Chapter-2

Voltage and Current

- Atom and their structure:

A atom has three parts. Electron, Proton and neutron. Electron carries negetive charge, proton carries positive charge and neutron is neutral.

- Voltage:

Voltage is the total work required to move a unit of charge between two points in a static electric field.

- hole $\longrightarrow$ is the absence of electron

- The negetive charge associated with a single electron is ~~called~~ $\longrightarrow$ $\boxed{1.6 \times 10^{-19} C}$

- $Q \longrightarrow W$ J

$1 \longrightarrow \frac{W}{Q}$ J

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

Current:

Normally,

Current is the flow of negetive charge

Applied machanism is $\boxed{\text{voltage}}$

result is $\boxed{\text{Current.}}$

in. t sec, thereis Flow q c

in 1 sec, " " $\frac{q}{t}$ q c

$$I = \frac{q}{t}$$

$$\Rightarrow q = It$$

1 volt: When 1 ~~joule~~ of work is done in carrying 1 coulomb of charge, from infinity to a point in the electric field, then the potenti at the point is called 1 volt.

1 amphere: If 1 coulomb of charge flows through a conductor in one second, the curre: flowing through the conductor is known as 1 amphere (1 A)

** The ~~ele~~ feature which has capability to flow electron is called voltage.

Voltage source is better.

There are two kinds of Bettery.

1. Primary (Non-rechargable)
2. Secondary (recharcable)

Conductor: Conductor are the materials or substances which allow electricity to flow through them.

Semiconductor: Semiconductor are the materials which have a conductivity between conductors and nonconductors or insulators.

Insulator: Insulator are the materials that hinder the free flow of electrons from one particle of the element to another.

Ammeter: Ammeter is a device used to measure either alternating or direct current

Voltmeter: A voltmeter is an instrument that measures the voltage or potential difference between two points of an electronic or electrical circuit.

Mathematical Term

2.1 Find the voltage between two points, if 60 J of energy are required to move a charge of 20C between the two points.

Solution: $W = VQ$

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

$$= \frac{60}{20}$$

$$= 3\,V$$

2.2 Determine the energy expended moving a charge of 50 μC between two points if the voltage between the points is 6V

Solution: $W = VQ$

$= 6 \, (50 \times 10^{-6})$

$= 300 \times 10^{-6} \, J$

$= 3 \times 10^{-4} \, J$

2.3 The charge flowing through the imaginary surface 0.16 C every 64 min. Determine the current in Amphere.

$$I = \frac{q}{t}$$

$$= \frac{0.16}{64 \times 610^{-3}}$$

$= 2.50 \, A$

2.4. Determine the long it will take 2×10^{16} electrons to pass through the imaginary surface if the current is 5 mA

$$I = \frac{q}{t}$$

$$t = \frac{q}{I} =$$

6.02×10^{23} e^- $\longrightarrow$ $1C$

1 e^- $\longrightarrow$ $\dfrac{1}{6.02 \times 10^{23}}$

4×10^{16} e^- $\longrightarrow$ $\dfrac{1 \times 4 \times 10^{16}}{6.02 \times 10^{23}}$

$= 6.41\ mC$

$$t = \frac{q}{I}$$

$$= \frac{6.41 \times 10^{-3}}{5 \times 10^{-3}}$$

$$= 1.28\ s$$

Chapter-3

Registor → রোধক

Registence → রোধ

Registivity → রোধকত্ব

Registor: A registor is an electrical component that limits or regulates the flow of electrical current in an electronic circuit

Resistance: Resistance is the opposition that a substance ~~offers~~ to the flow ~~electron~~ of electric current.

Resistivity: Resistivity is a property that describes the extent to which a material opposes the flow of electric current through it.

- The resistance of any material is due primarily to four factors:

  1. Material
  2. Length
  3. Cross-sectional area
  4. Temperature of the material.

$$R \propto \frac{l}{A}$$

- Types of resistor → Fixed
  → Variable

- Conductance: Conductance is defined as the ability of a substance to conduct electricity. Conductance is the inverse of resistance.

$$G = \frac{1}{R}$$

Unit → Simens

Chapter-4

Ohm's law, Power and Energy

Ohm's law: The voltage or potential difference between two points is directly proportional to the current or electricity passing through the resistance and directly proportional to the resistance of the circuit.

The formula for ohm's law $\boxed{V = IR}$

Easy to know:

Current (Effect) $\propto$ cause of voltage

Push → voltage

result → current

$$I \propto V$$

$$I = \frac{1}{R} V$$

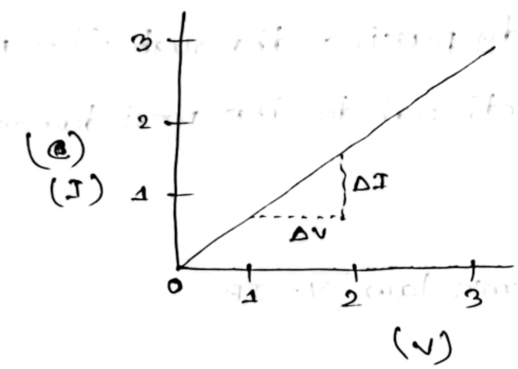
$$V = IR$$

যদি resister এর voltage হয়, তাহলে V

যদি supplying current (Vattery) এর voltage হয়, তাহলে E

Ploting ohm's law:

If we plot voltage on the x-axis of a graph and current on the y-axis of the graph, we will get a straight line.



Power (ক্ষমতা)

কাজ করার হার

Rate of doing work ⟶ Power ⟶ watt/HP

Ability of doing work ⟶ Energy ⟶ J

in t sec, work is done W J

" 1 " " " $\frac{W}{t}$ J

$P = Js^{-1}$

$Watt = Js^{-1}$

$$P = \frac{W}{t}$$

$$P = \frac{VQ}{t}$$

$$\Rightarrow \boxed{P = VI}$$

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

$$\boxed{P = \frac{V^2}{R}}$$

$$P = IR \times I$$

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

Efficiency:

useful power output devided by the total electrical power consumed is called efficiency

$$\eta = \frac{P_{out}}{P_{in}} \times 100\%$$

Mathematical term

4.1) Determine the current resulting from the application of a 9V battery across a network with a resistance of 2.2 Ω

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

$$= \frac{9}{2.2}$$

$$= 4.09\ A$$

4.2) Calculate the resistance of a 60W bulb if a current of 500 mA results from a applied voltage of 120 V

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

$$= \frac{120}{500 \times 10^{-3}}$$

$$= 240\ \Omega$$

4.3) Calculate the current through the 2kΩ resistor, if the voltage drop across it is 16V

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

$$= \frac{16\ V}{2 \times 10^{3}\ \Omega} = 8\ mA$$

4.6) Find the power delivered to the dc motor

Voltage 120V, Current 5A

$$P = VI$$
$$= 120 \times 5$$
$$= 600\ W$$
$$= 0.6\ kW$$

4.7) What is the power dissipated by a 5Ω resistor if the current is 4A ?

$$P = I^2R$$
$$= 4^2 \times 5$$
$$= 80\ W$$

4.16) What is the output in horsepower of a motor with an efficiency of 80% and an input current of 8A at 120 V ?

$$\eta\% = \frac{P_o}{P_i} \times 100$$

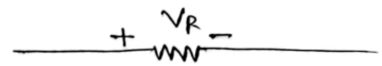
$$\Rightarrow 0.8 = \frac{P_o}{120 \times 8}$$

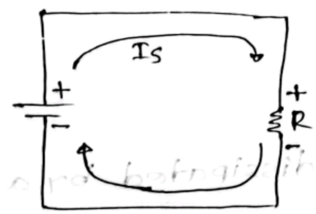
$$\Rightarrow P_o = 768\ W$$

or 1.03 hp.

Chapter-5

Series DC circuit



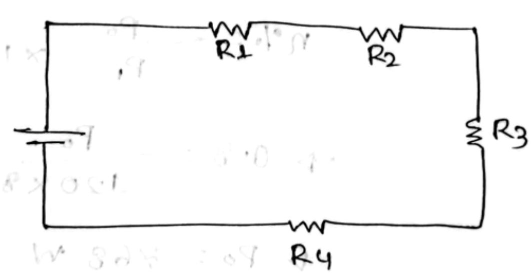


I_S = Supplied Current

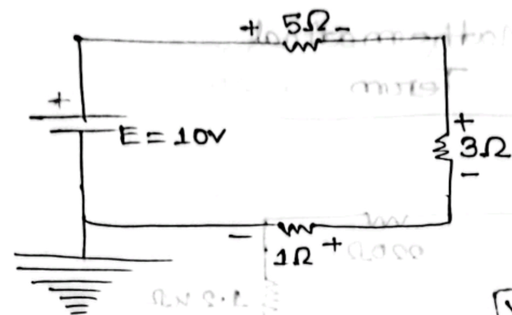
100% **Circuit:** In electronics, a circuit is a complete circular path that electricity flows through.

A simple circuit consists of a current source, conductors and a load.

Series resistors:



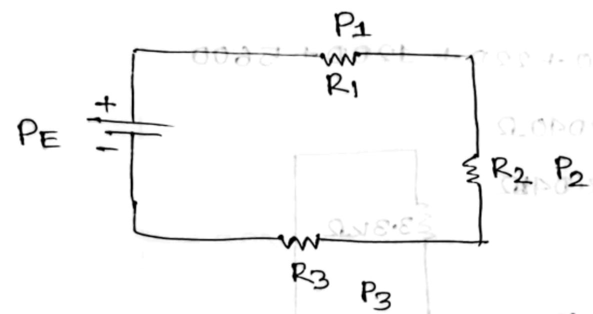
There is one pathway to flow current.



$\boxed{V_1 = I_1 R_1}$

$\boxed{V_2 = I_2 R_2}$

Power distribution in series circuit:

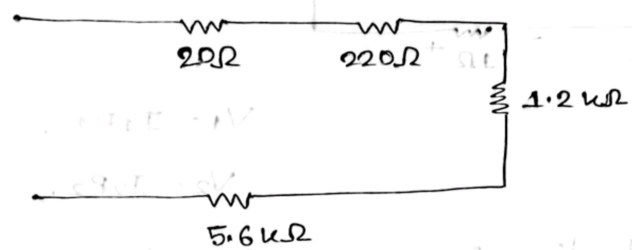


$$\boxed{P_E = P_1 + P_2 + P_3}$$

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

Mathematical Term

5.1)



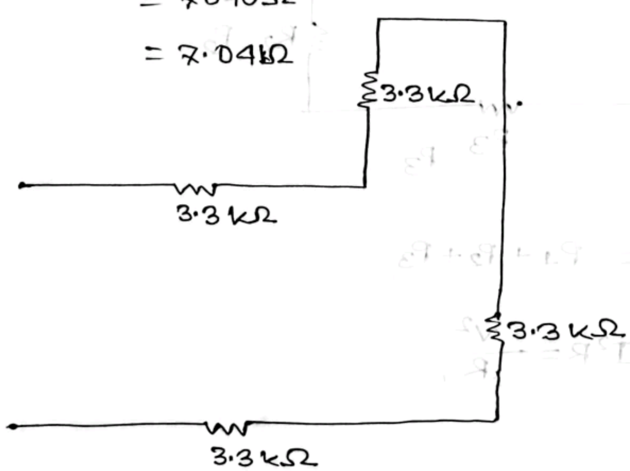
Totall resistance?

$RT = 20 + 220 + 1200 + 5600$

$= 7040\,\Omega$

$= 7.04\,k\Omega$

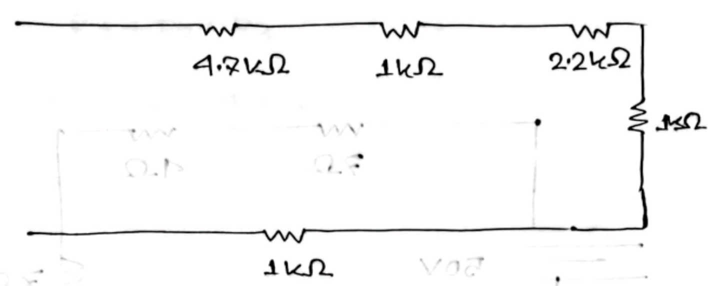
5.2)



$RT = 4 \times 3.3\,k\Omega$

$= 13.2\,k\Omega$

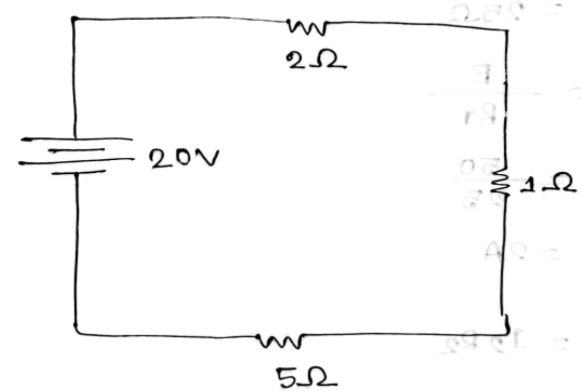
5.3)



$$R_T = 4.7 + 1 + 2.2 + 1 + 1 \ k\Omega$$

$$= 9.9 \ k\Omega$$

5.4)



a) Totall Resistance $R_T = 2 + 1 + 5 \ \Omega = 8 \Omega$

b) $I_S = \frac{E}{R_T}$

$= \frac{20}{8}$

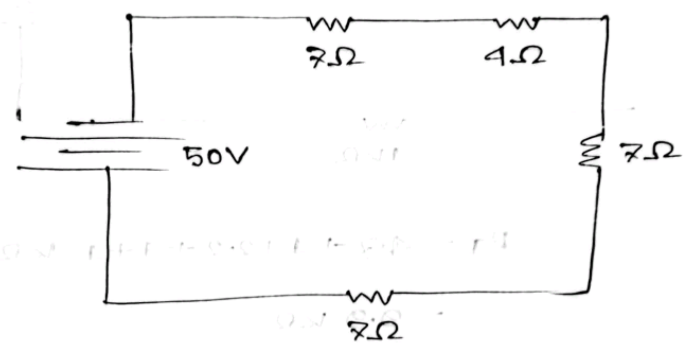
$= 2.5 \ A$

c) $V_1 = I_1 R_1 = I_S \times 2 = 2.5 \times 2 = 5 \ V$

$V_2 = I_S \times 1 = 2.5 \times 1 = 2.5 \ V$

$V_3 = I_S \times 5 = 2.5 \times 5 = 12.5 \ V$

5.5)



a) $R_T = 7+4+7+7$

$= 25\Omega$

b) $I_S = \frac{E}{R_T}$

$= \frac{50}{25}$

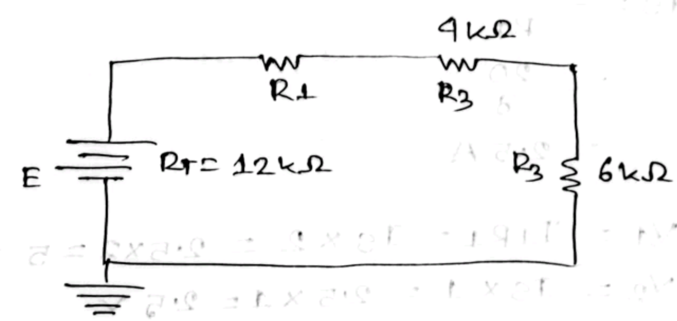
$= 2A$

c) $V_2 = I_2 R_2$

$= 2 \times 4\Omega$

$= 8V$

5.6)



*

$R_T = R_1 + R_2 + R_3$

$\Rightarrow 12\cancel{00} = R_1 + 4 + 6$

$\Rightarrow R_1 = 2\ k\Omega$

*

$E = I_s R_T$

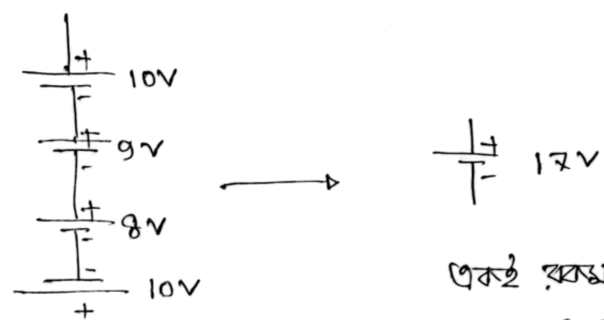
$= 6 \times 10^{-3} \times 12000$

$= 6 \times 10^{-3} \times 12 \times 10^{3}$

$= 72\ V$

5.5

Voltage sources in Series:



একই রকম
পোলারিটি থাকলে,
তখন যোগ করবে

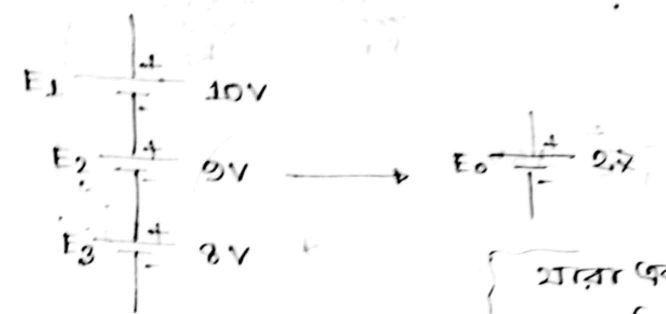
Kirchhoffs voltage law:

The voltage arround a loop equals the sum of every voltage drop in the same loop for any closed network, and equals zero.

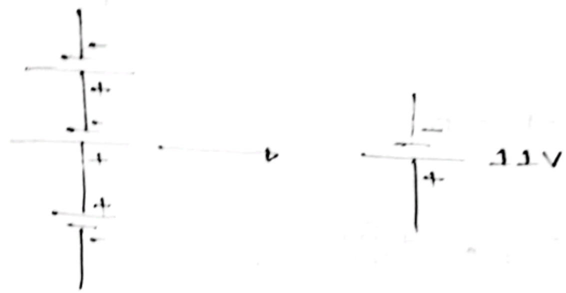
Kirchhoff's current law:

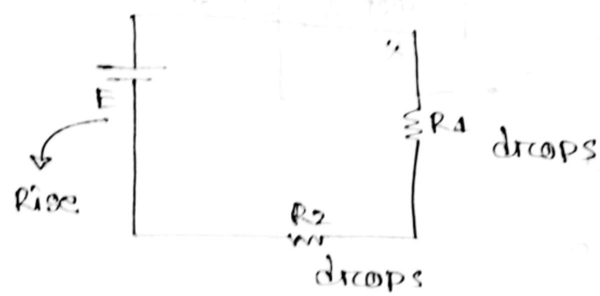
The algebric sum of all currents entering and exiting a node must equal zero.

Voltage source in Series:



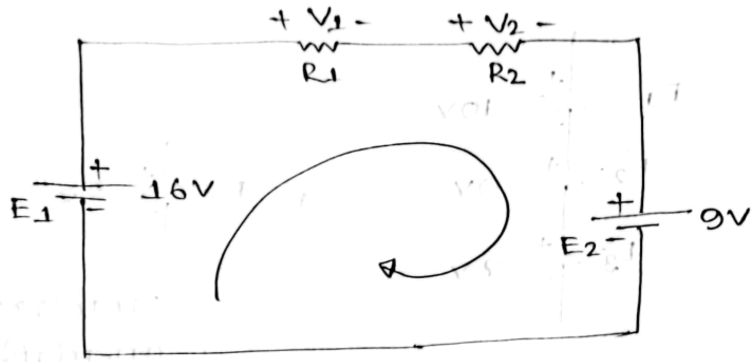
যারা একই রকম পোলারিটি, তাদের যোগ করবো।





$\sum$ Rise = $\sum$ drops

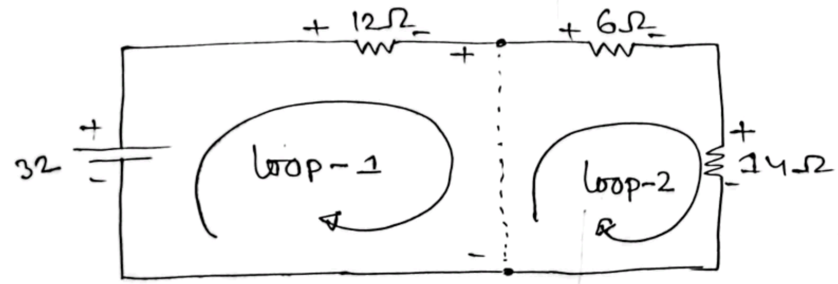
$\sum$ Rise = $\sum$ drops



$-$ to $+ \longrightarrow +$

$+$ to $- \longrightarrow -$

$$+E_1 - R_1 - R_2 - E_2 = 0$$



Applying KVL loop-1:

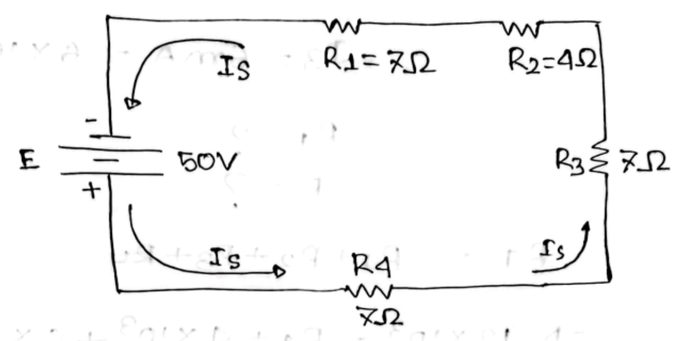
$$+32 - 12 - V_x = 0$$

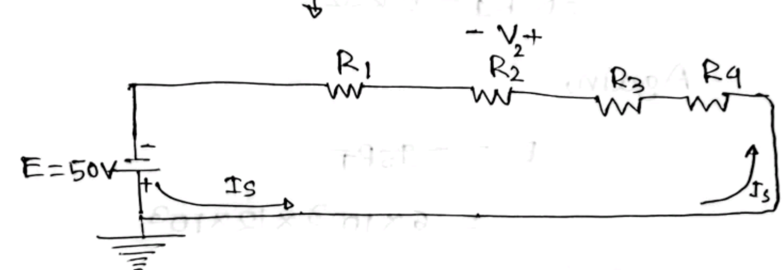
$$\Rightarrow V_x = 20\,V$$

Chapter 5

5.5

b)





The current now has a anticlockwise direction as shown in Figure ∴

$$I_S = \frac{E}{R_T} = \frac{50}{25} = 2A$$

∴ The totall current of Is is 2A

c)

$V_2 = IR_2$

~~$R_2 = \frac{V_2}{I_S}$~~

$= (2A)(4\Omega)$

$= 8V$

∴ The voltage across R_2 is 8V

5.6

Given that,

$R_T = 12\,k\Omega$

$= 12000\,\Omega$

$I_3 = 6\,mA = 6 \times 10^{-3}\,A$

$R_1 = ?$

$E = ?$

$R_T = R_1 + R_2 + R_3 + \cancel{R_4}$

$\Rightarrow 12 \times 10^3 = R_1 + 4 \times 10^3 + 6 \times 10^3$

$\Rightarrow R_1 = 2\,k\Omega$

Again,

$E = \cancel{I_S R_T}$

$= 6 \times 10^{-3} \times 12 \times 10^3$

$= \cancel{12V}\ 72V$

$\therefore R_1 = 2\,k\Omega$

$E = 72V$

5.7

a) Given that,

$R_1 = 1\,k\Omega$

$R_2 = 3\,k\Omega$

$R_3 = 2\,k\Omega$

$R_T = ?$

$$R_T = R_1 + R_2 + R_3$$
$$= 1\,k\Omega + 3\,k\Omega + 2\,k\Omega$$
$$= 5\,k\Omega$$

b) From a, we got $R_T = 5\,k\Omega$

$$I_S = \frac{E}{R_T}$$
$$= \frac{36}{5 \times 10^3}$$
$$= 6\,mA$$

c) From a, we got $R_T = 5\,k\Omega$

From b, we got $I_S = 6\,mA$

$$V_1 = IR_1$$
$$= 6 \times 10^{-3} \times 1 \times 10^3\ V$$
$$= 6\,V$$

$V_2 =$

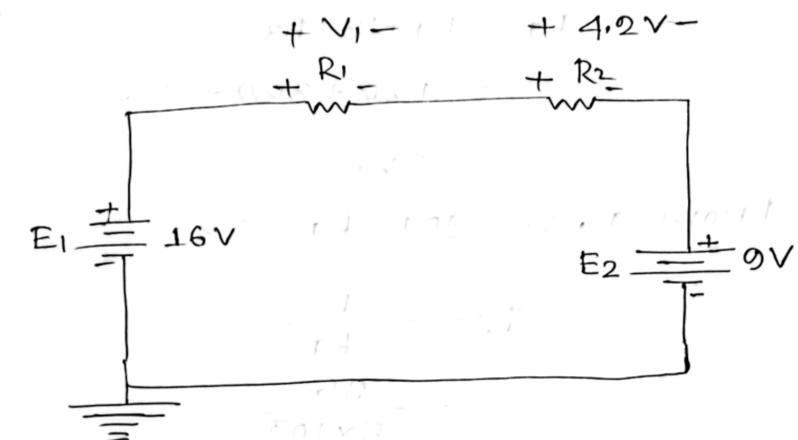
d) $P = E I_S$

$= 36 \times 6 \times 10^{-3}$ W

$= 216$ mW

e) $P_1 = I^2 R$

5.8

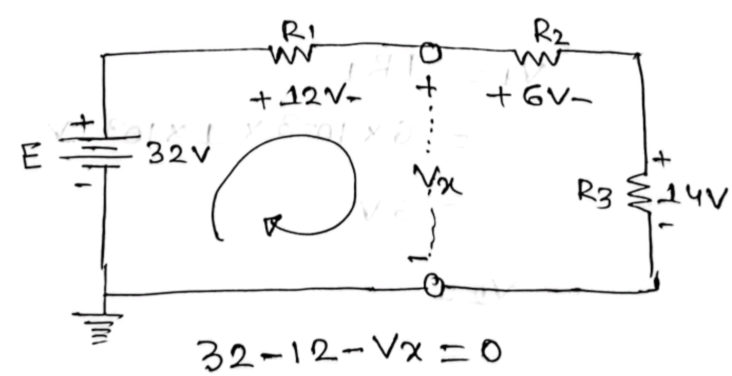


~~Fe~~ Applying KVL,

$16V - V_1 - 4.2 - 9 = 0$

$\Rightarrow V_1 = 2.8$ V

5.9



$32 - 12 - V_x = 0$

$\Rightarrow V_x = 20$ V

Home Work

7.3

Given that,

$R_A = R_1 = 4\Omega$

$R_2 = 4\Omega$

$R_3 = 4\Omega$

$\therefore R_B = R_2 \parallel R_3$

$= \frac{4 \times 4}{8}$

$= 2\Omega$

$R_4 = 0.5\Omega$

$R_5 = 1.5\Omega$

$\therefore R_C = 0.5 + 1.5$

$= 2\Omega$

$\cancel{\therefore R_C = R_3 \parallel R_4}$

$\cancel{= \frac{0.5 \times 1.5}{0.5 + 1.5}}$

$\cancel{= \frac{\;}{2}}$

$R_T = 4\Omega + R_B \parallel R_C$

$= 4\Omega + \frac{2 \times 2}{4}$

$= 5\Omega$

$\therefore I_s = \frac{10}{5}$

$= 2A$

$\therefore\ I_A = I_S = 2A$

and $I_B = I_C = \frac{I_A}{2} = \frac{2A}{2} = 1A$

Now,

voltage $V_A = I_A R_A$

$= 2 \times 4$

$= 8\,V$

$V_B = I_B R_B$

$= 1 \times 2$

$= 2\,V$

$V_C = V_B = 2V$

7.4:

Given that,

$R_1 = 9\Omega$

$R_2 = 6\Omega$

$\therefore\ R_A = R_1 \parallel R_2$

$= \frac{9 \times 6}{15} = \frac{\cancel{30}\ 54}{15} = \cancel{2\Omega}\ 3.6\Omega$

$R_3 = 4\Omega$

$R_4 = 6\Omega$

$R_5 = 3\Omega$

$\therefore\ R_B = 4 + \frac{6 \times 3}{9}$

$= 6\Omega$

$R_C = 3\Omega$

$\therefore\ \cancel{R_T = 2\Omega + 6\Omega + 3\Omega}$

$\cancel{= 11\Omega}$

$$\therefore R_T = 3.6\Omega + \frac{6 \times 3}{9}$$

$$= 5.6\Omega$$

$$\therefore I_S = \frac{16.8}{5.6}$$

$$= 3A$$

$$\therefore I_A = I_S = 3A$$

$$I_B = \cancel{\frac{16.8}{6\Omega}} \quad \frac{R_C I_A}{R_C + R_B}$$

$$= \frac{(3\Omega)(3A)}{6\Omega + 3\Omega} = \frac{9A}{9} = 1A$$

By KCL,

$$I_C = I_A - I_B$$

$$= 3A - 1A$$

$$= 2A$$

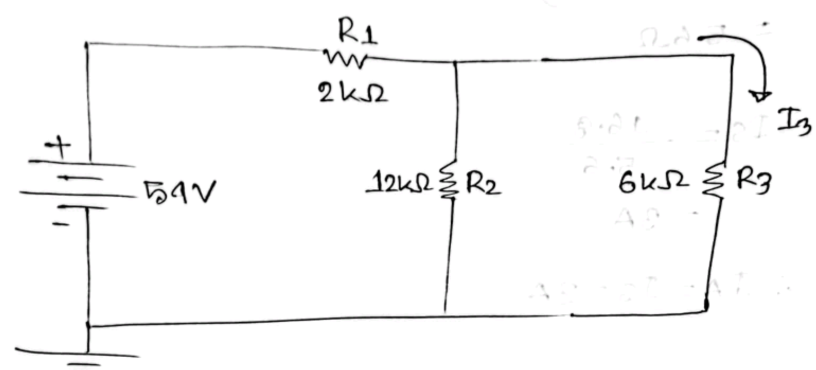
By ohm's law,

$$V_A = I_A R_A = (3A)(3.6\Omega) = 10.8V$$

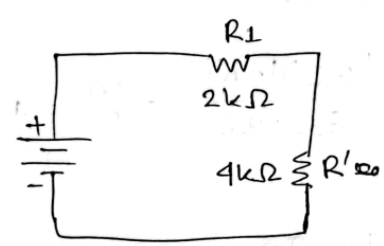
$$V_B = I_B R_B = V_C = I_C R_C = (2A)(3\Omega)$$

$$= \underline{\underline{6V}}$$

7.1



$I_3 = ?$



$$R' = \frac{R_2 R_3}{R_2 + R_3} = \frac{12 \times 6}{12+6} = \frac{72}{18} = 4\,k\Omega$$

$$R'' = R_1 + R' = 2 + 4 = 6\,k\Omega$$

$$I_S = \frac{54}{6\,k\Omega} = 9\,mA$$

Since R_1 and R' are in series, they have the same current I_S.

The result is $I_1 = I_S = 9\,mA$

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

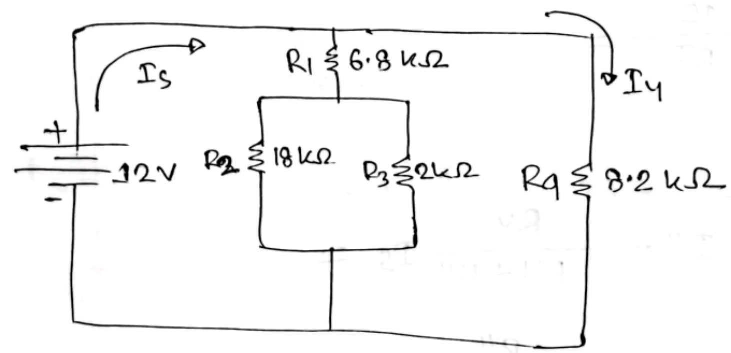
$$= \left(\frac{12\,k\Omega}{12\,k\Omega + 6\,k\Omega}\right) \times 9\,mA$$

$$= \frac{12}{\cancel{18}_{2} \times 1000} \times \cancel{9}$$

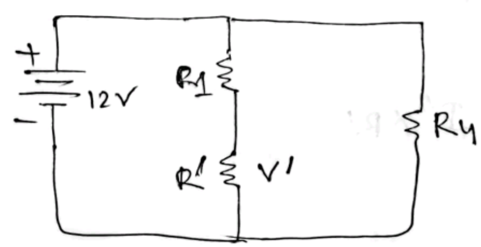
$$= 6 \times 10^{-3}$$

$$= 6\,mA$$

7.2



F. 7.5



Fg 1

$$R' = \frac{18 \times 2}{18+2}$$

$$= \frac{36}{20}$$

$$= 1.8\,k\Omega$$

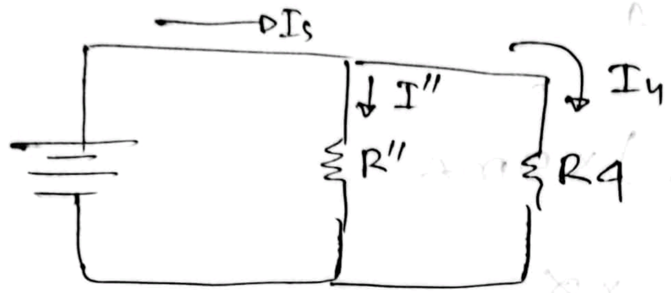


Fig 2

$$R'' = R1 + R'$$

$$=$$

$$R_T = \frac{R'' \times R4}{R'' + R4}$$

$$=$$

$$I_s = \frac{12}{R_T} =$$

From Fig-2

$$I'' = \frac{R4}{R4 + R''} I_s =$$

$$I_4 = \frac{R''}{R4 + R''} I_s =$$

From Fig-01,

$$V_2 = I'' \times R'$$

$$=$$

7·3 : Determine all the current and Voltage.

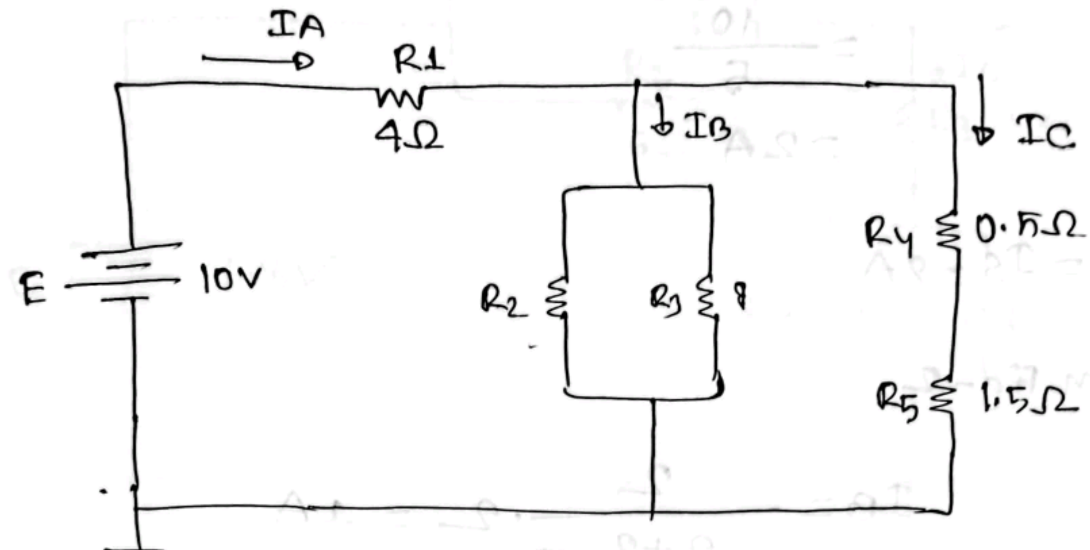


Fig-01

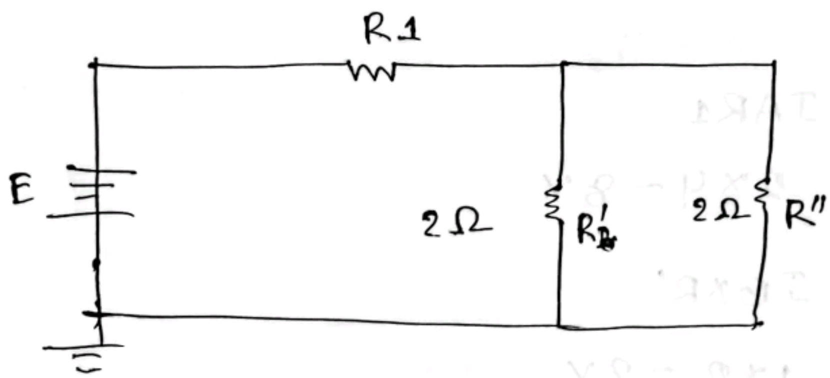


Fig-02

$$R' = \frac{R_2 \times R_3}{R_2 + R_3}$$

$$= \frac{4 \times 4}{8} = 2\Omega$$

$$R'' = 0.5\Omega + 1.5\Omega = 2\Omega$$

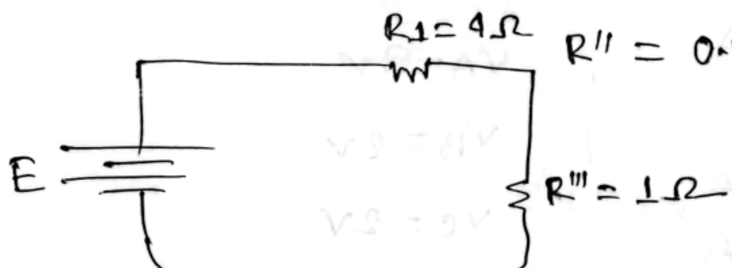


Fig-03

$$R''' = \frac{2 \times 2}{4}$$

$$= 1\Omega$$

$\therefore R_T = 5\Omega$

$$\therefore I_T = \frac{E}{R_T}$$

$$= \frac{10}{5}$$

$$= 2A$$

(i)

$I_A = I_S = 2A$

(ii) From Fig-2,

$$I_B = \frac{2}{2+2} \cdot 2 = 1A$$

$$I_C = \frac{2}{2+2} \cdot 2 = 1A$$

Now,

$$V_A = I_A R_1$$

$$= 2 \times 4 = 8V$$

$$V_B = I_B \times R'$$

$$= 1 \times 2 = 2V$$

$$V_C = I_C \times R'''$$

$$= 1 \times 2 = 2V$$

So,

$I_S = 2A$	$V_A = 8V$
$I_A = 2A$	$V_B = 2V$
$I_B = 1A$	$V_C = 2V$
$I_C = 1A$	

7.4

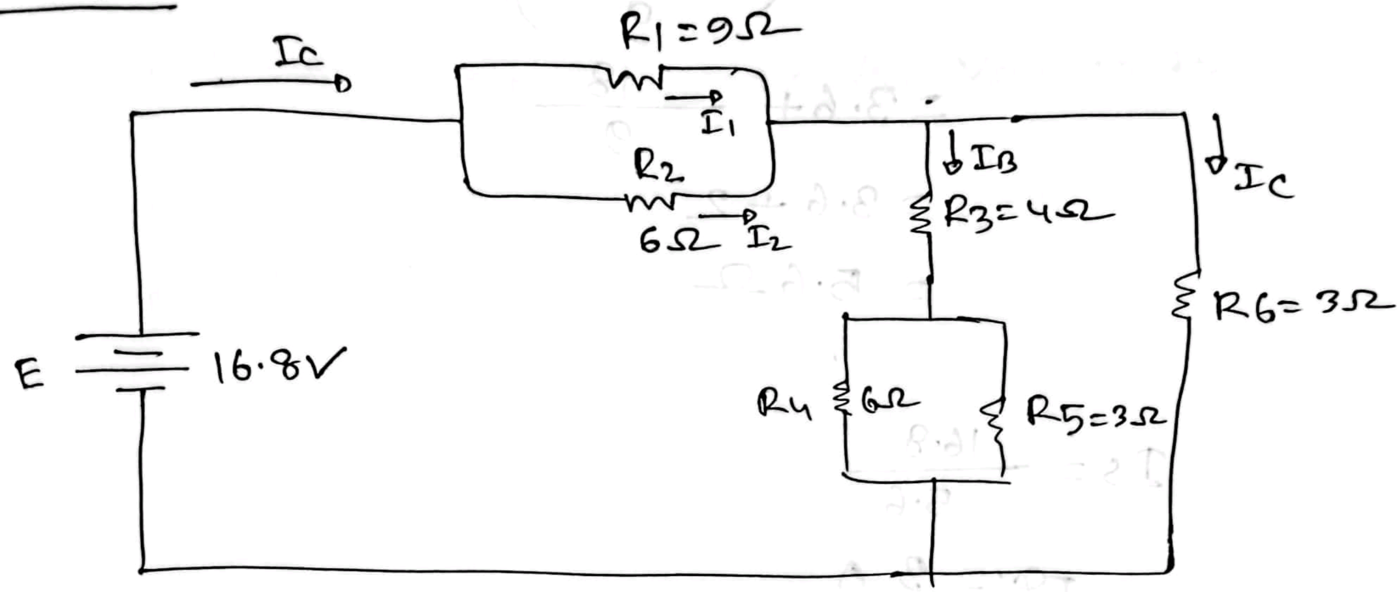


Fig-01

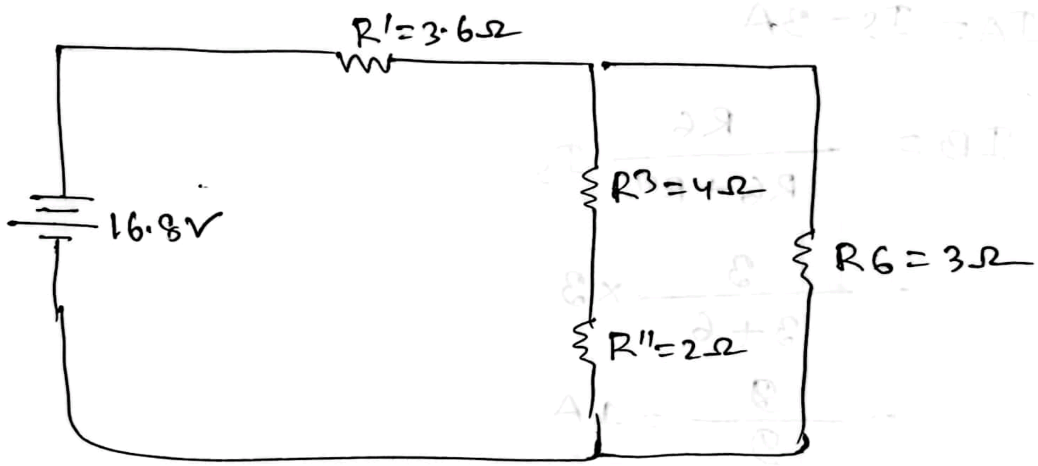
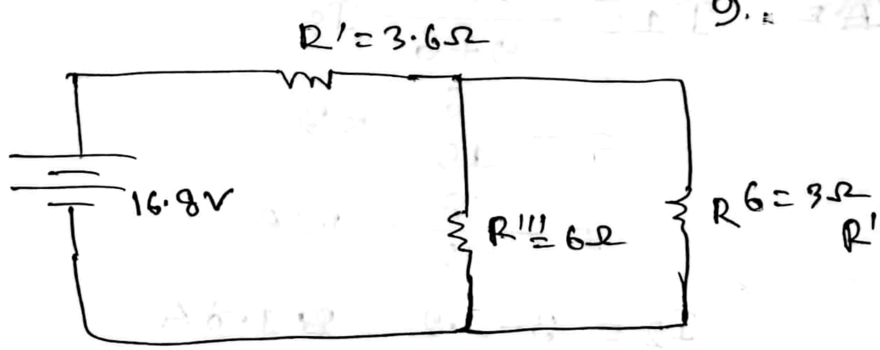


Fig-02

$$R' = \frac{9 \times 6}{15} = \frac{54}{15} = 3.6\Omega$$

$$R'' = \frac{18}{9} = 2\Omega$$



$$R''' = R3 + R''$$
$$= 4 + 2$$
$$= 6\Omega$$

$$RT = R' + (R''' \parallel R6)$$

$$RT = 3.6 + \left(\frac{3 \times 6}{9}\right)$$
$$= 3.6 + \frac{18}{9}$$
$$= 3.6 + 2$$
$$= 5.6\,\Omega$$

$$I_S = \frac{16.8}{5.6}$$
$$I_S = 3\ A$$

$$\therefore\ I_A = I_S = 3A$$

$$I_B = \frac{R_6}{R_6 + R'''}\, I_S$$
$$= \frac{3}{3+6} \times 3$$
$$= \frac{9}{9} = 1A$$

$$I_C = I_S - I_B = 3 - 1 = 2A$$

$$I_1 = \frac{6}{9+6}\, I_S$$
$$= \frac{6}{15} \times 3$$
$$= \frac{18}{15} = 1.2\,A$$

$$I_2 = 3 - 1.2 = 1.8\,A$$

$V_A = I_A R'$

$= 3 \times 3.6 = 10.8\,V$

$V_1 = V_2 = V_A = 10.8\,V$

$V_B = I_B \times R'''$

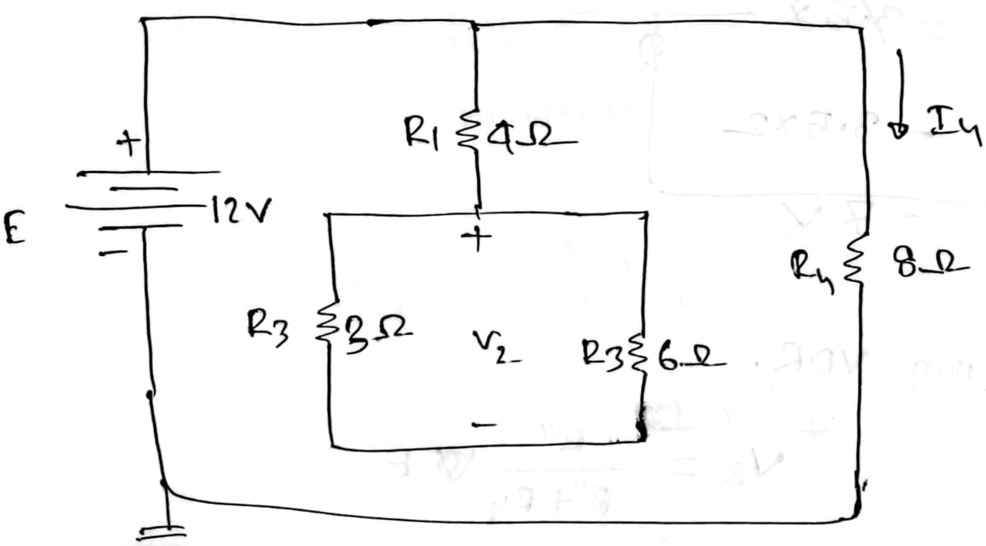
$= 1 \times 6\,V$

$V_C = I_C \times R_6$

$= 2 \times 3$

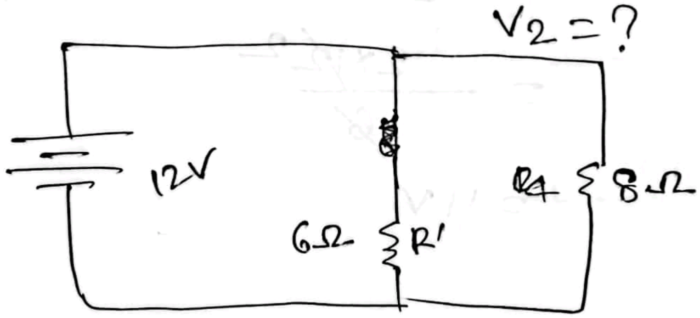
$= 6\,V$

7.5



$I_4 = ?$

$V_2 = ?$



$R' = R_4 + \left(\frac{6 \times 3}{9}\right)$

$= 4 + \frac{18}{9}$

$= 6\,\Omega$

$$R_T = \frac{6 \times 8}{8+6} = \frac{48}{14} = 3.4$$

$$I_S = \frac{12}{3.4} = 3.5$$

$$I_4 = \frac{6}{6+8} \cdot 3.5$$

$$= 1.5A$$

$$V_2 = I_S \times R''$$

$$= \cancel{3.5 \times 3.4}$$

$$= \cancel{11.9}$$

$$= 3.5 \times \frac{3 \times 6}{9}$$

$$= 3.5 \times 2$$

$$= 7V$$

Applying VDR,

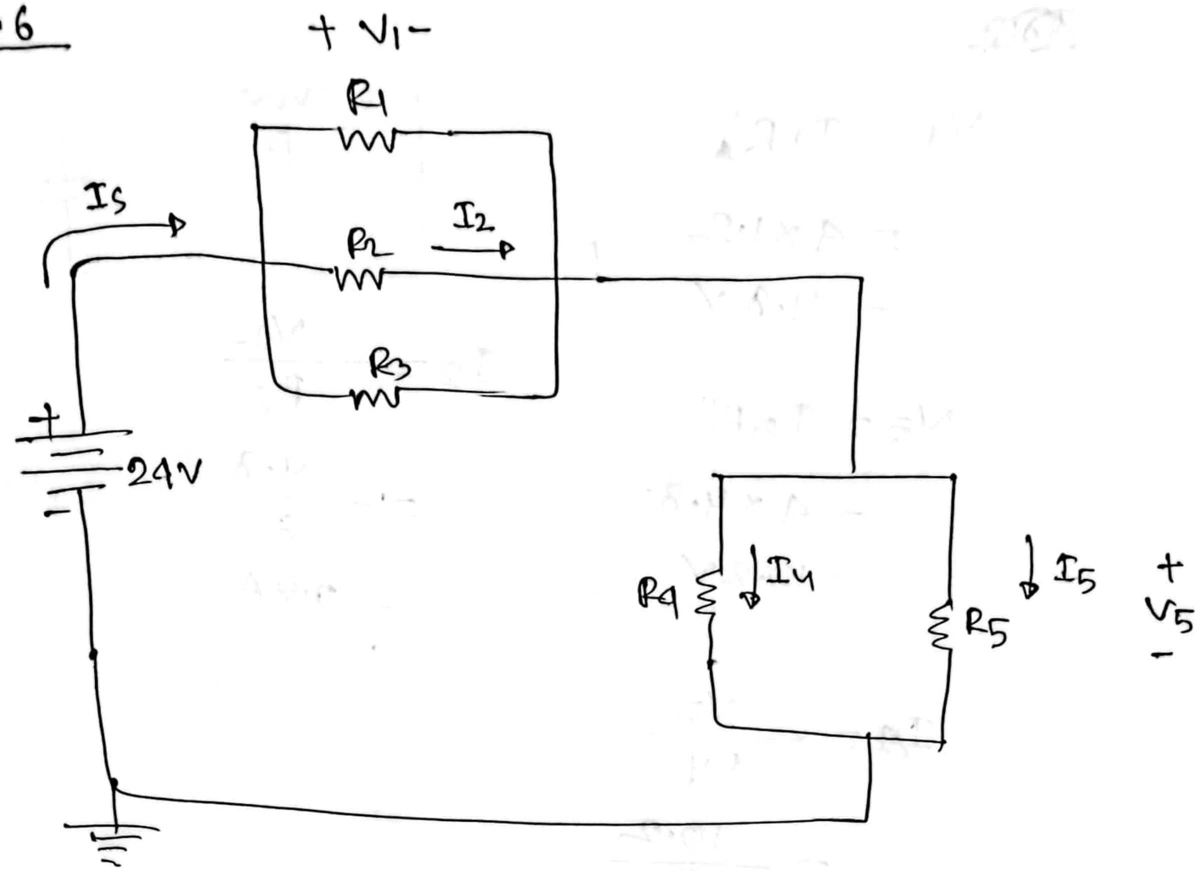
$$V_2 = \frac{R''}{R''+R_4} E$$

$$= \frac{2}{2+4} \times 12$$

$$= \frac{2 \times \cancel{12}^{2}}{\cancel{6}}$$

$$= 4V$$

7.6



Find the indicated current and Voltage for the networks.

$$R_T = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right)^{-1} + \frac{R_4 \times R_5}{R_4 + R_5}$$

$$= \left(\frac{1}{6} + \frac{1}{6} + \frac{1}{2}\right)^{-1} + \frac{96}{20}$$

$6 \,\overline{)\, 6,6,2}$
$\quad 1,1,2$

$$= \left(\frac{2+2+6}{12}\right)^{-1} + \frac{96}{20}$$

$$= \left(\frac{10}{12}\right)^{-1} + \frac{96}{20}$$

$$= \frac{12}{1.0} + \frac{96}{20}$$

$$= 6\Omega$$

$$I_s = \frac{24}{6}$$

$$= 4A.$$

20[illegible]

$V_1 = I_1 R'_1$

$= 4 \times 1.2$

$= 4.8\ V$

$V_5 = I_5 R''$

$= 4 \times 4.8$

$= 19.2\ V$

$I_2 = \dfrac{V_2}{R_2}$

$= \dfrac{4.8}{6}$

$= 0.8\ A$

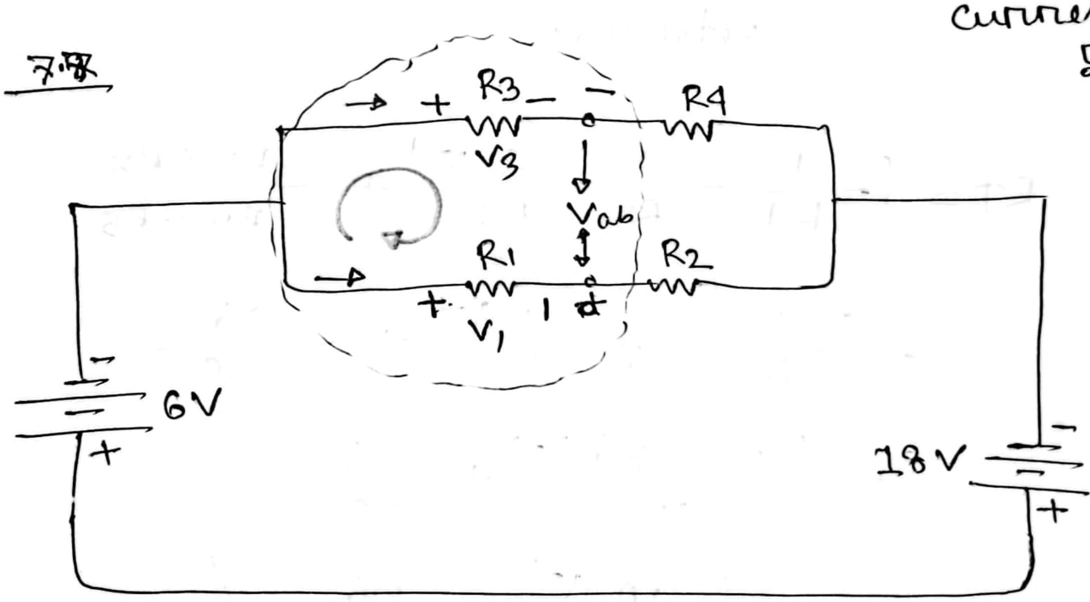
$I_4 = \dfrac{V_5}{R_4}$

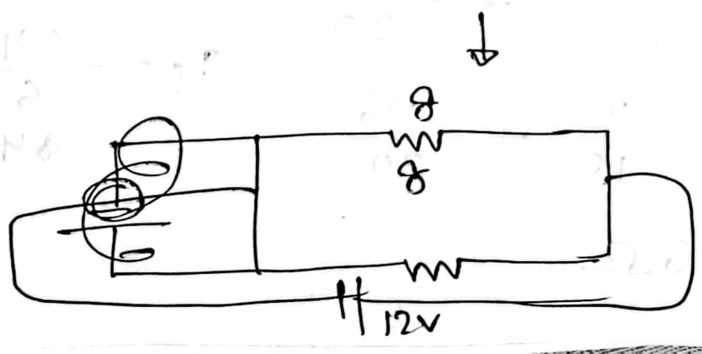
$= \dfrac{19.2}{8}$

$= 2.4\ A$

current যেদিকে ঢুকে, সেদিকে প্রথম

7.[illegible]



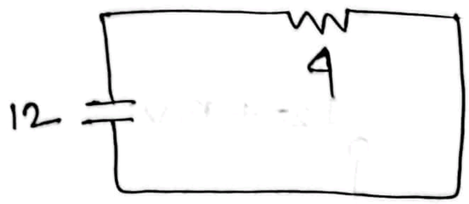


$V_1 = ?$

$V_3 = ?$

$V_{ab} = ?$

$I_5 = ?$



$$V_1 = \frac{R_1}{R_1+R_2} E = \frac{5}{5+3} \times 12 = 7.5V$$

$$V_3 = \frac{R_3}{R_3+R_4} E = \frac{6}{6+2} \times 12 = 9V$$

$$I_s = \frac{E}{R}$$

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

$$= 3A$$

Applying KVL,

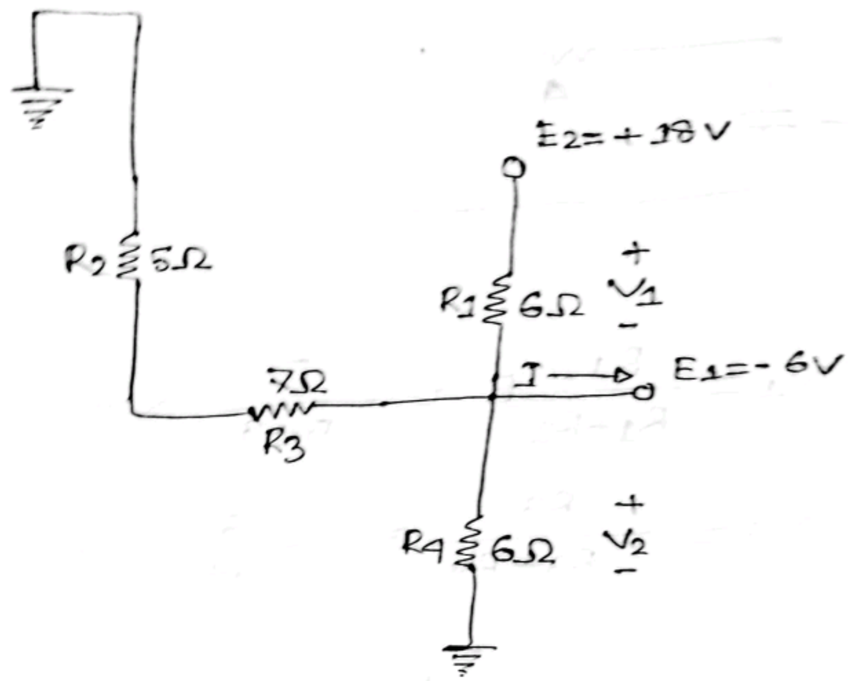
$$\cancel{-V_3 + V_{ab} + V_1}$$

$$-V_3 + V_{ab} + V_1 = 0$$

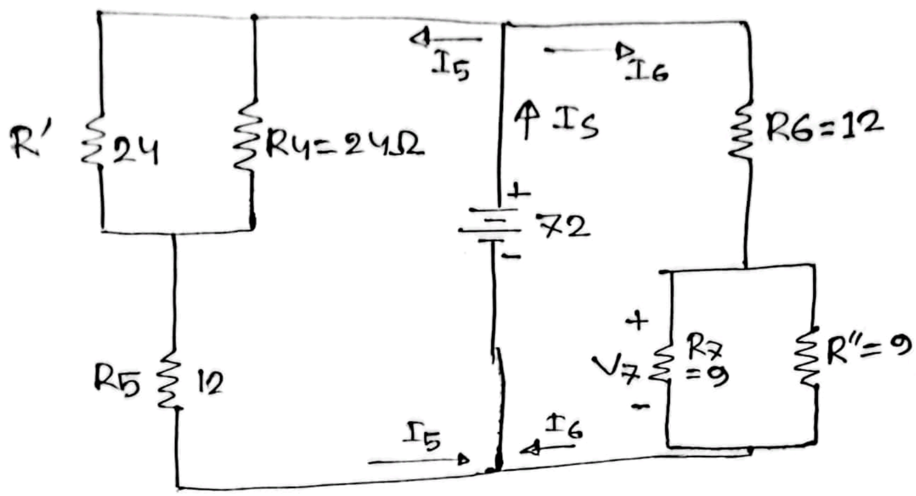
$$\Rightarrow -9 + V_{ab} + 7.5 = 0$$

$$\Rightarrow V_{ab} = 1.5$$

7.8



7.10



$$I_5 = \frac{E}{(R' \parallel R_4) + R_5}$$

$$= \frac{72}{\frac{24 \times 24}{24+24} + 12}$$

$$= 3\,mA$$

$$V_7 = \frac{R_7 \parallel R''}{R_7 \parallel R'' + R_6} E$$

$$= \frac{(4.5\,k\Omega)(72V)}{4.5\,k\Omega + 12\,k\Omega}$$

$$= \frac{324V}{16.5}$$

$$= 19.6\,V$$

$$I_6 = \frac{V_7}{R_7 \parallel R''}$$

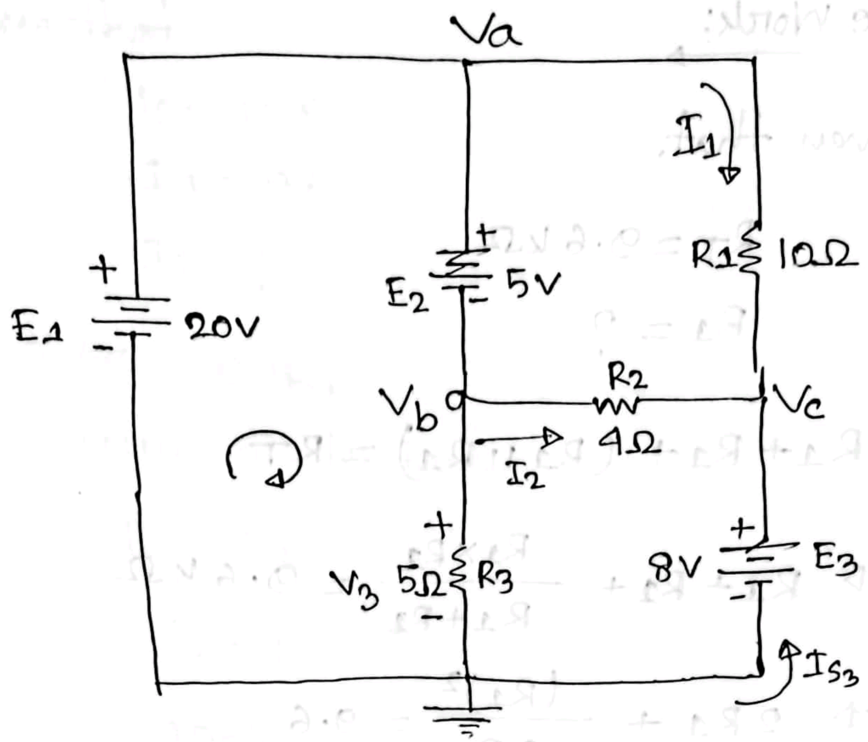
$$= \frac{19.6}{4.5}$$

$$= 4.35\,mA$$

$$\therefore I_s = I_5 + I_6$$

$$= 3mA + 4.35\,mA = 7.35mA$$

7.11



??

(a)

$V_a = E_1 = 20V$

$V_c = E_3 = 8V$

For V_b,

$+E_1 \pm E_2 - V_3 = 0$

$\Rightarrow 20 - 5 - V_3 = 0$

$\Rightarrow V_3 = 15V = V_b$

(b)

$V_{ac} = V_a - V_c$

$= 20 - 8 = 12V$

$V_{bc} = V_b - V_c$

$= 15 - 8$

$= 7V$

(c)

$I_2 = \frac{V_2}{R_2}$

$= \frac{V_{bc}}{R_2}$

$= \frac{7V}{4\Omega}$

$= 1.75A$

(d)

$I_1 = \frac{V_{ac}}{R_1}$

$= \frac{12}{10}$

$= 1.2A$

KCL,

$I_1 + I_2 + I_{S3} = 0$

$\Rightarrow I_{S3} + 1.75 + 1.2 = 0$

$\Rightarrow I_{S3} = -2.95A$

Home Work:

(6) Given that,

$R_T = 9.6\ k\Omega$

$R_1 = ?$

$R_1 + R_1 + (R_1 \parallel R_1) = R_T$

$\Rightarrow R_1 + R_1 + \dfrac{R_1 \times R_1}{R_1 + R_1} = 9.6\ k\Omega$

$\Rightarrow 2R_1 + \dfrac{(R_1)^2}{2R_1} = 9.6$

$\Rightarrow \cancel{2R_1 +}$

$\Rightarrow 2R_1 + \dfrac{R_1}{2} = 9.6$ 18

$\Rightarrow 4R_1 + R_1 = 19.2$

$\Rightarrow 5R_1 = 19.2$

$\Rightarrow R_1 =$

(7) a) We know that, in series circuit, current are same. In Figure 7.20,

$I_s = I_5 = I_6$. Because, source current wire, $(R_1 \parallel R_2)$ combination and $(R_3 \parallel R_4)$ combination are remain parallel.

b) Given that,

$I_s = 10A$

$I_1 = 4A$

$I_2 = ?$

Applying ~~KCL~~, ~~CDR~~,

Current divider Rule,

$I_s = I_2 + I_1$

$\Rightarrow 10A = I_2 + 4$

$\Rightarrow I_2 = 10 - 4$

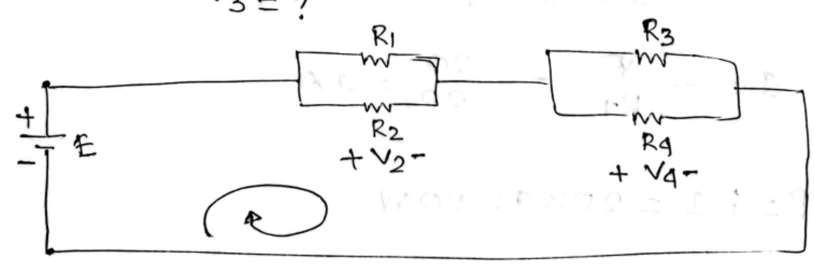
$\Rightarrow I_2 = 6\,A$

c) Given that,

$V_2 = 8V$

$E = 14$

$V_3 = ?$



Applying KVL

$E - V_2 - V_4 = 0$

$\Rightarrow -8 + 14 - V_4 = 0$

$\Rightarrow 6 - V_4 = 0$

$\Rightarrow V_4 = 6V = V_3$ Ans.

9 (a) $\cancel{R_T = R_1 + \{(R_2 \parallel R_3) \parallel R_4\}}$

$\cancel{= 11 + \{(}$

$$R_T = R_1 + (R_2 \parallel R_3 \parallel R_4)$$

$$= 11 + \frac{27}{3}$$

$$= 20\,\Omega$$

$$I_S = \frac{E}{R_T}$$

$$= \frac{80}{20} = 4\,A$$

$$I_4 = \frac{(R_2 \parallel R_3)}{(R_2 \parallel R_3) + R_4} I_S$$

$$= \frac{\frac{27}{2}}{\frac{27}{2} + 27} \times 4$$

$$= 1.33\,A$$

b) $V_1 = \cancel{\quad} I_1 R_1 = 4 \times 11 = 44\,V$

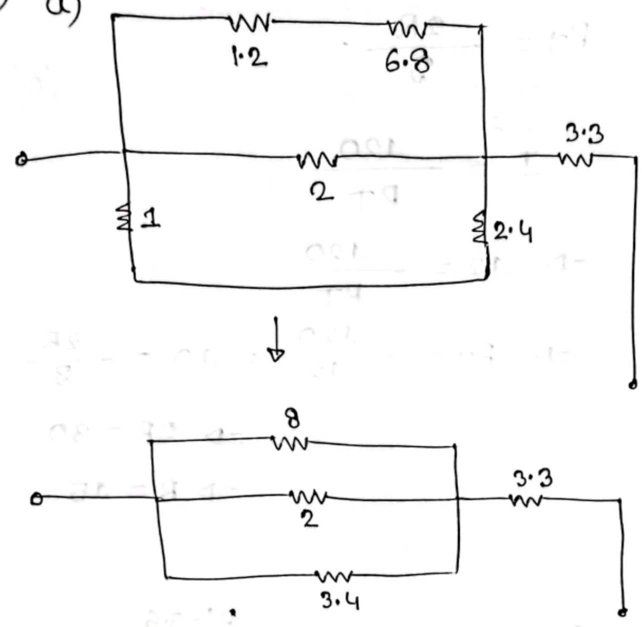
$$I_3 = \frac{(R_4 \parallel R_2)}{(R_4 \parallel R_2) + R_3} I_S$$

$$= \frac{\frac{27}{2}}{\frac{27}{2} + 27} \times 4$$

$$= 1.33$$

$$V_3 = I_3 R_3 = 1.33 \times 27 = 35.91\,V$$

12) a)



$$RT = (8 \parallel 2 \parallel 3.4) + 3.3$$

$$= \left\{ \left(\frac{8 \times 2}{8+2} \right) \parallel 3.4 \right\} + 3.3$$

$$= 1.26 + 3.33$$

$$= 4.59 \approx 4.6\,\Omega$$

$E = 48V$

$$I = \frac{48}{4.6} = 10.43\,A$$

b)

13)

$$R_T = \frac{2R}{3}$$

$$I = \frac{120}{R_T}$$

$$\Rightarrow 12 = \frac{120}{R_T}$$

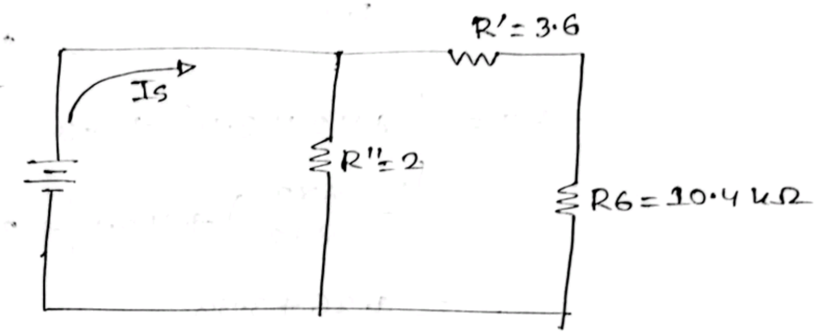
$$\Rightarrow R_T = \frac{120}{12} = 10 = \frac{2R}{3}$$

$$\Rightarrow 2R = 30$$

$$\Rightarrow R = 15$$

14)

~~RT~~



$$R' = \frac{9 \times 6}{15} = \frac{54}{15} = 3.6$$

$$R'' = \frac{12}{2} \parallel 3 = 6 \parallel 3 = \frac{18}{9} = 2$$

Home work

(a)

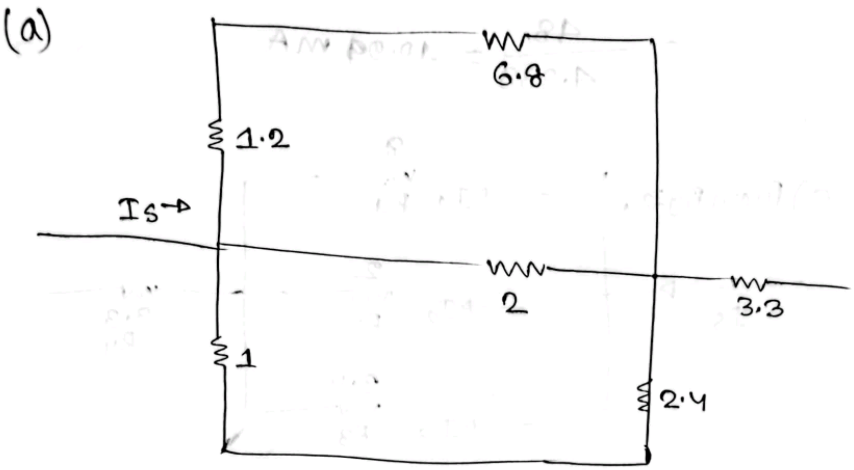


Fig-01

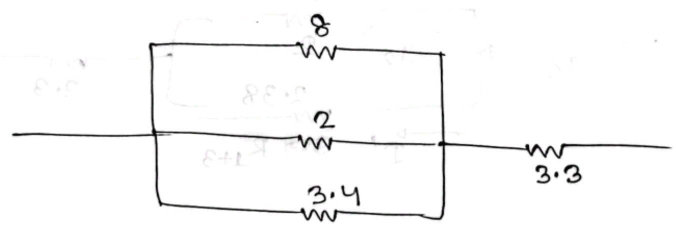


Fig-2

$$R_T = \left(\frac{8\times2}{10} \parallel 3.4\right) + 3.3$$

$$= \left(\frac{16}{10} \parallel 3.4\right) + 3.3$$

$$= (1.6 \parallel 3.4) + 3.3$$

$$= \frac{1.6\times3.4}{1.6+3.4} + 3.3$$

$$= \frac{5.44}{5} + 3.3$$

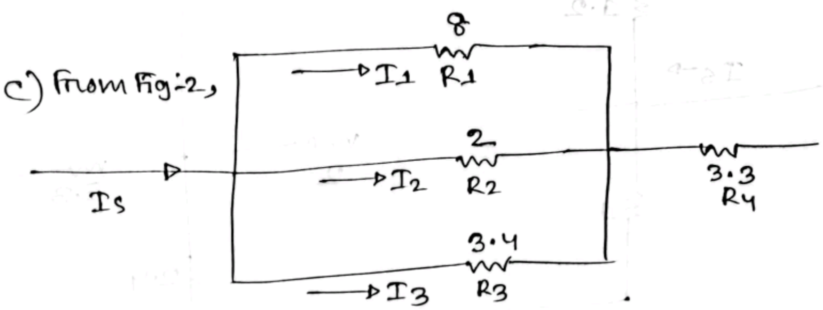
$$= 4.388\ K\Omega$$

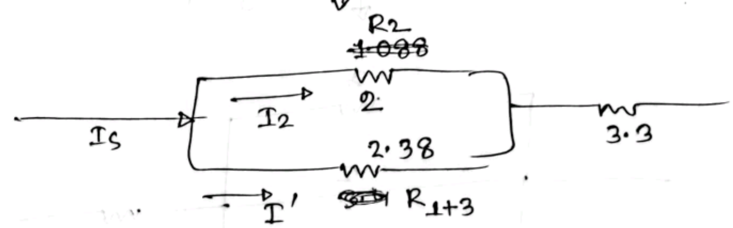
b)

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

$$= \frac{48}{4.388} = 10.94 \text{ mA}$$

c) From Fig-2,





$$R_{1+3} = \frac{3.4 \times 8}{3.4+8}$$

$$= \frac{27.2}{11.4}$$

$$= 2.38 \text{ k}\Omega$$

$$I_2 = \frac{2.38}{2+2.38} I_S$$

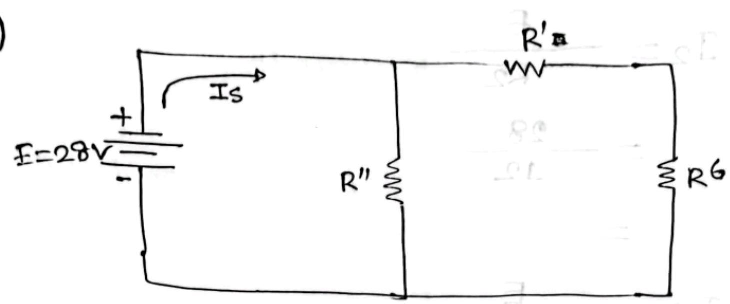
$$= 5.9 \approx 6 \text{ k}\Omega$$

$$V_2 = I_2 R_2$$

$$= 6 \times 2$$

$$= 12 \text{ V}$$

(7)



$$R' = \frac{9\times6}{9+6} = \frac{54}{15} = 3.6\ k\Omega$$

$$R'' = \left(\frac{12}{2} \parallel 3\right) = \frac{6\times3}{6+3} = 2\ k\Omega$$

$$RT = R'' \parallel (R' + R_6)$$

$$= 2 \parallel (3.6 + 10.4)$$

$$= 2 \parallel 14$$

$$= \frac{14\times2}{14+2}$$

$$= \frac{28}{16}$$

$$= 1.75\ k\Omega$$

(a)

$$Is = \frac{E}{RT} = \frac{28}{1.75} = 16\ mA$$

(b)

$$\cancel{I_2' = \frac{E}{R_2 + (R_1 \parallel R_3)} \times I_s}$$

$$\cancel{= \frac{28}{12 + \frac{12\times3}{15}} \times 16\ mA}$$

$$I_2 = \frac{E}{R_2}$$

$$= \frac{28}{12}$$

$$=$$

$$I_6 = \frac{E}{(R_4 \parallel R_5) + R_6}$$

$$= \frac{28}{\frac{9 \times 6}{9+6} + 10.4}$$

$$= \frac{28}{\frac{54}{15} + 10.4}$$

(b) $V_1 = E = 28\,V$

$V_5 = I_6 \times R_5$

$=$

(c) $I_3 = \frac{E}{R_3}$

$= \frac{28}{3} =$

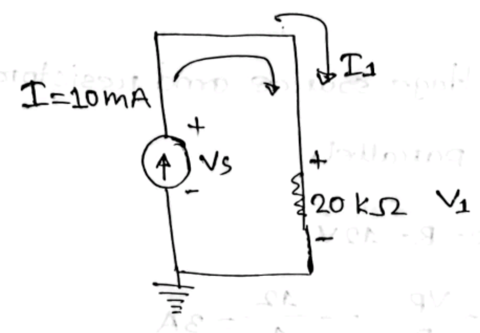
$P = \cancel{E}I_3$

$= 28 \times$

Chapter-8

Voltage এর ক্ষেত্রে $- \xrightarrow{I} +$

Resistance এর ক্ষেত্রে $+ \xrightarrow{I} -$



$V_s = ?$

$V_1 = ?$

$I_1 = ?$

$I_1 = I = 10\,mA$

The voltage across R_1

$V_1 = I_1 R_1$

$\Rightarrow \cancel{R_1 = \frac{V_1}{I_1}} = \cancel{\ }$

$= (10\,mA)(20k)$

$= 200\cancel{V}$

Since resistor R_1 and current source are in parallel, the voltage across each must be the same.

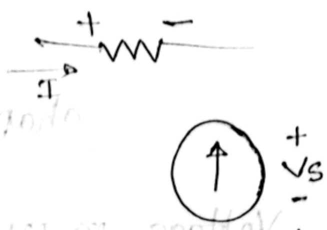
and $V_s = V_1 = 200V$

8.2

$V_S = ?$

$I_1 = ?$

$I_2 = ?$



current Source.

$V_S = E = 12\,V$

Further,

Since the voltage source and resistor R are in parallel.

$V_R = R = 12V$

$$I_2 = \frac{V_R}{R} = \frac{12}{4} = 3A$$

$\sum I_i = \sum I_o$

$\Rightarrow I = I_1 + I_2$

$\Rightarrow I_1 = 7 - 3 = 4A$

8.3

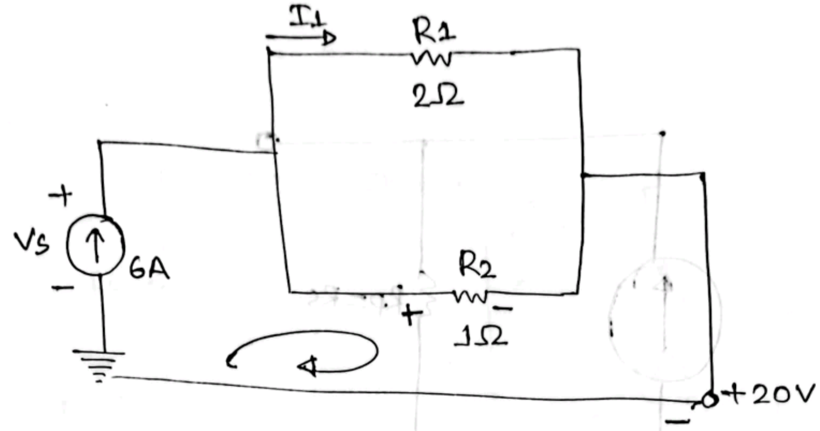
$$I_1 = \frac{R_2}{R_1 + R_2} I$$

$$= \frac{1}{1+2} \times 6$$

$$= 2A$$

$V_1 = I_1 R_1 = 2A \cdot 2\Omega$

$= 4V$

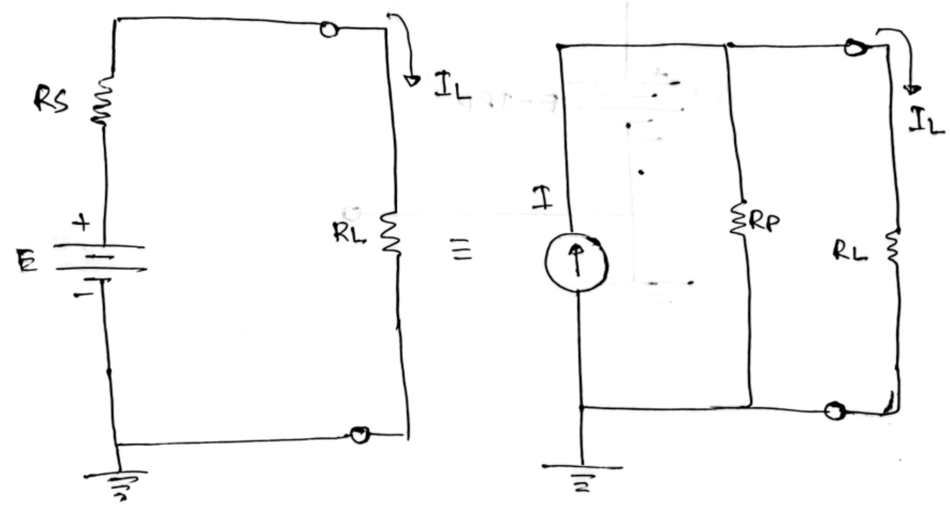


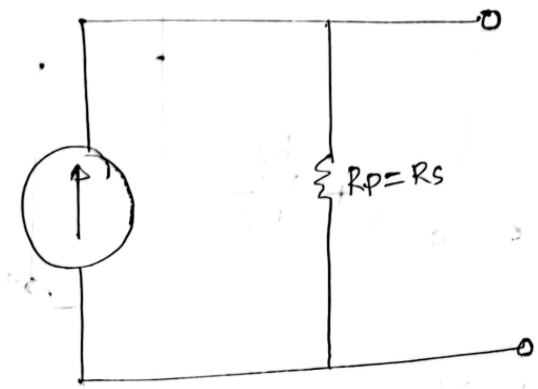
$$V_S - V_1 - 20 = 0$$

$$\Rightarrow V_S = V_1 + 20$$

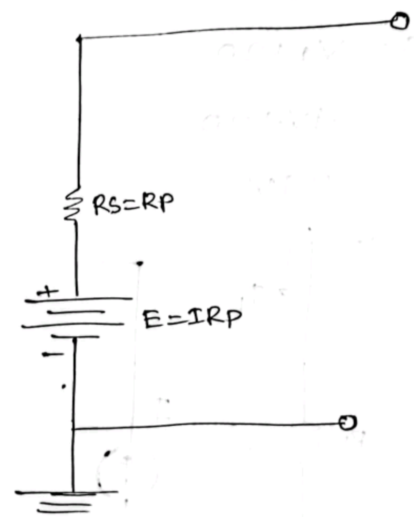
$$= 4V + 20$$

$$= 24V$$



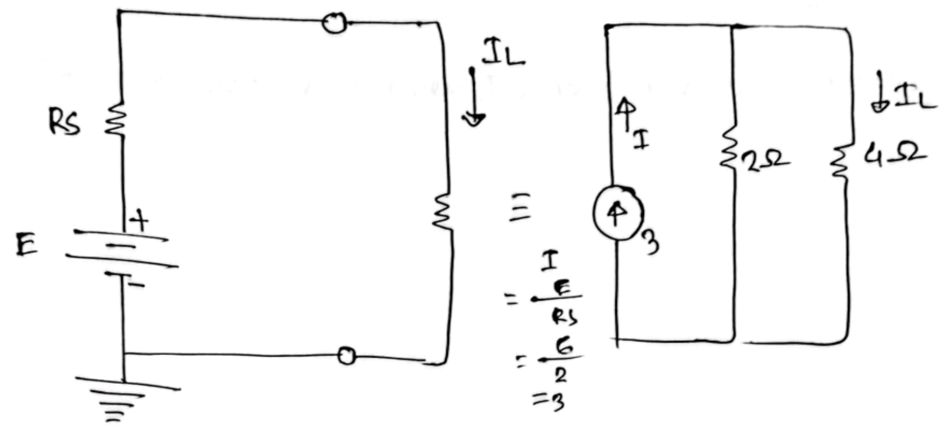


Rp=Rs



Rs=Rp
E=IRp

8.4



$$I = \frac{E}{RS} = \frac{6}{2} = 3$$

appying ohm's law,

a) $$I_L = \frac{E}{RS+RL}$$

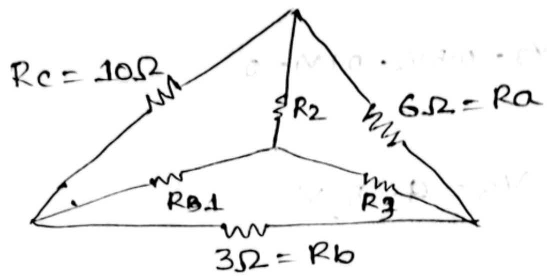
$$= \frac{6}{2+4} = \frac{6}{6} = 1\,A$$

c) $$I_L = \frac{RP}{RP+RL} I$$

$$= \frac{2 \times 3}{2+4} = 1$$

Y- Delta Formula

Δ to Y



$$R_1 = \frac{R_b R_c}{R_a + R_b + R_c}$$

$$R_2 = \frac{R_a R_c}{R_a + R_b + R_c}$$

$$R_3 = \frac{R_a R_b}{R_a + R_b + R_c}$$

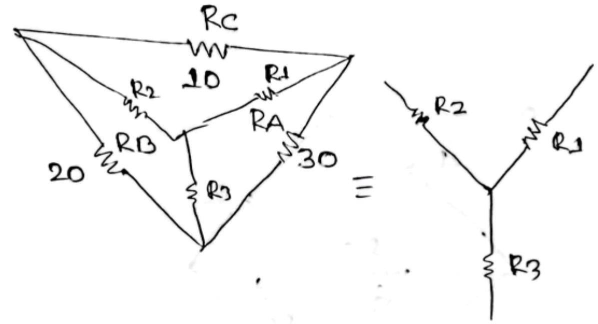
Y to Delta

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

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

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

8.27

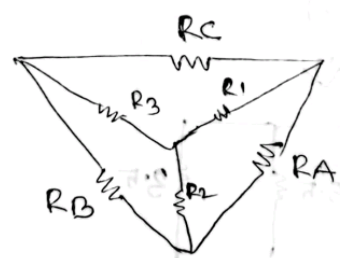


$$R_1 = \frac{10 \times 30}{10+20+30} = 5\Omega$$

$$R_2 = \frac{10 \times 20}{10+20+30} = 3\frac{1}{3}\Omega$$

$$R_3 = \frac{20 \times 30}{10+20+30} = 10\Omega$$

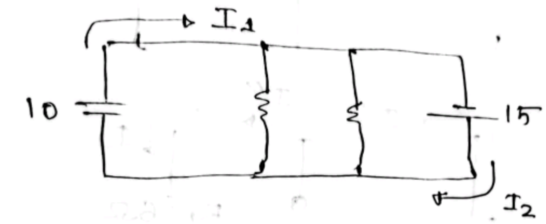
8.28



$$R_1 = \frac{R_C \times R_A}{R_1+R_2+R_3} =$$

Chapter-9

Superposition theorum:



$I_T = I_1 + I_2$

$E = V_1 + V_2$

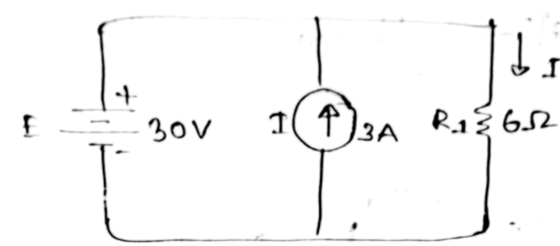
"Voltage Source কে replace করতে চাইলে short circuit করবে

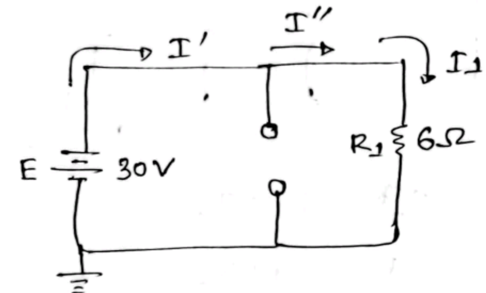
Current Source কে replace করতে চাইলে Open circuit করবে"

So Solve problem.

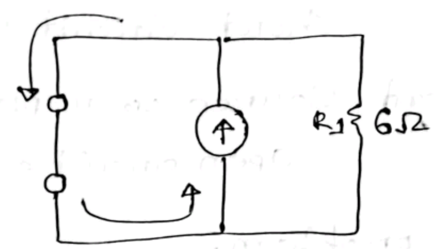
1) Totall resistence
2) Totall I
3) Current devider Rule

9.1





$$I'' = \frac{30}{\cancel{6}6} = 5\ A$$



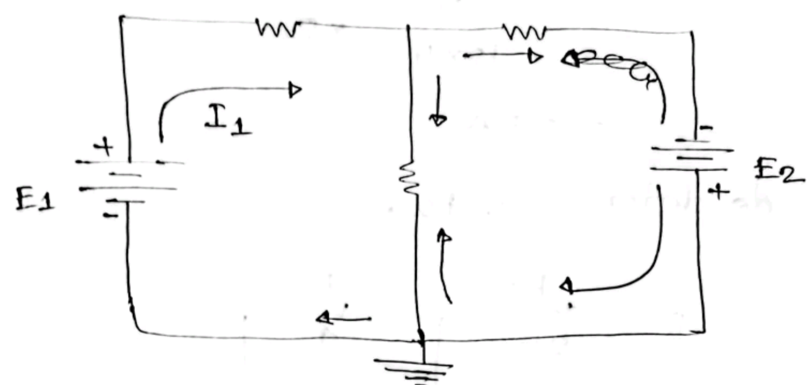
$I' = 0$

$I_1 = I' + I''$

$= 0 + 5$

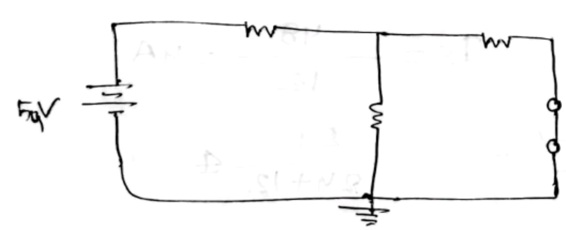
$= 5A$

9.2



$$\cancel{R_T = R_1 + \frac{4 \times 12}{4+12} = 24 + \frac{}{} = 27\Omega}$$

To determine current from E1,



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

$$= 27$$

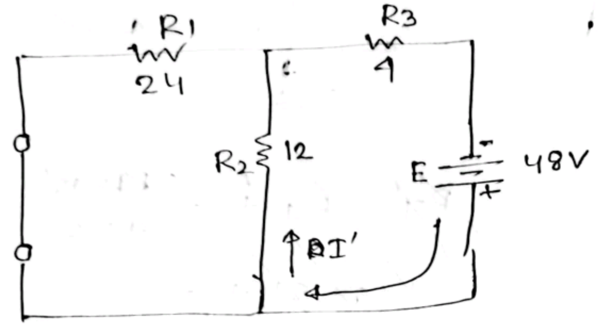
$$I_S = \frac{59}{27} = 2A$$

$$I_2 = \frac{R_3}{R_2 \times R_3} I_1$$

$$= \frac{4}{12 \times 4} \times 2$$

$$= 0.5\,A$$

To ~~de~~ determine E_2,



$$RT = 4 + \frac{24 \times 12}{24 + 12}$$

$$= 12\,\Omega$$

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

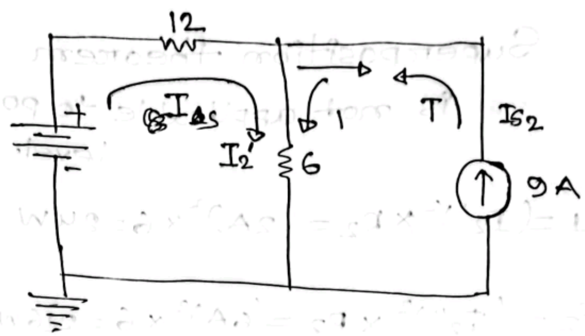
$$I' = \frac{24}{24+12} 4$$

$$= 2.67\,A$$

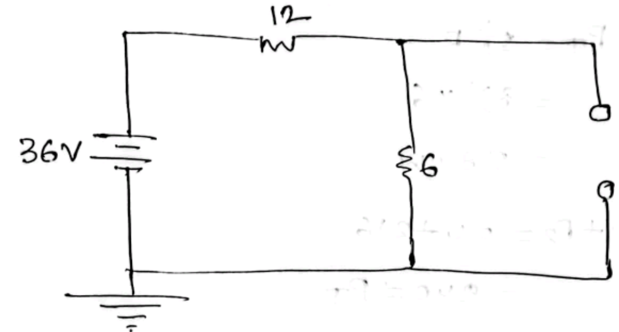
$$I_2 = 2.67 - 0.5$$

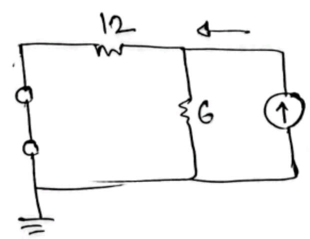
$$= 2.17\,A$$

9.3



1st Phase,





$$I_{s} = \frac{36}{12+6}$$

$$= \frac{36}{18}$$

$$= 2A$$

$$I_2' = \frac{R_1}{R_1+R_2} I$$

$$= \frac{12}{12+6} \times 9$$

$$= 6A$$

$\therefore$ Totall Current $2+6=\underline{\underline{8A}}$.

(b) Demonstrate,

Superposition theorem is not applicable to power level.

$$P_1 = (I_2')^2 \times R_2 = (2A)^2 \times 6 = 24W$$

$$P_2 = (I_2'')^2 \times R_2 = (6A)^2 \times 6 = 216W$$

$$P_T = I_2^2 R$$
$$= (8)^2 \times 6$$
$$= 384W$$

$$P_1 + P_2 = 24 + 216$$
$$= 240 \neq P_T$$

~~Class~~

Chapter-6

Series:

(i) $V = IR$

(ii) Cirssops Voltage law: In a close loop circuit, totall supplied voltage equal to totall dropped Voltage.

Or,

In a close loop circuit, totall summation of voltage equal to zero.

(iii) Voltage divider Rule: (VDR)

$$V_1 = \frac{R_1}{R_1 + R_2} \times V_T$$

$$V_2 = \frac{R_2}{R_1 + R_2} \times V_T$$

Parallel circuit solved by 3 Formula:

1) $V = IR$

2) KCL: In a junction point/node entering current and realesing current are equal.

$$I_{in} = I_{out}$$

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

3) CDR $\quad I_1 = \frac{I_T \times R_2}{R_1 + R_2} \quad I_2 = \frac{I_T \times R_1}{R_1 + R_2}$

যখন voltage related কথা আসবে তখন series দিয়ে চিন্তা করবো
যখন current related কথা আসবে, তখন parallel দিয়ে চিন্তা করবো।

* Conductance is reverse of resistance.

$$G = \frac{1}{R}$$

6.1

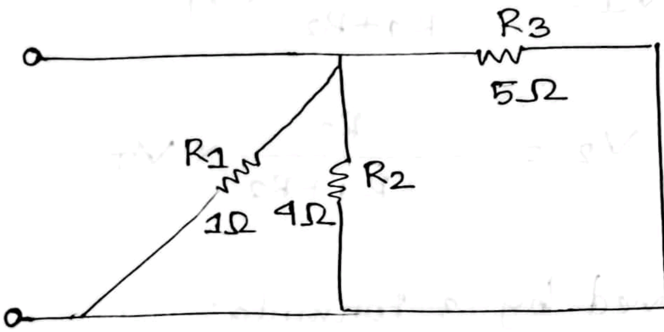
$$\cancel{G_1 = \frac{1}{R_1}}$$

$$\cancel{= \frac{1}{3}}$$

$$R_P = \left(\frac{3 \times 6}{6+3}\right) = \frac{12}{9} =$$

$$\therefore \quad G_P = \frac{1}{R_P} =$$

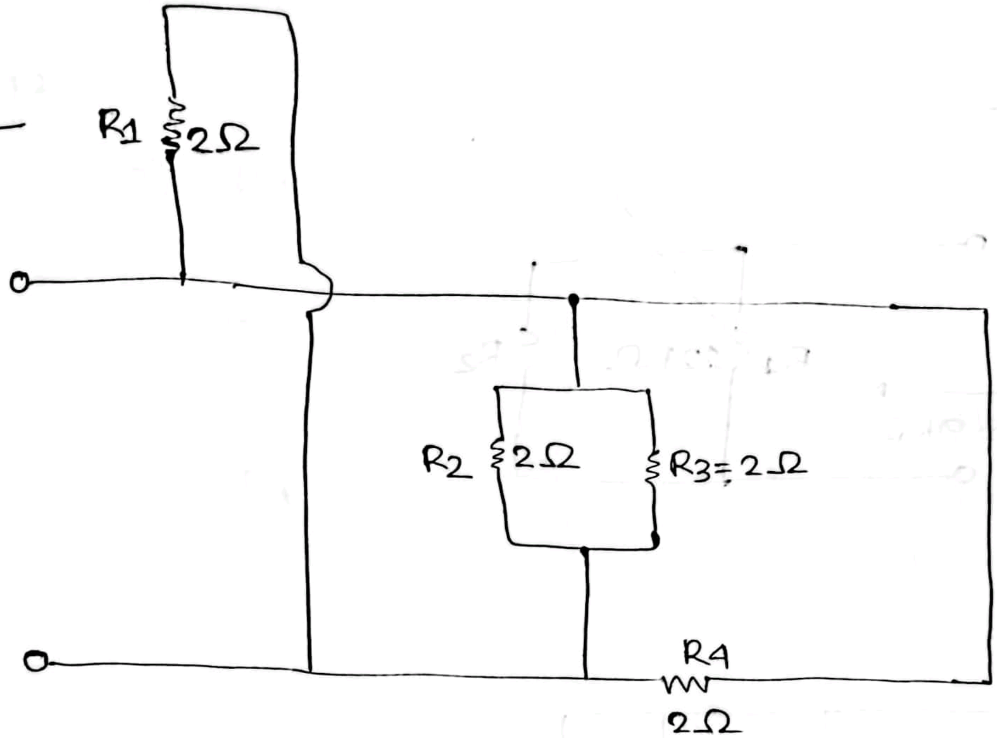
6.3



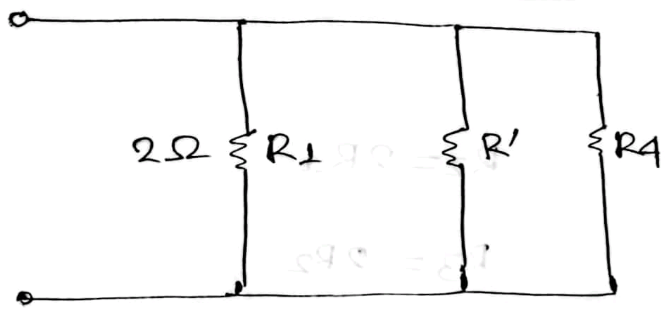
$$R' = \frac{1 \times 4}{1+4} = \frac{4}{5}$$

$$R_T = \frac{R_3 \times R'}{R_3 + R'}$$

6.6



$\Downarrow$



$$R' = \frac{2\times 2}{4} = 1\Omega$$

$\Downarrow$

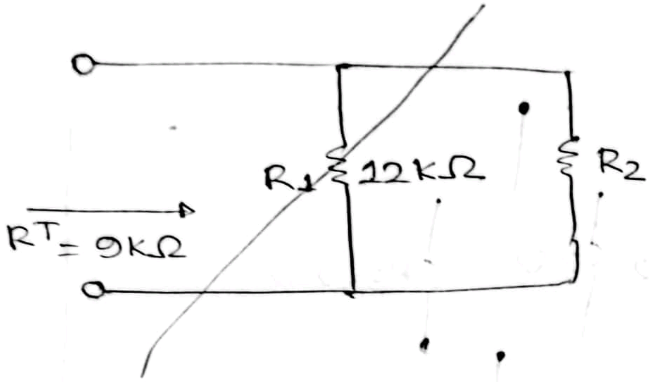
$$R'' = \frac{R' \times R4}{R' + R4}$$

$$= \frac{1\times 2}{1+2} =$$

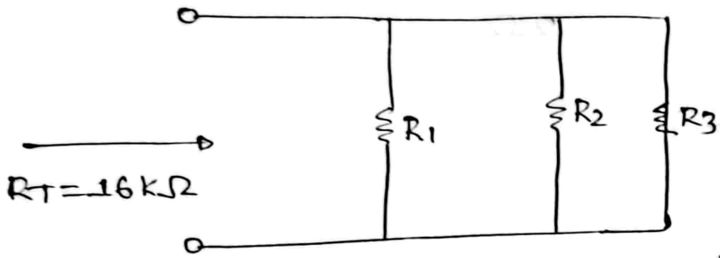
$$RT = \frac{R'' \times R1}{R'' + R1}$$

$$=$$

Q.10



Q.11 :



$$R_2 = 2R_1$$

$$R_3 = 2R_2 = 2\times 2R_1 = 4R_1$$

$$R_P = \left(\frac{1}{R_1} + \frac{1}{2R_1} + \frac{1}{4R_1}\right)^{-1}$$

$$= \left(\frac{4+2+1}{4R_1}\right)^{-1}$$

$$R_T = \frac{4R_1}{7}$$

$$\Rightarrow 16 \times 7 = 4R_1$$

$$\Rightarrow R_1 = 28\,k\Omega$$

$$R_2 = 56\,k\Omega$$

$$R_3 = 112\,k\Omega$$

6.12

a) $R_T = \dfrac{9 \times 18}{9+18} =$

b) $I_S = \dfrac{E}{R_T} =$

c) $I_1 = \dfrac{R_2}{R_1+R_2} \times I_S$

Alternet way,

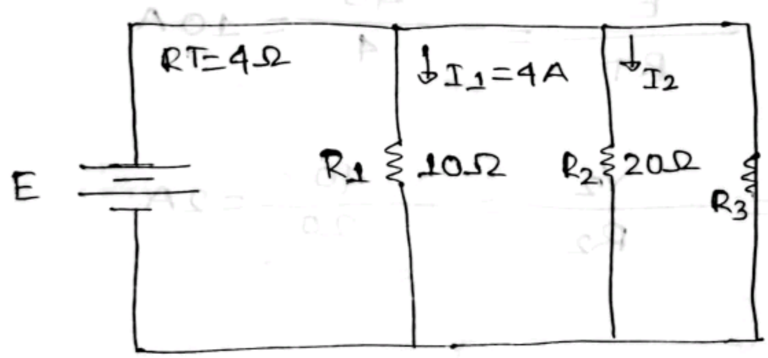
$I_1 = \dfrac{V_1}{R_1} = \dfrac{E}{R_1}$

$=$

$I_2 = \dfrac{R_1}{R_1+R_2} \times I_S$

$=$

6.14



a) $\cancel{R_3} = R_T = \left(\dfrac{1}{10} + \dfrac{1}{20} + \dfrac{1}{R_3}\right)^{-1}$

$\Rightarrow R_T = \left(\dfrac{2+1}{20} + \dfrac{1}{R_3}\right)^{-1}$

$\Rightarrow R_T = \left(\dfrac{3R_3+20}{20R_3}\right)^{-1}$

$$R_T = 4 = \frac{20 R_3}{3R_3 + 20}$$

$$\Rightarrow 12 R_3 + 80 = 20 R_3$$

$$\Rightarrow 80 = 8 R_3$$

$$\Rightarrow R_3 = 10 \Omega$$

b) $V_1 = I_1 R_1$

$= 4 \times 10$

$= 40 V$

In parrallel, voltage are equal.

So, $V_1 = E$

c) $I_S = \frac{E}{R_T} = \frac{40}{4} = 10 A.$

d) $I_2 = \frac{V_2}{R_2} = \frac{40}{20} = 2 A.$

Power distribution in parallel circuit:

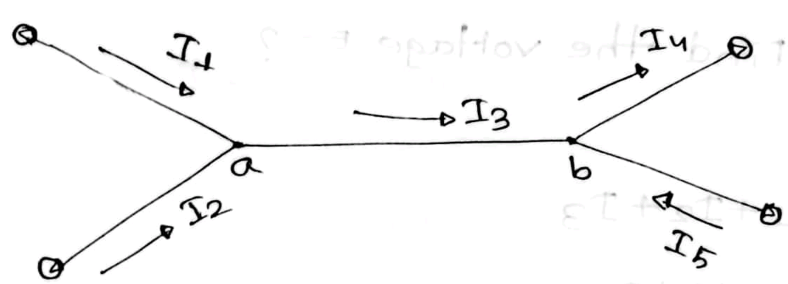
$$P_E = P_{R1} + P_{R2} + P_{R3}$$

$$P = EI$$

$$P = EI = I^2R = \frac{E^2}{R}$$

$\boxed{E = V}$

6.16



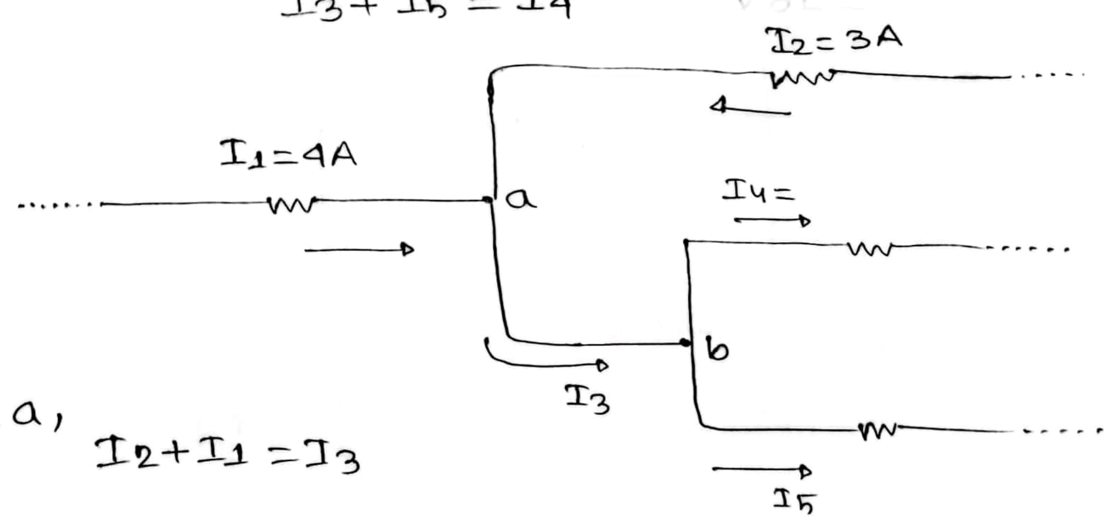
In node a,

$$I_1 + I_2 = I_3$$

In node b,

$$I_3 + I_5 = I_4$$

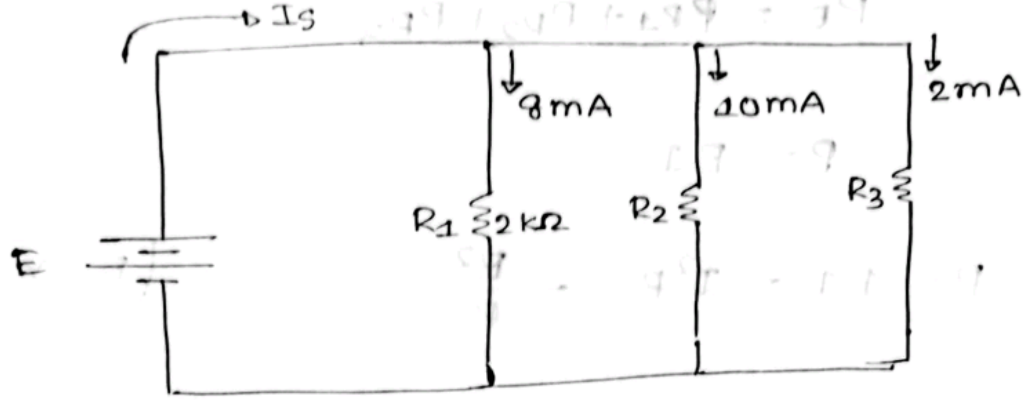
6.18



node a, $I_2 + I_1 = I_3$

node b, $I_3 = I_4 + I_5$

6.19



Determine the source current I_s=?

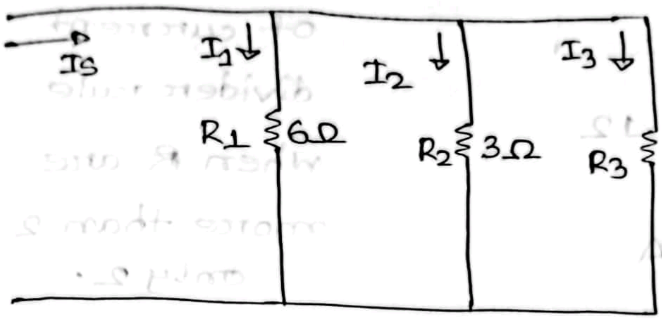
Find the voltage E = ?

$$I_s = I_1+I_2+I_3$$
$$= 8+10+2$$
$$= 20\,mA$$

$$E = V_1 = I_1R_1$$
$$= 8\times 2$$
$$= 16V$$

$$R_2 = \frac{V_2}{I_2}$$
$$= \frac{16}{10\times 10^{-3}}$$
$$= 1.6\times 10^3$$

6.21



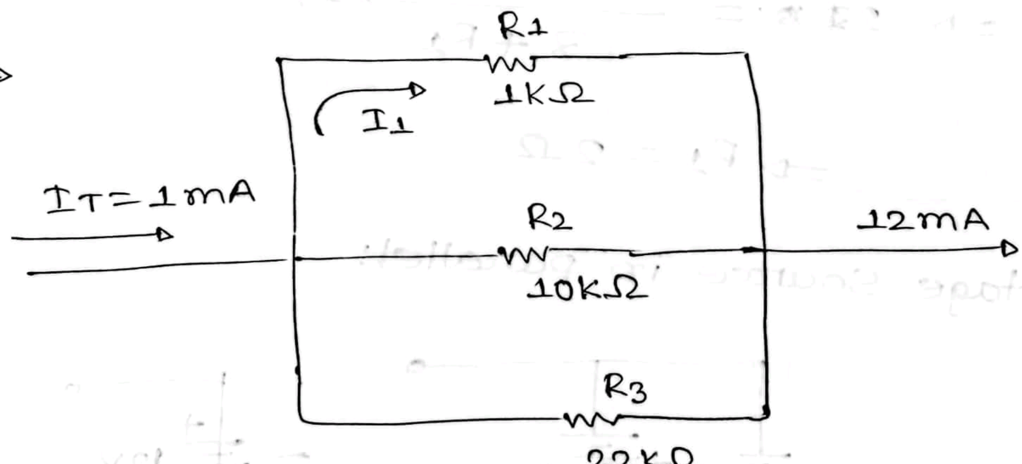
Determine $I_1, I_3, I_S = ?$

$$I_1 = \frac{I_2}{2} = \frac{2mA}{2} = 1mA$$

$$I_3 = 3 \times I_2$$
$$= 3 \times 2$$
$$= 6mA$$

$$I_S = I_1 + I_2 + I_3$$
$$= 1mA + 2mA + 6mA$$
$$= 9mA$$

6.22



$I_1 = ?$

$$R_T = \left(\frac{1}{1} + \frac{1}{10} + \frac{1}{22}\right)^{-1}$$
$$= 873.01\Omega$$

$I_1 R_1 = I_T R_T$

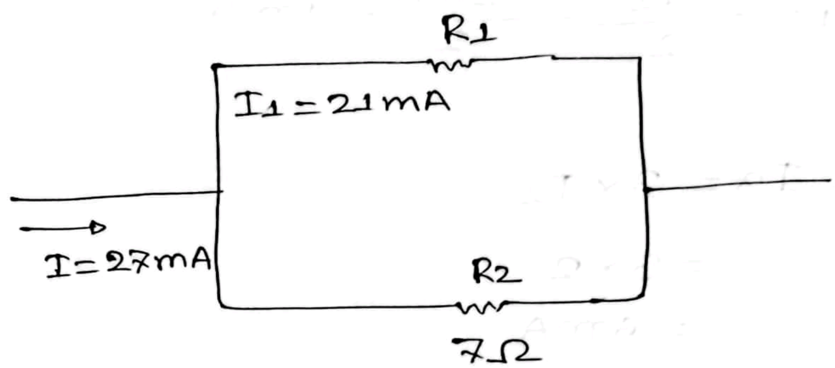
$$\boxed{I_1 = \frac{R_T}{R_1} \times I_T}$$

This is the equation of current divider rule when R are more than 2 or only 2.

$$= \frac{873.01}{1} \times 12$$

$$= 10.48\,mA$$

$\boxed{6.24}$

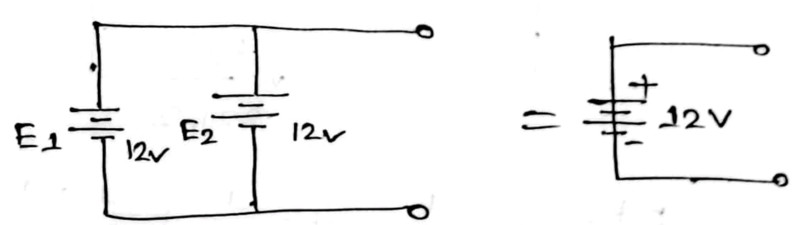


$$I_1 = \frac{\cancel{R_1}\ R_2}{R_1 + R_2} \times I$$

$$\Rightarrow 2\cancel{7}\,\cancel{0} = \frac{7}{7 + R_1} \times 27$$

$$\Rightarrow R_1 = 2\Omega$$

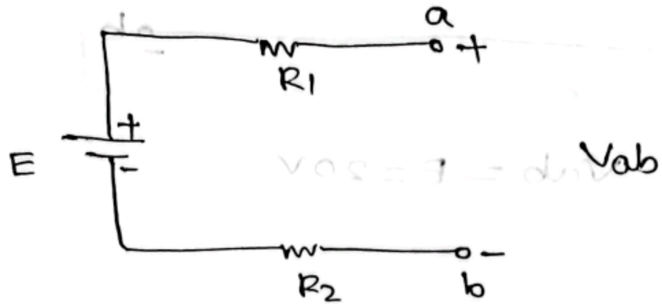
Voltage source in parallel:



Parallel circuit doesnot contain parallel voltage.

open circuit and short circuit:

Open circuit:

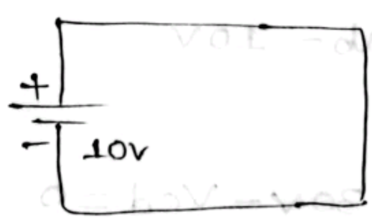


$$V_1 = I_1 R_1$$
$$= 0 \times R_1$$
$$= 0$$

E থেকে Supply দিলে

ভোল্টেজ open circuit টা তে drop হবে।

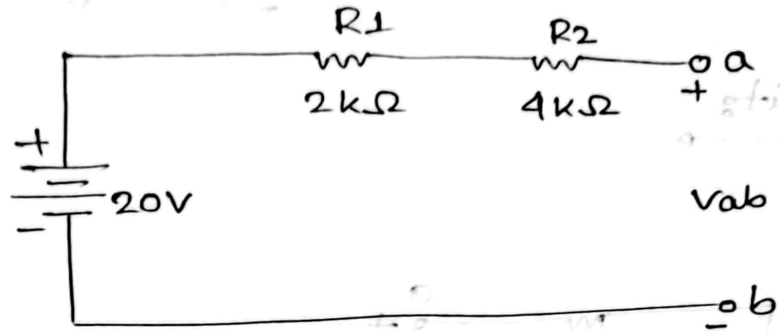
Short circuit:



$$I = \frac{V}{R}$$
$$= \frac{V}{0}$$
$$= \infty$$

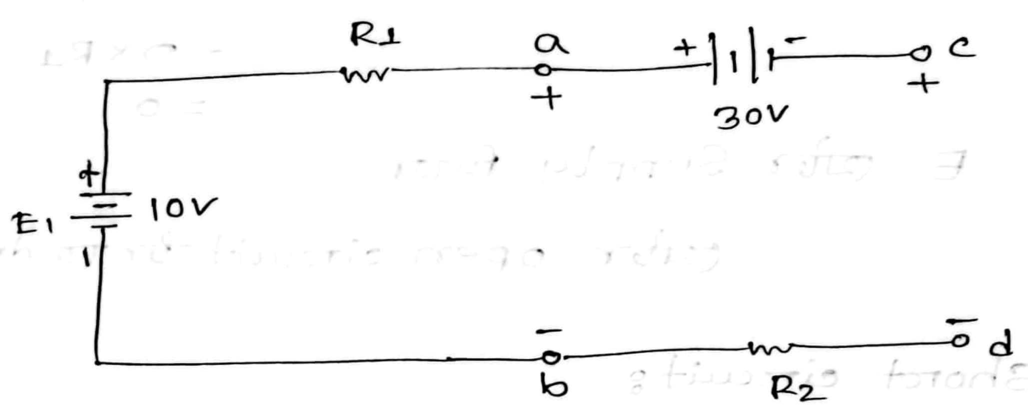
তাই মানুষ মারা যায়

6.25



$$V_{ab} = E = 20V$$

6.26



$$V_{ab} = 10V$$

applying,
KVL,

$$+E_1 - 30V - V_{cd} = 0$$

$$\Rightarrow 10 - 30 = V_{cd}$$

$$\Rightarrow V_{cd} = -20V$$

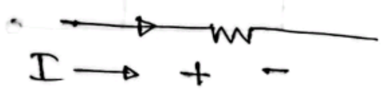
The -ve sign indicates that the actual voltage V_{cd} has the opposite polarity.

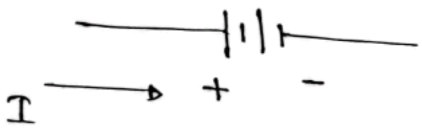
chapter-7

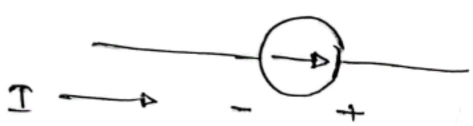
Series parallel circuit

chapter-8

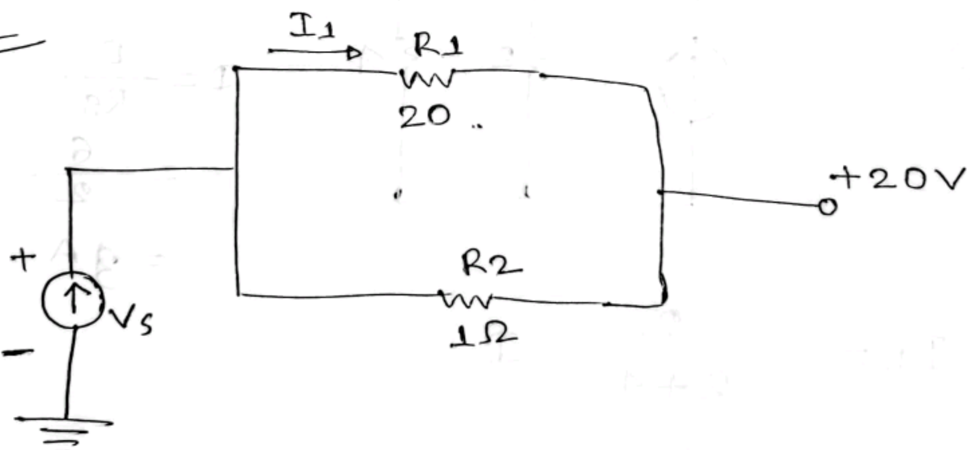
(dc)







8.3



$$+V_S - V_1 - 20V = 0$$

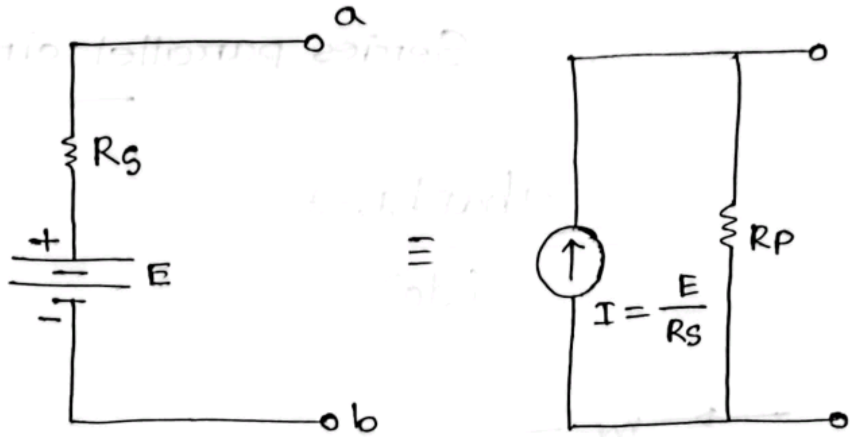
$$\Rightarrow V_S = V_1 + 20$$

$$= 4 + 20$$

$$= 24V$$

Source conversion:

ভোল্টেজে সোর্স রেজিস্টর সিরিজে থাকবে কিন্তু current source এ সোর্স ও রেজিস্টর parallel থাকবে।

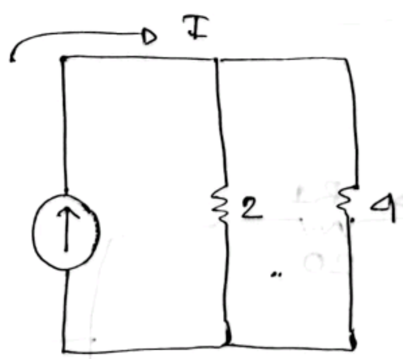


8.4

a) $I_L = \frac{E}{R_T}$

$= \frac{6}{6} = 1A$

দুইটা রেজি থাকলে তখন turning point দেখবো। turningpoint same হলে +হবে, অন্যথায় বিয়োগ b)



$I = \frac{E}{R_S}$

$= \frac{6}{2}$

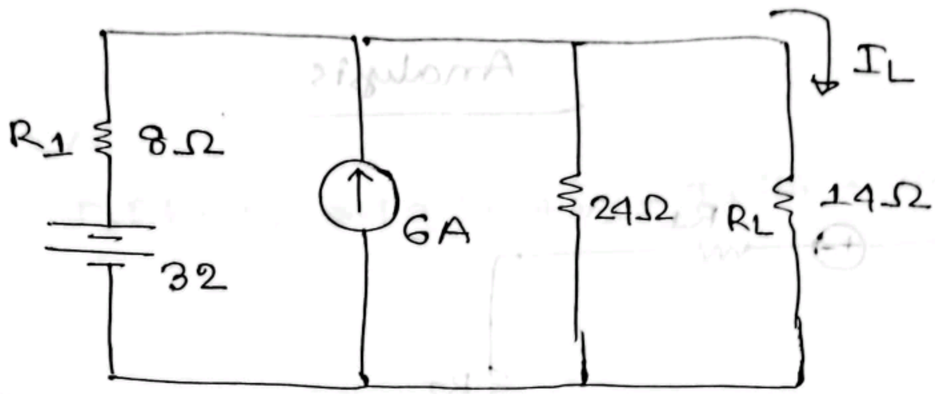
$= 3A$

$I_L = \frac{2}{2+4} I$

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

$= \frac{6}{6} = 1A$

৪.৯

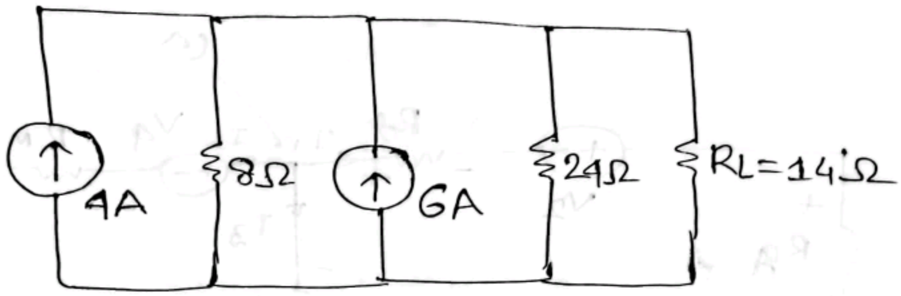


voltage & Resistor

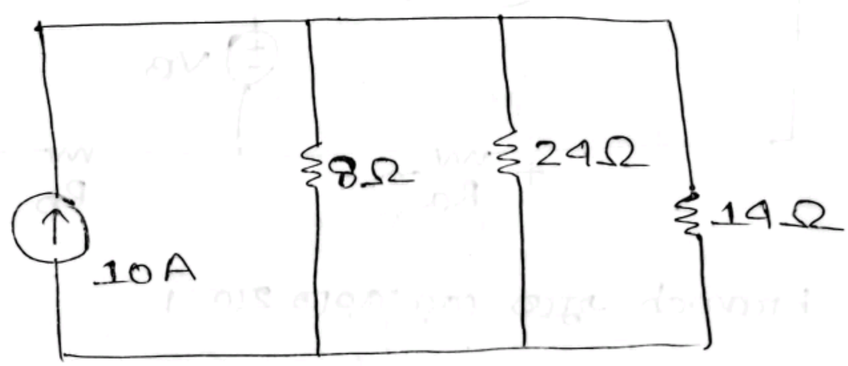
দুইটার দিয়েই current

ঢুকে প্রবেশ (+) দিয়ে

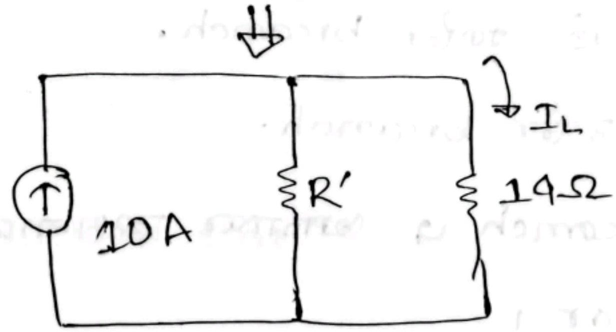
$I_L = ?$



$\Downarrow$



$\Downarrow$



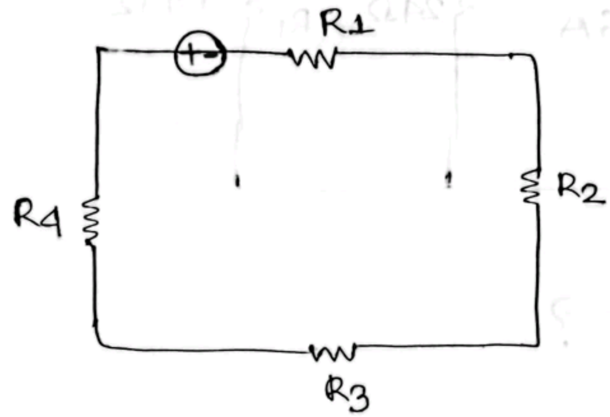
$$R' = \frac{24 \times 8}{24+8}$$

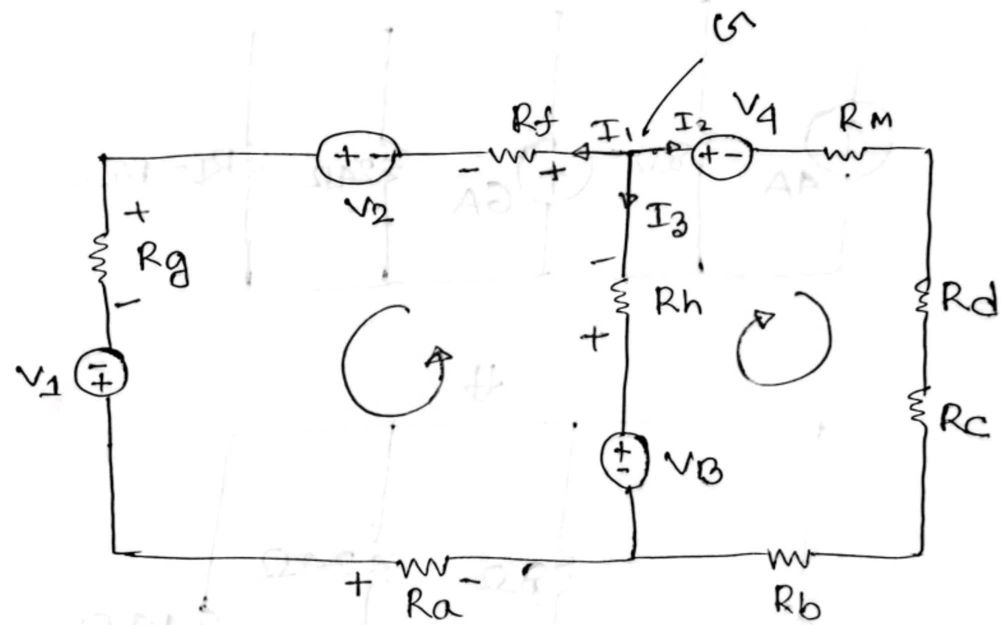
$=$

$$I_L = \frac{R'}{R'+14} 10$$

$= \boxed{}$

Branch-Current Analysis





→ প্রথমে branch খুঁজে বের করতে হবে।

যেটার মধ্য দিয়ে same current flow হবে, সেটাই একটা branch.

এখানে 3 টা branch.

→ প্রতিটি branch এ আলাদা আলাদা current apply করবো।

→ Current direction ইচ্ছামতো দিবো

1st loop, KVL,

$$-I_1R_f + V_2 - R_g I_1 + V_1 - I_1 R_a + V_B - I_1 R_h = 0$$
$$= 0$$

2nd loop, KVL,

$$-V_4 - I_2 R_m - I_2 R_6 - I_2 R_c - I_2 R_b + V_B - I_2 R_h$$
$$= 0$$

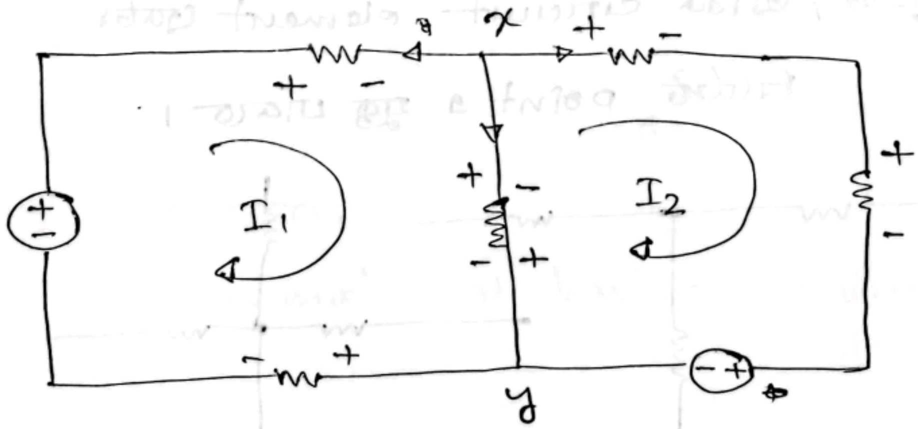
KCL, at junction G,

$$I_1 + I_2 + I_3 = 0$$

যেখানে যে sign থাকে, সেটা count করবো

branch analysis এ ~~তিন~~ যতটি current বের করবো, ততটি equation. হবে।

Mesh Analysis



i) Find mesh/ loop number
ii) Apply mesh current at each mesh
iii) Fixed the polarity of resistor
iv) KVL in each mesh

এখানে mesh/loop ২টি

KVL 1st mesh,

$$V_1 - R_1 I_1 + R_3 (I_1 - I_2) + R_2 I_1 = 0$$

KVL 2nd mesh,

$$R_3 (I_2 - I_1) + R_4 I_2 + R_5 I_2 + V_2 = 0$$

Nodal analysis

"Nodal analysis এ current source থাকে

কিন্তু voltage source শর্ট করতে হবে।"

" Mass analysis এ voltage source থাকে

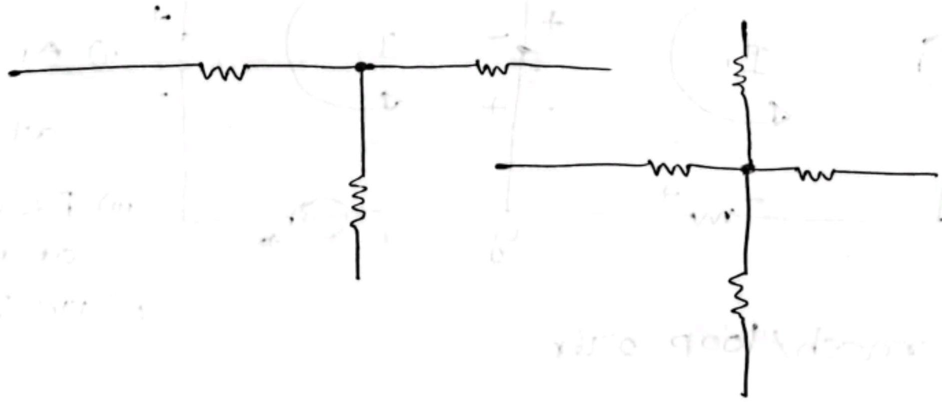
কিন্তু current source শর্ট করতে হবে।"

* Mass analysis এ current source যেখানে তাকে open করে দিতে

node মানে junction

তিনটে / অধিক circuit element যেখানে

নির্দিষ্ট point এ যুক্ত থাকে।



প্রতিটা node এর মধ্যে কি পরিমাণ voltage থাকছে

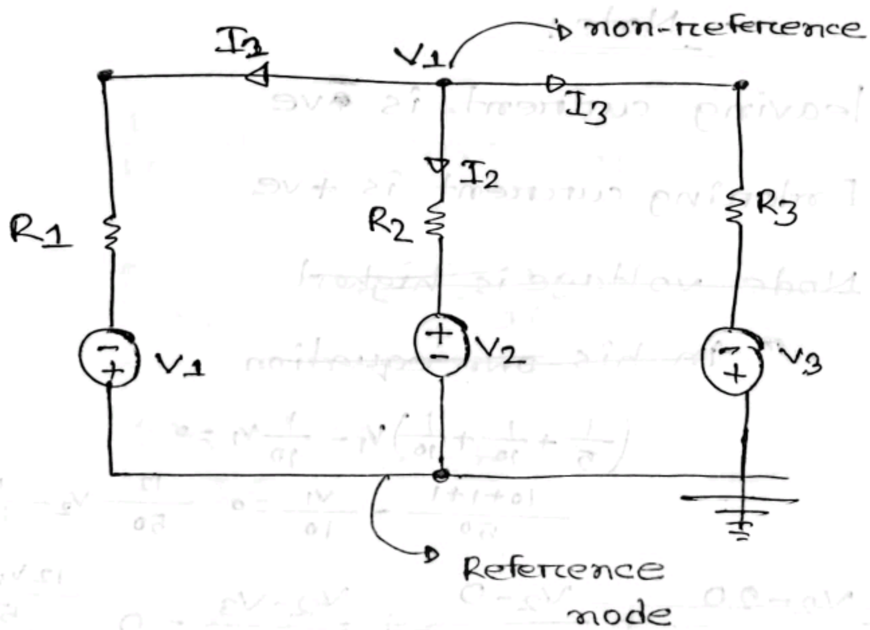
সেটা বের করার জন্য আমরা nodal analysis ব্যবহার করি

Steps: i) Node সংখ্যা বের কর

ii) Reference এবং নন-রেফারেন্স node ধর

iii) Non-reference node এ ইচ্ছামতো voltage ধর

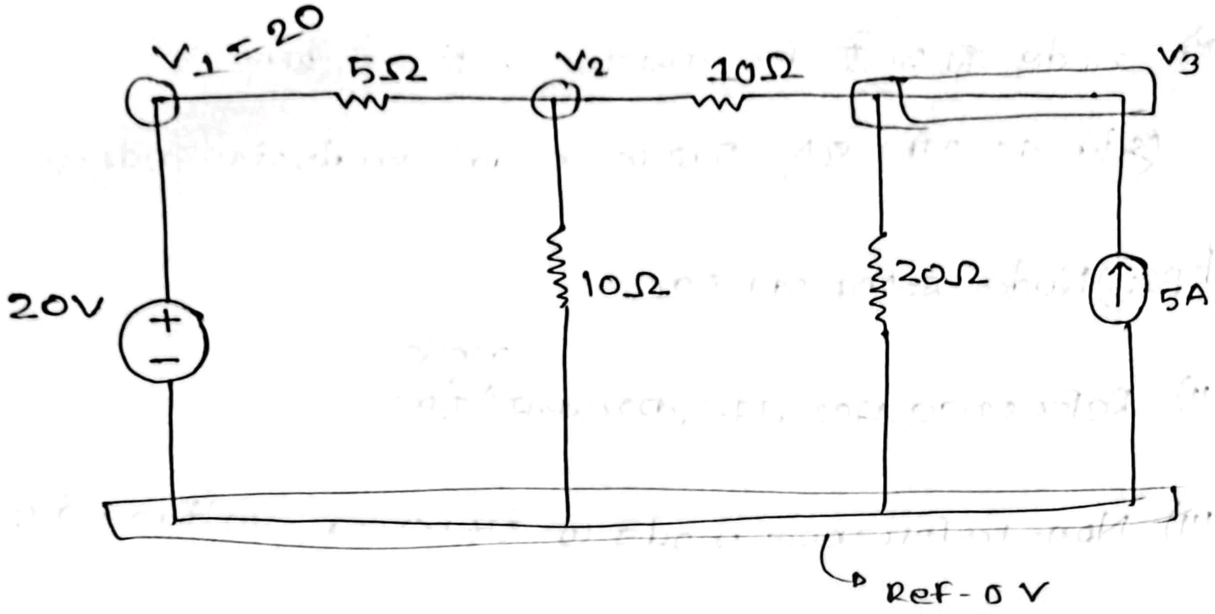
iv) প্রতিটা non-reference এর মধ্যে KCL apply কর & equation solve.



KCL,

In any junction,

Summation of leaving current = summation of entering current



Assumption : Current leaves node

Note:

leaving current is -ve

Entering current is +ve

~~Node voltage is highest~~

~~in his own equation~~

$$\left(\frac{1}{5}+\frac{1}{10}+\frac{1}{10}\right)V_1 - \frac{1}{10}V_1 = 0$$

$$\frac{10+1+1}{50} - \frac{V_1}{10} = 0 \qquad \frac{12}{50}V_2 - \frac{1}{10}V_3 = 0$$

$$\frac{12V_2 - 5V_3}{50} = 0$$

~~Node 2:~~

~~For V_2,~~

$$\cancel{\frac{V_2-20}{5} + \frac{V_2-0}{10} + \frac{V_2-V_3}{10} = 0}$$

$\cancel{\Rightarrow 4V}$ $4V_2 - V_3 = 40$

~~For V_3~~ ~~V_1~~ V_1:

$$\cancel{\left(\frac{1}{5}+\frac{1}{10}\right)V_2 - \left(\frac{1}{10}\right)V_3 = 0}$$

$$\cancel{\Rightarrow \left(\frac{10+5}{50}\right)V_2}$$

V_2 :

$$\left(\frac{1}{5}+\frac{1}{10}+\frac{1}{10}\right)V_2-\frac{1}{10}V_3=0$$

$$\Rightarrow \frac{10+5+5}{50}V_2-\frac{V_3}{10}=0$$

$$\Rightarrow \frac{20V_2-5V_3}{50}=0$$

$$\Rightarrow 4V_2-V_3=0 \longrightarrow (1)$$

V_3 :

$$\left(\frac{1}{10}+\frac{1}{20}\right)V_3-\frac{1}{10}V_2=5$$

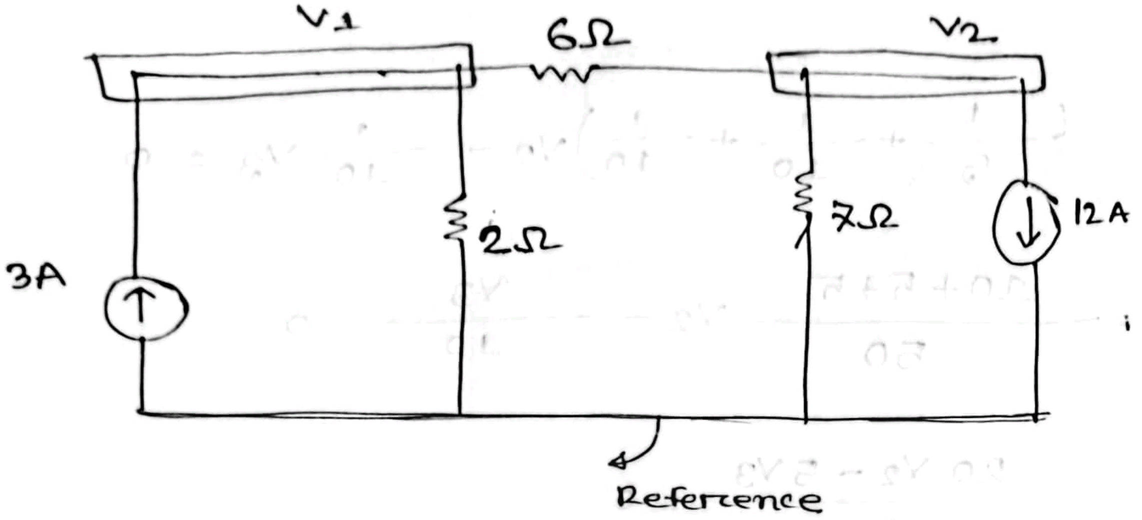
$$\Rightarrow \frac{2+1}{20}V_3-\frac{1}{10}V_2=5$$

$$\Rightarrow \frac{3V_3-2V_2}{20}=5$$

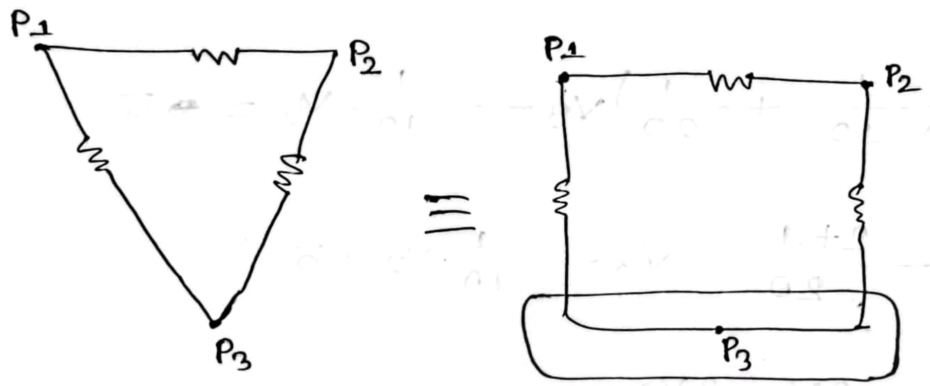
$$\Rightarrow 3V_3-2V_2=100$$

$$\Rightarrow -2V_2+3V_3=100 \longrightarrow (11)$$

Then eqn solve:



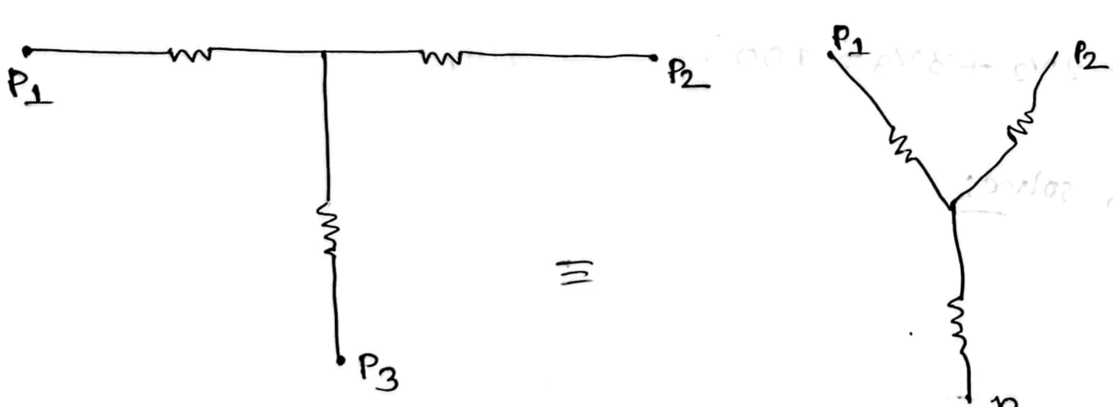
Y-Δ conversion



(Δ network)

Pi configeration

(Δ network)

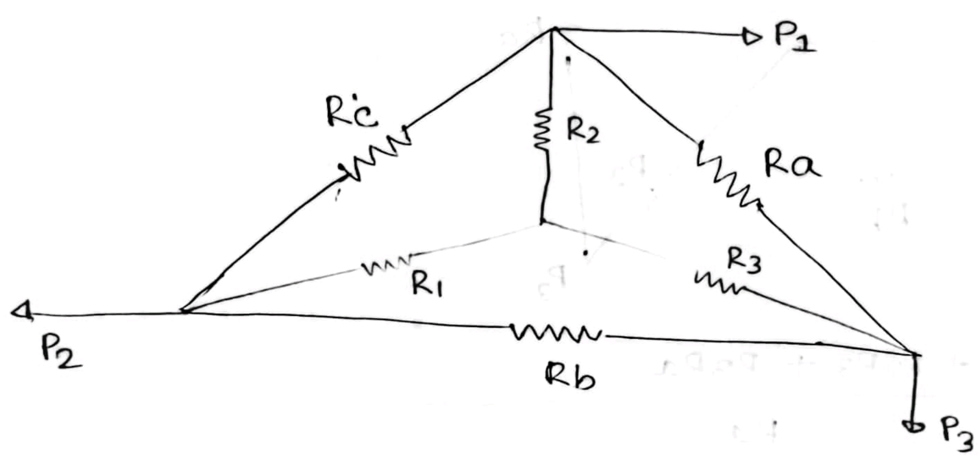


Y- network

→ 3 টা resistor এর common point থাকলে Y-connection

→ অন্যথায় delta (Δ) connection.

Conversion : Δ to Y

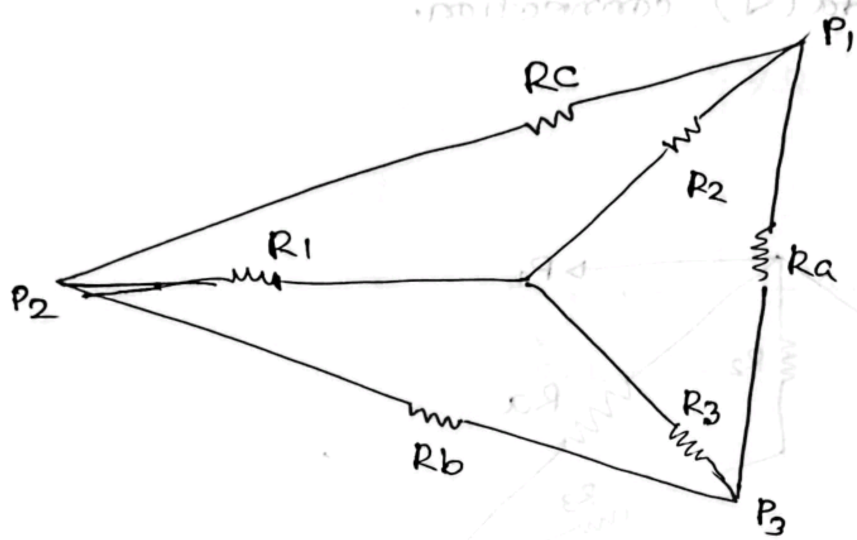


$$R_1 = \frac{R_b R_c}{R_a + R_b + R_c}$$

$$R_2 = \frac{R_c R_a}{R_a + R_b + R_c}$$

$$R_3 = \frac{R_a R_b}{R_a + R_b + R_c}$$

Conversion Y to Δ



$$R_a = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_1}$$

$$R_b = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_2}$$

$$R_c = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_3}$$

Chapter-13

① Waveform: The waveform describes the shape of one cycle of the voltage or current. Current can be generated as an alternating current.

② Instantaneous value: The magnitude of a waveform at any instant of time.

③ peak amplitude: The maximum value of a waveform as measured from its average or mean.

④ Peak amplitude: The maximum instantaneous value of a ~~waveform~~ function as measured from the zero volt level.

⑤ Peak to peak value: Peak to peak value means the sum of the magnitude of the positive and negetive peaks.

6) Periodic waveform : A waveform that continually repeats itself after the same time interval.

7) Period (T) : The time of a periodic waveform.

8) Cycle : The portion of a waveform contained in one period of time.

9) Frequency (f) : The number of cycle that occur in 1 second.

1 Hertz (Hz) = 1 cycle per second.

m Short,

Pick amplitude : Avarage value - Highest point

Pick value : 0 - highest

Pick to pick value : +ve to -ve.

$$1 \text{ Radians} = \frac{\pi}{180^\circ}$$

$$1^\circ \text{ Degree} = \frac{180^\circ}{\pi}$$

$$\text{Angular velocity} = \frac{\text{distance (degree or radians)}}{\text{time (Second)}}$$

$$\omega = \frac{\alpha}{t}$$

$$\Rightarrow \alpha = \omega t$$

The basic mathematical formate for the sinosoidal waveform is $\underbrace{A_m}_{\text{Pick value}} \sin\alpha = A_m \sin \omega t$

For the electrical quantities such as current or voltage,

$$i = I_m \sin \omega t$$

$$e = E_m \sin \omega t$$

cos phase relations: $\longrightarrow$

$$\left.\begin{array}{l} \sin(-\alpha) = -\sin\alpha \\ \cos(-\alpha) = \cos\alpha \end{array}\right\}$$

$\cos\alpha = \sin(\alpha + 90^\circ)$

$\sin\alpha = \cos(\alpha - 90^\circ)$

$-\cos\alpha = \sin(\alpha - 90^\circ)$

$-\sin\alpha = \sin(\alpha \pm 180^\circ)$

$$y = A_m \sin(\omega t + \theta)$$
$$= A_m \sin(\underbrace{\omega t - \theta}_{\alpha})$$

$$G_1 \text{ (Avarage value)} = \frac{\text{Algebric sum of areas}}{\text{length of curve}}$$