Lumped parameters networks

The network that has simple elements and a set of connecting leads. it is called a lumped parameter network.

Distributed parameters n/w.

N/w that has infinite number of small elements.

Node:- A point at which two or more elements have a common connection

Path:- If no node was encountered once, then the set of nodes and elements that we have passed through is defined as a path.

loop ~~node~~:- If the node at which we started is the same as the node on which we ended then the path is called a ~~node~~. loop.

Branches : Branches are connection between nodes.

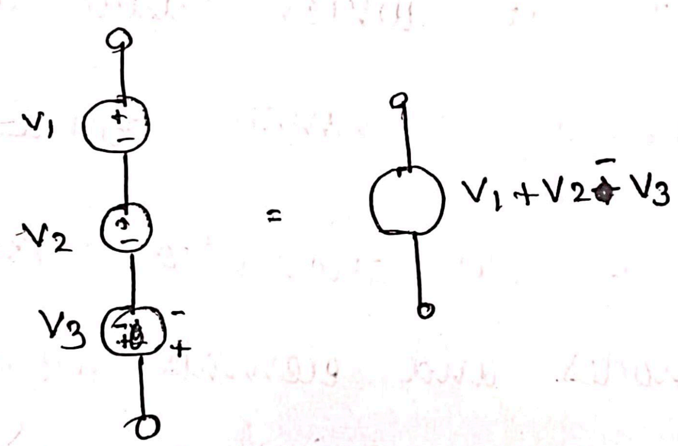
Network :-

interconnection of two (or) more simple circuit elements.

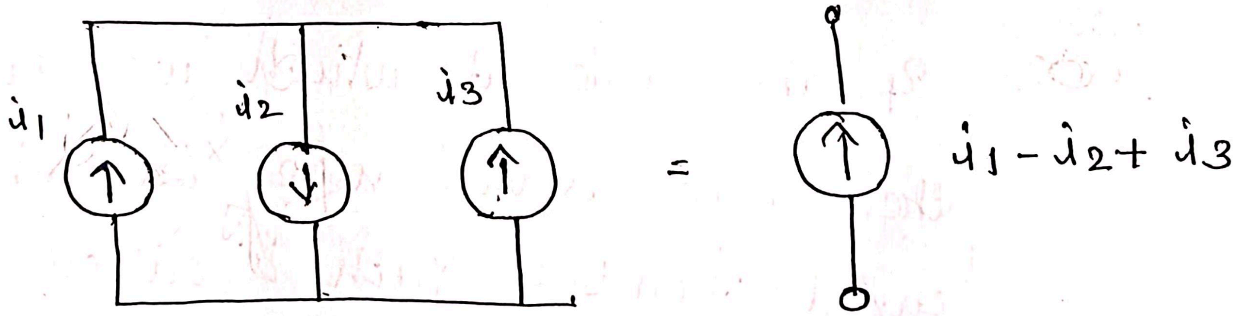
Circuit :- If the N/W contains atleast one closed path it is called a circuit.

Series and parallel connected sources.

① series connected voltage source can be replaced by a single source.



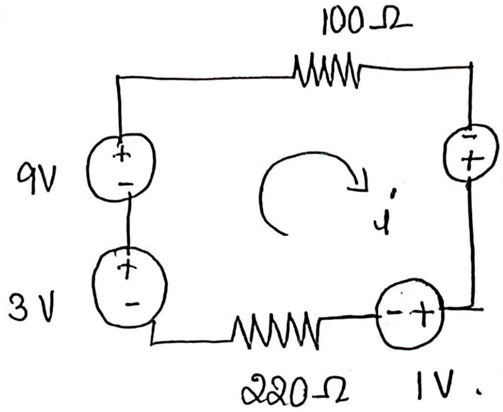
* If voltage sources are in parallel only same voltage will be there.



Practically current sources are not allowed to be connected in series.

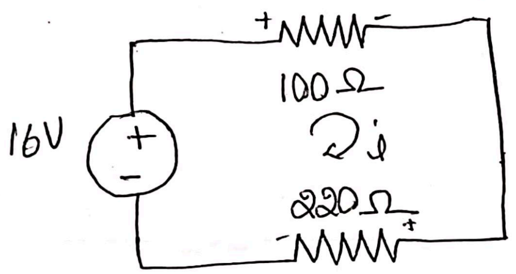
Series and parallel connected sources.

Q1. Determine the current 'i' in the circuit by first combining the sources into a single equivalent voltage source.



Soln: series connected voltage sources can be combined into a single source.

$3V + 9V + 5V - 1V = 16V$



KVL

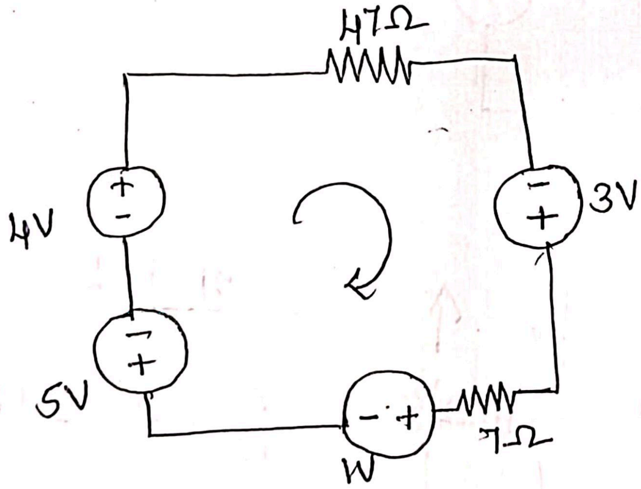
$16V + 320i = 0$

$320i = -16$

$i = \frac{-16}{320}$

$= -0.05$

Q2. Determine the current i in the ckt below.



Soln

$-5V + 4V + 3V - 1V$

$= 1V$

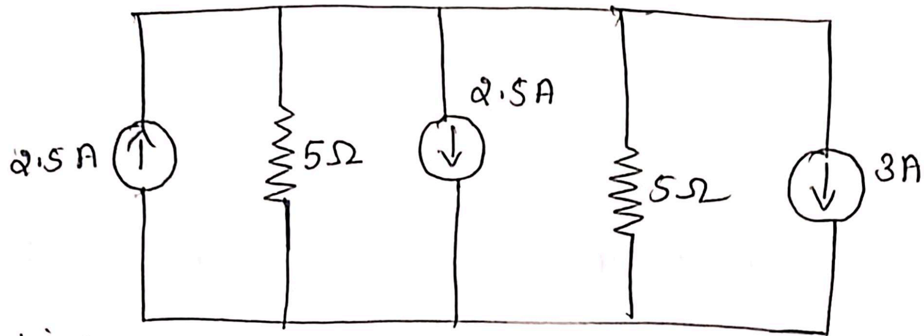
$54i + 1V = 0.$

$i = \frac{-1}{54}$

$= -0.0185A.$

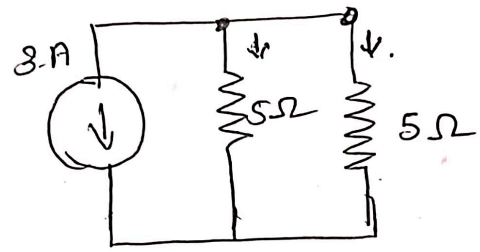
Q3. Determine the voltage in the circuit by first combining the source into a single equivalent current source.

(27)



Combine ct source

$$-2.5 + 2.5 + 3 = 3A.$$



$\cancel{R} = \cancel{\frac{25}{10}} = \frac{R_1 R_2}{\cancel{R_1 + R_2}}$.

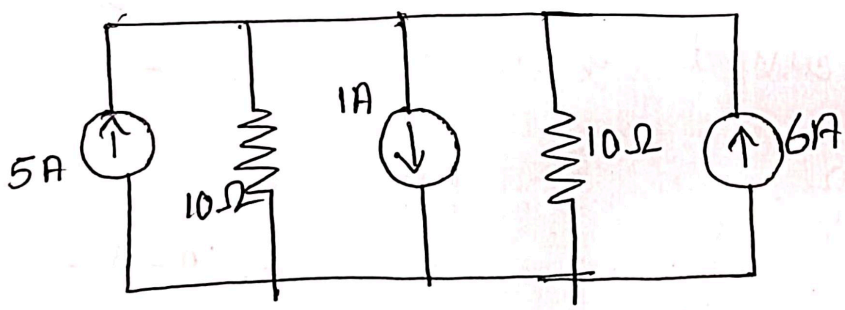
Apply KCL

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

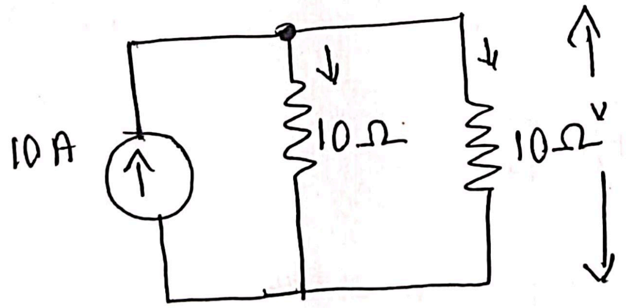
$$\frac{V}{5} + \frac{V}{5} = 3$$

$$\frac{2V}{5} = 3 \Rightarrow V = \frac{15}{2} = 7.5\,V.$$

24)



$$5 + 6 - 1 = 10A$$



Apply KCL

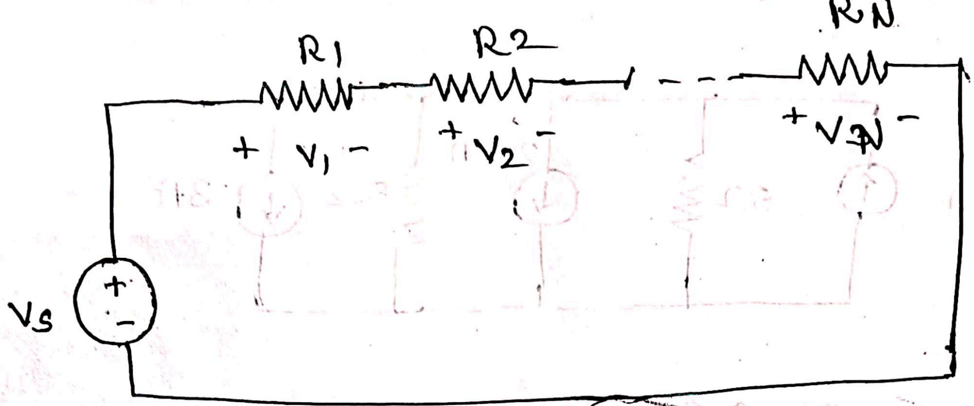
$$\frac{V}{10} + \frac{V}{10} = 10$$

$$2V = 100$$

$$\boxed{V = 50\,V}$$

Resistors in series and parallel.

Consider the series combination of N- resistors shown below.



we want to replace the N- resistors with a single equivalent resistor, Req.

Apply KVL,

$$V_S = V_1 + V_2 + V_3 + \text{----} V_N$$

$$V_S = iR_1 + iR_2 + iR_3 + \text{----} iR_N$$

$$V_S = i(R_1 + R_2 + R_3 + \text{---} R_N)$$

$$V_S = i R_{eq}$$

where $\boxed{R_{eq} = R_1 + R_2 + R_3 + \text{----} R_N}$

For parallel Resistors are

Incoming ct = outgoing current.

$$i_S = i_1 + i_2 + \cdots i_N.$$

$$i_S = \frac{V}{R_1} + \frac{V}{R_2} + \cdots \frac{V}{R_N}$$

$$= V\left[\frac{1}{R_1} + \frac{1}{R_2} + \cdots \frac{1}{R_N}\right]$$

$$\therefore \frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots \frac{1}{R_N}.$$

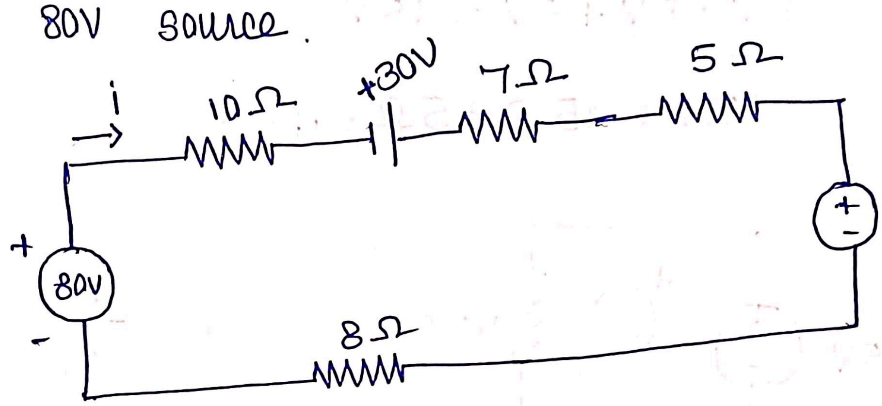
18/7 present not enrolled
34, 35, 37, 38, 42, 55

19/7 47 not enrolled

(30)

25 Resistors in series and parallel.

25) use resistance and source combination to determine the current 'i' in fig below & the power delivered by the 80V source.



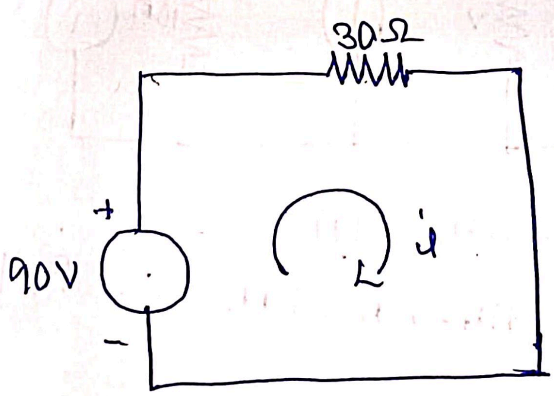
Soln

combine voltage source.

$+80 + 30V - 20V = 90V$

combine resistors

$10+7+5+8 = 30\Omega$.



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

$= \frac{90}{30}$

$\boxed{i = 3A}$

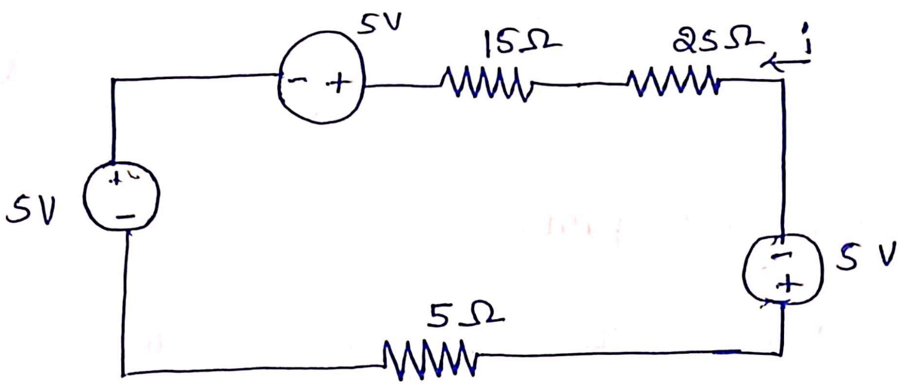
Power = VI

$= 80 \times 3$

$= 240$ watts.

(31)

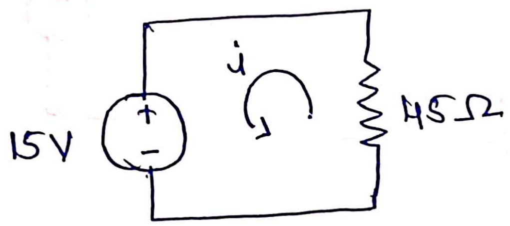
26)



vtg

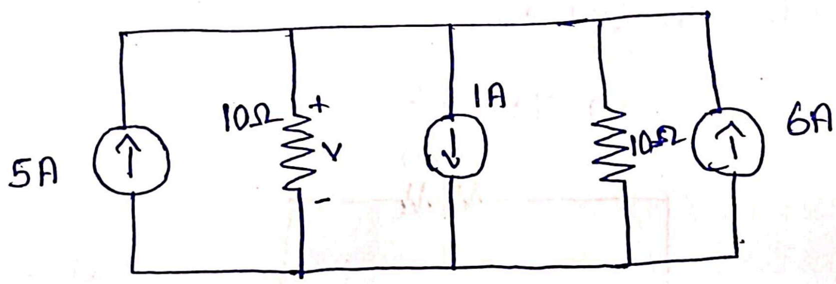
$5V + 5V + 5V = 15V.$

$15\Omega + 25\Omega + 5\Omega = 45\Omega.$



$i = \frac{-V}{R} = \frac{-15}{45} = -0.333A$

27) Determine v in the circuit by combining the 3 current sources and two 10Ω resistors.

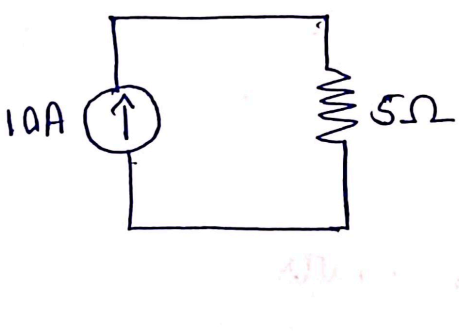


$5A + 6A = 11A$

$11A - 1A = 10A$

$R_1 \parallel R_2 = \frac{R_1 R_2}{R_1 + R_2}$

$= \frac{\cancel{10\Omega}\,\cancel{10}\Omega}{\cancel{20}\Omega}$ 5Ω

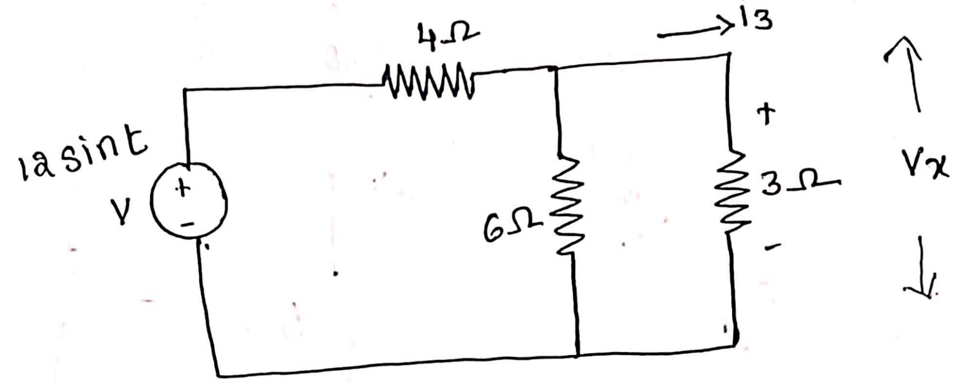


$V = IR$

$= 10 \times 5$

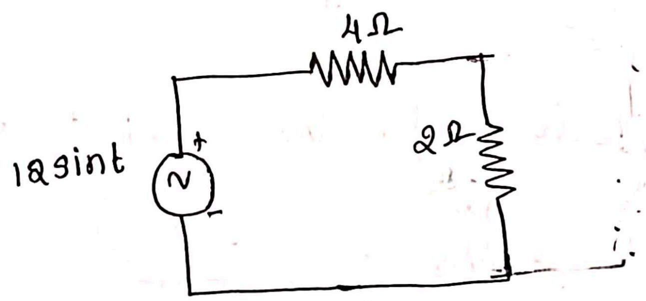
$\boxed{V = 50V}$

28) Determine V_x in the circuit using voltage division rule.



<u>soln</u>

$$R_{eq} = \frac{1}{R_1} \parallel 1/R_2 = \frac{R_1 R_2}{R_1 + R_2} = \frac{6\times 3}{6+3} = \frac{18}{9} = 2$$



By voltage divider rule,

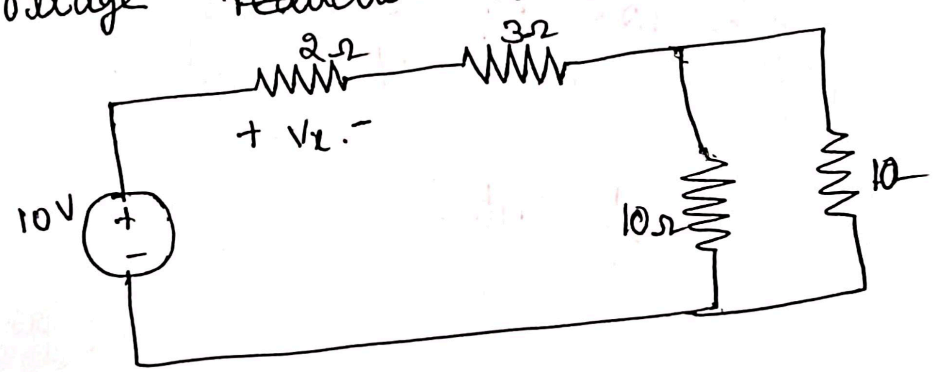
$$V_x = V \cdot \frac{2}{4+2}$$

$$= 12 \sin t \times \frac{2}{6}$$

$$= 12 \sin t (1/3)$$

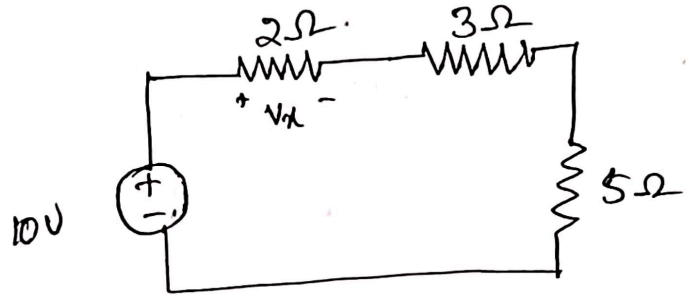
$$\boxed{V_x = 4 \sin t}$$

29) use voltage ~~reduction~~ division to determine V_x.

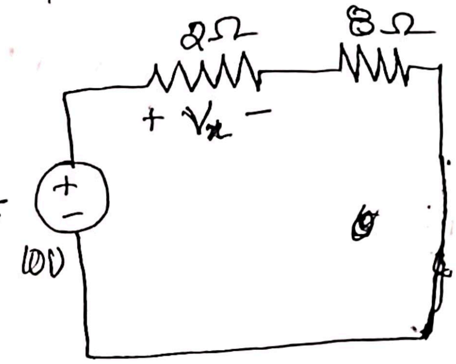


33

$$R_1 \| R_2 = \frac{R_1 R_2}{R_1 + R_2} = \frac{10 \times 10}{10 + 10} = \cancel{\frac{25}{10}} \; \frac{100}{20} = 5\Omega .$$



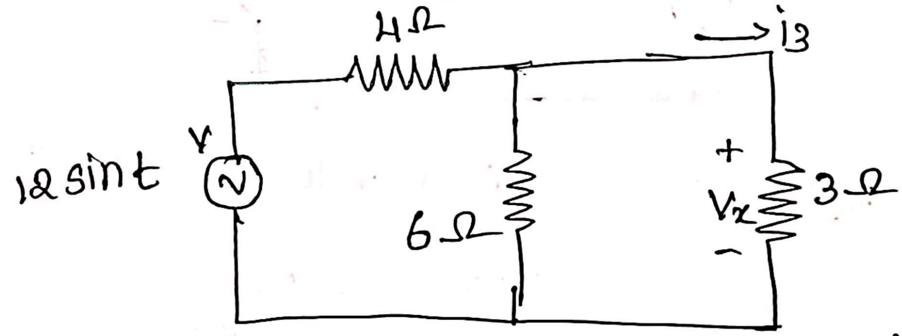
=



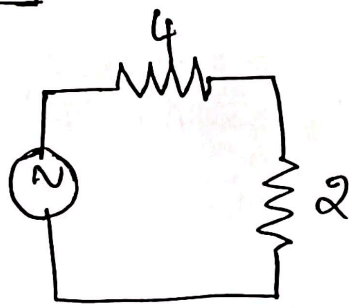
By vtg divider Rule

$$V_x = V \cdot \frac{2}{2+8} = 10 \times \frac{2}{10} = 2V .$$

30) write an expression for the current through 3Ω resistor



$$R_1 \| R_2 = \frac{R_1 R_2}{R_1 + R_2} = \frac{\cancel{6} \times \cancel{3}}{\cancel{9}} = 2$$



$$i_3 = i \times \frac{6}{6+3}$$

$$= \frac{\overset{4}{\cancel{12}} \sin t}{\cancel{6}} \cdot \frac{\cancel{6}}{\cancel{9}\,3}$$

$$= \frac{4}{3} \sin t .$$

$$i = \frac{V}{R} = \frac{12 \sin t}{6}$$