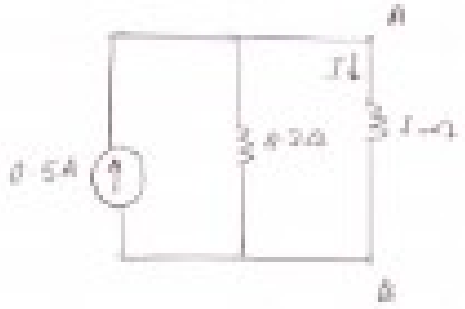
R_N

$$R_N = (3 \| 2) + (2 \| 3)$$

$$\frac{3 \times 2}{3+2} + \frac{2 \times 3}{2+2}$$

$$\frac{6}{5} + 1 = \frac{11}{5} = 2.2\Omega$$



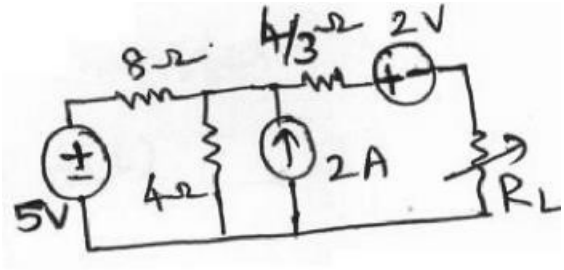


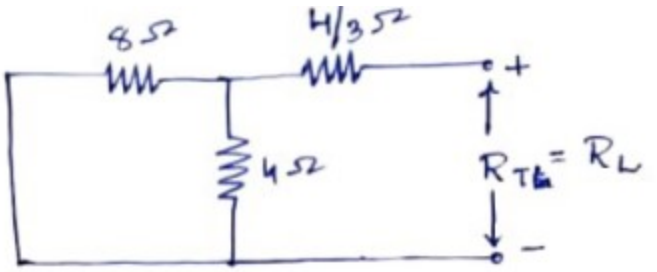
By current division rule

$$I = 0.5 \times \left(\frac{2.2}{2.2+1}\right)$$

$$I = 0.34345A$$

5. (a) Find the value of R_L for which maximum power is delivered to it. (6)(CO3) (L3)





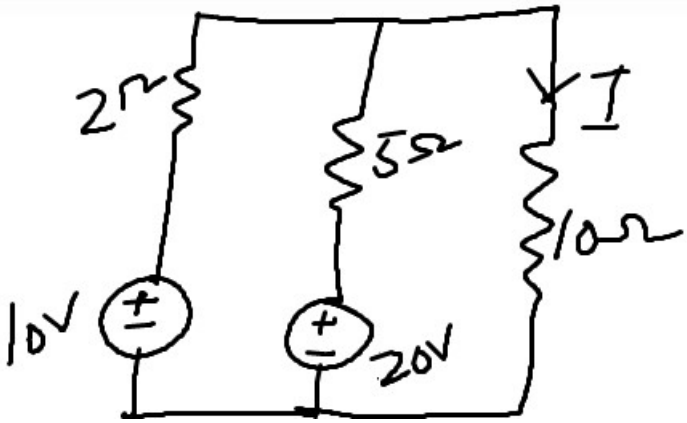
$$R_T = R_L = \frac{8(4)}{8+4} + \frac{4}{3} = \frac{32}{12} + \frac{4}{3}$$

$$= \frac{32+16}{12}$$

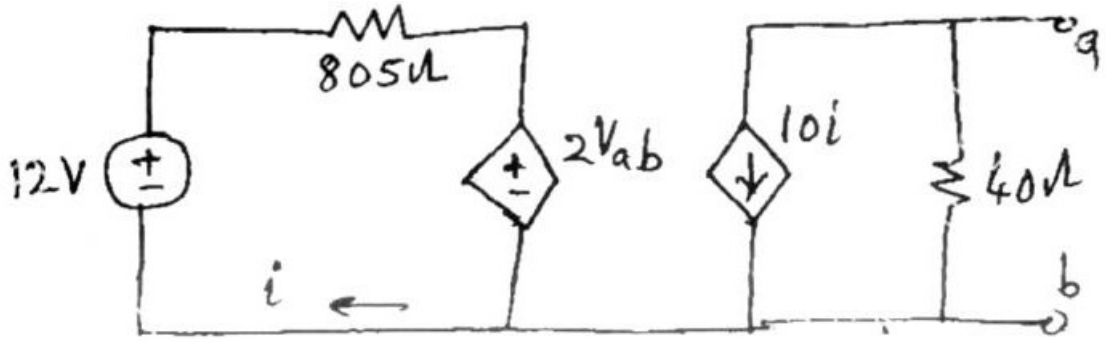
$$= \frac{48}{12} 4$$

$$R_T = R_L = 4\,\Omega$$

(b) Find current through I using Millman's Theorem. (4)(CO3) (L3)



6. Find Thevenin's & Norton's equivalent circuit for the given network. (10)(CO3) (L3)



Apply KVL to loop 1

$$12 - 805i - 2V_{ab} = 0$$

$$805i + 2V_{ab} = 12 \quad \text{—— (1)}$$

Apply KVL to loop 2

$$V_{ab} = 40(-10i)$$

$$i = \frac{-V_{ab}}{400} \quad \text{—— (2)}$$

Sub (2) in (1)

$$805\left(\frac{-V_{ab}}{400}\right) + 2V_{ab} = 12$$

$$-2.0125V_{ab} + 2V_{ab} = 12$$

$$-0.0125V_{ab} = 12$$

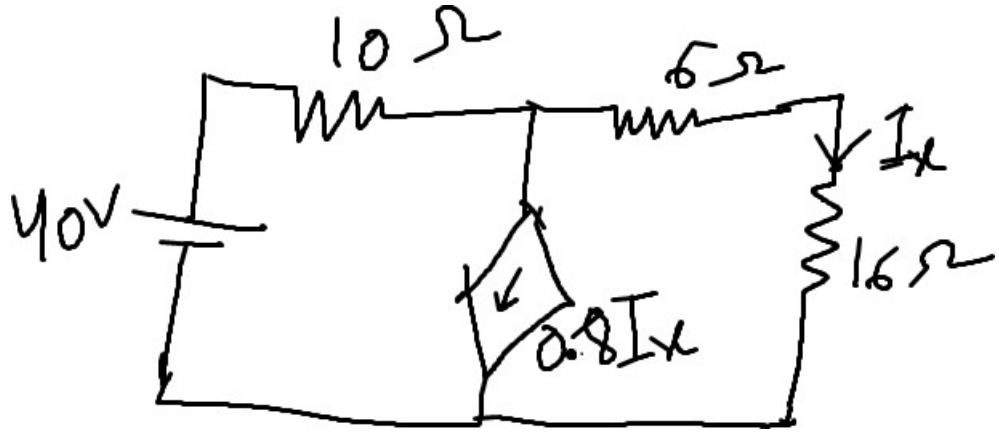
$$V_{oc} = V_{ab} = -960V.$$

$$\therefore i = \frac{-V_{ab}}{400}$$

$$= \frac{-(-960)}{400} = 2.4A.$$

$$i_{40} = 10i = 10 \times 2.4 = 24A \text{ (a to b.}$$

7. (a) Find current through 16Ω resistor using Norton's Theorem. (5)(CO3) (L3)



To find V_{th} :-

$I_x = 0 \Rightarrow 0.8V_x = 0$

$\therefore V_{th} = 40\ V$

To find I_{sc} :-

$I_{sc} = I_x$

KCL at node :-

$$0.8I_x + \frac{V_x - 40}{10} + \frac{V_x}{6} = 0$$

$$0.8I_{sc} + \frac{V_x - 40}{10} + I_{sc} = 0$$

$$1.8I_{sc} + 0.1V_x = 4$$

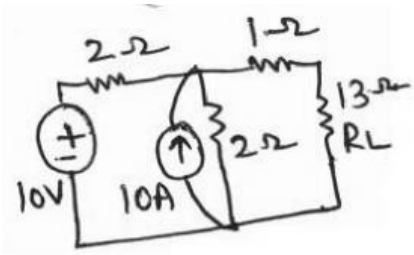
$$1.8I_{sc} + 0.1(6I_{sc}) = 4 \Rightarrow I_{sc} = 1.666\ A$$

$$R_{th} = \frac{V_{th}}{I_{sc}} = \frac{40}{1.666} = 24\ \Omega \quad -1M$$

$$I_{16\Omega} = \frac{1.666 \times 24}{24+16} \approx 1\ A \quad -2M$$

-3-

(b)Find current through R_L using Thevenin's Theorem (5)(CO3) (L3)



$V_{th} = V_x$

KCL @ node :-

$$10 = \frac{V_x}{2} + \frac{V_x - 10}{2}$$

$\therefore V_x = V_{th} = 15\ V$

$$R_{th} = \frac{2 \times 2}{2+2} + 1 = 2\ \Omega$$

$$i_L = \frac{V_{th}}{R_{th} + R_L} = 1\ A$$