Basic Electrical Engineering
(BEE)
Unit 1

In which branch, we studies about resistence, inductors, energy sources, electric circuit's elements, equipment and components.

Electrical sourec of energy provides energy to the circuit. These sourecs are two types -
(i) DC Source (ii) AC Source

(i) DC Source :- DC circuits are the circuits which are excited by unidirectional (Direct current) energy source such as batteries, cells etc.

(ii) AC Source :- AC circuits are the circuits which are excited by alternating current (AC) energy Source.

In DC Source, Capacitor and inductor don't show their presence.

- Electric Current :- Current is basically flow of electric charge with respect to time.

$$I = \frac{dQ}{dt}$$ where Q is charge in coulomb
t is time in seconds.

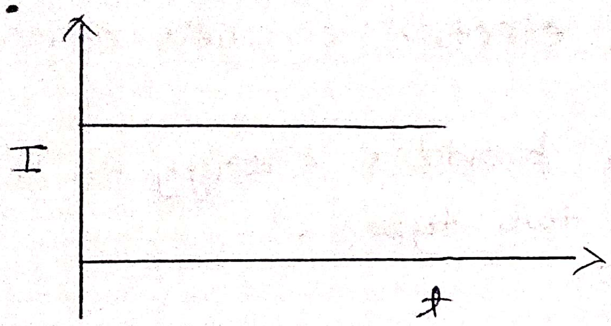
Current is generally measured in Ampere.

Direction of current is the same as the direction of flow of Positive charge which is opposite to the flow of electrons.

There are two types of current-

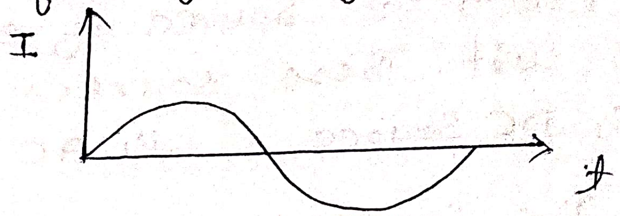
(i) DC Current

- The flow of charge is constant and is in one direction



(ii) AC Current

- Flow of charge is not uniform. It changes with time.
- Charge flow in one direction for certain time and then flow of charge in other direction



* Electric potential :-

The electric potential of a point may be defined as amount of work done to bring a unit positive charge from infinity to that point.

$$\boxed{V = \frac{W}{Q}}$$

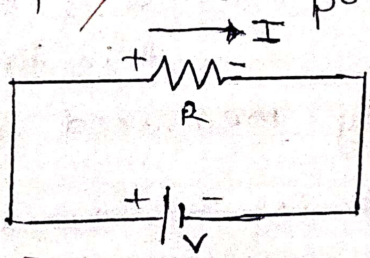
when $Q = 1$ coulomb

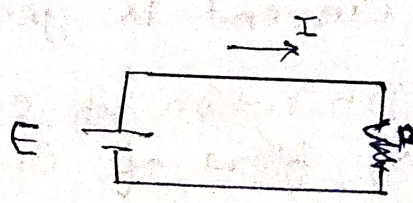
$$\boxed{V = W}$$

The unit of potential is volt (V)

It is defined for always two points not for singal.

higher potential point is termed as positive terminal and the lower potential point is termed as negative terminal.





* Electromotive Force (EMF):-

Electromotive force is nothing but a voltage generated by a source, such as battery, generator, cell etc. Thus electromotive force (emf) is not a force but a potential which drives the flow of electric current in a circuit

* Electric Power :-

In an electrical circuit, when flow of charges takes places some amount of work is done.
The electrical power (P) is defined as amount of work done per unit time.

$$\boxed{P = \frac{W}{t} = \frac{VQ}{t} = VI}$$

Unit of Power is watt (W)
* (1 H.P. = 746 W)

* Ohm's Law :-
The current (I) passing through a cunductor is directly proportional to the potential difference (V) across the ends of the conductor provided the physical conditions (temprature, ~~resist~~ resistivity, dimensions etc.) remain the same."

$$I \propto V$$
$$I = V/R$$

where R = resistance which is measured in ohms.

• Resistance :-
Resistance is the property of resistor (Conductor) which oppose the flow of current.

$$R = \frac{\rho l}{A}$$

l = length of conductor
A = cross-sectional area
ρ = resistivity of conductor.

$\Rightarrow$ $G = \frac{1}{R}$ = Conductance.
[unit mho = $(\Omega)^{-1}$]
siemens

$\Rightarrow$ * Reciprocal of ρ is called conductivity.

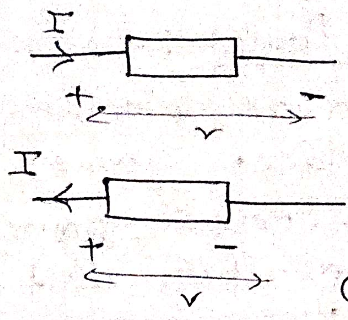
$$\boxed{\sigma = \frac{1}{\rho}}$$

unit of σ is siemens per meter.

by ohm's law
$V = IR$

$\because P = VI$

$$\boxed{P = I^2R = V^2/R}$$



$P = VI$
(absorbed)
(consumed)

$P = VI$
(delivered)

* Basic elements

Active element

An energy source is said to be an active element of the circuit.

<u>Ex.</u> betteries, generators, poroperty biased transistors.

Passive elements

A circuit element which is not an energy source is a passive element. work as a load in circuit.

<u>Ex.</u> Resistors, inductors, capacitors, diodes etc

~~*Kirchhoff's Laws~~

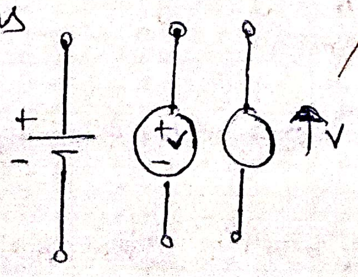
* Energy Sources :-

These sources provide necessary excitation to an electric Network.

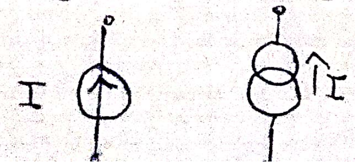
Ideal Sources

-> Voltage supply constant
-> internal resistence = 0
-> independent on others
-> effeciency = 100%

Symbols

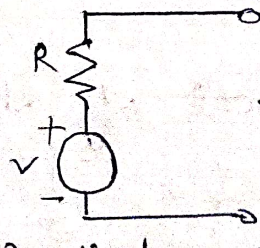


for Ideal current source



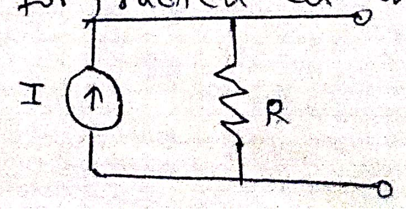
Practical Sources

-> have loses.
-> internal resistence ≠ 0
-> dependent on others.
-> not have ~~the~~ 100% effeciency.



Practical voltage Source.

for Practical current source

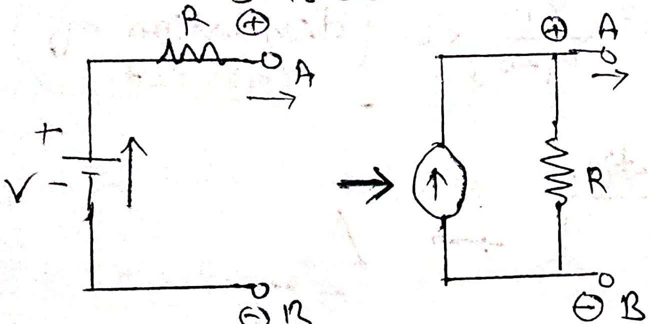
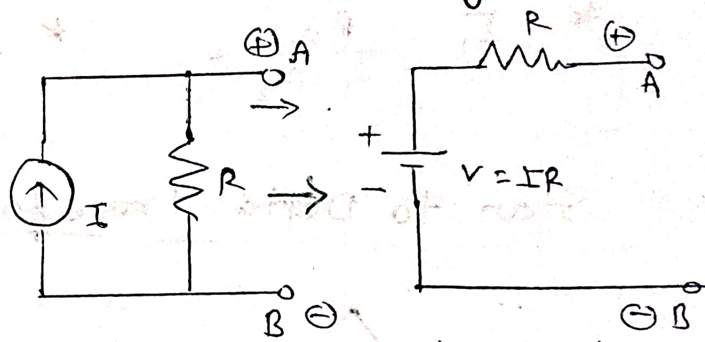


Note

1. In Parallel branches, we can't apply different ~~magnotitud~~ magnitudes.
2. Current can't be connected in series combination.

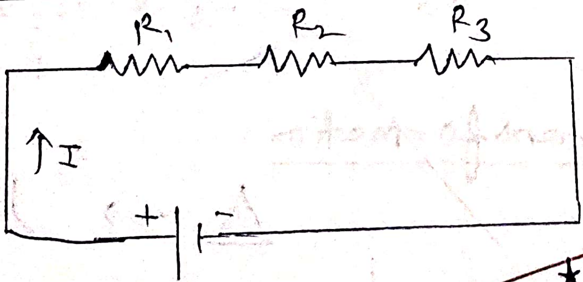
Source Conversion :-

A practical voltage source can be converted in practical current source and a practical current source can be converted in practical voltage source.

Voltage to Current Source	Current to Voltage Source
	
(given) (equivalent)	(given) (equivalent)

Note The polarity of the terminal should not be changed.

Resistors in series combination :-



Current will flow same in all resistors in series comb.

$V_1 = IR_1$ $V_3 = IR_3$

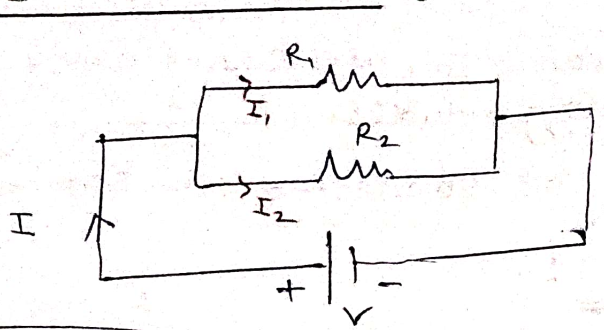
$V_2 = IR_2$

$\star$ $R_{eq} = R_1 + R_2 + R_3 \ldots$

$\star$ **note**

$$V_n = \frac{R_n}{\Sigma R} \cdot V$$ (deridation of voltage in series)

Resistors in Parallel :-



→ they are connected end to end with each other making their ends at common potential.

★ $\boxed{R_{eq} = \dfrac{R_1 R_2}{R_1 + R_2}}$

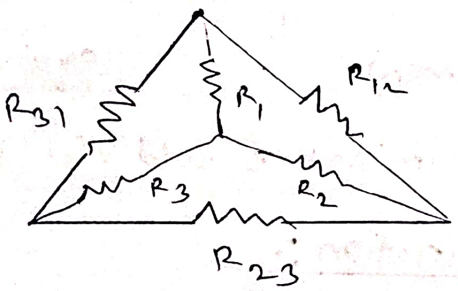
$$\left(\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots + \frac{1}{R_n} \right)$$

★ $[G_{eq} = G_1 + G_2 + G_3 + \dots + G_n]$

★ $I_1 = \dfrac{R_2}{R_1 + R_2} \times I$ ★ $I_2 = \dfrac{R_1}{R_1 + R_2} \times I$ (deviation of current)

Star to Delta transformation

$\curlywedge \Rightarrow \triangle$



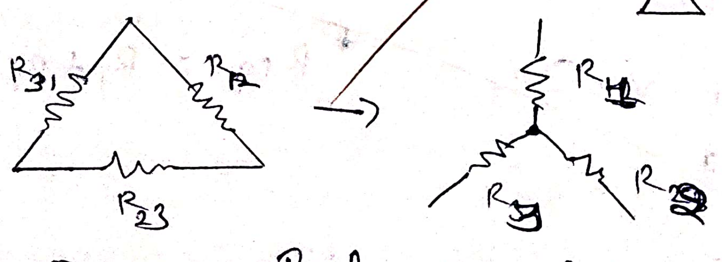
$$R_{31} = R_1 + R_3 + \frac{R_3 R_1}{R_2}$$

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

$$R_{23} = R_2 + R_3 + \frac{R_2 R_3}{R_1}$$

Delta to Star transformation.

$\triangle \rightarrow \curlywedge$



$$R_{12} = \frac{R_1 R_2}{R_1 + R_2 + R_3} \qquad R_1 = \frac{R_{12} \cdot R_{31}}{R_{12} + R_{23} + R_{31}}$$

$$R_{23} = \frac{R_2 \cdot R_3}{R_1 + R_2 + R_3} \qquad R_2 = \frac{R_{23} \cdot R_{21}}{R_{12} + R_{23} + R_{31}}$$

$$R_{31} = \frac{R_3 \cdot R_1}{R_1 + R_2 + R_3} \qquad R_3 = \frac{R_{31} \cdot R_{23}}{R_{12} + R_{23} + R_{31}}$$

* Kirchhoff's Laws :-

There are two types of Kirchhoff's law.

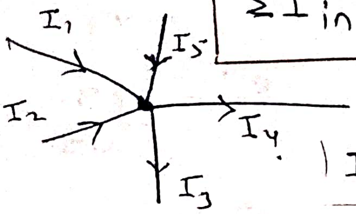
1. Kirchhoff's Current law (KCL):-

In any electric circuit,
the algebric sum of all the currents meeting at any node is zero. $\boxed{\Sigma I_{Tot} = 0}$

or at any node incoming current = sum of outgoing current

$$\boxed{\Sigma I_{in} = \Sigma I_{out}}$$

Ex



$$I_1 + I_2 + I_5 = I_3 + I_4$$

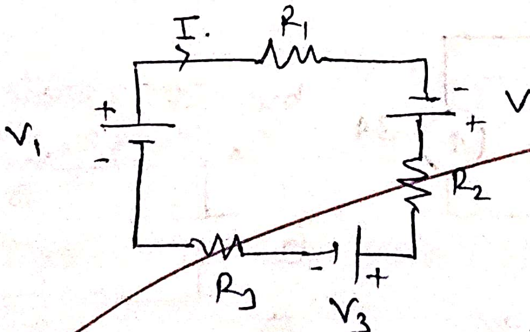
→ This law is based on law of conservation of charges.

2. Kirchhoff's voltage law (KVL):-

In any electrical circuit,
" the algebric sum of ~~all~~ voltage rises is equal to algebric sum of voltage drops around any closed path (or loop or current) "

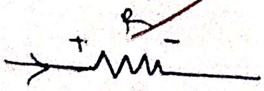
$$\boxed{\Sigma V_{tot} = 0}$$

→ This law is based on law of conservation of energy



$$\boxed{0 = V_1 - IR_1 + V_2 - IR_2 - V_3 - IR_3}$$

Note

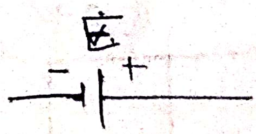


direction of movement

$V = -IR$

otherwise

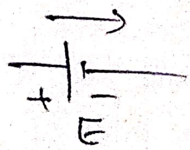
$V = IR$



Direction of movement

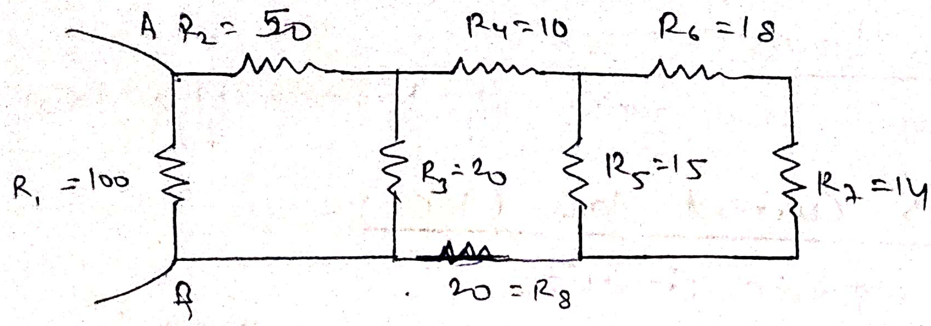
$V = +E$

is



$V = -E$

Ex



Find resistence between A & B Point

Series ①

$R' = R_6 + R_7 = 32\,\Omega$

Parallel ②

$R'' = \dfrac{R' R_5}{R' + R_5} = \dfrac{32 \times 15}{47}$

③ $R''' = R'' + R_8 + R_4$ (Series)

$R''' = \dfrac{32 \times 15}{47} + 20 + 10$

$R''' = \dfrac{1890}{47}\,\Omega$

④ R_3 & R''' = Parallel

$R^* = \dfrac{R_3 R'''}{R_3 + R'''} = \dfrac{\frac{1890}{47} * 20}{\frac{1890}{47} + 20}$

$R^* = \dfrac{3780}{283}$

⑤ R^* & R_2 Series

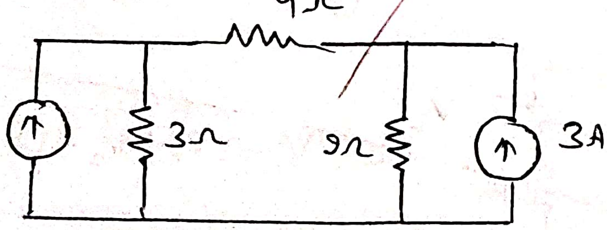
$R^{**} = \dfrac{3780}{283} + 50 = \dfrac{27930}{283}$

⑥ now R^{**} & R_1 = Parallel

$Req = \dfrac{\frac{27930}{283} \times 100}{\frac{27930 + 28300}{283}}$

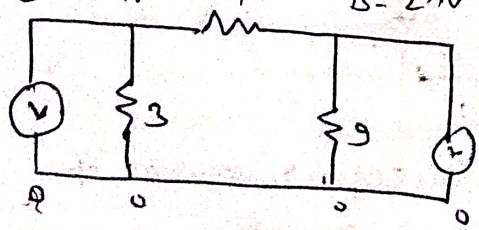
$Req = 49.67\,\Omega$ Ans

Q

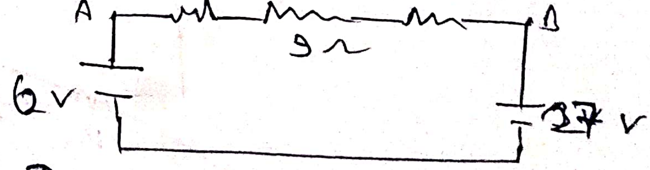


⇓

6V = A 4 B = 27V



by conversing it



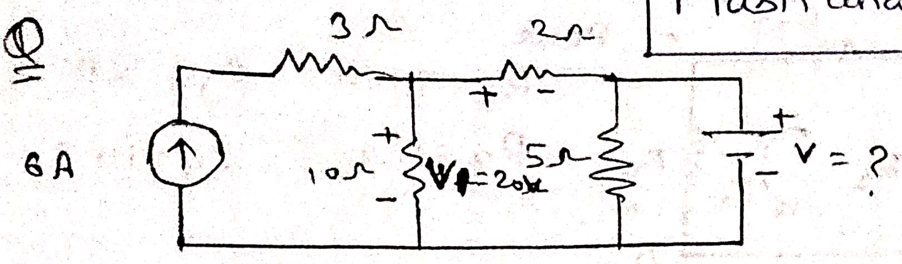
$V_{tot} = 33$ Volt

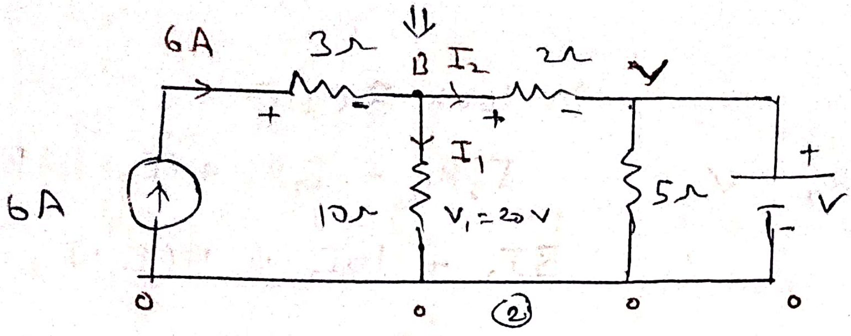
$I = \dfrac{33}{Req} = \dfrac{33}{3+4+9}$

$= 2.1$ Amp

Mash analysis

Q





in Loop 2

At node B $\underline{B = 20V}$ or $-2I_2 - V_{BC} + 20 = 0$

$I_1 + I_2 = 6$ $-8 - V_{BC} = -20$

$6 = \frac{-V+20}{2} + \frac{-0+20}{10}$ $(V_{BC} = 12\text{ Volt})$

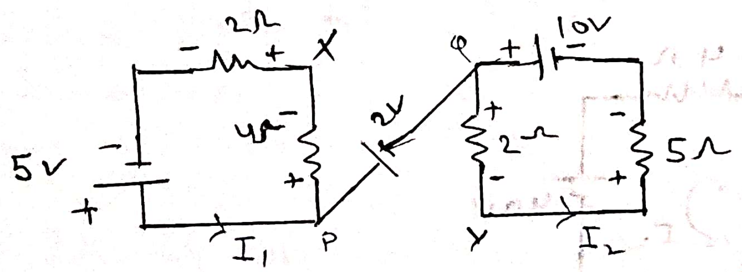
$12 = -V + 20 + 4$ $I_1 + I_2 = 6$

2.

$8 = -V + 20$ $I_2 = 6 - 2$

$V = +8$ Volt $\boxed{I_2 = 4\text{ Amp}}$

Q **



$V_{xy} = ?$

Soln in loop 1 in Loop 2

$I_1 = \frac{5}{6}$ Amp $I_2 = +\frac{10}{7}$ Amp

at x, Voltage ~~at y, voltage~~

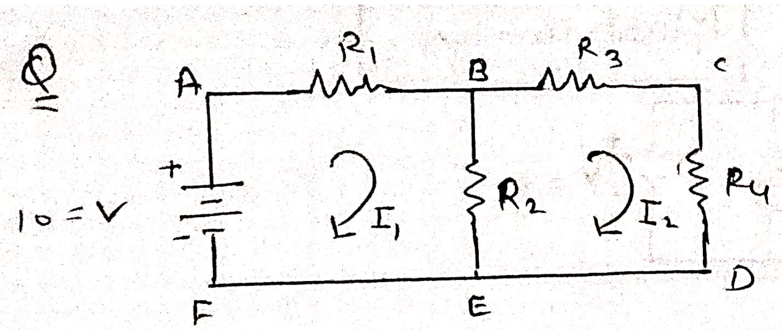
loop xpQY

$\frac{x-5}{4} = \frac{5}{6}$ $V_{xy} = 4 \times \frac{5}{6} - 2 - 2 \times \frac{10}{7}$

$x =$ $V_{xy} = \frac{10}{3} - 2 - \frac{20}{7} = \frac{70-42-60}{21}$

$V_{xy} = -\frac{32}{21} = 1.51$ Volt

Q



Here

$R_1 = 2\Omega$ $R_3 = 5\Omega$

$R_2 = 4\Omega$ $R_4 = 10\Omega$

Soln

in loop ABEF

$I_1R_1 + (I_1 - I_2)R_2 = V$

$2I_1 + (I_1 - I_2)4 = 10$

$6I_1 - 4I_2 = 10$ —— (ii)

by (i)

$\frac{\cancel{6}^{3} \times 19I_2}{\cancel{4}_2} - 4I_2 = 10$

$57I_2 - 8I_2 = 20$

$49I_2 = 20$

$I_2 = 20/49$ Amp

$\boxed{I_2 = 0.408 \text{ Amp}}$

in loop BCDE

$I_2R_3 + I_2R_4 + (I_2 - I_1)R_2 = 0$

$5I_2 + 10I_2 + 4(I_2 - I_1) = 0$

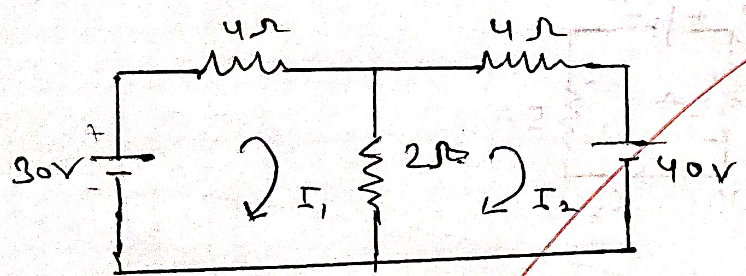
$19I_2 - 4I_1 = 0$

$I_1 = \frac{19I_2}{4}$ —— (i)

$I_1 = \frac{0.408 \times 19}{4}$

$I_1 = 1.93$ Amp

Q



Soln

in loop 1

$4I_1 + 2(I_1 - I_2) = 30$

$6I_1 + 2I_2 = 30$

$3I_1 - I_2 = 15$ —— (i)

by eq (i) & (ii)

$\cancel{3I_1} - I_2 = 15$

$+ \quad \cancel{-3I_1} + 9I_2 = -60$

$8I_2 = -45$

in loop 2

$4I_2 + (I_2 - I_1)2 = -40$

$6I_2 - 2I_1 = -40$

$3I_2 - I_1 = -20$ —— (ii)

$I_2 = -\frac{45}{8}$

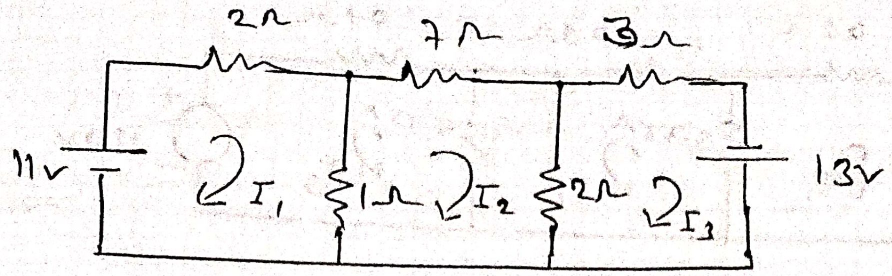
$I_2 = +5.265$ Amp

$I_1 = \frac{+3 \times 45 - 20}{8}$

$I_1 = +28.125 - 20$

$I_1 = 8.125$ Amp

Q



Soln

in loop 1

$2I_1 + 1(I_1 - I_2) = 11$

$3I_1 - I_2 = 11$ — (i)

in loop 2

$7I_2 + (I_2 - I_3)2 + (I_2 - I_1)1 = 0$

$10I_2 - 2I_3 - I_1 = 0$

$I_1 = 10I_2 - 2I_3$ — (ii)

in loop 3

$3I_3 + (I_3 - I_2)2 = 13$

$5I_3 - 2I_2 = 13$ — (iii)

by eq (i)

$30I_2 - 6I_3 - I_2 = 11$

$29I_2 - 6I_3 = 11$ — (iv)

by eq (iv) & (iii)

$6(5I_3 - 2I_2 = 13)$

$+\ 5(-6I_3 + 29I_2 = 11)$

$\Rightarrow$

$30I_3 - 12I_2 = 78$

$+\ -30I_3 + 145I_2 = 55$

$133I_2 = 133$

$\boxed{I_2 = 1\ Amp}$

by eq (iii)

$5I_3 - 2(1) = 13$

$5I_3 = 15$

$\boxed{I_3 = 3\ Amp}$

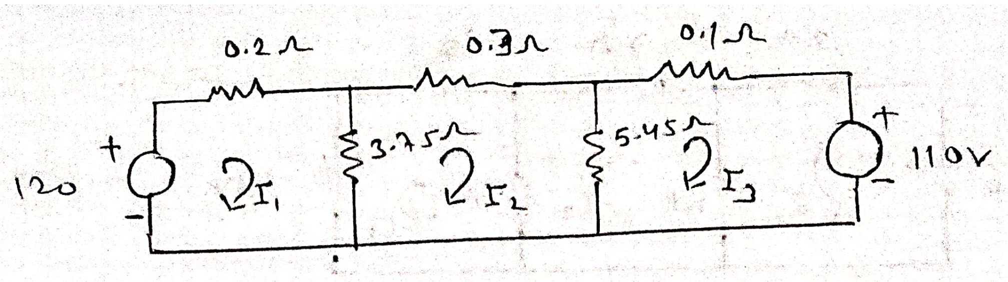
by eq (i)

$3I_1 - 1 = 11$

$I_1 = 12/3$

$\boxed{I_1 = 4\ Amp}$

Q



Soln

in loop 1

$0.2I_1 + (I_1 - I_2)3.75 = 120$

$3.95I_1 - 3.75I_2 = 120$ — (i)

in loop 2

$0.3I_2 + (I_2 - I_3)5.45 + (I_2 - I_1)3.75 = 0$

$9.5I_2 - 5.45I_3 - 3.75I_1 = 0$ — (ii)

$I_1 = \dfrac{9.5I_2 - 5.45I_3}{3.75}$

$I_1 = 2.53I_2 - 1.45I_3$ — (iv)

in loop 3

$0.1I_3 + (I_3 - I_2)5.45 = -110$

$5.55I_3 - 5.45I_2 = -110$ — (iii)

by eq (i) & (iv)

$\cancel{5.55I_3 - 5.45I_2}$

$3.95I_1 - 3.75I_2 = 120$

$3.95[2.53I_2 - 1.45I_3] - 3.75I_2 = 120$

$9.9I_2 - 5.72I_3 - 3.75I_2 = 120$

$6.15I_2 - 5.72I_3 = 120$ — (v)

by eq (iii) & (v)

$5.55I_3 - 5.45I_2 = -110$

$6.15I_2 - 5.72I_3 = 120$

by solving them

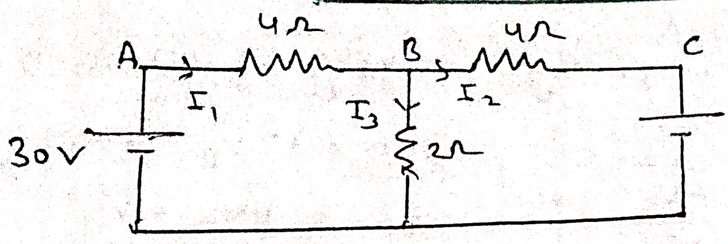
$I_1 = 30$ Amp

$I_2 = 20$ Amp

$I_3 = 10$ Amp

Nodal Analysis

Q.



Solve it with nodal method.
I_1, I_2 & $I_3 = ?$
V_A, V_B & $V_C = ?$

~~On node A~~

$$I_1 = \frac{V_B - V_A}{4}$$

$$I_2 = \frac{V_B - V_C}{4}$$

$$I_3 = \frac{0 - V_B}{2}$$

on node B

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

$$\frac{V_B - 30}{2} + \frac{V_B - 40}{2} = -V_B$$

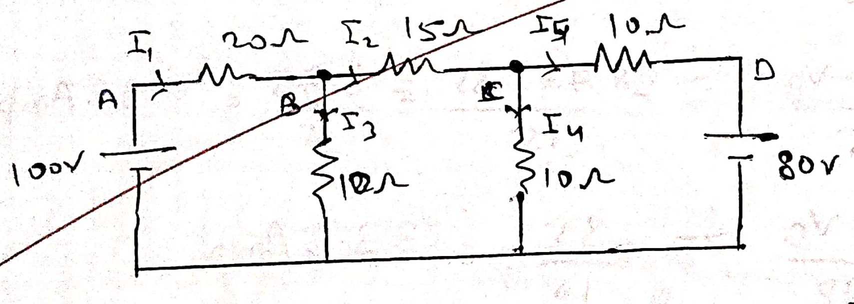
$$4V_B = 70$$

$$\boxed{V_B = 17.5 \text{ Volt}}$$

$$I_1 = \frac{17.5 - 30}{4} \qquad I_2 = \frac{17.5 - 40}{2} \qquad I_3 = \frac{-17.5}{2}$$

$I_1 = 3.125$ Amp $\qquad I_2 = 5.265$ Amp $\qquad I_3 = -8.39$ Amp

Q.



$$I_1 = \frac{V_B - V_A}{20} \qquad I_2 = \frac{V_C - V_B}{15} \qquad I_3 = \frac{0 - V_B}{10}$$

$$I_4 = \frac{0 - V_C}{10} \qquad I_5 = \frac{V_C - V_D}{10}$$

at node B

$$I_1 = I_2 + I_3$$

$$\frac{V_B - 100}{20} = \frac{V_C - V_B}{15} - \frac{V_B}{10}$$

$$\frac{V_B - 100}{4} = \frac{V_C - V_B}{3} - \frac{V_B}{2} \Rightarrow 6V_B - 600 = 20V_B - 8V_C$$

$$300 = 13V_B - 4V_c \quad \text{—(i)}$$

at node c

$$I_2 + I_5 = I_4$$

$$\frac{V_c - V_B}{\cancel{15}_{3}} + \frac{V_c - 80}{\cancel{10}_{2}} = \frac{-V_c}{\cancel{10}_{2}}$$

$$5V_c - 2V_B - 240 = -3V_c$$

$$240 = 8V_c - 2V_B$$

$$4V_c - V_B = 120 \quad \text{—(ii)}$$

by Solving eq (i). & (ii)

$$300 = 13V_B - 4V_c$$

$$+\;\; 120 = 4V_c - V_B$$

$$420 = 12V_B$$

$$V_B = \frac{420}{12} = \frac{70}{2}$$

$$\boxed{V_B = 35\,\text{Volt}}$$

in eq (ii)

$$120 + 35 = 4V_c$$

$$V_c = \frac{1860}{48} = \frac{155}{4}$$

$$\boxed{V_c = 38.75\,\text{Volt}}$$

<u>now</u>

$$I_1 = \frac{V_B - V_A}{20} = \frac{35 - 100}{20} = -3.75\,\text{Amp}$$

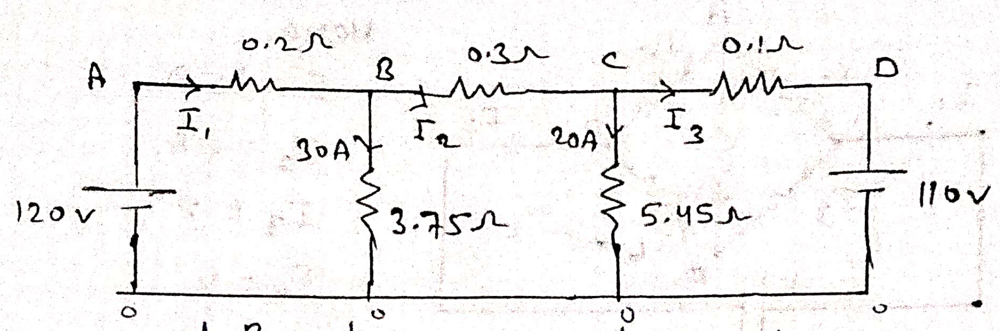
$$I_2 = \frac{V_c - V_B}{15} = \frac{38.75 - 35}{15} = \frac{3.75}{15} = 0.25\,\text{Amp}$$

$$I_3 = \frac{0 - V_B}{10} = \frac{-35}{10} = -3.5\,\text{Amp}$$

$$I_4 = \frac{0 - V_c}{10} = \frac{-38.75}{10} = -3.875\,\text{Amp}$$

$$I_5 = \frac{V_c - V_B}{10} = \frac{38.75 - 35}{10} = +0.375\,\text{Amp}$$

Q



Sol^n

at B node

$I_1 = I_2 + 30$

at C node

$I_2 = 20 + I_3$

$I_1 = \frac{V_B - 120}{0.2}$ $\qquad$ $I_2 = \frac{V_C - V_B}{0.3}$ $\qquad$ $I_3 = \frac{110 - V_C}{0.1}$

$30A = \frac{V_B - 0}{3.75}$

$V_B = -112.5V$

& $20 = \frac{0 - V_C}{5.45}$

$V_C = -109.0$ Volt

in $I_3 = \frac{110 - 109}{0.1} = \frac{1}{0.1}$

$\boxed{I_3 = 10 \text{ Amp}}$

$I_2 = 20 + I_3$

$\Rightarrow \boxed{I_2 = 30 \text{ Amp}}$

$I_1 = 30 + 30$

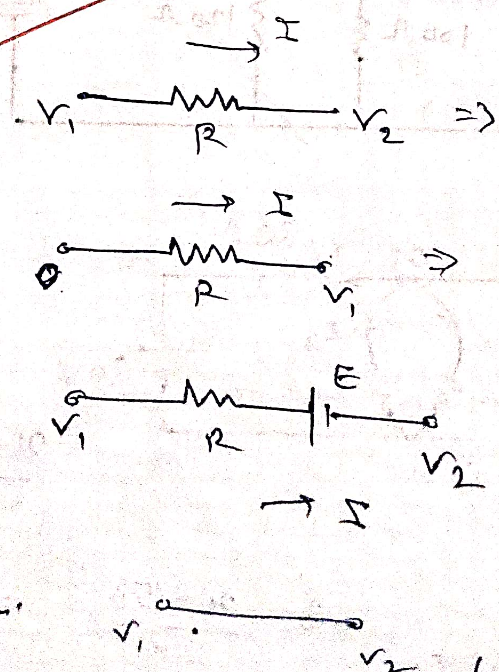
$\boxed{I_1 = 60 \text{ Amp}}$

* Super Node Condition ⇒

when ideal voltage source present b/w two refrence node.

procedure ⇒

Replace v.s. with their internal r to apply KCL.



$\Rightarrow I = \frac{V_1 - V_2}{R}$

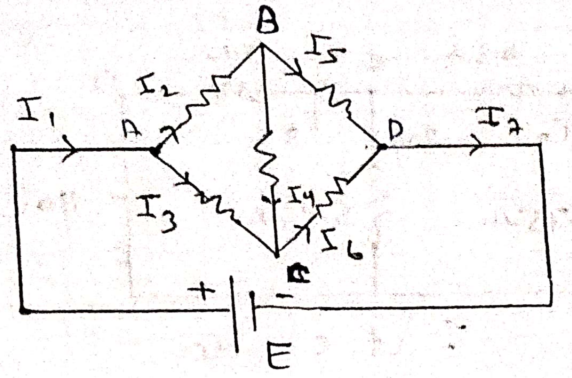
$\Rightarrow I = \frac{V_1}{R}$

$\Rightarrow I = \frac{V_1 - V_2 - E}{R}$

$I =$ Undifined

$(V_1 = V_2)$

①



Here
$I_1 = 15A$
$I_2 = 8A$
$I_3 = ?$
$I_4 = ?$
$I_5 = 6A$
& $I_6 = ?$

evaluate unknown current..

at node A

$I_1 = I_2 + I_3$

$15 = 8 + I_3$

$\boxed{I_3 = 7\,Amp}$

at node B

$I_2 = I_4 + I_5$

$8 = I_4 + 6$

$\boxed{I_4 = 2\,Amp}$

at node D

$I_5 + I_6 = I_7$

$6 + 9 = I_7$

$\boxed{I_7 = 15\,Amp}$

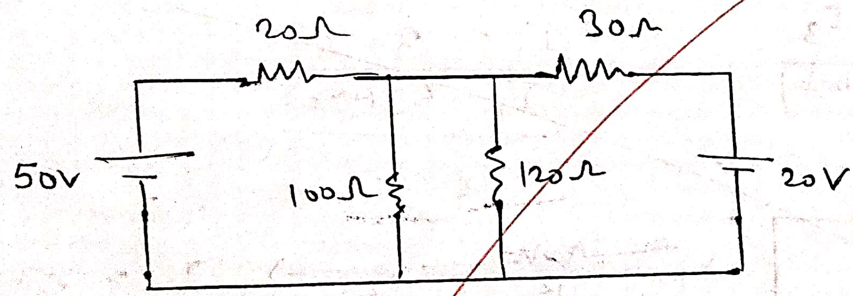
at node C

$I_3 + I_4 = I_6$

$7 + 2 = I_6$

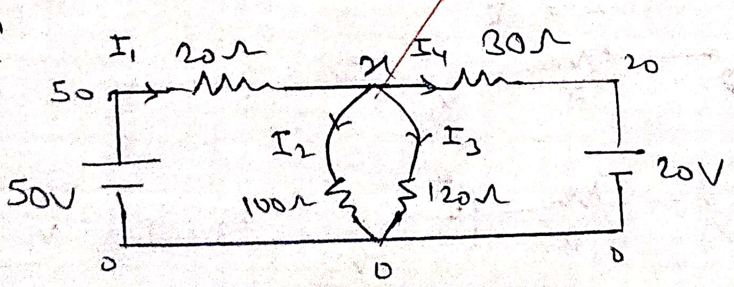
$\boxed{I_6 = 9\,Amp}$

②



Find current in 100Ω by nodal methead.

Soln



(by KCL)

at node x

$I_1 = I_2 + I_3 + I_4$

$$\frac{x-50}{20} = \frac{+x}{100} + \frac{x}{120} + \frac{20-x}{30}$$

$$\frac{x-50}{\cancel{20}} = \frac{+6x+5x+400-20x}{\cancel{600}\ 30}$$

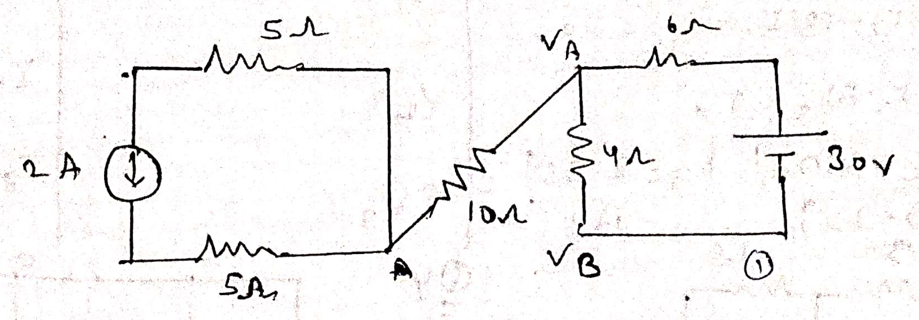
$30x - 1500 = +6x + 5x + 400 - 20x$

$39x = 1900 \Rightarrow \boxed{x = 48.71\,V}$

$$I_2 = \frac{48.71}{100}$$

$\boxed{I_2 = 0.48\,Amp}$

Q



Soln

Loop 1: by deridation of Voltage

$$V_{AB} = \frac{4}{4+6} \times 30 \qquad \left(V_{xy} = \frac{R_{xy}}{R_{eq}} \times V_{tot} \right)$$

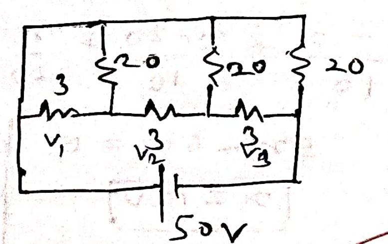
$$V_{AB} = 12\ \text{Volt}$$

by deridation of current

$$I_{AB} = \frac{6}{4+6} \times 2 = 6/5\ \text{Amp.}$$

Practice

Q1



Find voltage across 3Ω resister.

(KVL)

in loop 1

$20(I_1 - I_2) + 3(I_1 - I_4) = 0$

$23 I_1 = 20 I_2 - 3I_4$ — (i)

in loop 2

$20(I_2 - I_3) + 20(I_2 - I_1) + 3(I_2 - I_4) = 0$

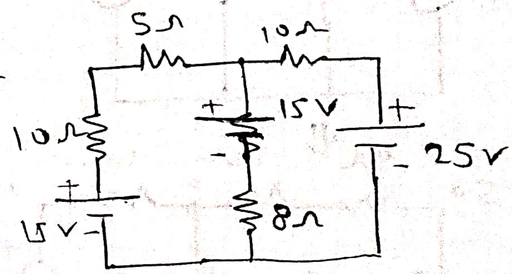
$43 I_2 - 20 I_3 - 20 I_1 - 3I_4 = 0$ — (ii)

in loop 3

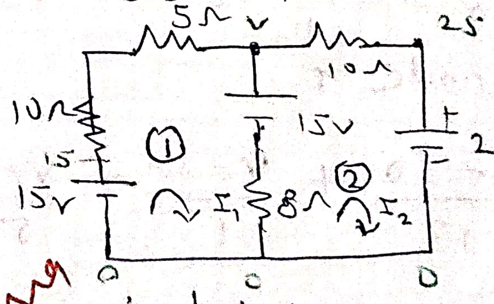
$20 I_3 + 20(I_3 - I_2) + 3(I_3 - I_4) = 0$

$43 I_3 - 20 I_2 - 3 I_4 = 0$ — (iii)

Q2



Find the current in 8Ω resister.



in loop 1

$5I_1 + 8(I_1 - I_2) + 10 I_1 = 15 + 15$

$23 I_1 - 8 I_2 = 0$

$I_2 = \frac{28}{8} I_1$ — (i)

in loop 2

$10 I_2 + (I_2 - I_1)8 = -25 + 15$

$18 I_2 - 8 I_1 = +10$ — (ii)

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(7)

$23I_1 - 20I_2 - 3I_4 = 0$ —(i)

$-20I_2 + 43I_3 - 3I_4 = 0$ —(iii)

$-20I_1 + 43I_2 - 20I_3 - 3I_4 = 0$ —(ii)

$9I_4 - 3I_1 - 3I_2 - 3I_3 = 50$ —(iv)

by eq (iii) & (i)

$$-20\cancel{I_2} = \cancel{3I_4} - 23I_1$$
$$-20I_2 = -43I_3 + \cancel{3I_4}$$
$$- \quad + \qquad + \qquad -$$

$$43I_3 = 23I_1 \quad \text{—(v)}$$

$$(I_1 = 1.86I_3)$$

by eq3 (ii) & (iv)

$$-60I_1 + 129I_2 - 60I_3 - \cancel{9I_4} = 0$$
$$\cancel{9I_4} - 3I_1 - 3I_2 - 3I_3 = 50$$
$$+$$

$$-63I_1 + 126I_2 - 63I_3 = 50$$

by eq (v)

$\cancel{54.78I_3}$

$$-63 \times 1.86I_3 + 126I_2 - 63I_3 = 50$$
$$-180.18I_3 + 126I_2 = 50 \quad \text{—(vi)}$$

Now by eq (vi) & (vii)

$$-180.18I_3 + 1.59 \times 129I_3 = 50$$
$$-180.18I_3 + 205.17I_3 = 50$$
$$24.99I_3 = 50$$
$$\boxed{I_3 = 2.08A}$$

(8)

$I_2 = \frac{23}{8}I_1$ (i), $18I_2 - 8I_1 = 10$ (ii)

by eq-iii)

$$18 \times \frac{23}{8}I_1 - 8I_1 = 10$$
$$(51.75 - 8)I_1 = 10$$
$$I_1 = \frac{10}{43.75}$$
$$I_1 = 0.228 \text{ Amp}$$

by eq (i)

$$I_2 = 0.228 \times \frac{23}{8}$$
$$I_2 = 0.655 \text{ Amp}$$

Current in 8Ω

$$I_8 = I_2 - I_1 = 0.427 \text{ Amp.}$$

by eq (iii) & (ii)

$$-20I_2 + 43I_3 - \cancel{3I_4} = 0$$
$$-20I_1 + 43I_2 - 20I_3 - \cancel{3I_4} = 0$$
$$- \quad + \qquad - \qquad + \qquad +$$

$$20I_1 - 63I_2 + 63I_3 = 0$$

by eq (v)

$$20 \times 1.86I_3 - 63I_2 + 63I_3 = 0$$
$$(37.2 + 63)I_3 - 63I_2 = 0$$
$$100.2I_3 - 63I_2 = 0$$
$$1.59I_3 = I_2 \quad \text{—(vii)}$$

by eq (vii)

$I_2 = 1.59 \times 2.55$

$\boxed{I_2 = 4.05\ Amp}$

by eq (v)

$I_1 = 1.86 \times 2.55$

$\boxed{I_1 = 4.74A}$

by eq (iv)

$9I_4 = 50 + 3\times 4.74 + 3\times 4.05 + 3\times 2.08$

$I_4 = \dfrac{50 + 14.22 + 12.15 + 6.24}{9}$

$I_4 = \dfrac{82.61}{9} = 9.17\ Amp$

$\boxed{I_4 = 9.17\ Amp}$

Now voltage in 3 Ω resisters

$V_1 = (I_4 - I_1)3$

$\boxed{V_1 = 13.29V}$

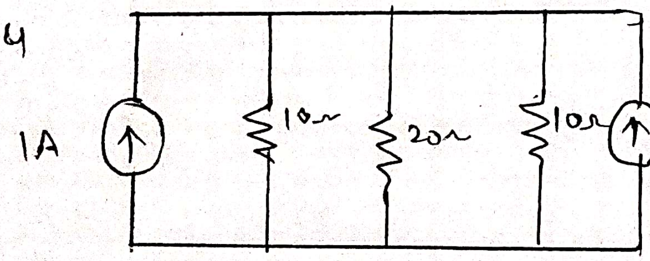
$V_2 = (I_4 - I_2)\times 3$

$\boxed{V_2 = 15.36V}$

$V_3 = (I_4 - I_3)3$

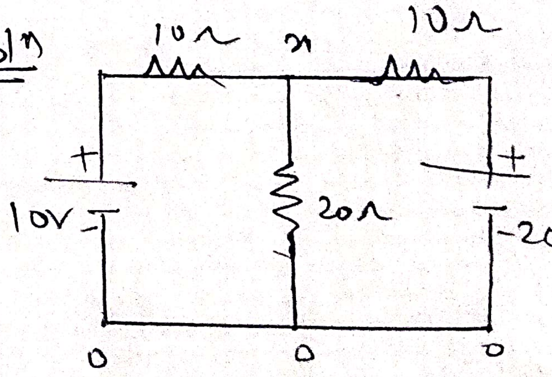
$\boxed{V_3 = 21.27V}$

Q4



determine the current in 20Ω resister by nodal anglysis.

Soln



at Node at x

$\dfrac{x-10}{10} + \dfrac{x-20}{10} + \dfrac{x}{20} = 0$

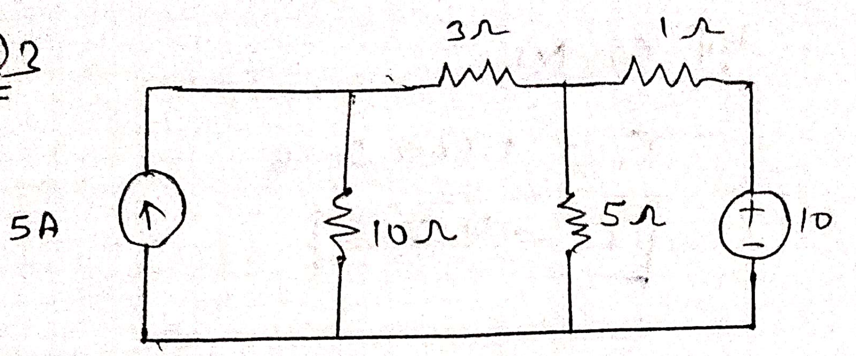
$5x - 60 = 0$

$\boxed{x = 12V}$

$I_{20} = \dfrac{12}{20}$

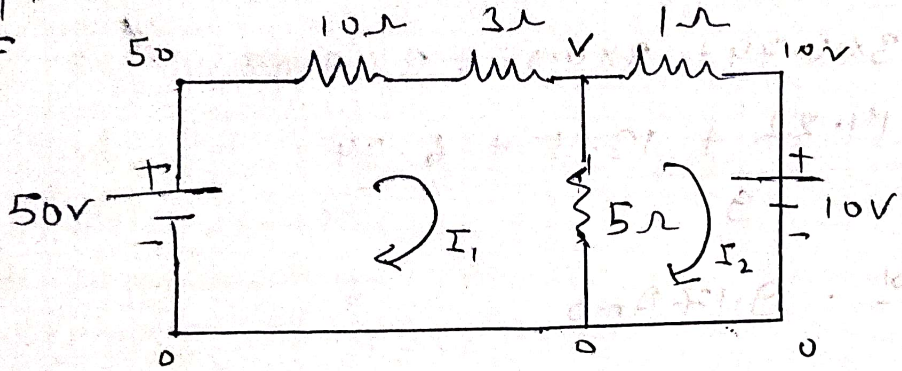
$\boxed{I_{20} = 0.6\ Amp}$ Ans

Q2



write the node voltage equation & determine the current in branches

Soln



for I_1

$$I_1 = \frac{V-50}{13}$$

$$I_1 = 3.19 \text{ Amp}$$

at node v

$$\frac{v-50}{13} + \frac{v-10}{1} + \frac{v}{5} = 0$$

for I_2

$$I_2 = \frac{8.43-10}{1}$$

$$I_2 = 1.57 \text{ Amp}$$

$$5v - 250 + 65v - 650 + 13v = 0$$

$$83v - 700 = 0$$

$$\boxed{v = 8.43 \text{ Volt}}$$

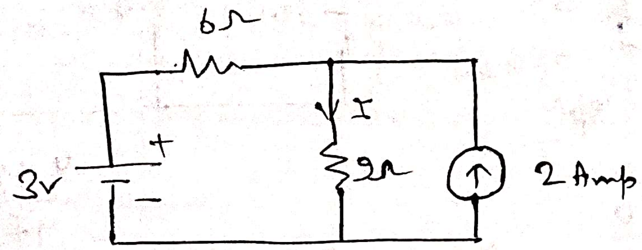
So $I_{10} = I_3 = 3.19$ A | $I_5 = I_1 - I_2 = 1.62$ Amp | $I_{1\Omega} = 1.57$ Amp

★ Superposition principal ★

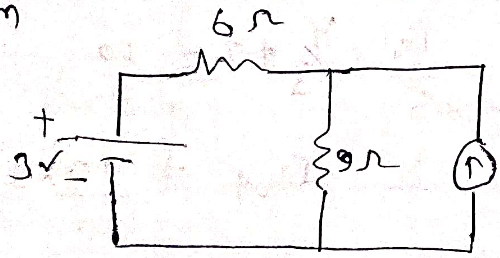
In a linear electrical network having more than 1 independent energy sources, the response in any branch is equals to the algebric some of all the responses due to each individual source acting alone.

→ When voltage source is removed, that branch should be treated as short and for Current Source, branch should be treated as open.

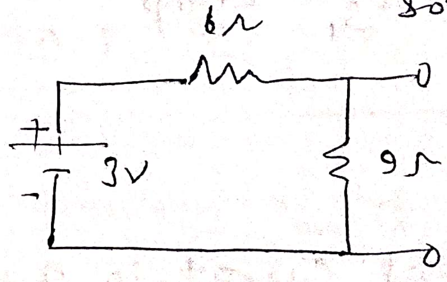
①



Soln

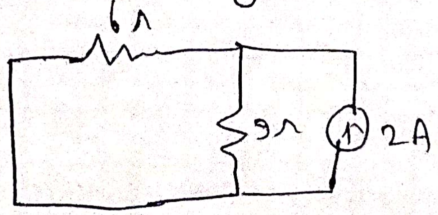


(i) removing the current source



$$I_v = \frac{3}{15} = \frac{1}{5} = 0.2\ \text{Amp}$$

(ii) by removing the voltage source

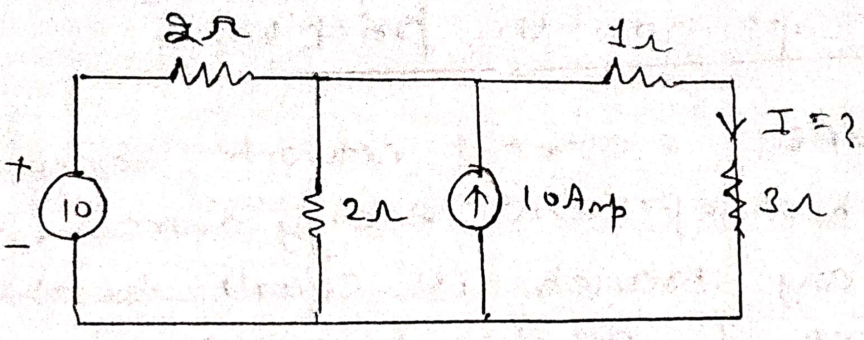


$$R_{eq} = \frac{6\times 9}{15} = \frac{18}{5} = 3.2\ \Omega$$

$$I_A = \frac{6}{9+6}\times 2 = \frac{6}{15}\times 2 = \frac{4}{5} = 0.8\ \text{Amp}$$

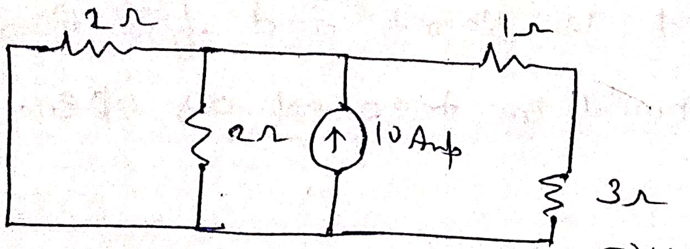
So total current in $9\Omega = 0.8 + 0.2 = \underline{1\ \text{Amp}}$

Q 2



Sol^n

by removing voltage source



$\Rightarrow 4\Omega$

(1)Ω $\quad \frac{3\times1}{4} = \frac{3}{4}\Omega$

voltage source = 10 Volt

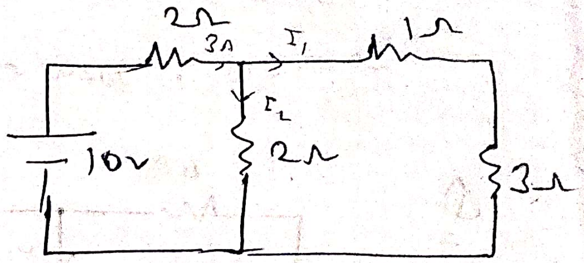
$$I_3 = \frac{10}{4+1} = \frac{10}{5}$$

$I_{3_1} = 2$ Amp

Total Current in 3Ω

= ~~4 Amp~~ = 3 Amp

by removing ~~voltage~~ Current source



$$\frac{4\times2}{4+2} = \frac{4\times2}{6}$$

$\frac{4}{3}\Omega$

$$R_{eq} = \frac{4}{3} + 2 = \frac{10}{3}\Omega$$

$$I_{tot} = \frac{10\times3}{10} = 3\text{ Amp}$$

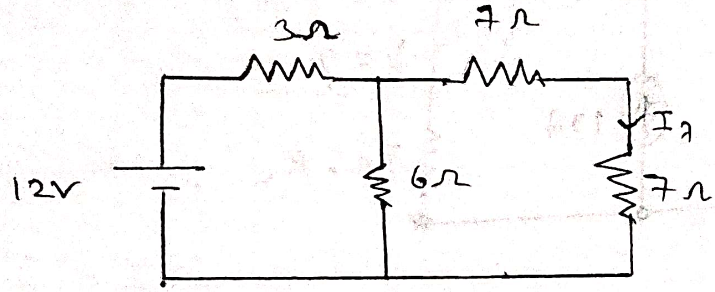
$$I_{3_2} = \frac{2}{6} \times 3$$

I_{3_2} = ~~1~~ Amp

Thevenin's theorem

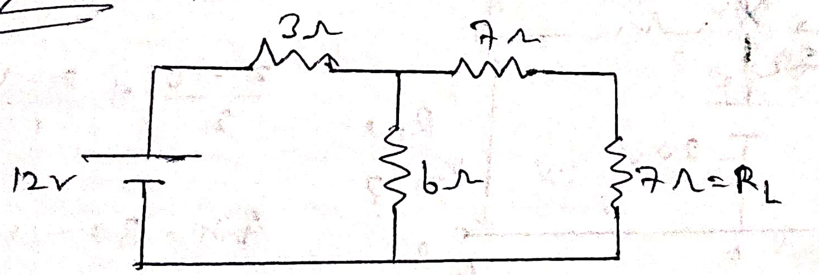
Statement Any two terminals linear active electrical network can be replaced by an ideal voltage source V_{th} in series with a resistance R_{th}. Where V_{th} is the open circuit voltage across two terminals. & R_{th} is the equelent resistance of the network from the two terminals.

Ex -

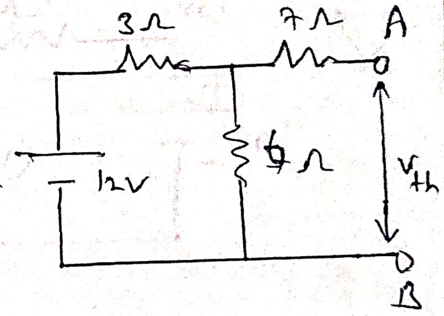


Find current in 7 Ω Resister I_7 = ?

Soln
= eq circuit



⇒



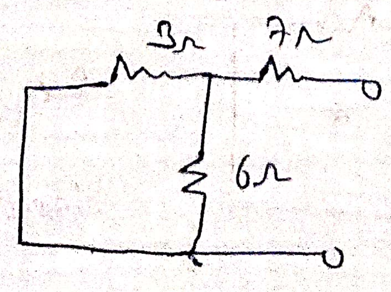
Firstly we have to calculate V_{th} & Req

$$V_0 = V_{th} = 12 \times \frac{6}{6+3} = \cancel{12}^{4} \times \frac{\cancel{6}^{2}}{\cancel{9}_{3}} = 8\,V$$

$$\boxed{V_0 = V_{th} = 8V}$$

for Req

remove all voltage sources & current circut.

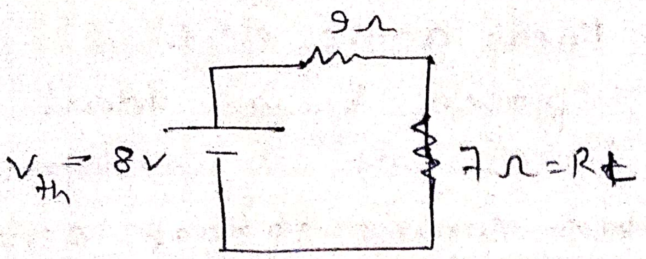


$$Req = \frac{3 \times 6}{3+6} + 7$$

$$= 2 + 7$$

$$\boxed{Req = 9\Omega = R_{TH}}$$

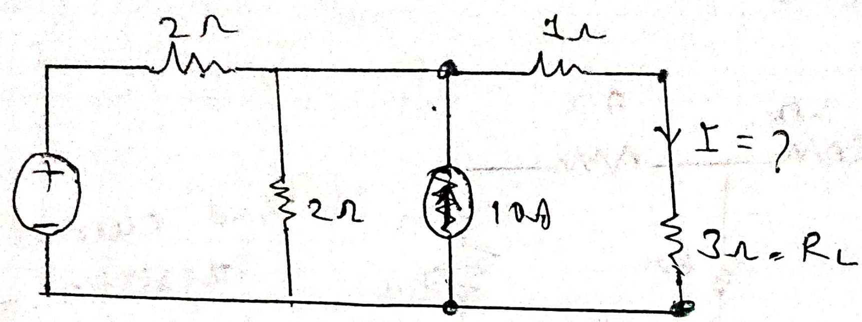
Now eq^n circuit ⇒



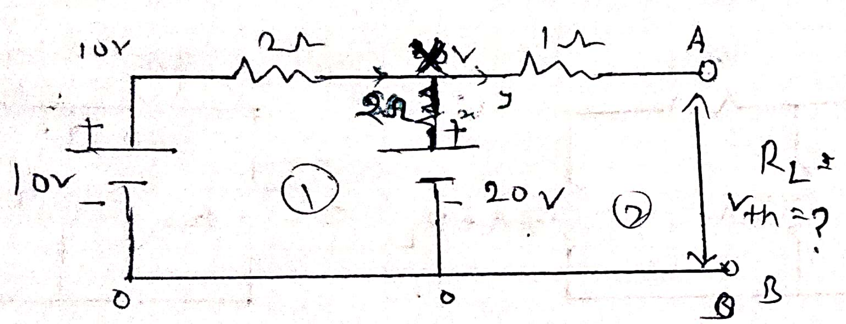
$$\Rightarrow \quad I_{th} = \frac{8}{9+7} = \frac{8}{16} = 0.5\,Amp$$

$$\boxed{I_{7\Omega} = 0.5\,Amp} \quad \text{Ans}$$

Q



Sol^n



at node x

$$\frac{x-10}{2} + \frac{x-V}{1} + \frac{x-20}{2} = 0$$

$$4x - 30 - 2V = 0$$

$$2x - V = 30 \quad \text{-i}$$

V_{AB} =

$$I_{tot} = \frac{10}{2} = 5\,Amp$$

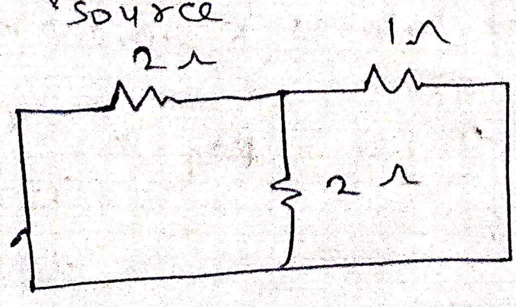
$$I_1 = \frac{20}{2} = 10\,Amp$$

$$I_2 = 5\,Amp$$

$$V_A = \frac{20}{1} = 5$$

$$\boxed{VA = 5\,Volt} = V_{th}$$

Removing V_{source}

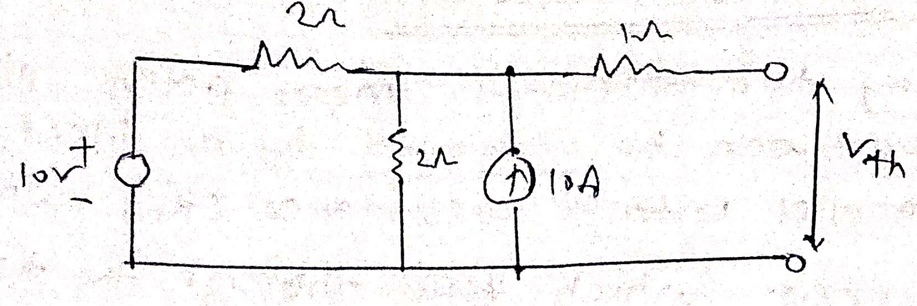


Req = 2Ω

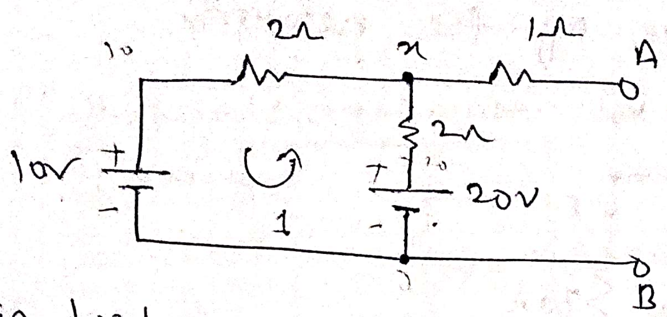
Hence $R_{th} = 2 + 3$
$= 5\,\Omega$

$$I = \frac{15}{5}$$

$$I = 3\,Amp$$



⇓



in loop 1

$2I + I \times 2 = -10 + 20$

$4I = 10$

$I = 2.5$ Amp

$V_x =$

$\frac{20 - x}{2} = 2.5$

$-x + 20 = 5$

$\boxed{x = 15 \text{ Volt}}$

$V_{AB} = 15$ Volt

then current

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

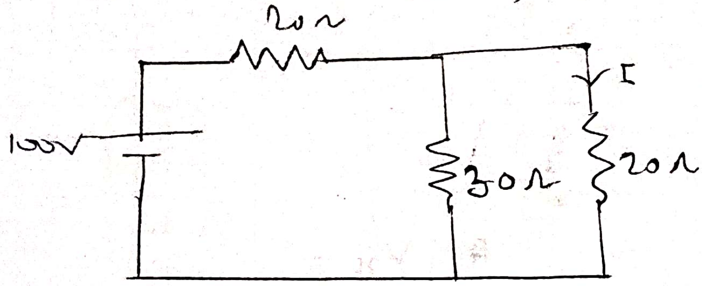
$I_L = \frac{15}{5} = 3$ Amp

$R_{eq} + R_L = 3 + 2 = 5\Omega$

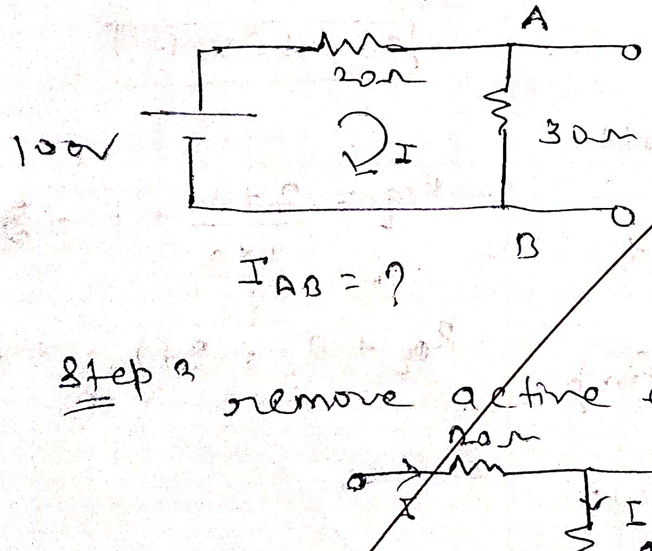
Norton's theorem

* **Statement** Any two terminals linear active electrical network can be replaced by an ideal current source. In parallel with a resistence (R_n) where (I_n)
$I_{(n)}$ is the current which flow through the two terminal when they are short circuited. and R_n is the equalent resistence of the network. ⟶ internal resistance of voltage (Source)

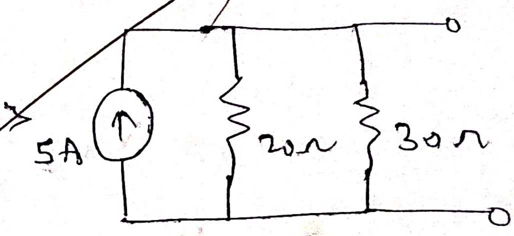
Q



Step 1 $R_L = 20\Omega$
remove R_L from the circuit.

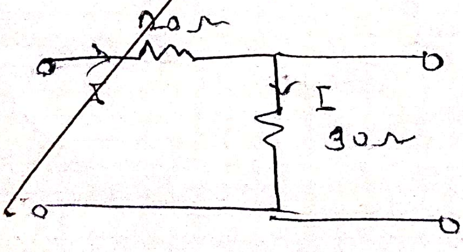


⟹



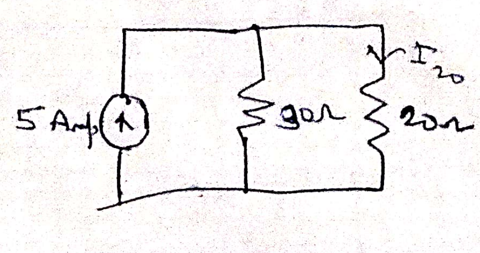
$I_{AB} = ?$ $\qquad$ $I_{AB} = I_n = 5\,Amp$

Step 2 remove active element ~~req = 20~~



$R_n = 30\Omega$

eq circuit -

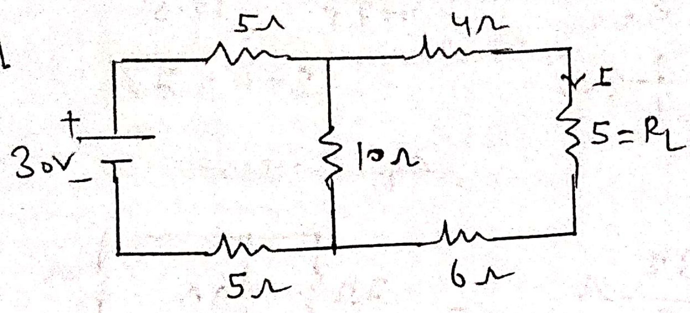


$$I_{20} = \frac{5 \times 30}{50} \Rightarrow$$

$$\boxed{I_{20} = 3\,Amp}$$ Ans

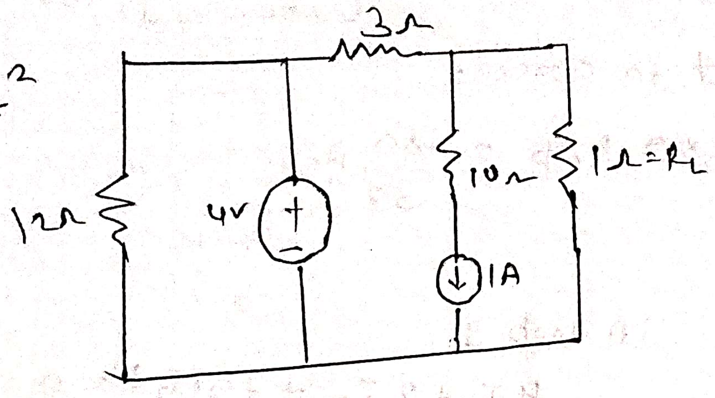
Assignment (7)

Q1



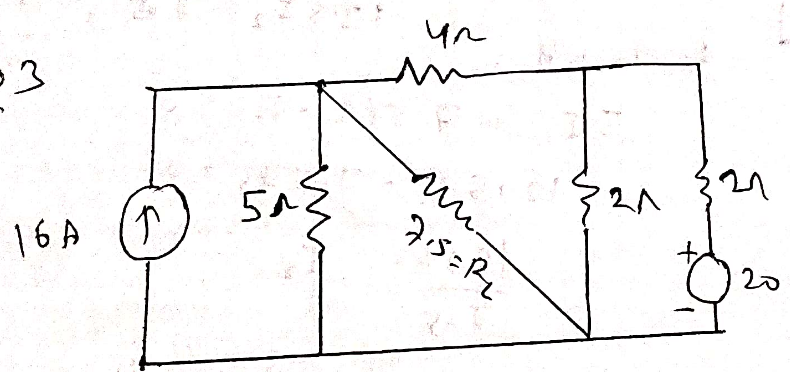
Find current through 5Ω resistor by norton's & thevenin's theorem.

Q2



Determine the current through 1Ω resistor through thevenin's & norton's theorem.

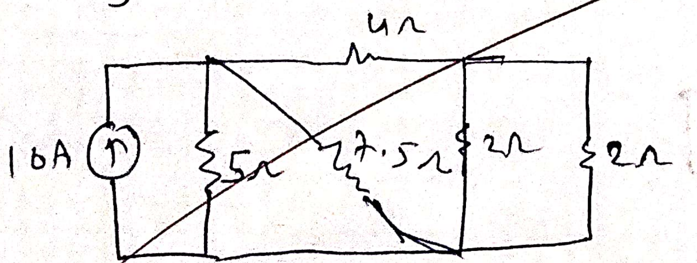
Q3



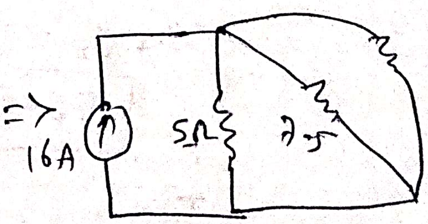
Find the current through 7.5 Ω Resistor by Superposition principal.

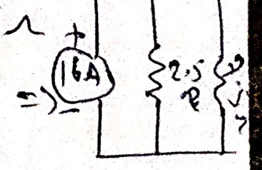
Solutions

Q3 by removing voltage source



=>



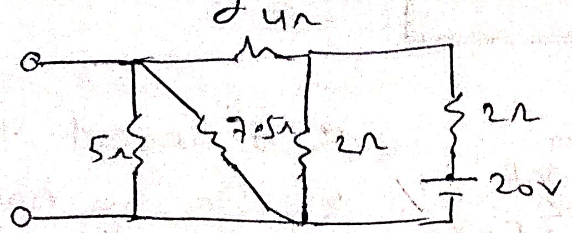


$$Req = \cancel{\frac{2.5 \times 7.5}{2.5+7.5}} = \frac{\cancel{2.5 \times 7.5}}{10} \Omega =$$

So $I_{L_1} = \frac{2.5}{7.5+2.5} \times 16$

$I_{L_1} = \cancel{4 Amp}$

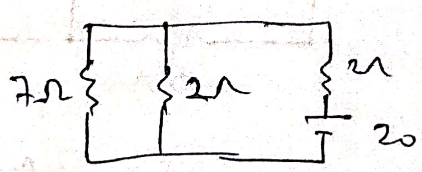
Step 2
by removing current source



$$\frac{5\times7.5}{5+7.5} = \frac{5\times7.5}{12.5} = 3\,\Omega$$

$$3+4 = 7\,\Omega$$

eq Circuit



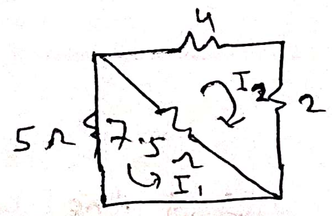
Req =

$$R_{eq} = \frac{7\times2}{9} + 2 = \frac{32}{9}\,\Omega$$

So total current in circuit

$$I = \frac{20\times9}{32}\text{ Amp} = \frac{180}{32}\text{ Amp}$$

Current division



in loop 2

$$4I_2 + 2I_2 + 7.5(I_2-I_1) = 0$$

$$13.5I_2 - 7.5I_1 = 0 \quad \text{(ii)}$$

in loop 1.

$$5I_1 + 7.5(I_1-I_2) = 0$$

$$12.5I_1 - 7.5I_2 = 0$$

$$\frac{12.5I_1}{7.5} = I_2$$

$$I_1 = \frac{3}{5}I_2 \quad \text{(i)}$$

by eq (ii)

$$13.5I_2 - 7.5\times\frac{3}{5}I_2 = 0$$

$$13.5I_2 - 4.5I_2 = 0$$

$$9I_2 = 0$$

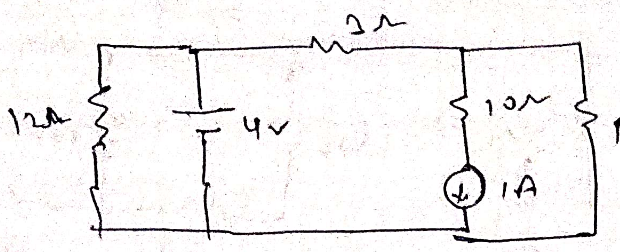
$$\boxed{I_2 = 0}$$

$$I_1 = 0$$

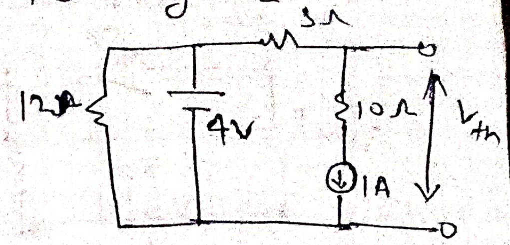
So $I_{L2} = 0$

Hence total current in load R_L is 4 Amp.

Q2 by thevenins theorem

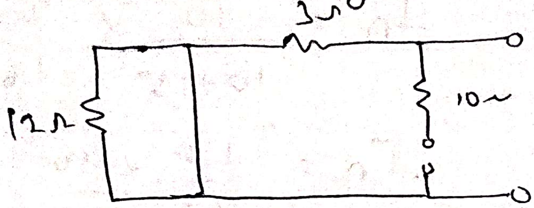


Removing R_L



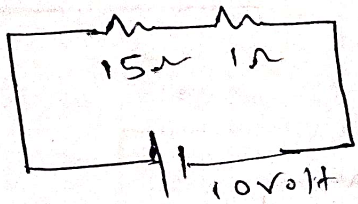
$V_{th} = 10 \times 1 = 10$ Volt

Now removing all active elements.



$R_n = 15\Omega$

So eq circuit



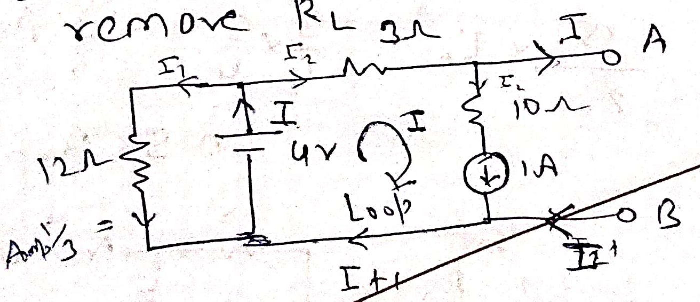
So current in R_L

$I_L = \frac{10}{15+1} = \frac{10}{16}$ Amp

$I_L = 0.625$ Amp.

by norton's theorem.

remove R_L



in Loop

~~$3I + 10I + 10 = 4$~~

~~$13I = -6$~~

~~$I = -6/13$~~

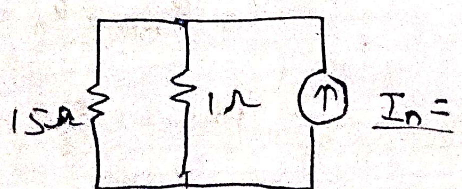
$I_1 = \frac{4}{12} = 1/3$ Amp

$3(I+1) + 10 + = 4$

$I+1 = -6/3 = -2$

$I = -2-1 = -3$ Amp.

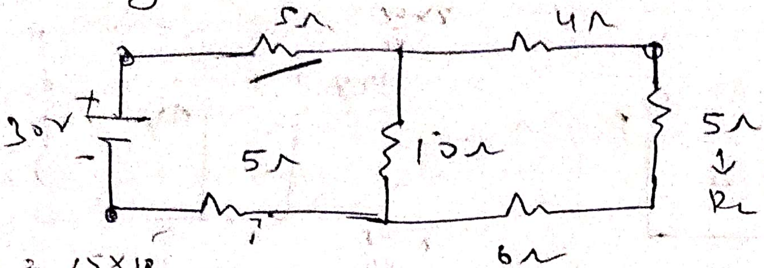
for $R_{eq} = 15\Omega$ (12+3)



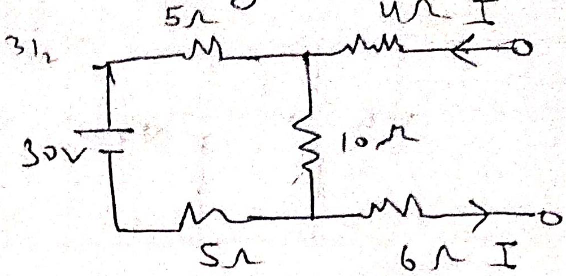
$I_n =$

$I_L = \frac{15}{16} \times I_n = \frac{15}{16} \times \quad =$

Q1 by norton's theorem

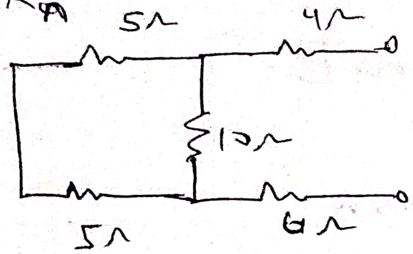


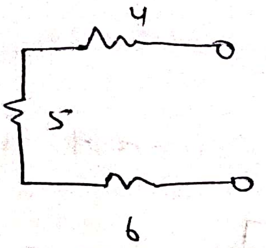
removing R_L



$R_{eq} = \frac{15\times 10}{25} = 6\Omega + 5 + 5$
$= (16\Omega)$

for R_N





$R_n = 15\Omega$

$\because I_{total} = \frac{30}{16}$ ~~$30/20$ Amps~~ $= 3/2$ Amp

$I_n = \frac{10}{10+15} \times \frac{30}{16}$

$I_n = \frac{10}{25} \times \frac{30}{16}$

$\boxed{I_n = 3/4 \text{ Amp}}$ Ans

Rqn circuit

$I_{total} = \frac{30}{20}$

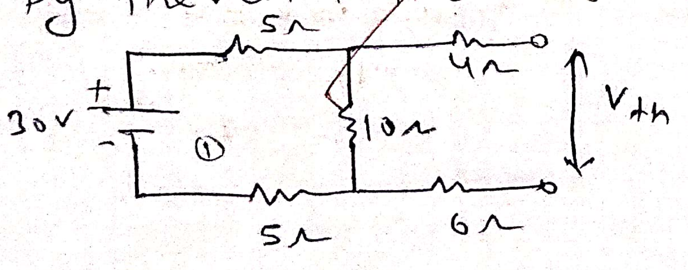
$I_{total} = 3/2$ Amp

I_n =

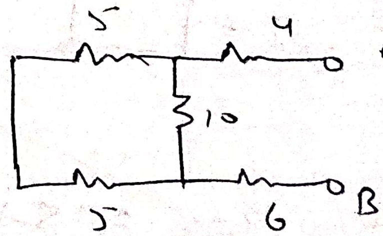
$I_L = \frac{15}{20} \times I_n = \frac{3}{4} \times \frac{3}{4} = \frac{9}{16}$ Amp

0.56 Amp

by thevenin theorem



for R_0 =



$R_{AB} = R_n = 15\Omega$

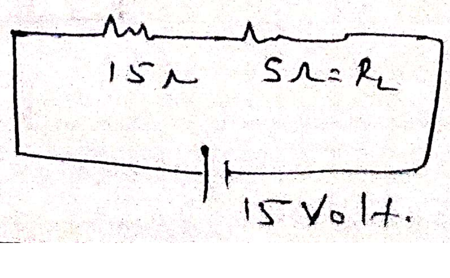
$I_1 = \frac{30}{20} = 3/2$ Amp

$V_{10} = V_{th} = 3/2 \times 10 = 15$ Volt

$I_L = \frac{15}{20} = 3/4$

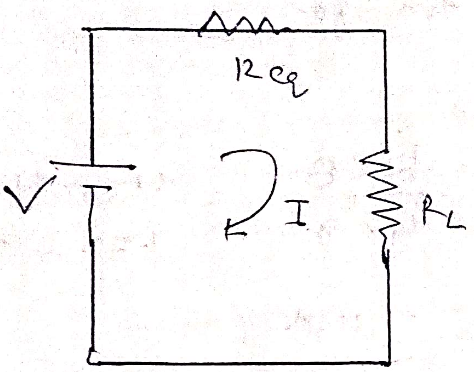
$\boxed{I_L = 0.75 \text{Amp}}$

now eq. circuit



★ Max. Power transfer ★ theorem

⇒ Maximum Power will be transfered from a source network to the load if the load resistance R_L is equalent to the total resistance of the circuit.



$$I_{max} = \frac{V}{R_L + R_S}$$

$\because R_L = R_S$ (Condition for Max Power)

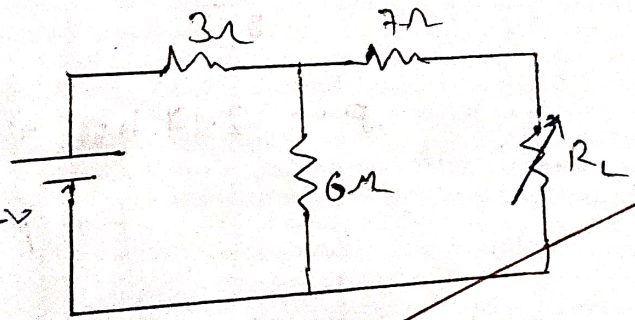
$$\boxed{I_{max} = \frac{V}{2R_L}}$$

maximum power will be

$$P_{max} = I_{max}^2 R_L$$

$$\boxed{P_{max} = \frac{V^2}{4R_L}}$$

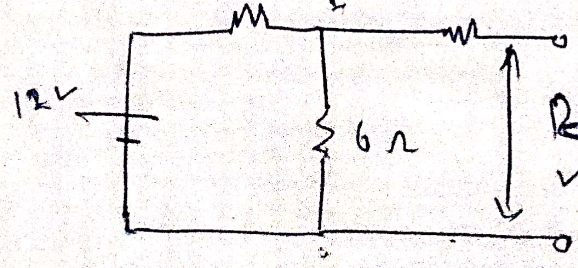
Ex.



In given circuit what is the max^m Power that can be absorbed by the load Resistance R_L. If it varies. What is the power absorbed by Load R_L if.

(i) $R_L = 7\Omega$ (ii) $R_L = 11\Omega$

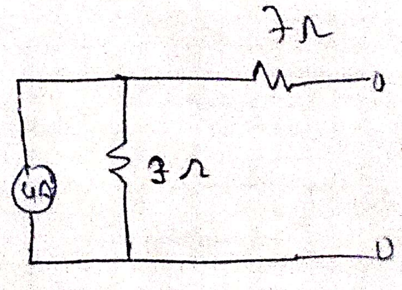
~~eq circuit~~

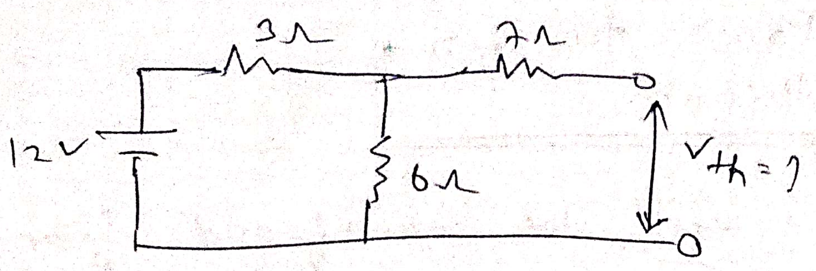


Req =

$V_{th} = ?$

=





$V_{th} = \frac{\cancel{6}^{2}}{\cancel{9}_{3}} \times \cancel{12}^{4}$ Req = 3+6 = 9 Ω

$V_{th} = \underline{8\,\text{Volt}}$

Condition for max power transfer

$R_{eq} = R_L = 9\,\Omega$

$P_{max} = \frac{V^2}{4R_L} = \frac{8 \times 8}{4 \times 9} = \cancel{4\,\text{watt}}$ 1.77 watt

(i) $R_L = 7\,\Omega$

$I = \frac{V}{R} = \frac{V}{R_L + R_S}$

$= \frac{8}{9+7}$

$I_{max} = \frac{1}{2}$ Amp

$P = I_{max}^2 R_L$

$P = \frac{1}{4} \times 7 = 1.75$ watt

(ii) $R_L = 11\,\Omega$

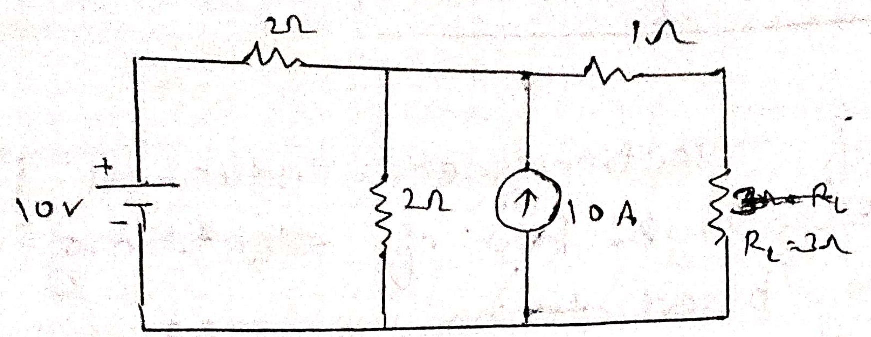
$I = \frac{8}{11+7} = \frac{8}{18} = \frac{4}{9}$

$P = I^2 R_L$

$P = \frac{16}{81} \times 11$

$P = 2.17$ ~~Amp~~ watt

Q

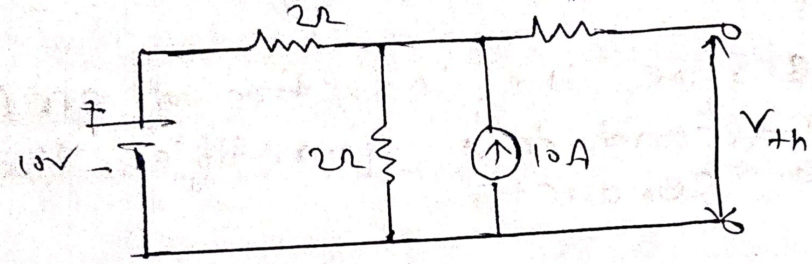


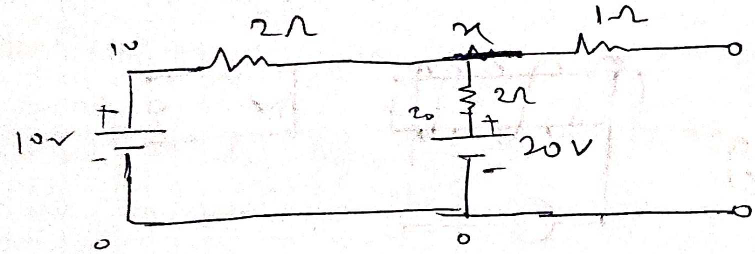
what the max^n power transfers or absorbed by load resistors of ~~3Ω if its varies~~

what is the power absorbed by load resistor 3Ω = ?

Sol^n

by removing R_L





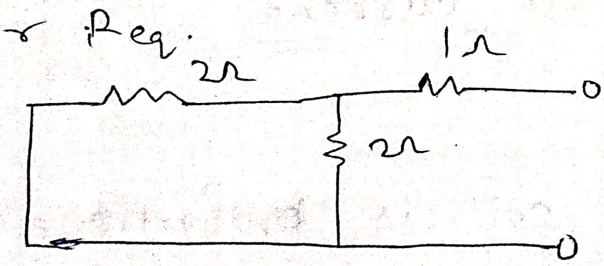
$$\frac{20-x}{2} + \frac{10-x}{2} + \frac{x}{1} = 0$$

$$2x = 30\text{ volt}$$

$$\boxed{x = 15\text{ Volt}}$$

$V_{th} = 15$ Volt

for Req.



$R_S = 2\Omega \Rightarrow$

$$I_{max} = \frac{V}{R_L + R_S} = \frac{15}{2+3} = 3\text{ Amp}$$

$$P_{max} = I^2_{max} R_L = (3)^2 \times 3 = 27\text{ watt.}$$

now

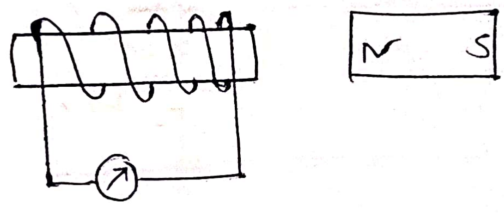
$$P_{max} = \frac{V^2}{4R_L} = \frac{15 \times 15}{4 \times 2} = \frac{225}{8} = 28.125\text{ watt.}$$

Faraday's Law

→ Faraday's law of electromagnetic induction is also known as Faraday's law of electromagnetism. which help us to predict how a magnetic feild intract with an electrical circuit to produce emf. This phenomenea is known as electromagnetic induction. Faraday's law of electromagnetism consists of two laws.

The first law describe the induction of emf in a conductor and second law quantifies the emf produced in the conductor.

First law :-



whenever a conductor is placed in a varing magnetic feild ~~and~~ an **emf** is induced.

If the circuit is closed a current is also induced. which is called "induced current".

Second law :-

The induced emf in a coil is proportional to the rate of change of magnetic

$$e = -N\frac{d\phi}{dt}$$

Here

e = induced emf

N = number of turns in a coil or conductor

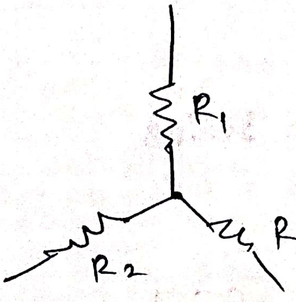
ϕ = Magnetic flux.

★ Lenz's law : The ~~indecured~~

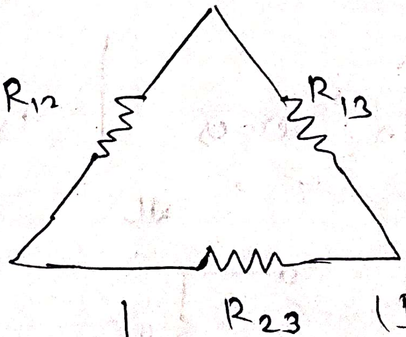
The induced emf with different polarities induce a current whose magnetic feild opposes the change in magnetic flux. through the loop in order to insure that the orignal flux is maintained through the loop when current flows through it.

⇒ Lenz's law is the most convenient method to determine the direction of current. It states that the direction of an current is always oppose the change in magnetic flux in the circuit. or the megnetic feild that produce ~~#~~ induced current.

★ Questions on Star - Delta formation.



(Star)



(Delta)

Star → Delta

$$R_{12} = R_1 + R_2 + \frac{R_1 \cdot R_2}{R_3}$$

$$R_{23} = R_2 + R_3 + \frac{R_2 \cdot R_3}{R_1}$$

$$R_{31} = R_3 + R_1 + \frac{R_3 \cdot R_1}{R_2}$$

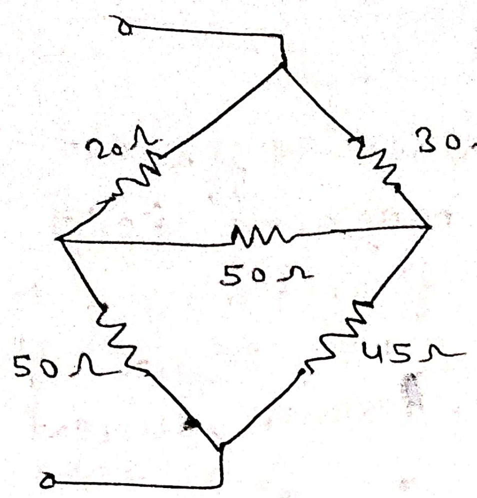
Delta → Star

$$R_1 = \frac{R_{13} \cdot R_{12}}{R_{13} + R_{12} + R_{23}}$$

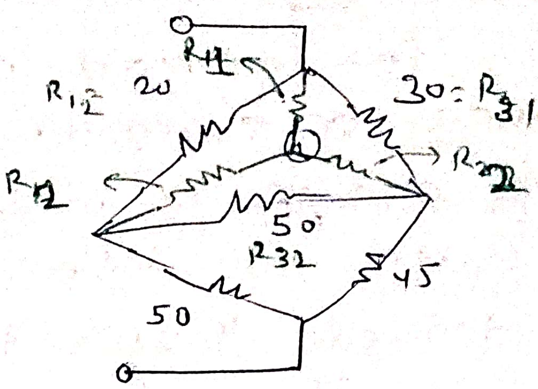
$$R_2 = \frac{R_{23} \cdot R_{21}}{R_{13} + R_{12} + R_{23}}$$

$$R_3 = \frac{R_{32} \cdot R_{31}}{R_{31} + R_{32} + R_{12}}$$

Q



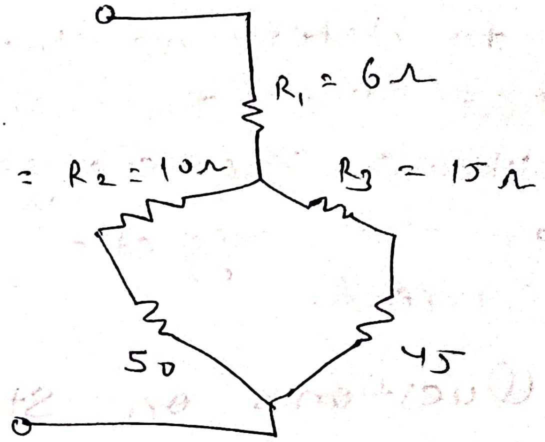
let delta 1



$$R_1 = \frac{R_{12} \cdot R_{31}}{\Sigma R} = \frac{20 \times 30}{100} = 6\,\Omega$$

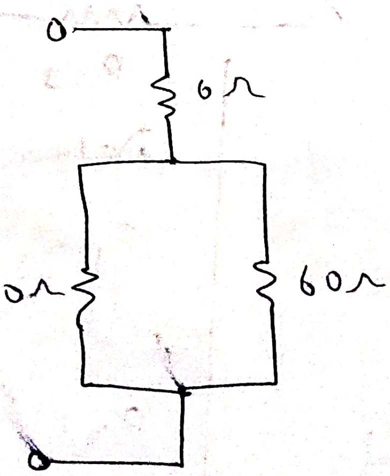
$$R_2 = \frac{R_{21} \cdot R_{32}}{\Sigma R} = \frac{20 \times 50}{100} = 10\,\Omega$$

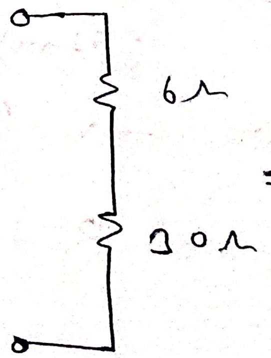
$$R_3 = \frac{R_{31} \cdot R_{32}}{\Sigma R} = \frac{30 \times 50}{100} = 15\,\Omega$$



Now

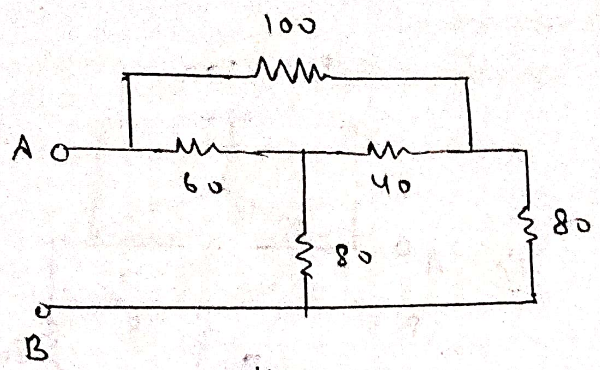
10 & 50 in series | 15 & 45 in series



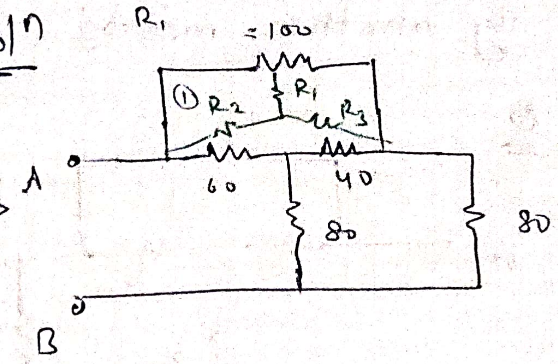


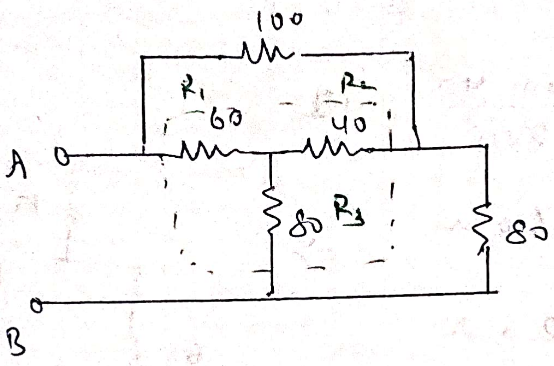
$$\boxed{R_{eq} = 36\,\Omega} \text{ Ans}$$

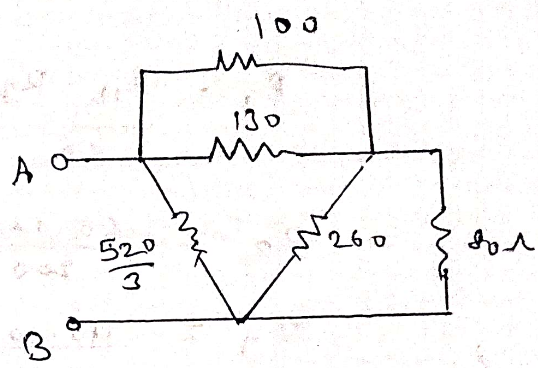
Q



Soln







for star to delta

$$R_{12} = 60 + 40 + \frac{60 \times 40}{80}$$

$$R_{12} = 130\,\Omega$$

$$R_{23} = 40 + 80 + \frac{80 \cdot 40}{60}$$

$$= 520/3\,\Omega$$

$$R_{31} = 60 + 80 + \frac{60 \cdot 80}{40}$$

$$= 260\,\Omega$$

in circuit

100 & 130 in Parallel

$$R_{eq(1)} = \frac{1300}{23}\,\Omega = 56.52$$

80 & 260 in Parallel

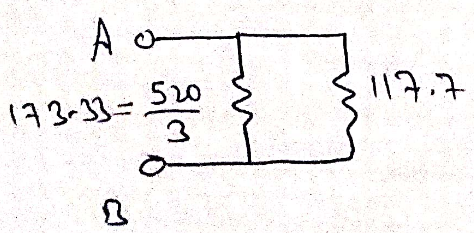
$$R_{eq(2)} = \frac{1040}{17}\,\Omega = 61.17\,\Omega$$

Now

$R_{eq(1)}$ & $R_{eq(2)}$ in series

$$R_{eq(3)} = 117.7\,\Omega$$

Hence eq. circuit is



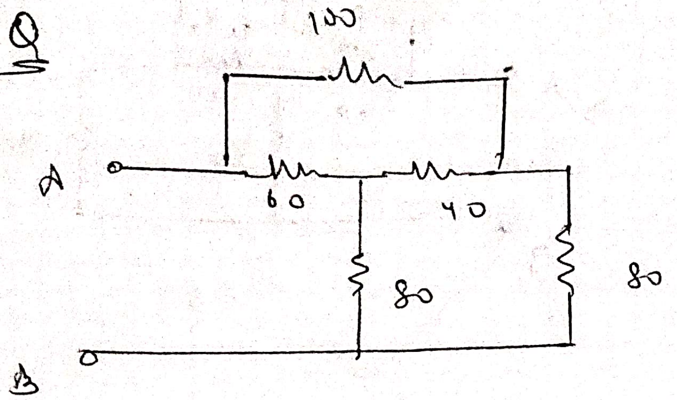
Now Req

$$R_{eq} = \frac{117.7 \times 173.33}{291}$$

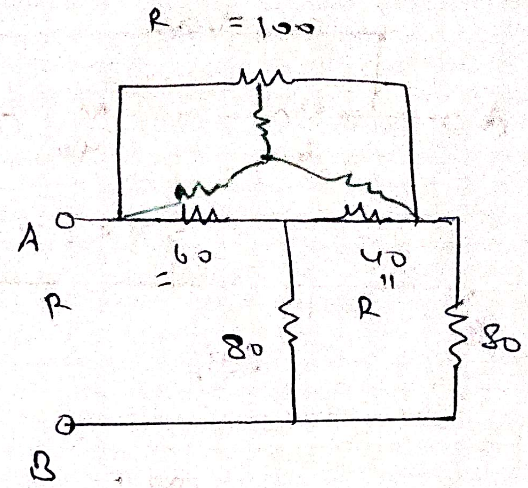
$$\boxed{R_{eq} = 70.09\,\Omega}$$ Ans

By another method

Q



⇒

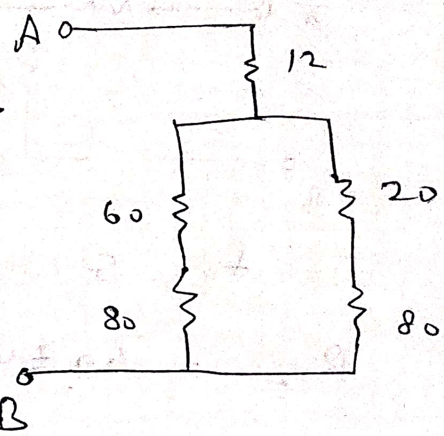


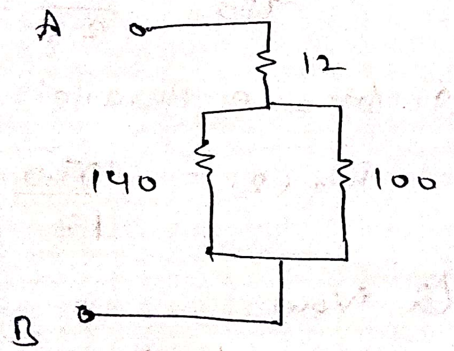
$$R_1 = \frac{R_{12} \cdot R_{31}}{\Sigma R} = \frac{60 \times 40}{200} = 12\ \Omega$$

$$R_2 = \frac{60 \cdot 100}{200} = 60\ \Omega$$

$$R_3 = \frac{40 \cdot 100}{200} = 20\ \Omega$$

⇒





$$R_{eq} = 12 + \frac{140 \times 100}{240}$$

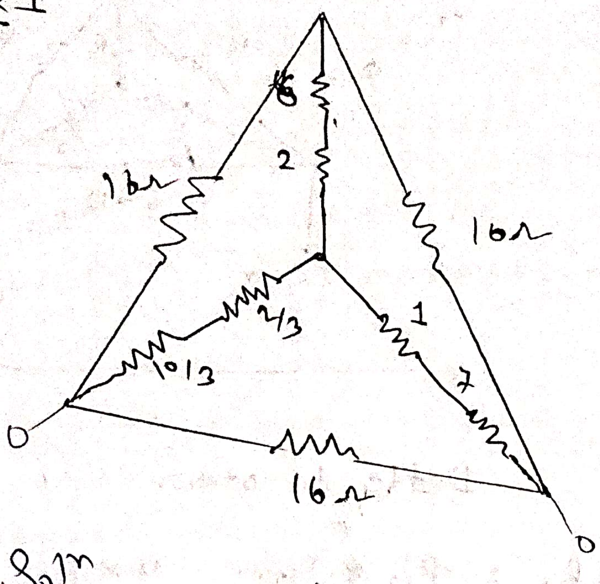
$$R_{eq} = 12 + 58.33$$

$$\boxed{R_{eq} = 70.33\ \Omega}$$

Answer

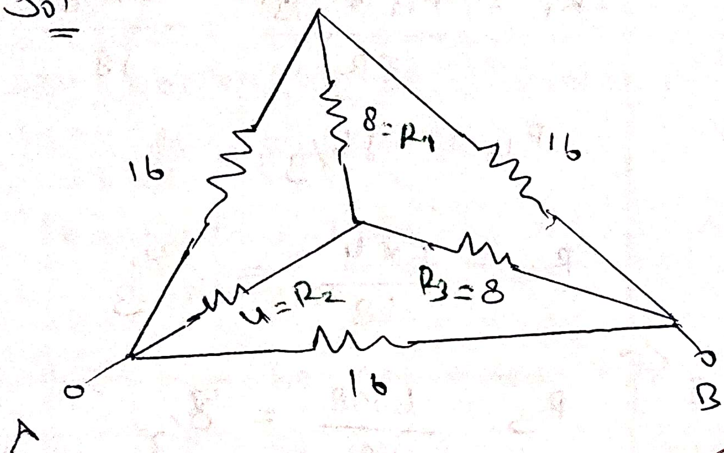
Assignment 2

Q 1

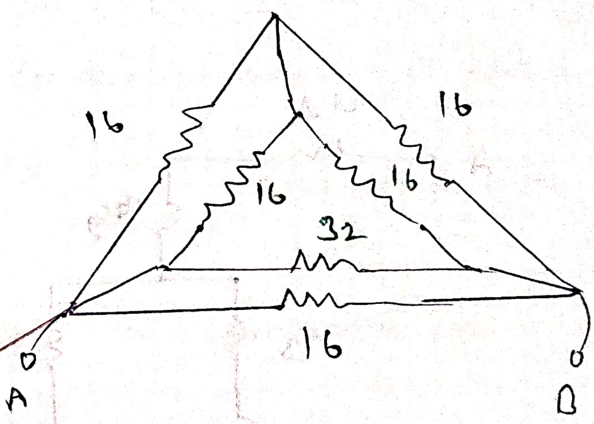


Find the eqa Resistance of the circuit using Star-delta formation.

Soln



Star to delta



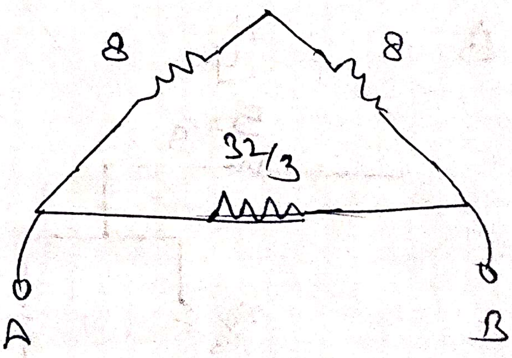
$$R_{12} = R_1 + R_2 + \frac{R_1 \cdot R_2}{R_3}$$

$$R_{12} = 8 + 4 + \frac{8 \cdot 4}{8} = 16\Omega$$

$$R_{23} = 8 + 4 + \frac{8 \cdot 4}{8} = 16\Omega$$

$$R_{31} = 8 + 8 + \frac{8 \cdot 8}{4} = 32\Omega$$

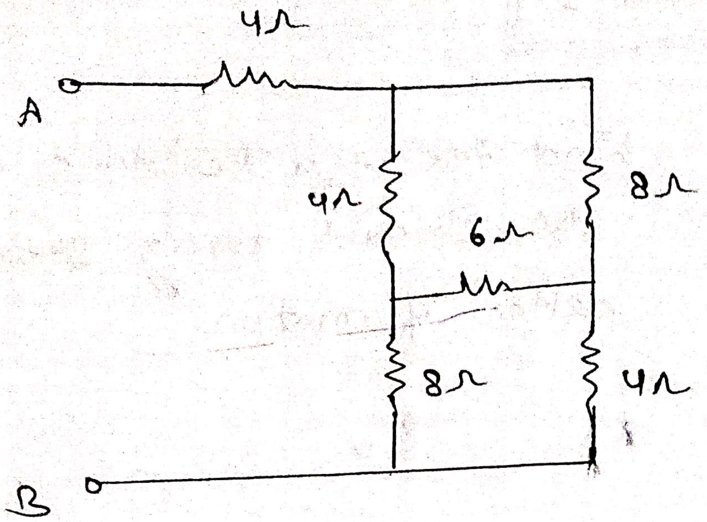
⇓

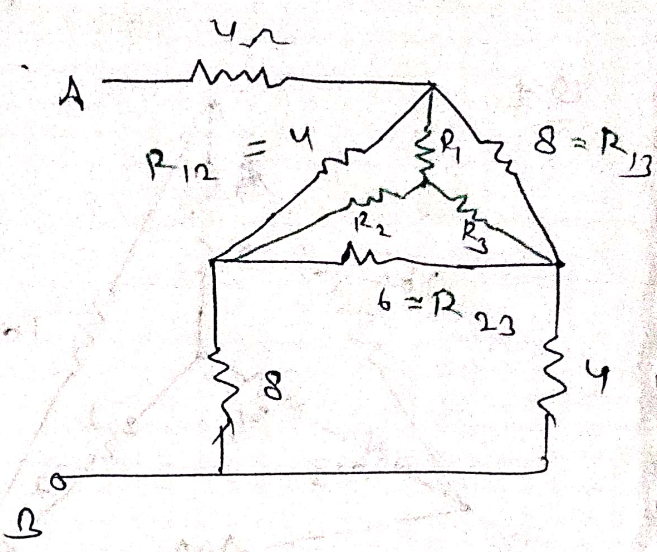


Now 16 & 32/3 in parallel

$$R_{eq} = \frac{16 \times 32/3}{16 + 32/3} = 32/5\ \Omega = 6.4\ \Omega$$

Q2





Determine the Req. btw A & B through star delta formation.

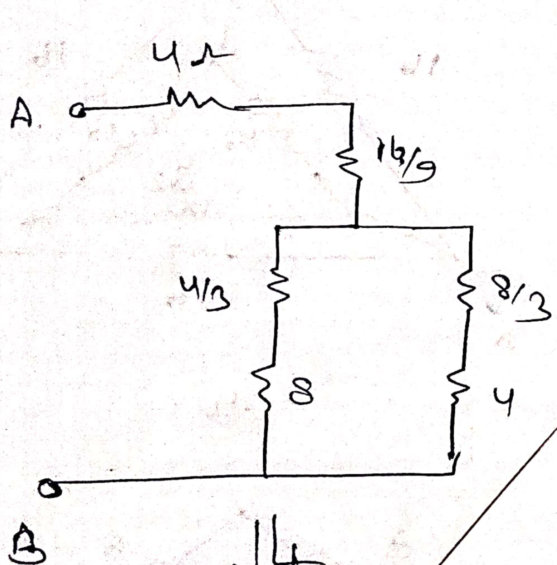
Delta to star

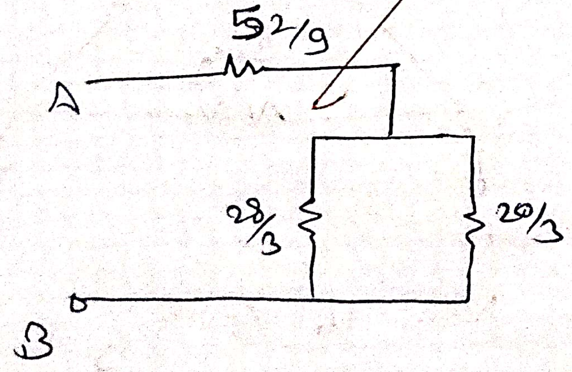
$$R_1 = \frac{R_{12} * R_{31}}{\Sigma R} = \frac{4 \times 8}{18}$$

$$R_1 = 16/9$$

$$R_2 = \frac{6 \times 4}{18} = 4/3$$

$$R_3 = \frac{6 \times 8}{18} = 8/3$$





$$Req = \frac{52}{9} + \frac{\frac{28}{3} \times \frac{20}{3}}{\cancel{\frac{48}{3}}\ 16}$$

$$Req = (52 + 35)\frac{1}{9}$$

$$Req = 87/9 = 9.67\ \Omega \text{ Ans}$$

* BEE *

(Basic electronics and Engineering)

Basic Terminology of BEE

- **Electrical energy :-**

Electrical energy is energy related to forces on electrically charged particles and the movement of those particles. This energy is supplied by the combination of current and voltage (electric potential difference)

- **Voltage :-**

Voltage is also known as potential difference, electric pressure or electric tension. voltage is the difference in electric potential between two points of a surface (Conductor).

- **Electric current :-**

Electric current refers to the flow of electrons in an electrical circuit. It is measured in Ampere.

There are two type of current

(i) Static (ii) Dynamic

DC AC

(i) **Direct current :-**

Direct current accurs when the current flows in one constant direction, D.C. normally comes from battries, solar panels. or A.C to D.C converters, D.C. is preffered type of power for all electronic & electrical devices. There is no frequences in D.C Power.

(ii) **Alternate current :-**

A.C. current accures when the electric current changes its direction, A.C. is preffered type of Power that is delivered to homes and business through transmission lines.

Resistor :-

A resistor represents a given amount of resistence in a circuit. Resistence is a property of resistor that oppose the flow of current. Resistence is measured by 'ohms' (Ω) by the ohm's law

$\because V = IR$

$\boxed{R = V/I}$ Symbole

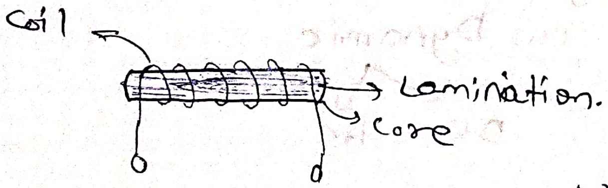
Ohm is represented by omega symbol. (Ω)

Capacitors :-

A capacitor is a device that is used to store charge in electric form. This property is known as capacitence of capacitor. The charge that is stored in capacitor is measured by Coulomb and the unit of capacitor is Farad. Symbol – or $\boxed{C = Q/V}$

Inductors :-

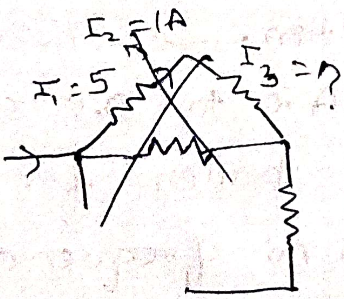
Inductor is a coil that is used to store charge in megnatic form. Inductors are used in electronic circuit to oppose the charge in electric current. Symbol – Unit → Henery.

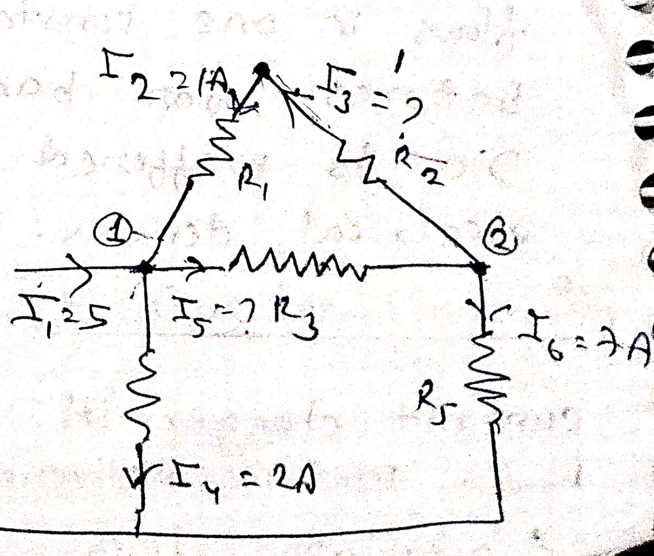


$\boxed{L = \frac{\phi}{I}}$

where ϕ = flux
L = inductance.

Q





node 1

$I_1 + I_2 = I_5 + I_4$

$5 + 1 = I_5 + 8$

$\boxed{I_5 = 8A}$ 8 $\boxed{I_5 = 4 Amp}$

$\cancel{I_2 = I_3 = 4A}$

Fundamentals

Current flow :-

Current flow basically means the flow of electric charges with respect to time.

In a electric circuit, when the electric charge is flowing in one direction, the current will flow in the opposite direction. The electric current flow starts from the negative terminal to the positive terminal of the battery, as the electron will flow from the positive terminal to the negative terminal.

From ohm's law, the expression for current is

$$\boxed{V = IR}$$

Here V is the voltage of the bettery, R is the resistence connected in the circuit, and I is the current flow in the circuit.

⇒ From ohm's law the current can be defined as the voltage through the circuit per unit resistence.

⇒ The unit of current is Ampere (A).

⇒ When the current flow through the circuit, it causes heating in that device; as a result, we can get light in an incandescent light bulb. The heating is known as "Joule heating"

Current is of two types:

- DC Current
- AC Current.

• DC Current :-

DC current which is created from a DC Voltage Source.

- **AC Current :-**

AC current which is created from AC Voltage source.

In an atom the number of neutrons and protons are same. Basically, an atom is electrically neutral. The electrons near the neucleus are strongly bounded and the outer electrons are loosely bounded. The loosely bounded electrons may be detached from the atoms. Now, when the external voltage applies, the loosely bounded electrons come out from the orbit and start drifting toward a direction according to the direction of the applied voltage and electric field. This causes a flow of current through the circuit.

x [Current flow basically means the flow of electric charges with respect to time. In an electric circuit when the electric charge is flowing in one direction, the current will flow in the opposite direction.] x

Q what causes current to flow?

Ans An electrical phenomenon is caused by flow of free electrons from one atom to another. The characteristics of current electricity are opposite to those of static electricity, wires ~~are~~ made up of conductors such as copper or aluminium... Current flow from (+) to (-)ive and e^- flows from (-)ive to (+)ve.

Why current flow from (-)ve to (+)ve...?

because the e^- always ~~atta~~ move towards the ~~(+)ve attractor~~, ~~curren~~ (+)ve attractor, the holes will tends to flow to the negative. Hole flow is usually called "conventional current". Flows from (+)ve to (-)ve, e^- flow goes in the reverse direction, from (-)ve to (+)ve Voltage

Q What is current; explain?

Current is a flow of electrical charge carriers, usually electrons or electrondeficient atoms.
Electric current can be either direct or alternating. Direct current (DC) flows in the same direction at all points in time, although the instantaneous magnitude of the current might vary.

Q What is current & voltage?

Current is the rate at which electric charge flows past a point in a circuit. In other words, Current is the rate of flow of charge.
Voltage, also called electromotive force is the potential difference in charge between two points in an electrical field.

Q What is current and its types?

There are two types of current : direct & Alternating.
In a direct current, abbreviated DC, the electrons move in one direction.
In a Alternation, abbreviated AC, the direction of current should ~~be~~ fluctuate.