A	B	C	D
5	5	10	10
8	10	10	10
10	8	10	4.
8	5+10	5+2	2.+8

'Linear' & 'Circuit'

'Diode'

$$I = \text{Const}\left(e^{\frac{Vq}{KT}} - 1\right)$$

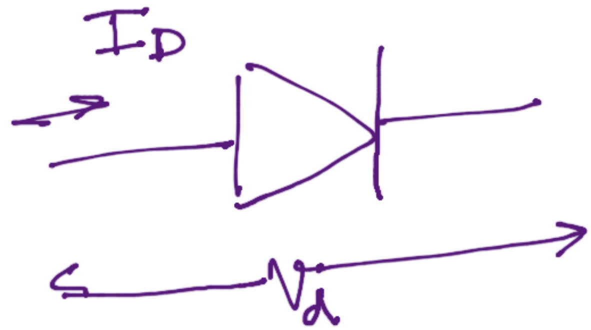
'Linear'

Expand

$$\ln \frac{(I+1)}{\text{Const}} = \frac{Vq}{KT}$$

$$e^{x} = 1 + \frac{x}{\lfloor 1} + \frac{x^2}{\lfloor 2} + \frac{x^3}{\lfloor 3} \cdots$$

diode equation



$$I_D = I_s \left[\exp\left(\frac{V_d}{V_T}\right) - 1 \right]$$

Non eq.

V_T = Thermal Voltage = $\frac{K \cdot T}{q}$

K = Boltzmann's constant.

T = Temp (K)

q = Charge = 1.6×10^{-19} C

I_s = Constant.

$\equiv$ Leakage current.

= Rev. Sat. Current

$$\exp \frac{V}{V_T} = \exp 'a'$$

$$a = \frac{V}{V_T}$$

$$\exp a = 1 + a + \frac{a^2}{\lfloor 2} + \frac{a^3}{\lfloor 3} + \cdots\cdots$$

Diode in Non Linear

Under what conditions can it be considered Linear.

$a \rightarrow$ small (< 1)

higher $\underbrace{a^2, a^3, \ldots}_{\text{neglection}} \rightarrow$ v. small negligible

$$\exp a = 1 + a$$

$$\exp\frac{V_d}{V_T} = I_s\left(1+\frac{V}{V_T}-1\right)$$

$$\text{if} \quad \frac{V_d}{V_T} \dot{<} 1 \Rightarrow V_d << V_T$$

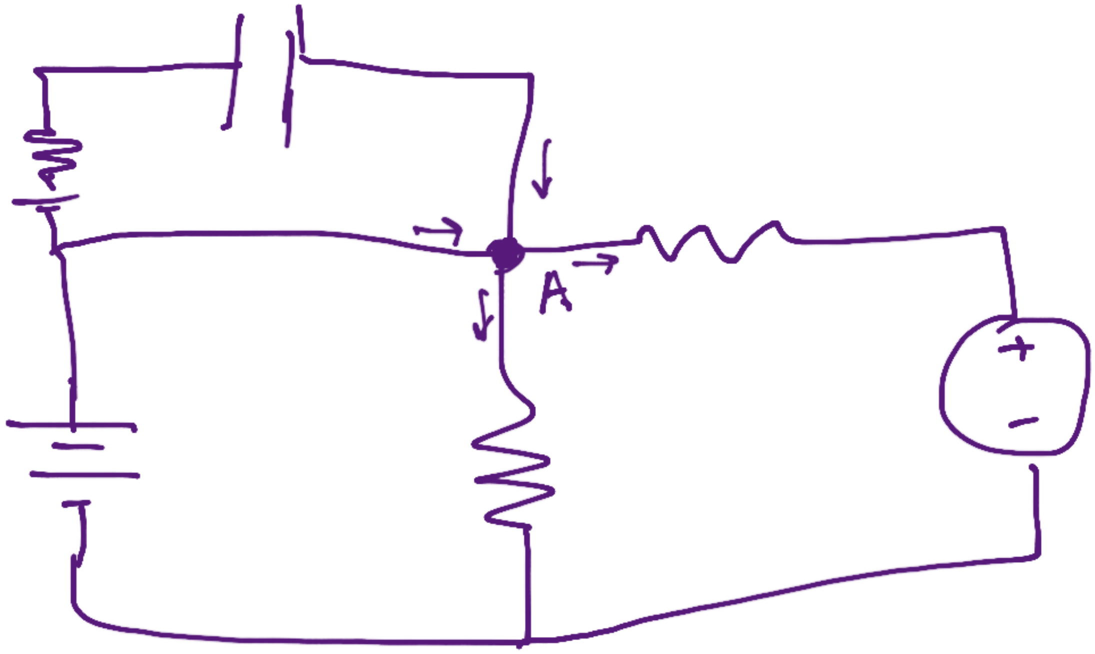
$$V_T = \frac{K(300K)}{q} = 26\,mV$$

What is the imp. of Linearization?

- Easy mathematical solution.
- analysis

Imp condition under which diode is linear.

	A	B	C	D
	5	5	10	10
	8	10	10	10
14th	10	8	10	4.
	8	5+10	5+2	2.+8
	10	10	10	10
16th	10	10	10	10
	10	10	10	10
	10	10	10	10

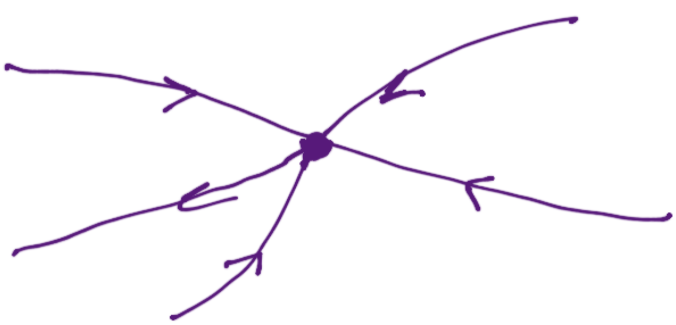


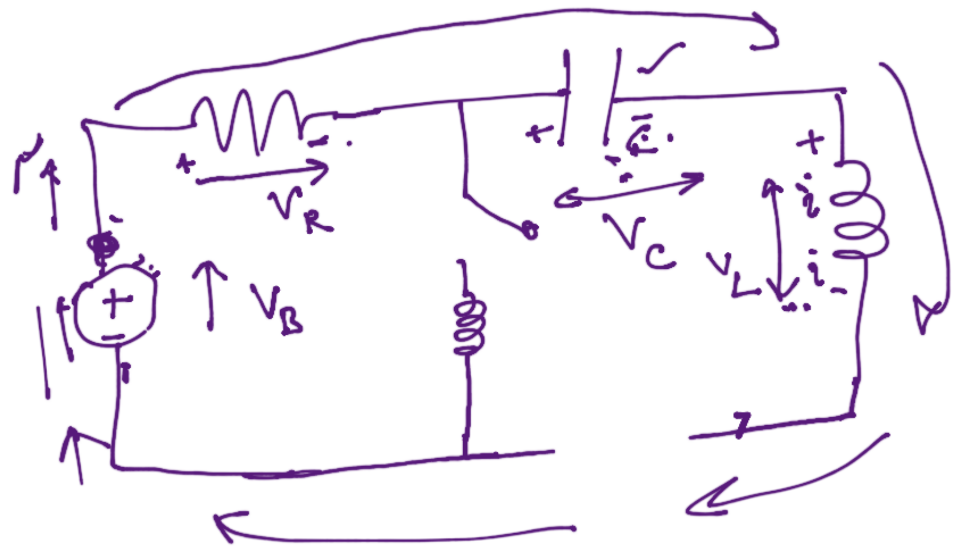
Total current at Node A

Net current = 0

KCL Kirchhoff's Current Law

$$\sum i_{in} + \sum i_{out} = 0$$





What is the total voltage/potential gained by the carrier. $= 0$

KVL   Kirchoff's Voltage Law

$$\sum V = 0$$

$$V_B = V_R + V_C + V_L$$

$$\Rightarrow \quad V_B - V_R - V_C - V_R = 0$$

$$\Rightarrow \quad \sum_{(loop)} V = 0$$

KVL

loop

$R_2 \times i_2 - R_1 \times i_1 = 0 \Rightarrow i_1 = 2 i_2$

$V_1 = i_1 / 30 = i_2 / 15$ [Ohm's]

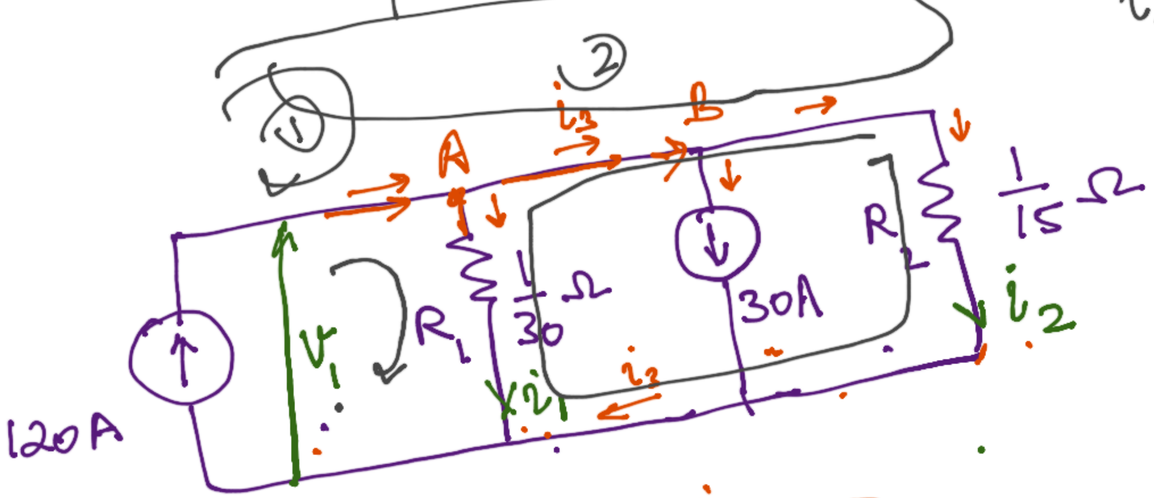
$i_1 + i_2 + 30 = 120$ (KCL)

$30 V_1 + 15 V_1 + 30 = 120$

$V_1 = \frac{90}{45} = 2$

$i_1 = 60$

$i_2 = 30$



(Mindful of direction KCL)

Node A $120A = i_1 + i_3$

$i_3 + 30A$

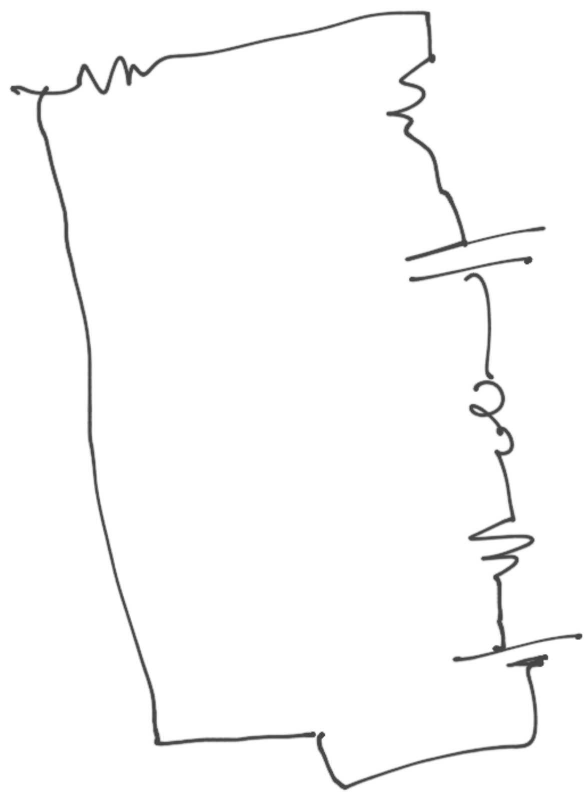
Node B $i_3 = i_2$

$i_1 + i_2 + 30 = 120$ (KCL)

Ohm's law $\frac{1}{30} i_1 = \frac{1}{15} i_2 \rightarrow i_1 = i_2 * 2$

$V = 2V,\ i_1 = 60A,\ i_2 = 30A$ $\quad i_1,\ i_2,\ V_1$ [B]

$\boxed{\text{KVL}}$

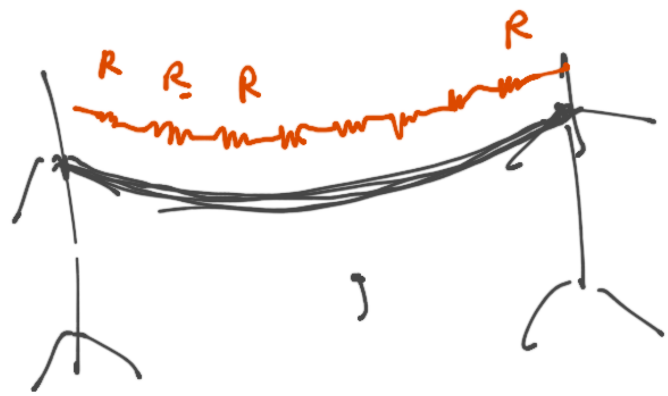


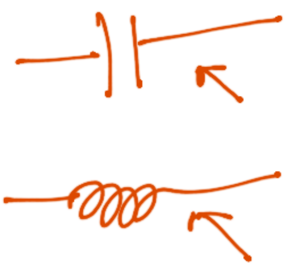
KVL

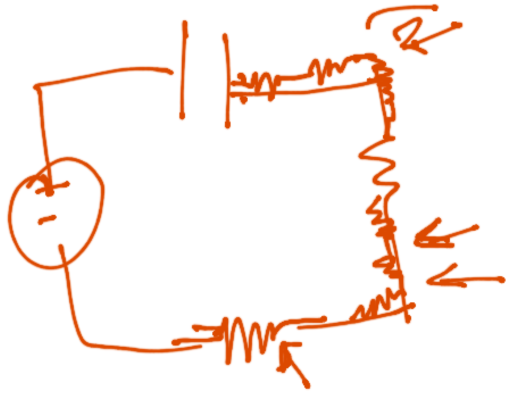
Chap-3

Lumped

Distributed







Uniformly present throughout the length of cord.

10K

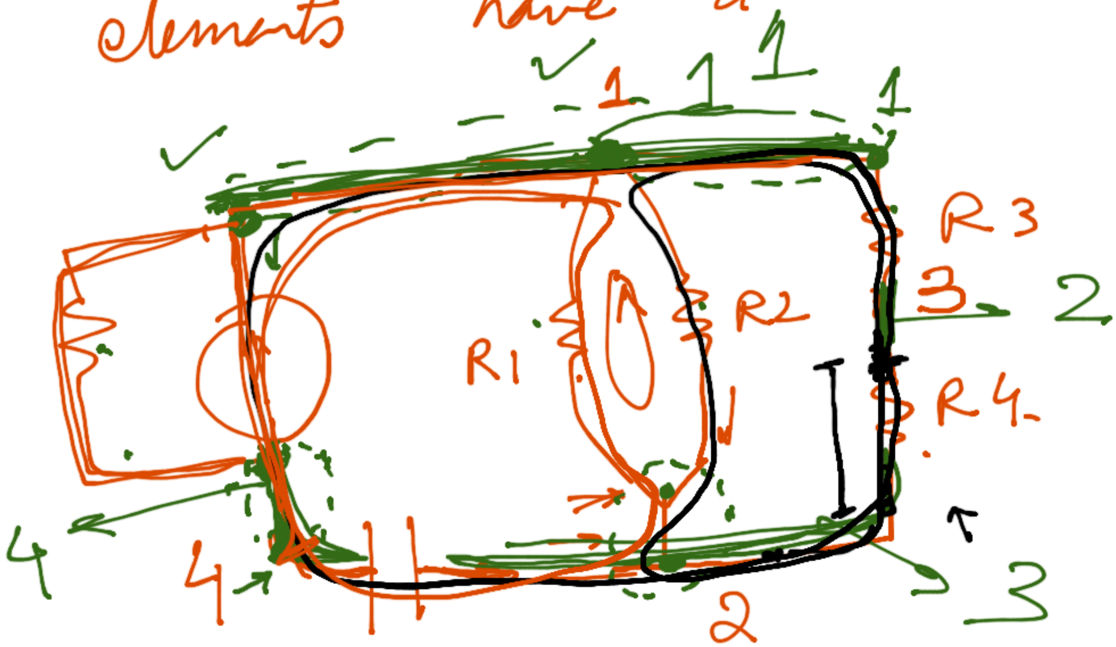
100K

1M

⋮

Node

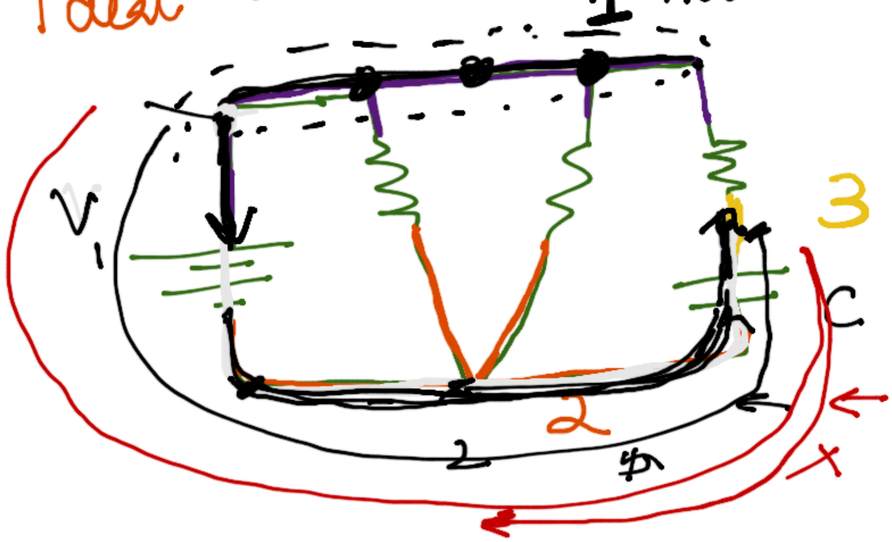
A point at which two or more elements have a common connection.



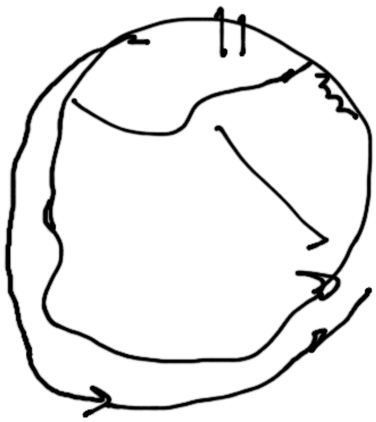
1

4 Nodes

→ Ideal wire connection.



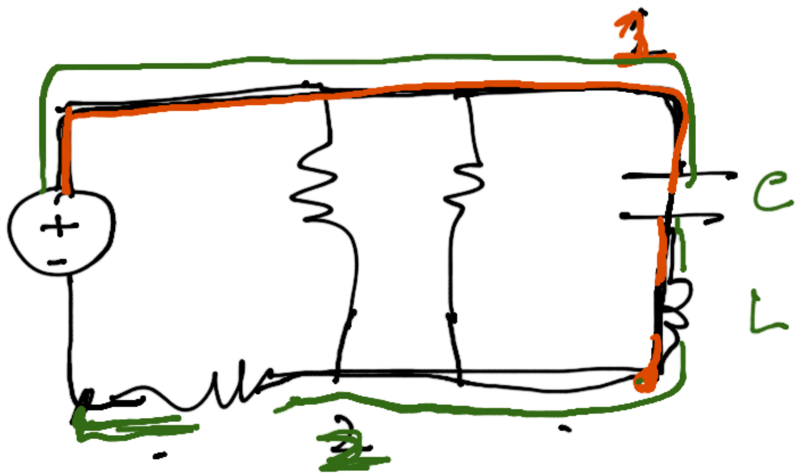
Path : No node or element is covered twice



Loop : Path starting & ending point are same.

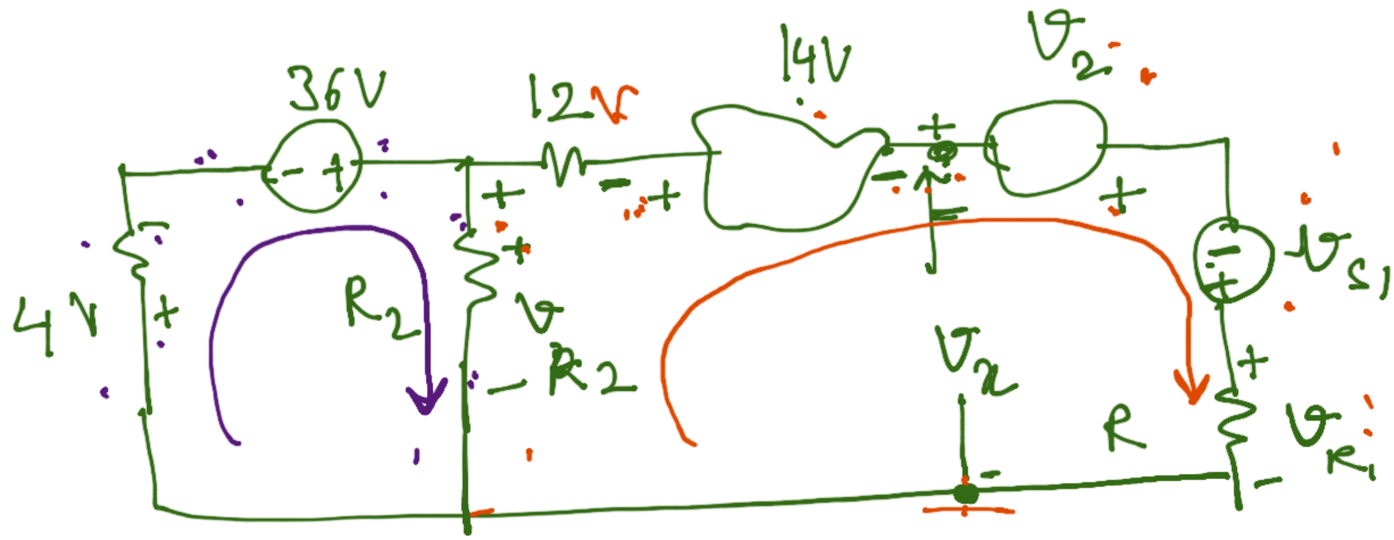
Element = Component : R, C, V_{source}, I_{source}, L

Branch : One path with one element and its two node.



Loop KVL $\sum v = 0$

Node KCL $\sum i = 0$



KVL & find v_{R_2} & v_x

$$-4V + 36V - v_{R_2} = 0$$

$$\underline{v_{R_2} = 32V}$$

$$32 - 12V - 14V + v_2 + v_{s_1} - v_{R_1} = 0$$

$$v_2 + v_{s_1} - v_{R_1} = 6V = v_x$$

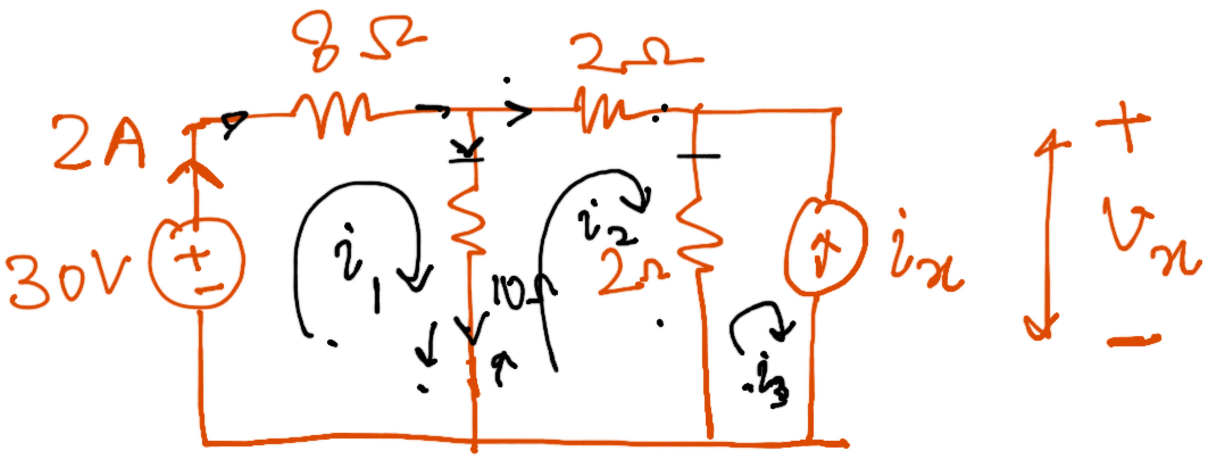
1. Drop $\rightarrow$ + ⏦ −

Pot. Inc.

v_i ?

2. Loop :

Fix dir. of traversing.



Voltage across the current source i_x ?

KVL & KCL

$$v_x = 12.8V$$

$$i_1 = 2A$$

L1 $\quad 30 - 8\times 2 - 10\times(2 - i_2) = 0$

$$\Rightarrow \quad i_2 = 1.4\,V$$

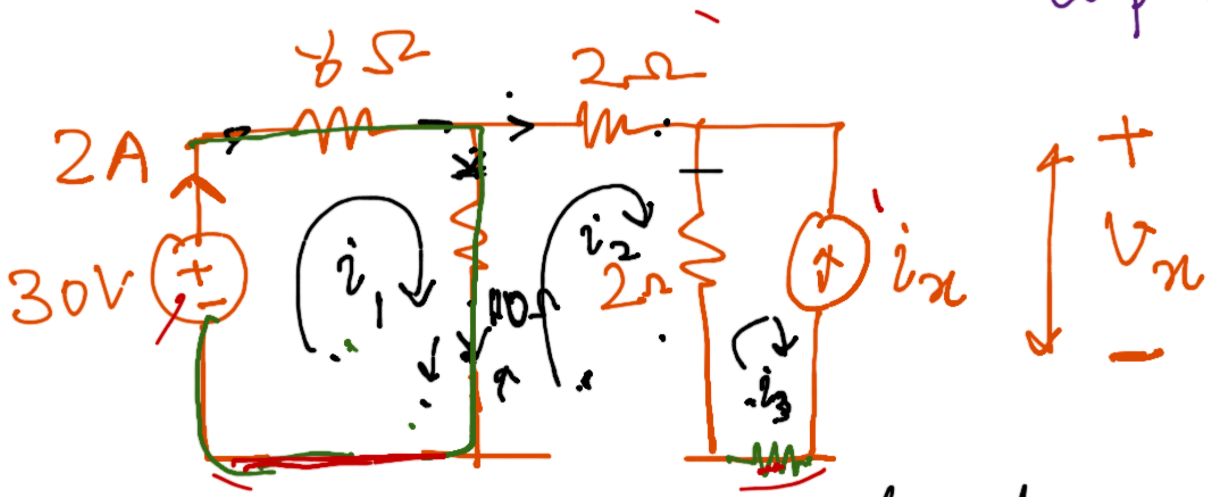
L2 $\quad 10(i_2 - i_1) - 2 * i_2 - 2(i_2 - i_3) = 0$

$$i_3 = \ ?$$

L3 $\quad 2(i_3 - i_2) - v_x = 0$

$v_x = 12.\ V$

'Loop current'



1. Assumed current direction

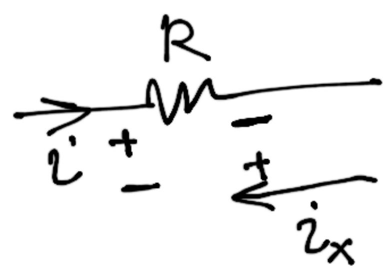
(Drop, Rises)

Clock. assume current in each loop.

i_1 , i_2 , i_3

2. Write KVL

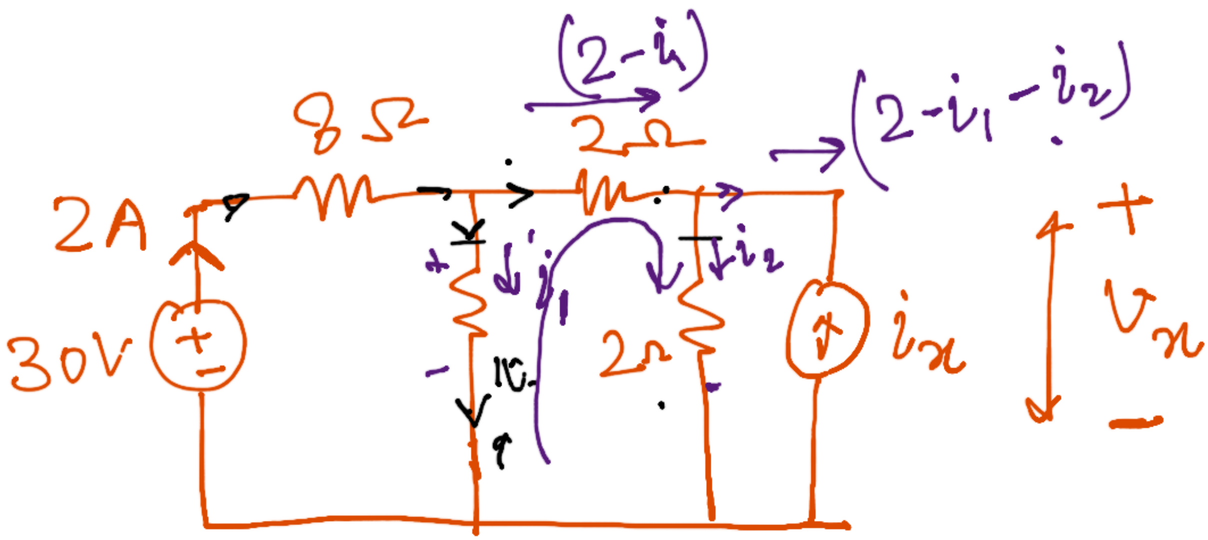
R . iR



$R(i - i_x)$

$10(i_1 - i_2)$

'Branch current'



$$30 - 8\times 2 - 10\, i_1 = 0$$

$$i_1 =$$

$$+10\, i_1 - 2\,(2-i_1) - \underbrace{2\, i_2} = 0$$

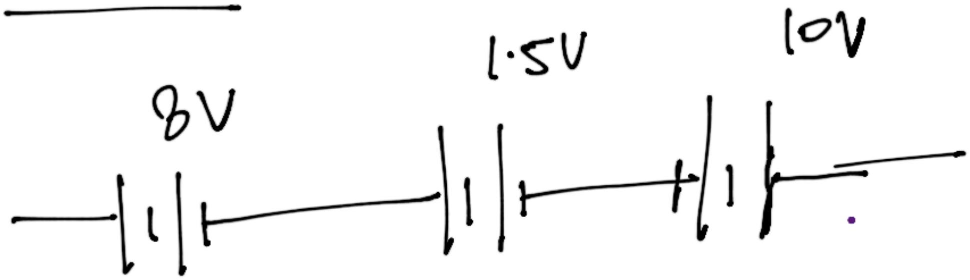
$$i_2 = 0$$

$$v_x = 2i$$

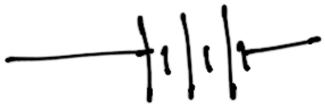
Assume current Branch

Loop

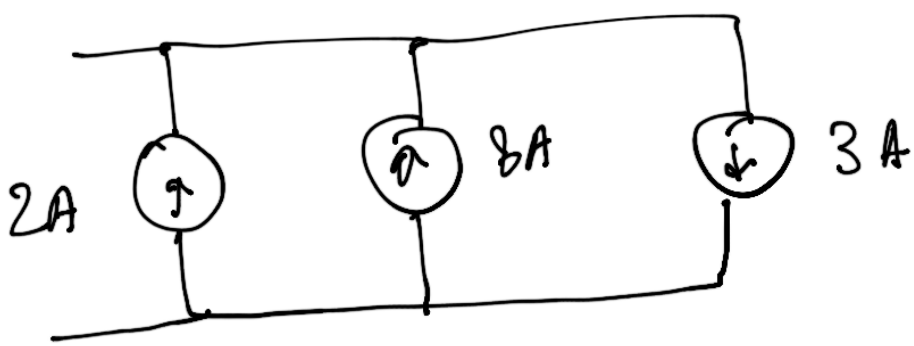
Series



$\equiv$



$\Sigma(8 + 1.5 - 10)$

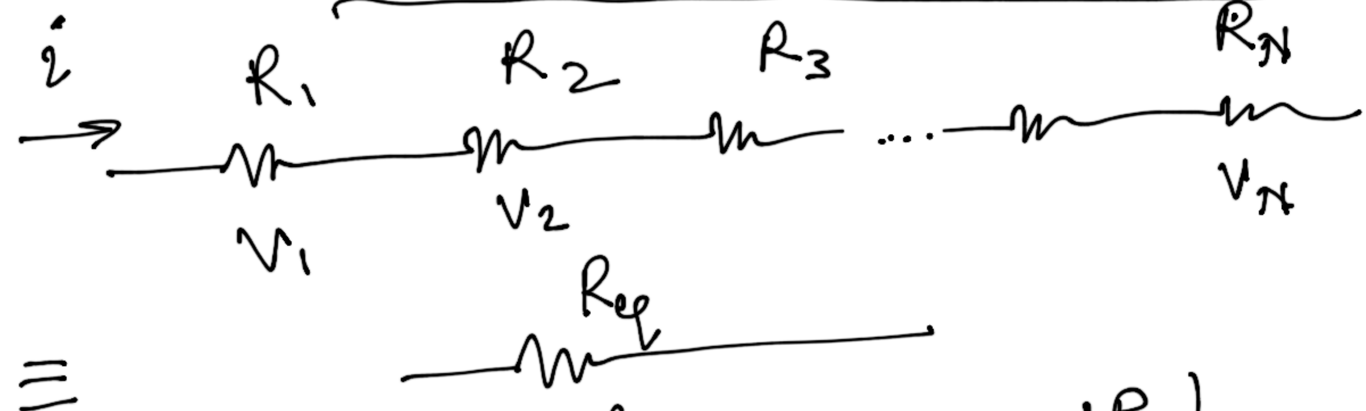


$\equiv$

$(2+8-3)$

$= 7A$

Resistances in Series & Parallel



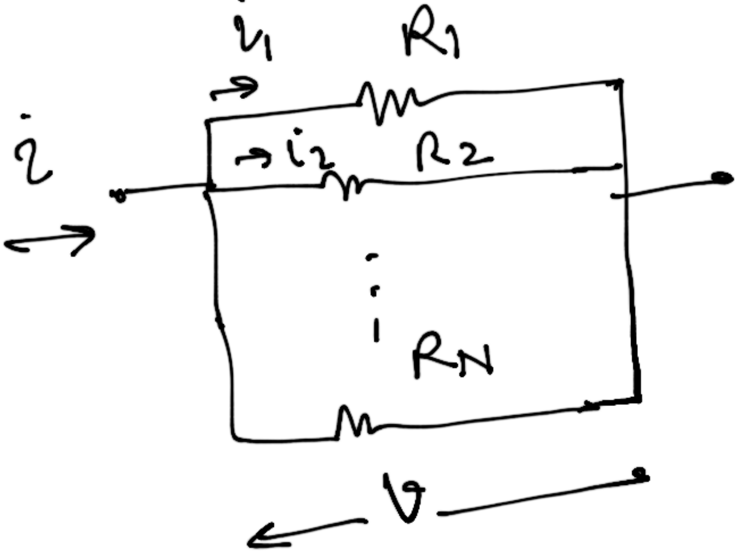
$$R_{eq} = \sum (R_1 + R_2 + \cdots + R_N)$$

$$V_{eq} = (V_1 + V_2 \quad)$$

$$= \sum V_i$$

$$= i \sum (R_1 + R_2 \cdots)$$

$$= i R_{eq}.$$



$$I = \sum i$$

$$= i_1 + i_2 \cdots i_N$$

$$= \frac{v}{R_1} + \frac{v}{R_2} \cdots + \frac{v}{R_N}$$

$$= v \left(\frac{1}{R_1} + \cdots + \frac{1}{R_N} \right)$$

$$I = v / R_{eq}$$