20/03/2023

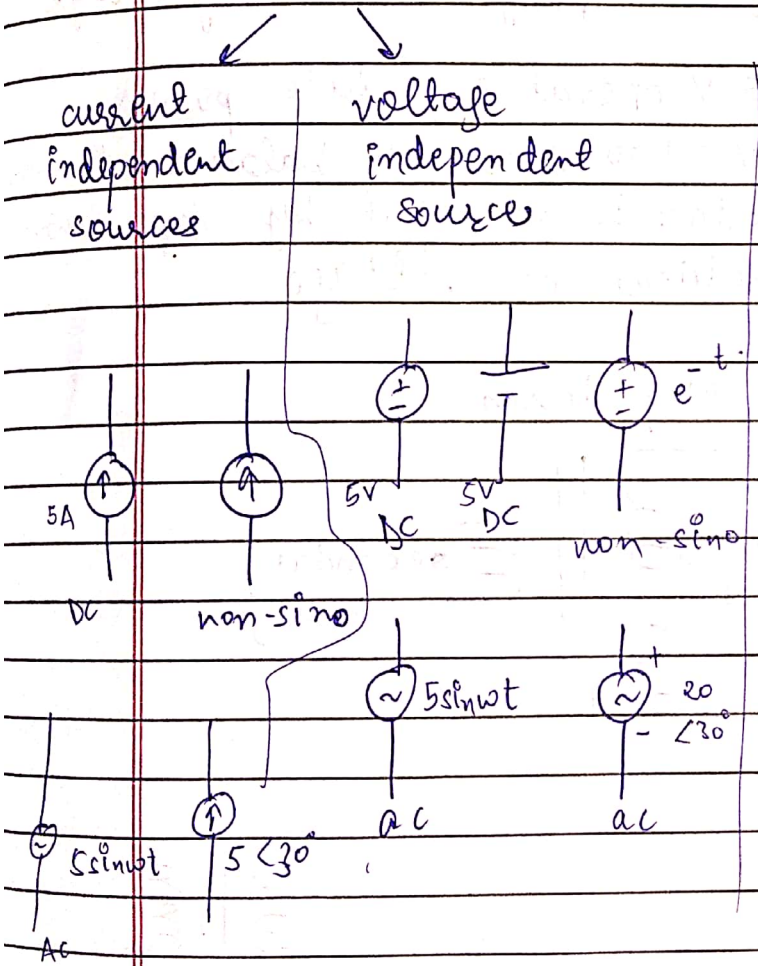
BEEE

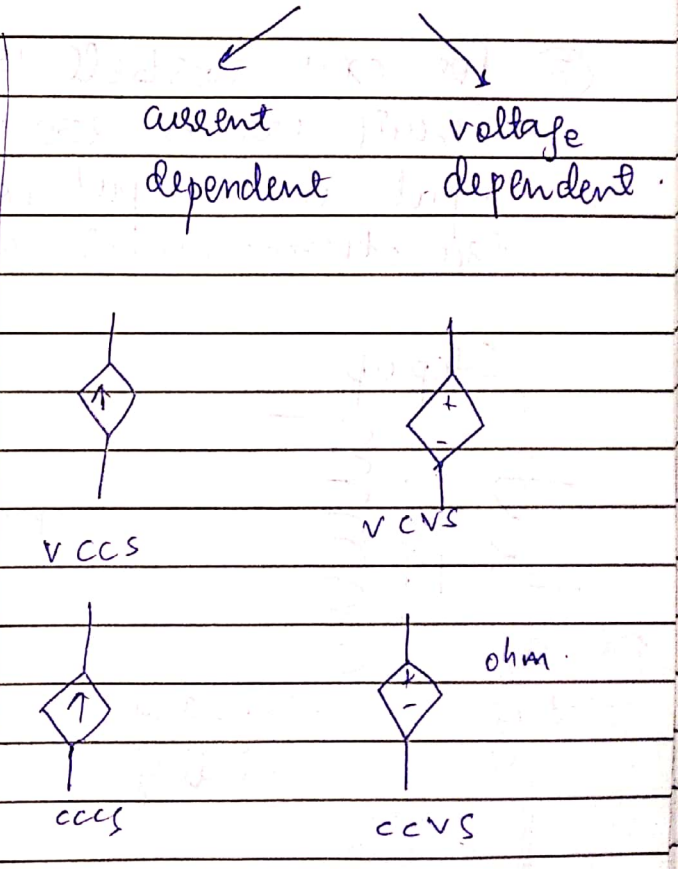
① Independent Sources

both voltage and current dont depend on voltage or current else where in the circuit

② Dependent sources

both voltage or current depends on voltage or current else where in circuit.





Q) Why AC is required over DC?

In AC flow of current changes its dirn forward and backward periodically

DC → it flows in a single dirn steadily.

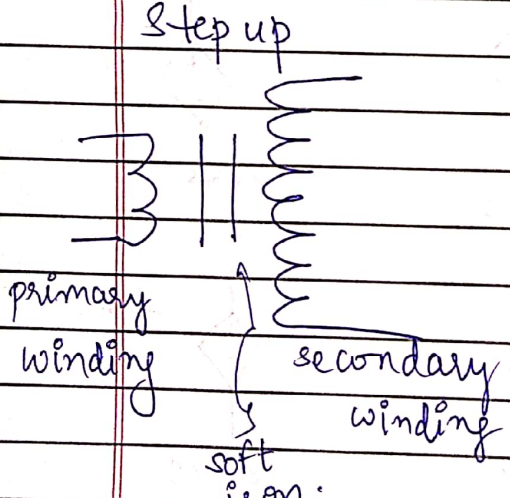
AC it has frequency loss over (DC) over transmission over long distance.
cheaper to generate.

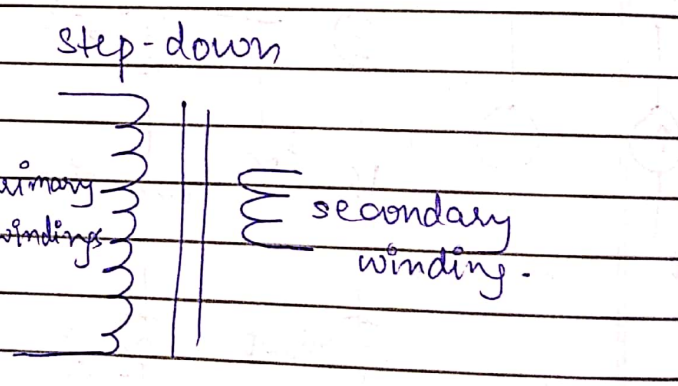
TRANSFORMERS

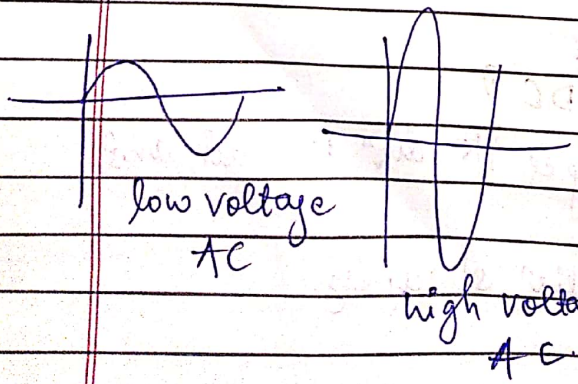
① Voltage coming into the transformer from power source is primary voltage.

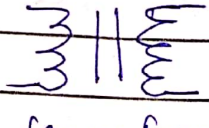
② That which is going to supply is secondary voltage.

③ for ex → doorbell 15 V operates, while power circuit carries 230 V - 100 V so this balance between input and output voltage is managed by step down transformer which reduces the voltage.







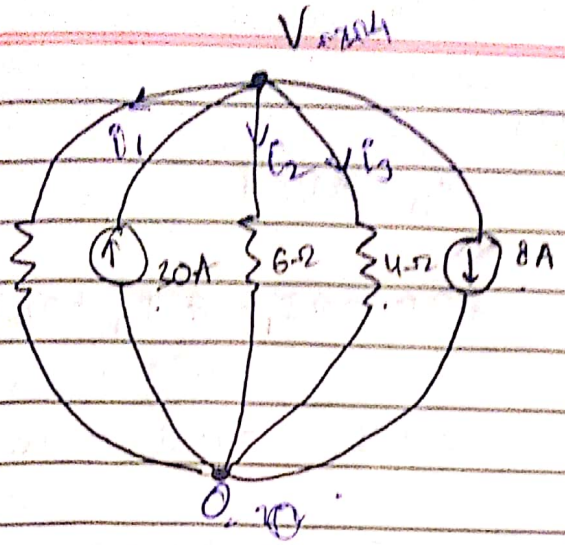


transformers symbol

Principle → Mutual induction

$$\frac{V_s}{V_p} = \frac{N_s}{N_p} = \frac{I_p}{I_s}$$

22/08/2023



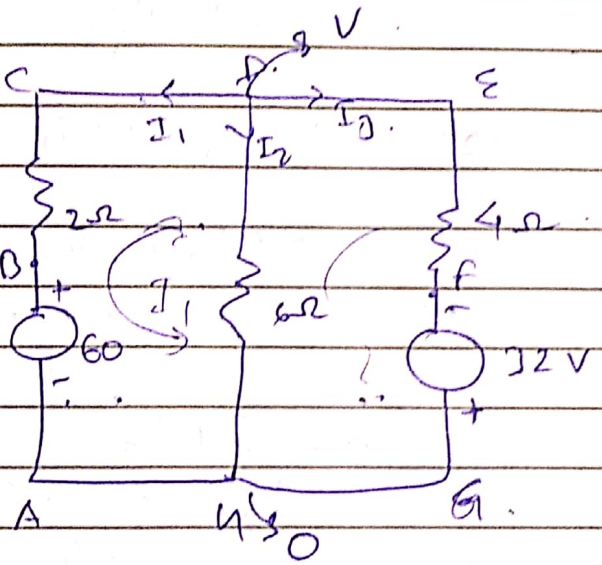
Find value of V.

$i_1 + i_2 + i_3 + 8 = 30$

$i_1 + i_2 + i_3 = 22$

$\frac{V}{2} + \frac{V}{6} + \frac{V}{4} = 22$

$V = 24\ V$.



$I_1 + I_2 + I_3 = 0$

$\frac{V-60}{2} + \frac{V-0}{6} + \frac{V+32}{4} = 0.$

$-60 + 2I_1 + 6(I_1 - I_2) = 0$ ⇒ $-60 + 8I_1 - 6I_2 = 0$

$8I_1 - 6I_2 = 60$

$4I_2 - 32 + 6(I_2 - I_1) = 0.$ ⇒ $10I_2 - 32 - 6I_1 = 0.$

$6I_1 - 10I_2 = -32$

$I_1 = \frac{60 + 6I_2}{8}$

$6 \times \frac{(60 + 6I_2)}{8} - 10I_2 = -32$

$180 + 18I_2 - 40I_2 = -128.$

$308 = 22I_2$

$I_2 = 14$

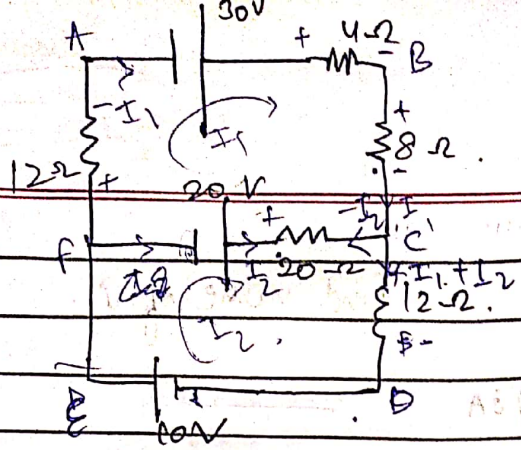
$\frac{60 + 84}{8}$

$\frac{144}{8}$

$I_1 = 18.$

∴ through 6ohm = 4A.

Q



Q Find the magnitude

Q

In ABCf.

$+30 - 4I_1 - 8I_1 + 20I_2 - 12I_1 - 20 = 0$

$24I_1 - 20I_2 = 10$

$20 - 20I_2 - 12(I_1 + I_2) + 10 = 0$

$30 = 20I_2 + 12I_1 + 12I_2$

$30 = 32I_2 + 12I_1$

$60 = 64I_2 + 24I_1$

$10 = -20I_2 + 24I_1$

$50 = 84I_2$

$I_2 = 0.595$

$I_2 = 0.6$

$10 = -12 + 24I_1$

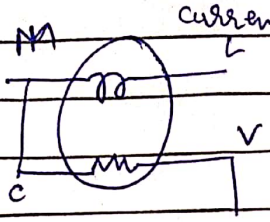
$\frac{22}{24} = I_1$

$I_1 = 0.9$

SYMBOLS →

Resistor — variable resistor — Inductor — capacitor — AC source — DC source

Voltmeter — Ammeter — fuse — I ϕ variac



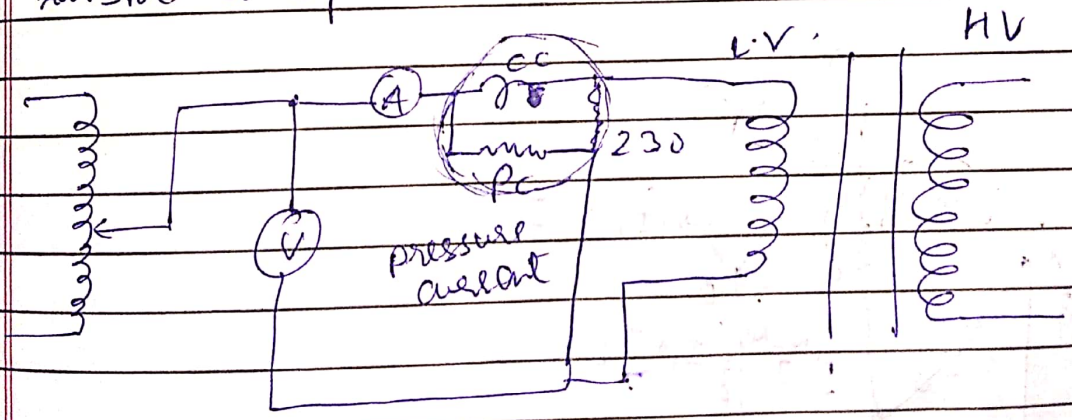
Wattmeter

Wattmeter shows reactive power

AC circuit → three types of power.

- Active: gets consumed
- Reactive: To & fro. goes from source comes back to source
- Apparent: sum of Active and Reactive.

Transformer experiment:



$P_0 = V_{rated} I_0 \cos\phi_0$

$\cos\phi_0 = \frac{P_0}{V_{rated} I_0}$

$R_c = I_0 \cos\phi_0$

$I_m = I_0 \sin\phi_0$.

$R_c = \frac{V_{rated}}{I_c}$

$X_m = \frac{V_{rated}}{I_m}$.

$\cos\phi_0 = \frac{P}{V_{rated} I_0}$.

$I_0 = I_c + I_m$.

$I_c = I_0 \cos\phi_0$.

$I_m = I_0 \sin\phi_0$.

$Z_{sc} = \frac{V_{sc}}{I_{sc}}$.

$P_{s.c} = I_{s.c}^2 R_{eq}$.

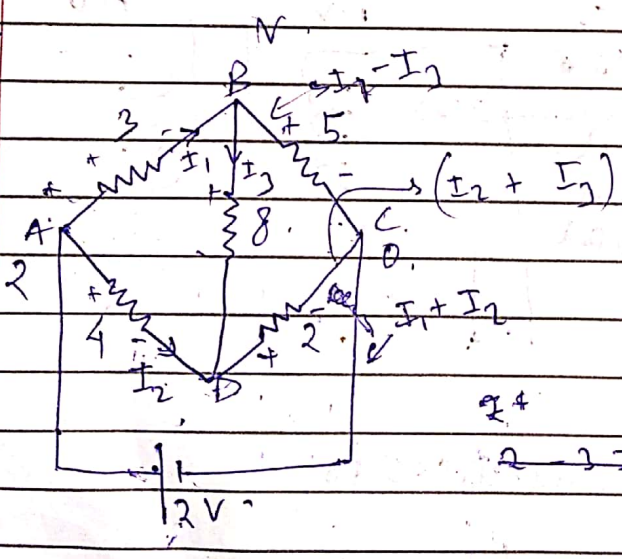
$X_{eq} = \sqrt{Z_{sc}^2 - R_{eq}^2}$.

Active : $P = VI\cos\phi$

Reactive : $Q = VI\sin\phi$ V_{AR}. KVA,

$S = \sqrt{P^2 + Q^2}$ = - -

Q.



$\Sigma +$

$2 - 3I_1 - 8I_3 - 4I_2 = 0$.

$\Sigma *$

In ABDA

$3I_1 + 8I_3 - 4I_2 = 0$ — (i)

In BCDB

$5(I_1 - I_3) - 2(I_2 + I_3) - 8I_3 = 0$

$5I_1 - 5I_3 - 2I_2 - 2I_3 - 8I_3 = 0$

$5I_1 - 15I_3 - 2I_2 = 0$ — (ii)

In DCA

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

$6I_2 + 2I_3 = 2$ — (iii)

$$\begin{bmatrix} 3 & -4 & 8 \\ 5 & -2 & -15 \\ 0 & 6 & 2 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 2 \end{bmatrix}$$

3-1

$15I_1 - 45I_3 - 6I_2 = 0$

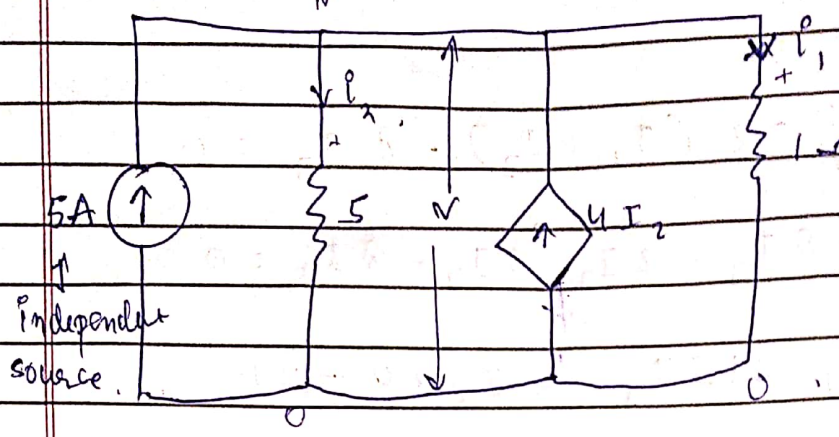
$2I_3 + 6I_2 = 2$

$15I_1 - 43I_3 = 2$

$I_1 = 0.28$

$I_2 = 0.316$

$I_3 = 0.53$



$i_1 + i_2 = 5 + 4I_2$

$i_1 - 3i_2 = 5.$

$V - \frac{3xV}{5} = 5$

$5V - 3V = 25$

$V = 12.5.$

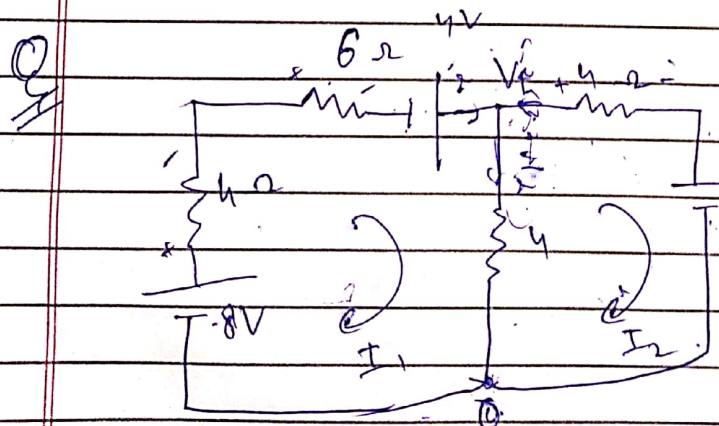
for solving a particular network

2 methods

Nodal Analysis → $n = j - 1$

Mesh Analysis → $m = b - (j-1) = 5 - (3-1)$

$= 3$



$\frac{V_1 - 4 - 8}{6+4} + \frac{V_1 - 8}{4} + \frac{V_1}{4} = 0.$

$\frac{V_1 - 12}{10} + \frac{V_1 - 8}{4} + \frac{V_1}{4} = 0$

$\frac{V_1 - 12}{10} + \frac{2V_1 - 8}{4} = 0.$

$24V_1 - 128 = 0.$ $4V_1 - 48 + 20V_1 - 80 = 0.$

$V_1 = \frac{128}{24}$

$V_1 = 5.33\ V$

$-8 + 4I_1 + 6I_1 - 4 + 4(I_1 - I_2) = 0$.

$14I_1 - 4I_2 = 12$.

$28I_1 - 8I_2 = 24$

$4I_2 + 8 + (I_2 - I_1)4 = 0$,

$-4I_1 + 8I_2 = -8$.

$28I_1 - 8I_2 = 24$

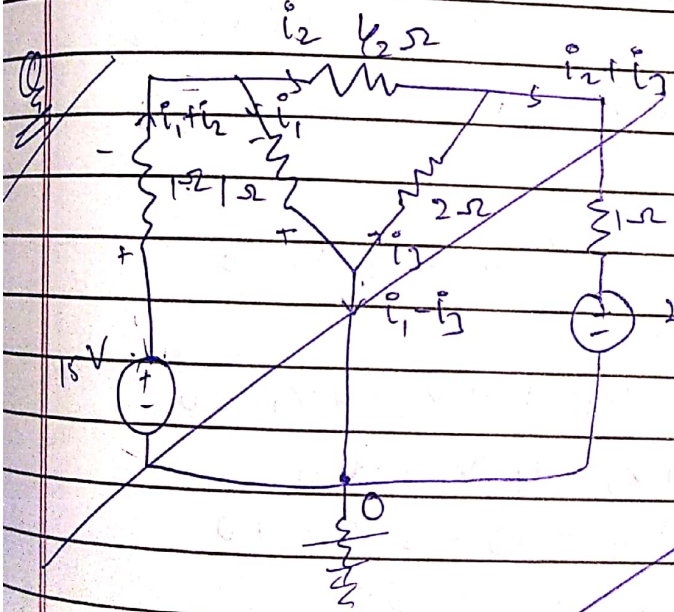
$24I_1 = 16$.

$I_1 = 0.67$.

$18.76 - 8I_2 = 24$

$-8I_2 = 5.24$

$I_2 = -0.655$



$n = j - 1$

$n = 4 - 1$

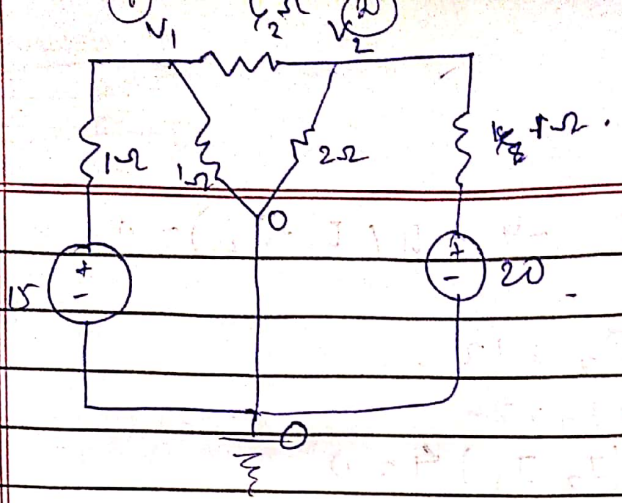
$n = 3$.

$i_1 + i_2 + i_3 = 15 - (i_1 + i_2) + i_1 \times 1 = 0$.

$15 - i_1 - i_2 + i_1 = 0$.

$i_2 \times 1 = i_3 \times 2$

Q



$$\frac{V_1 - 15}{1} + \frac{V_2 - 20}{1} + \frac{V_1 - 0}{1}$$

$$\frac{V_1 - 15}{1} + \frac{V_1 - 0}{1} + \frac{V_1 - V_2}{4} = 0$$

$$\frac{V_2 - 20}{1} + \frac{V_2}{2} + \frac{V_2 - V_1}{4} = 0$$

$$4V_1 - 2V_2 = 15$$

$$4V_1 = 15 + 2V_2$$

$$\frac{2V_2 - 40 + V_2}{2} + 2V_2 - 2V_1 = 0$$

$$3V_2 - 40 + 4V_2 - 4V_1 = 0$$

$$7V_2 - 4V_1 = 40$$

$$7V_2 - 15 - 2V_2 = 40$$

$$5V_2 = 55$$

$$V_2 = 11\ V$$

$$V_1 = 9.25$$

$$37 - 4V_1 = 40$$

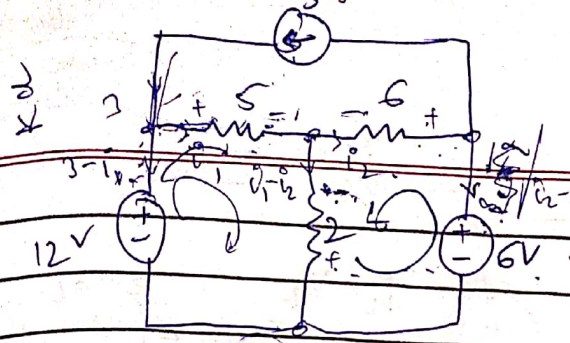
$$37 = 4V_1$$

$$V_1 = 9.25$$

$m = b - (j-1)$

$m = 6 - (4-1)$

$= 6 - 3 = 3$



$-5i_1 + 2(i_1 - i_2) + 12 = 0$

$i_2 \times 6 - 6 - (i_1 - i_2) \times (-2) = 0$.

$-5i_1 - 5i_1 + 2i_1 - 2i_2 + 12 = 0$.

$3i_1 + 2i_2 = 12$.

$6i_2 + i_1 - i_2 = 6$

$i_1 + 5i_2 = 6$.

$i_1 = 6 - 5i_2$

$3(6 - 5i_2) + 2i_2 = 12$.

$18 - 15i_2 + 2i_2 = 12$.

$6 = 13i_2$,

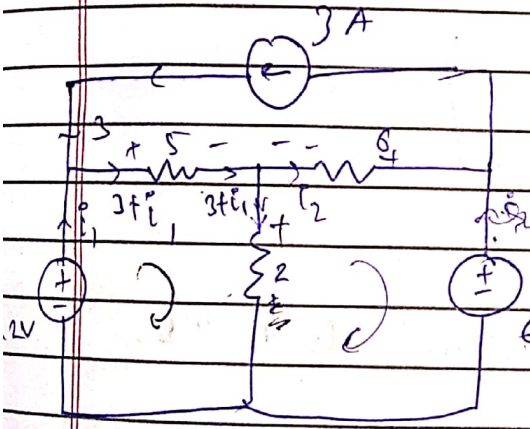
$i_2 = \frac{6}{13}$.

$i_1 = 1.2$

$i_2 = 0.46$

$-12 + (I_1 + 3)5 + (I_1 - I_2)2 = 0$

$6 + (I_2 - I_1)2 + (I_2 + 3)6 = 0$



$3i_1 + 12 = 12$.

$3i_1 = 12 - 12$

$3i_1 = 0$

$-12 + (3 + i_1)5 + (3 + i_1 - i_2) \times 2 = 0$

$-12 + 15 + 5i_1 + 6 + 2i_1 - 2i_2 = 0$.

$7i_1 - 2i_2 = -9$,

$-i_2 \times 6 + 6 + (i_2 - 3 - i_1) \times 2 = 0$.

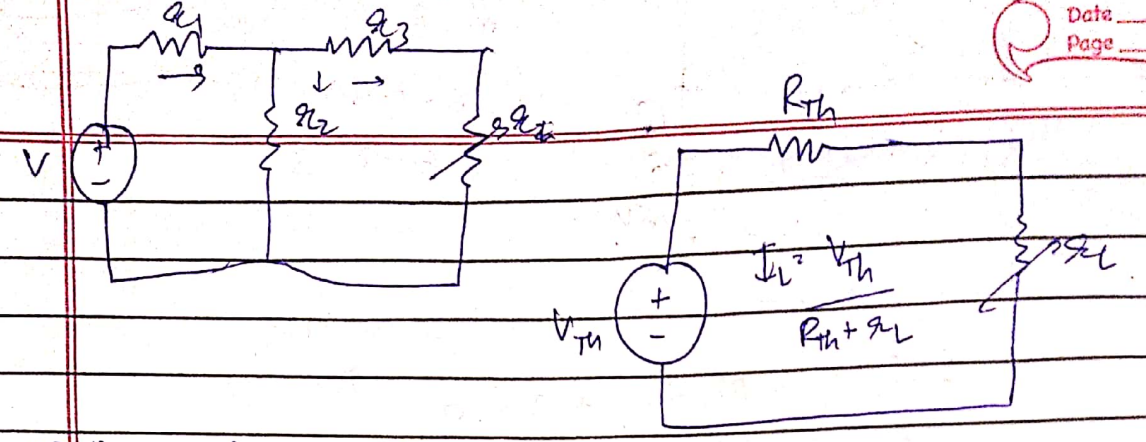
$-6i_2 + 6 + 2i_2 - 6 - 2i_1 = 0$.

$4i_2 = -2i_1$

$2i_2 = -i_1$

$i_1 = -1$.

THEVENIN'S THEOREM



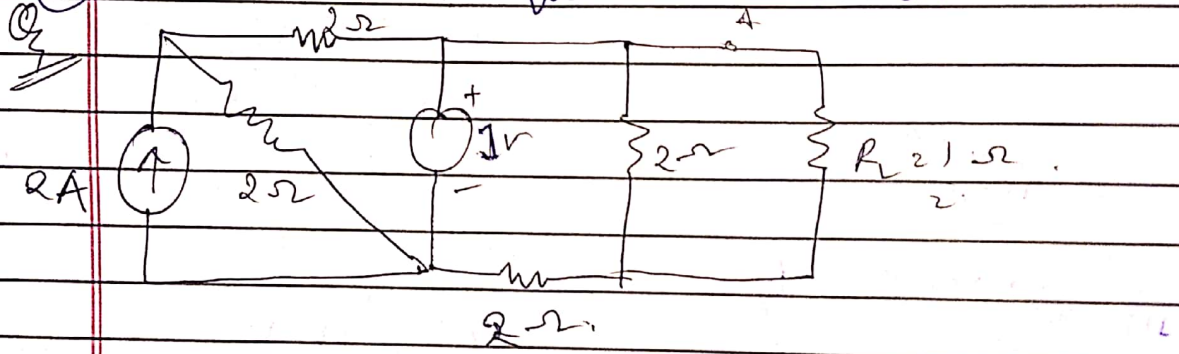
(1) Remove load resistor and find V_{oc}. → open circuit voltage across load resistor.

(2) ~~Voltage~~ Replace independent sources with their internal resistance

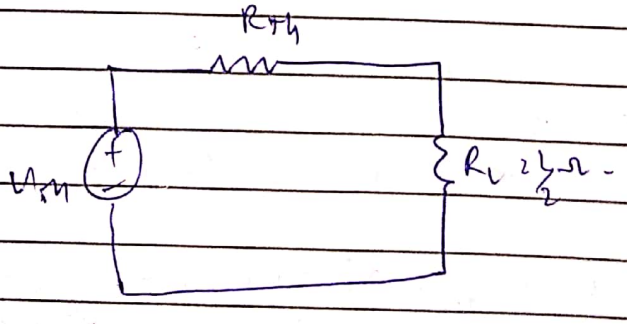
voltage dependent → I.R. = 0 → close circuit → short circuit

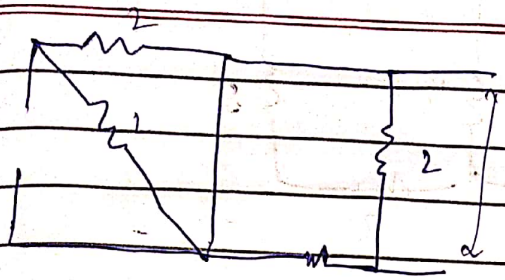
current dependent → infinite → open circuit.

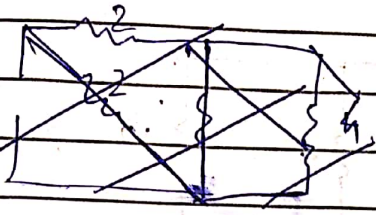
(3) Draw thevenin equivalent circuit

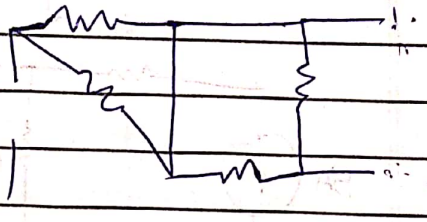


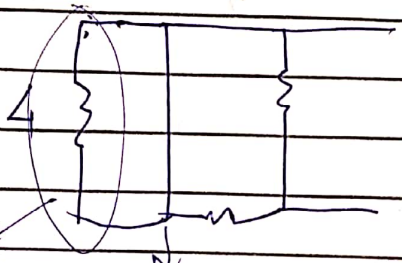
find V_{Th} and R_{Th} across terminals A & B.





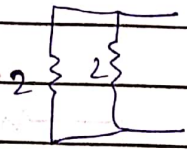




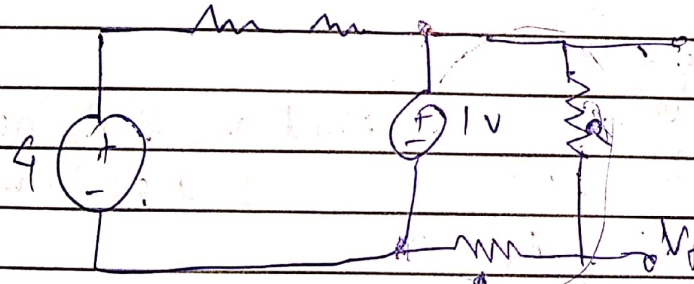


no use

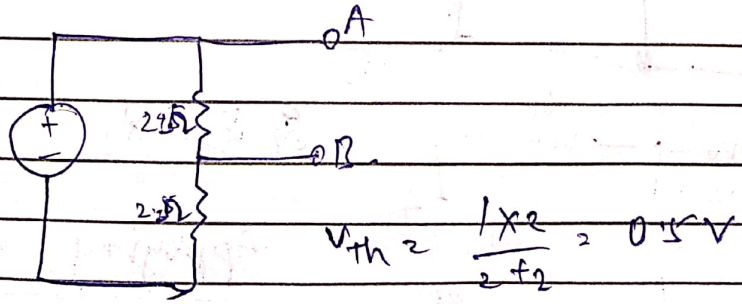
short circuit



$R_{Th} = 1\,\Omega$

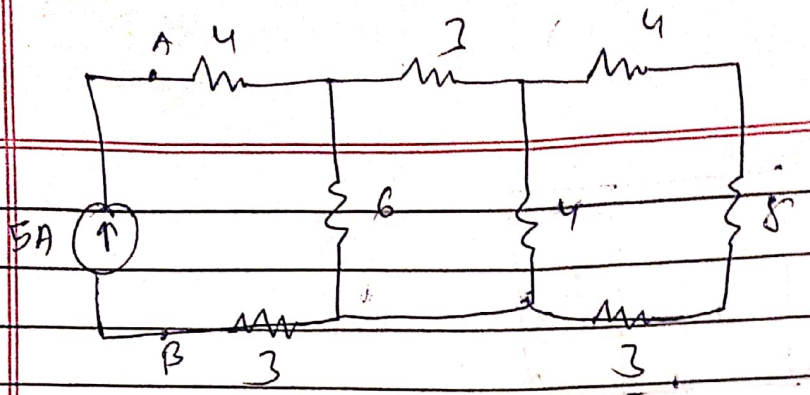


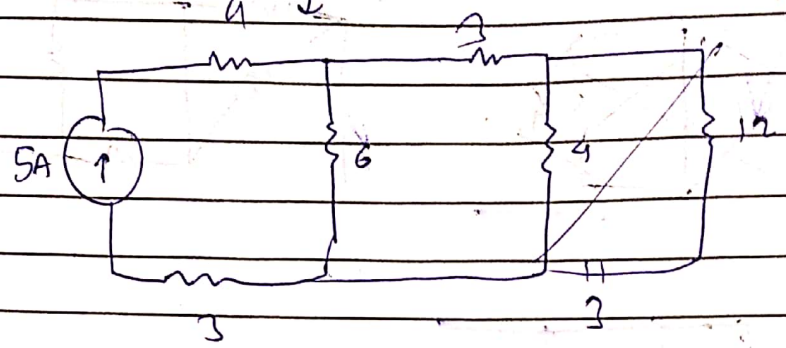
$V_{th} = \frac{1 \times 2}{2+2} = 0.5\,V$

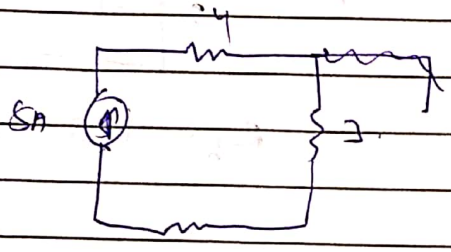


$V_{th} = \frac{1 \times 2}{2+2} = 0.5\,V$

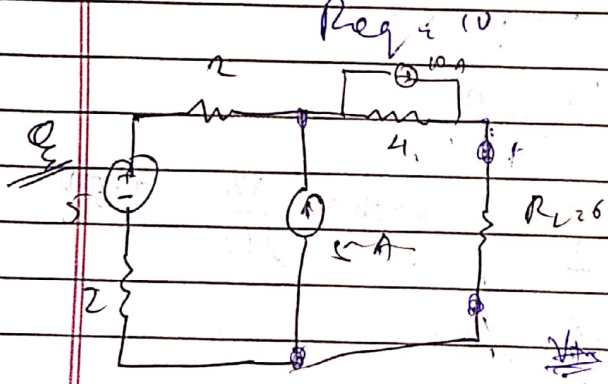
$I_2 = \frac{V_{th}}{R_{th} + R_2} = \frac{0.5}{1+0.5} = \frac{1}{3}$



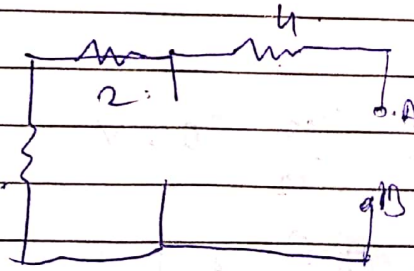




3.

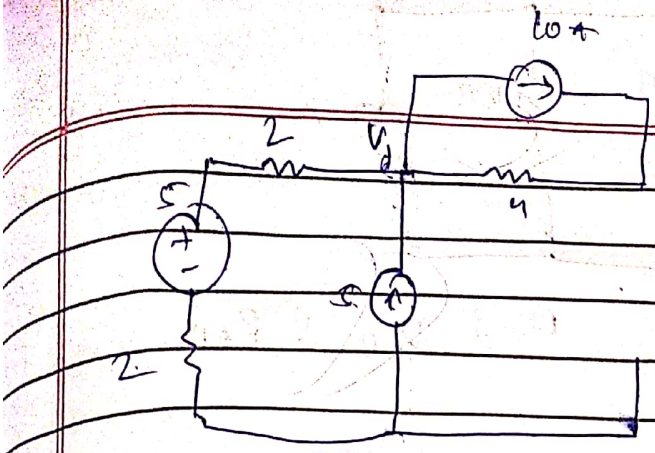


Find V_{Th} & R_{Th} across load resistance.



$R_{Th} = 8.$

Applying nodal



$R_{Th} = 8\Omega$.

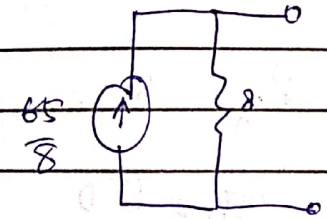
$$\frac{V_1 - 5}{4} - 5 + \frac{V_1 - V_{Th}}{4} + 10 = 0$$

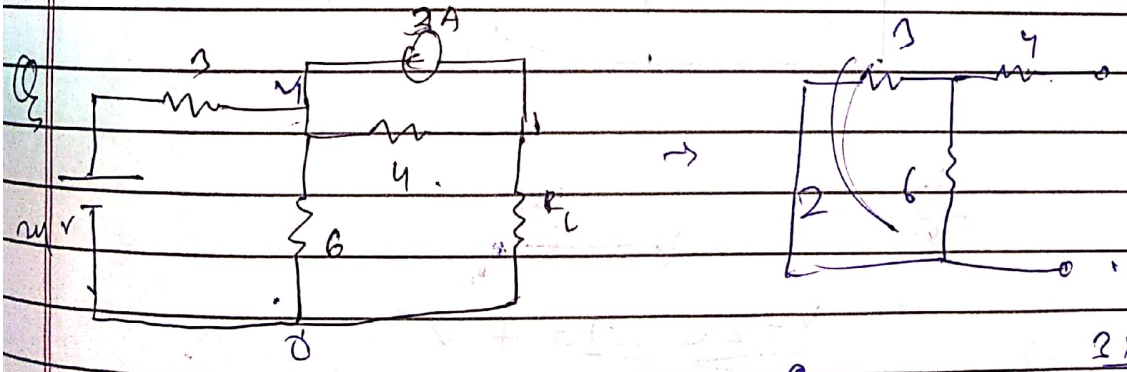
$$\frac{V_{Th} - V_1}{4} - 10 = 0$$

$V_1 = 25$

$$V_{Th} - 25 - 10 = 0$$

$$V_{Th} = 65$$





$$R_{Th} = \frac{3 \times 6}{9} = 2.$$

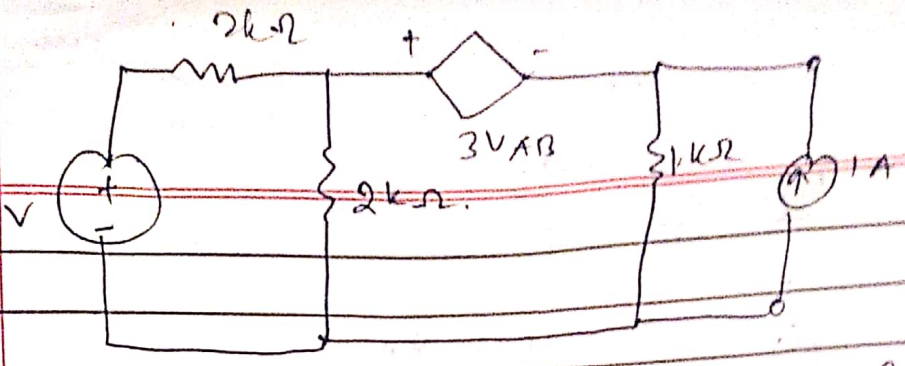
$$\frac{V_1 - 24}{3} + \frac{V_1}{-3} + \frac{V_1 - V_{Th}}{4} + \frac{V_1 - 0}{6} = 0 \quad \therefore R_{Th} = 6.$$

$$\frac{V_{Th} - V_1}{1} + 3 = 0$$

$$\frac{2V_1 - 48 + V_1}{6} = 0$$

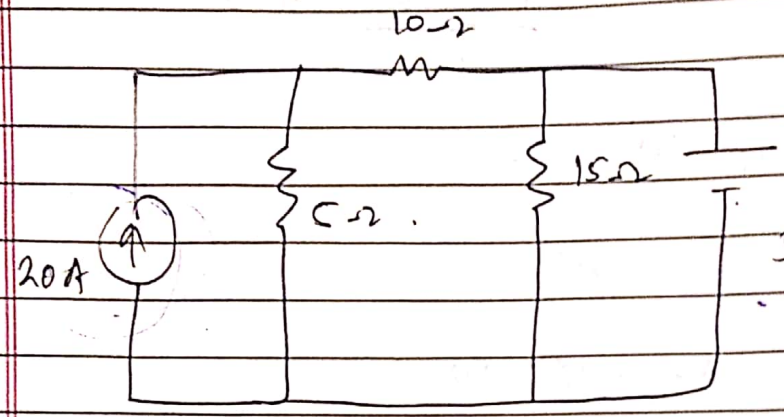
$V_{Th} - 16 + 3 = 0$; $V_1 = 16 \rightarrow V_{Th} = 4$.

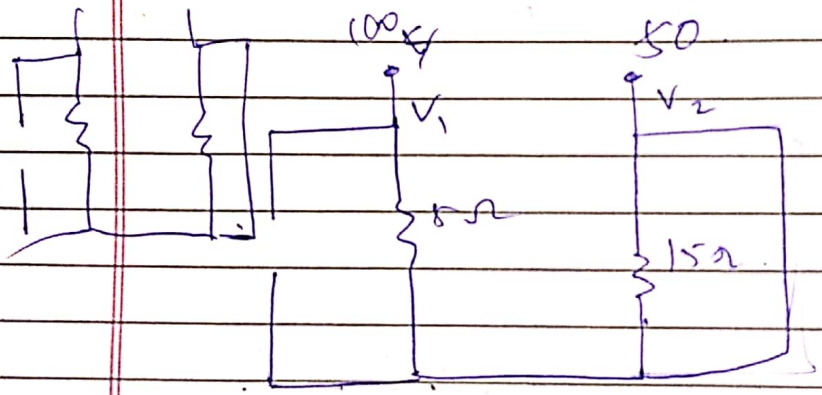
Q5



Find V_{AB} & P_{AB}.

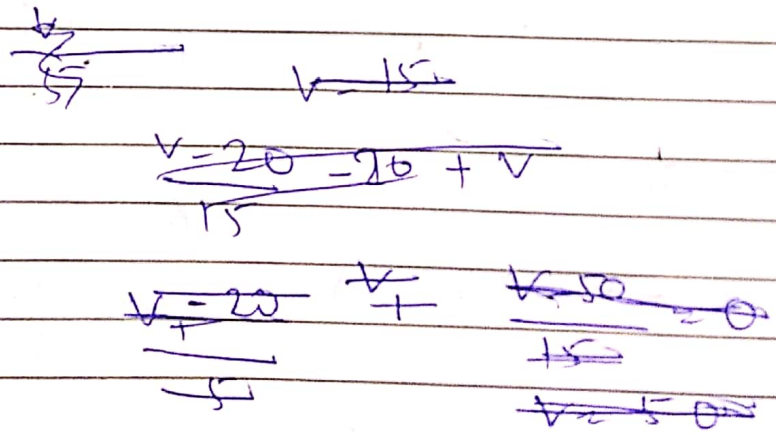
Q

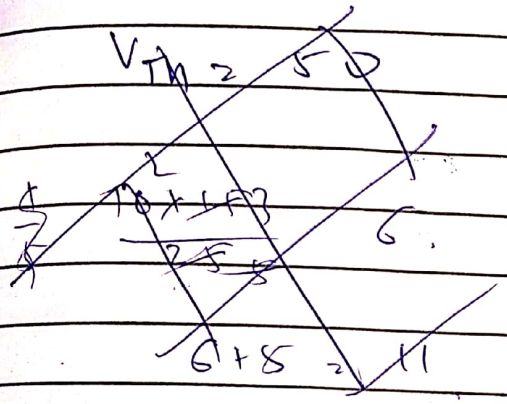


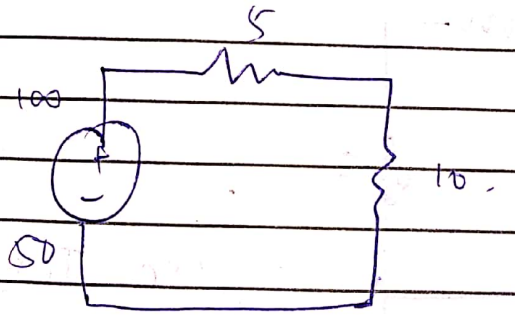


$R_{Th} = 5$

$V_{Th} = 50$

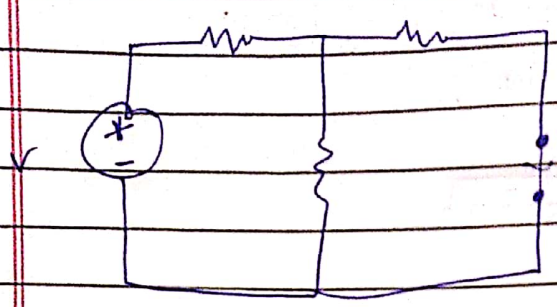


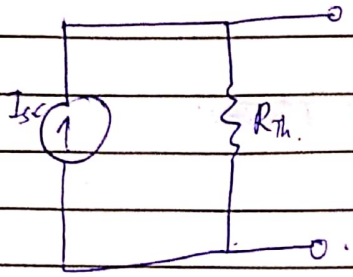




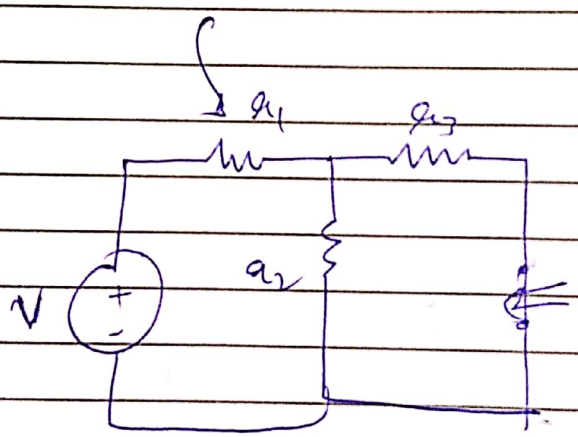
$$I_L = \frac{50}{5+10} = 3.34A$$

NORTON'S THEOREM



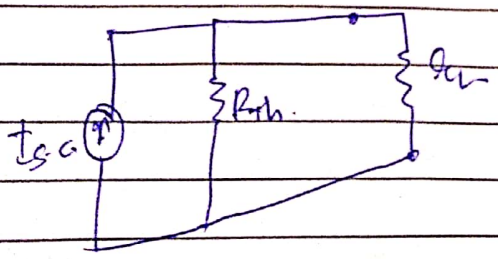


$$I_1 = \frac{V}{R_1 + \frac{R_2 R_3}{R_2 + R_3}}$$

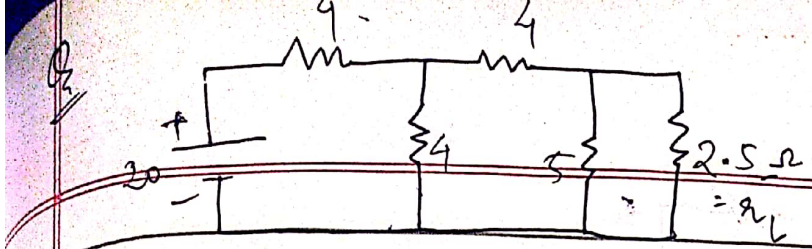


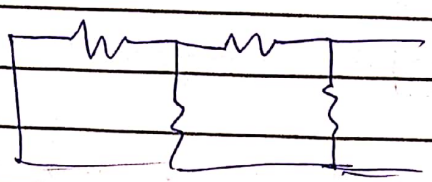
$$I_{SC} = I_1 \times \frac{R_3}{R_2 + R_3}$$

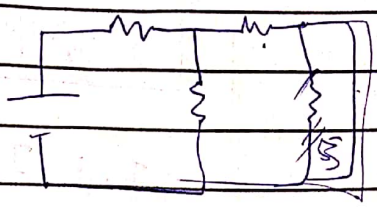
$$R_{Th} = R_3 + \frac{R_1 R_2}{R_1 + R_2}$$

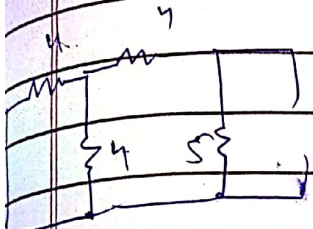


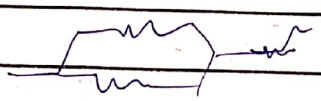
$$I_L = I_{S.C} \times \frac{R_{Th}}{R_{Th} + R_L}$$











2 + 4 = 6.

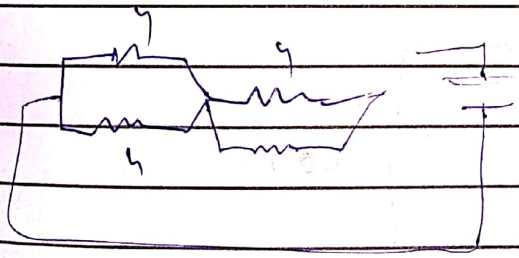
Eq Resistance.

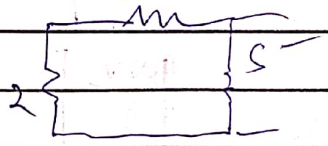
$\frac{20}{9} + \frac{16}{8}$.

$I_{sc} = \frac{3.3 \times 4}{4+4} = 1.66.$

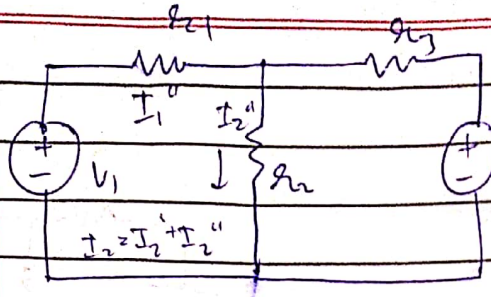
$I_L = \frac{1.66 \times 30}{2.5 + 30} = \frac{11}{11} = 0.86\ A.$

$R_{th} = \frac{30}{11}$





Superposition



$I_1 = I_1' - I_1''$

$I_3' = I_1' \times \frac{R_2}{R_2 + R_3}$

$I_3 = I_3' - I_3''$

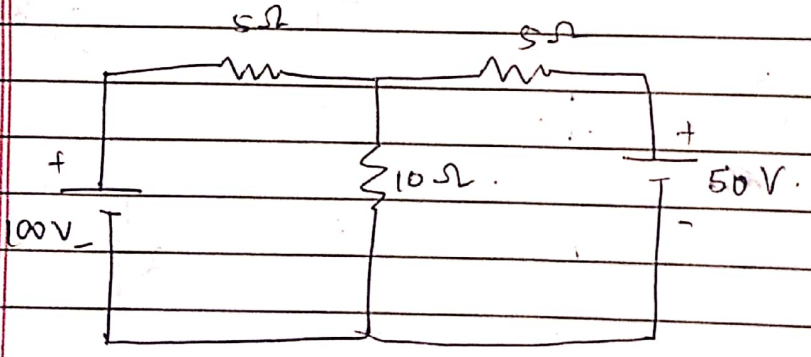
$I_2' = I_1' - I_3'$

$I_3'' = \frac{V_2}{R_3 + \frac{R_1 R_2}{R_1 + R_2}}$

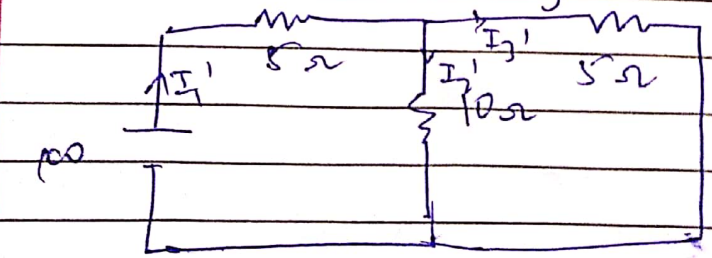
$I_1'' = I_3'' \times \frac{R_2}{R_2 + R_1}$

$I_2'' = I_3'' - I_1''$

Ex →



short circuiting one source



$\frac{10}{3} + 5 = \frac{25}{3}$

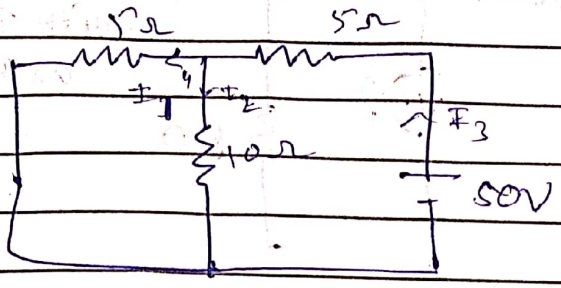
$\frac{10 \times 5}{15} = \frac{50}{15}$ 10

$I_2' = I = \frac{100}{\frac{25}{3}} = 4 \times 3 = 12A$.

$I_2' = \frac{5}{15} \times 12 = 4A$.

$I_3' = 8A$.

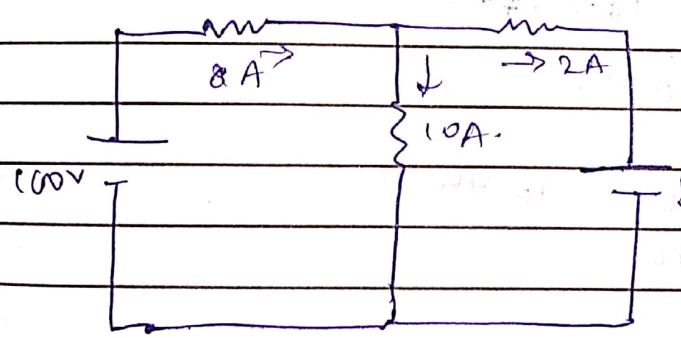
Now short circuit other source.



Eq resistance $= \frac{50}{\frac{25}{3}} = 6\Omega$.

$I_3'' = \frac{50 \times 3}{25} = 6A$.

$I_2'' = \frac{5}{15} \times 6 = 2A$. $\quad I_1'' = 4A$.

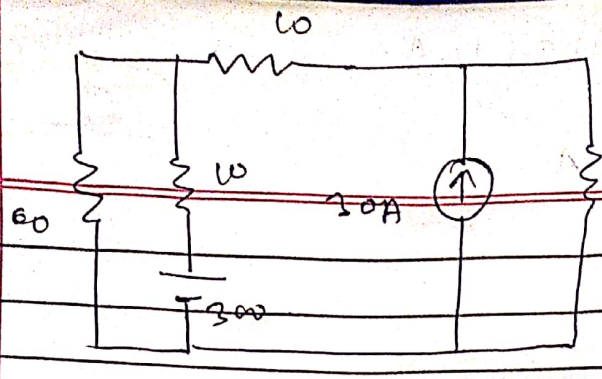


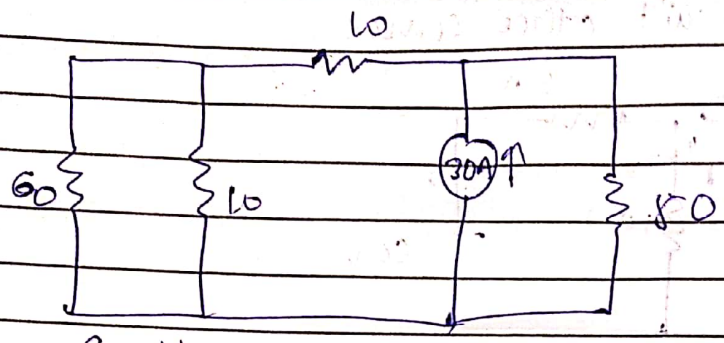
$I_1 = 8A$

$I_2 = 6A$

$I_3 = 2A$.

Q.





with 30A as source

$60 \parallel 10 = \frac{60 \times 10}{70} = \frac{60}{7}$

$\frac{130 \parallel 50}{7}$

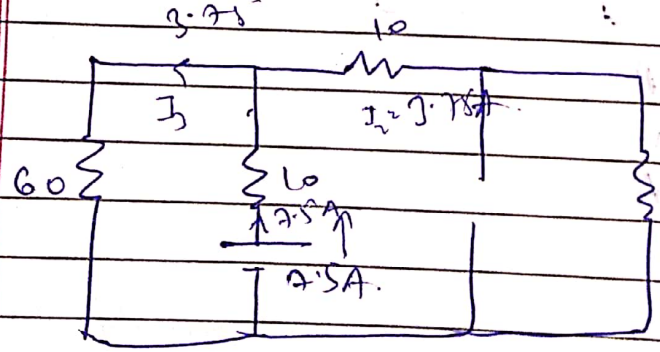
60 series 10

$\frac{7}{7} : \frac{60 + 10}{7} = \frac{130}{7} = 18.57.$

$\frac{30 \times 18.57}{18.57 + 50}$

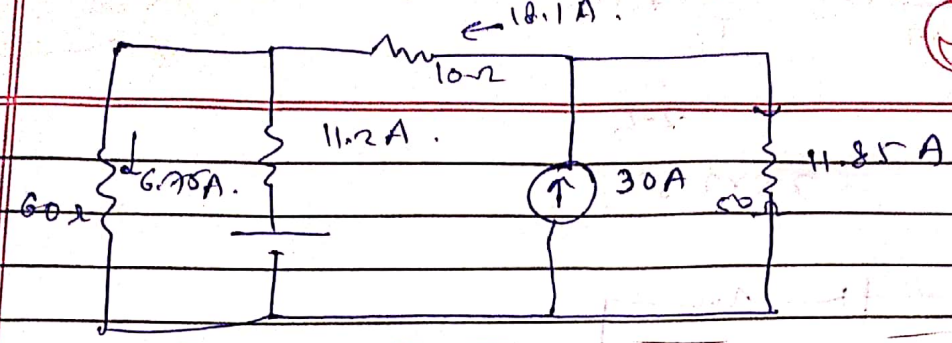
$= 8.1$

$\frac{21.87 \times 60}{70} = 18.74$

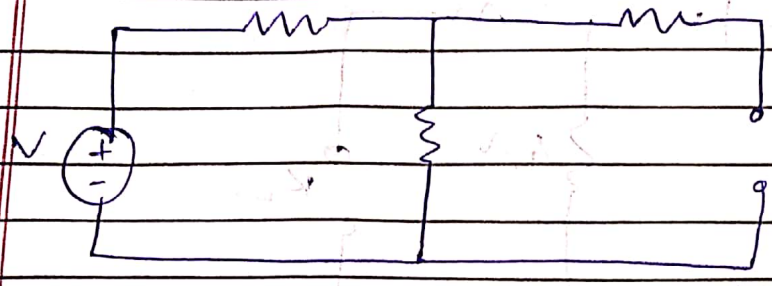


$I_1 = \frac{300}{10 + \frac{60 \times 60}{60 + 60}} = 7.5\ A.$

total equivalent.

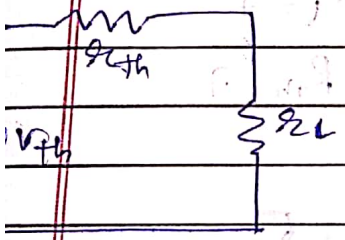


MAXIMUM POWER EQUIVALENT THEOREM



$$R_L = R_3 + \frac{R_1 R_2}{R_1 + R_2}$$

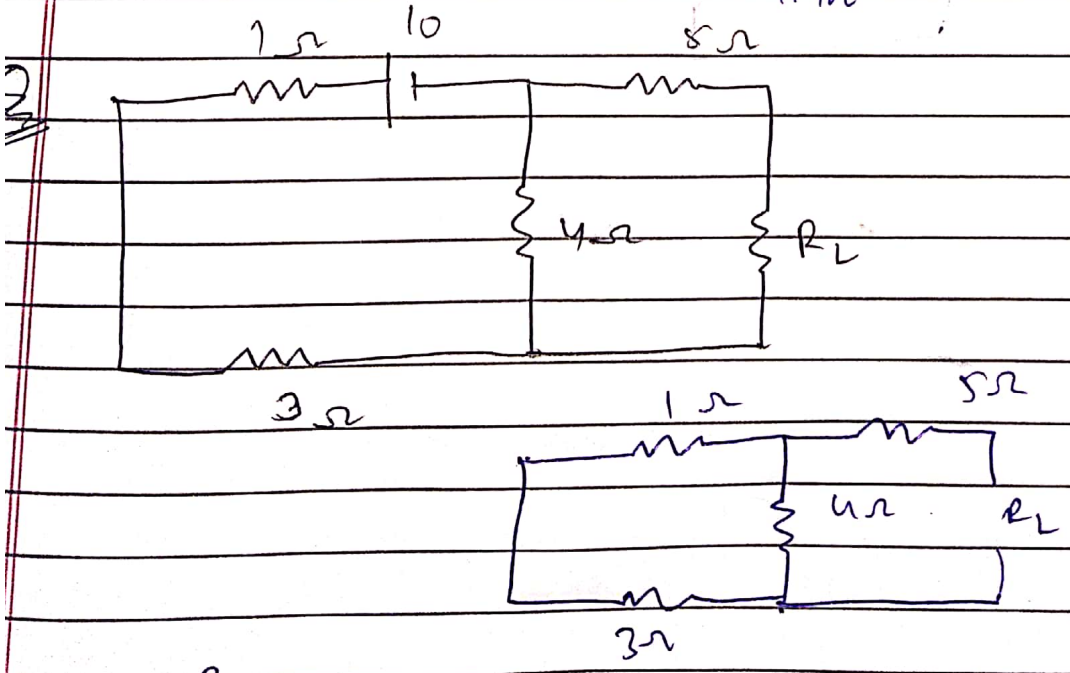
$$P = I_L^2 R_L$$



$$P = \left(\frac{V_{Th}}{R_{Th} + R_L}\right)^2 \times R_L$$

$R_{Th} = R_L$ for max^m power.

$$P_{max} = \frac{V_{Th}^2}{4R_{Th}}$$

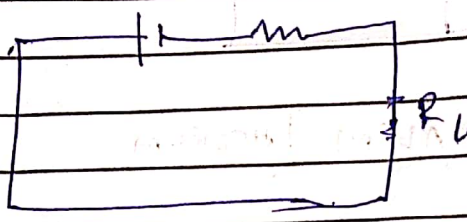


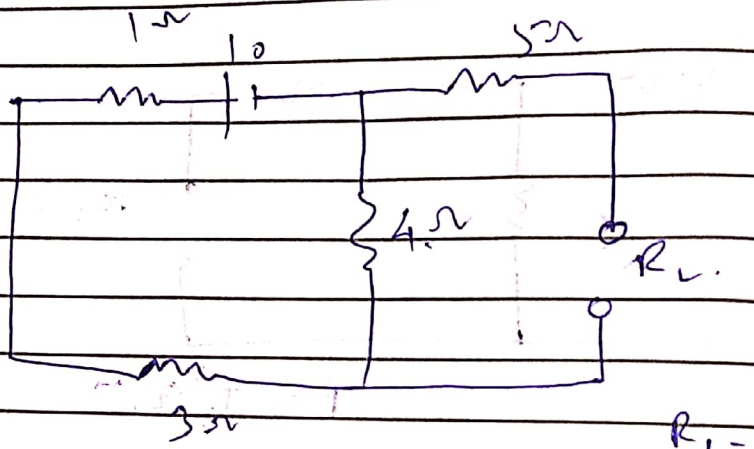
$R_L = 7\Omega$

$\frac{4}{4+4+12} \times 10 = \frac{4}{16} \times 10$

2.5.

$= 2.5 \times 2.5$

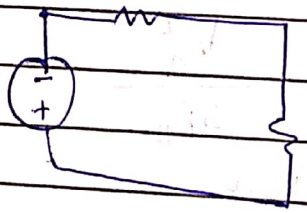




$R_L = 7$

$\frac{10}{8} = I = 1.25$

$R_{th} = 7$



$1.25 \times 4 = 5$