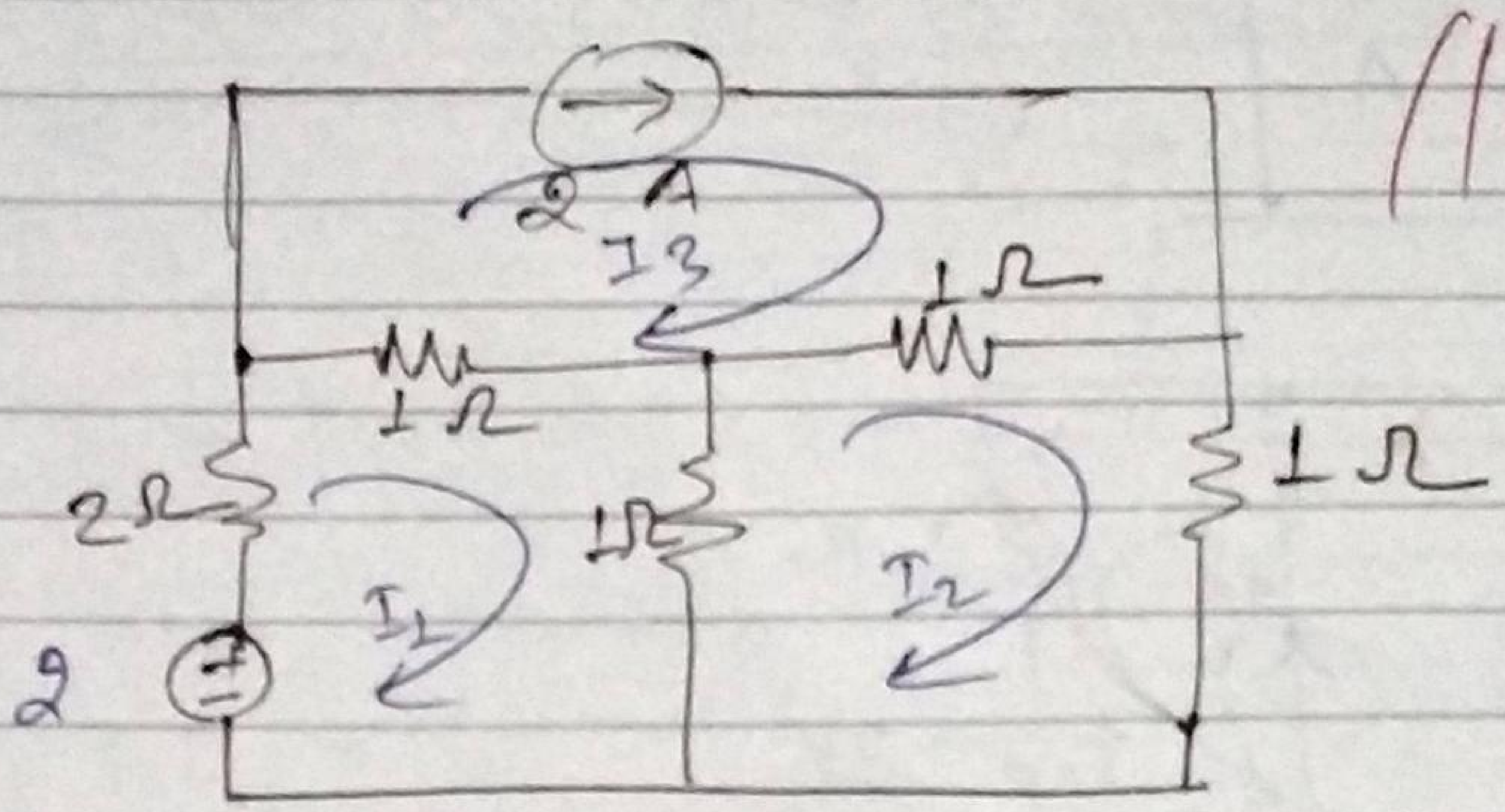
Ques. Find the mesh current in the below N/W –



// Single mesh bcz current source is only in one mesh. //

(1) :–

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

$$4I_1 - I_2 - I_3 = 2 \quad \text{—— (1)}$$

(2) :–

$$(I_2 - I_3) + I_2 + (I_2 - I_1) = 0$$

$$-I_1 + 3I_2 - I_3 = 0 \quad \text{—— (2)}$$

(3) :– $I_3 = 2A$ —— (3)

(3) in (1) & (2) :–

$$4I_1 - I_2 = 4 \quad \text{—— (4)}$$

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$-I_1 + 3I_2 = 2$ —— (5)

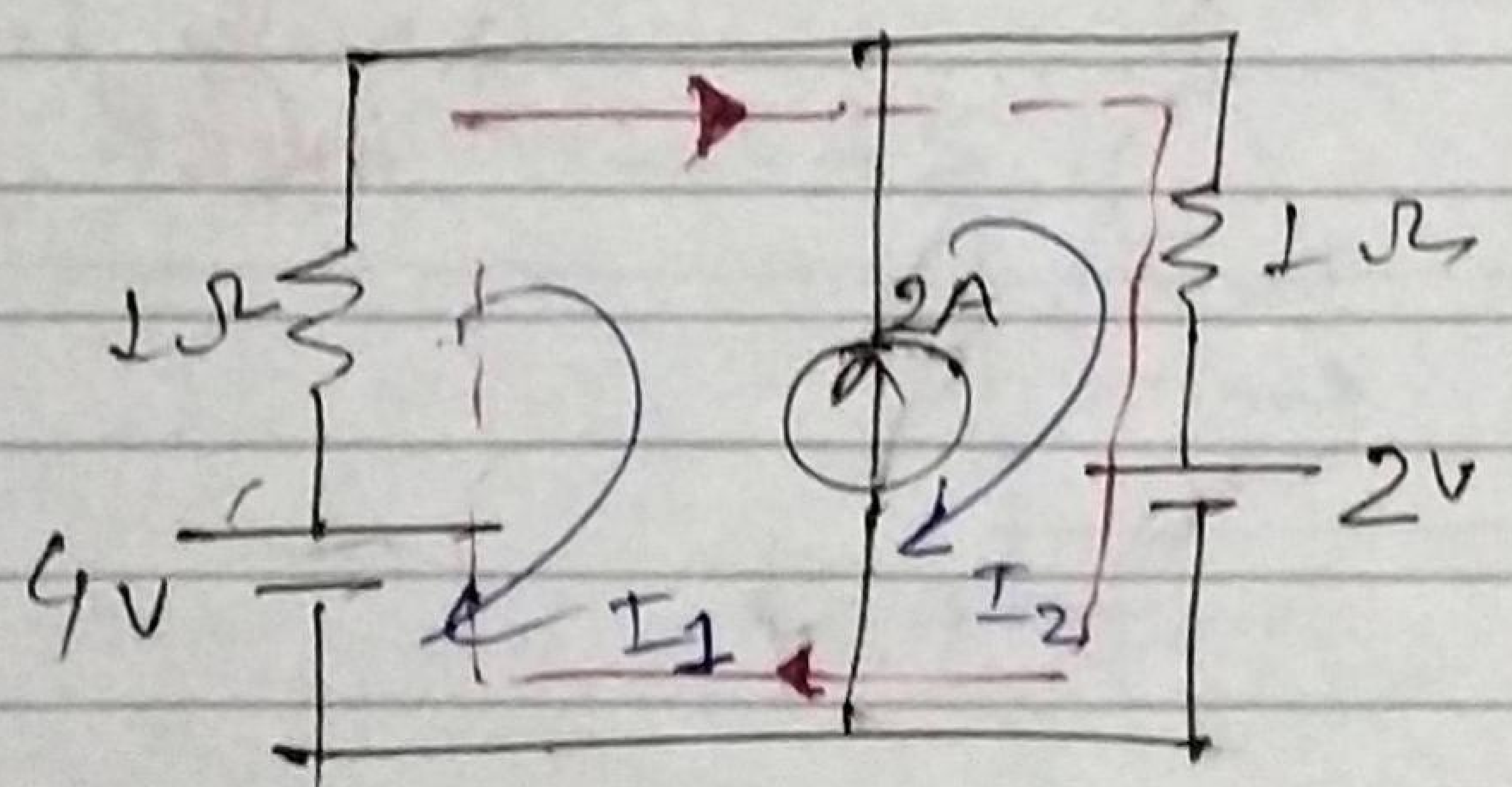
$3 \times (4) + (5) \Rightarrow$

$11 I_1 = 14$ $\quad \boxed{I_1 = \frac{14}{11} A}$

$-\frac{14}{11} + 3I_2 = 2 \Rightarrow 3I_2 = 2 + \frac{14}{11}$

$\boxed{I_2 = \frac{12}{11} A}$

Ques :-



Super mesh :- $-4 + I_1 + I_2 + 2 = 0$

$I_1 + I_2 = 2$ —— (1)

$-I_1 + I_2 = 2$ —— (2)

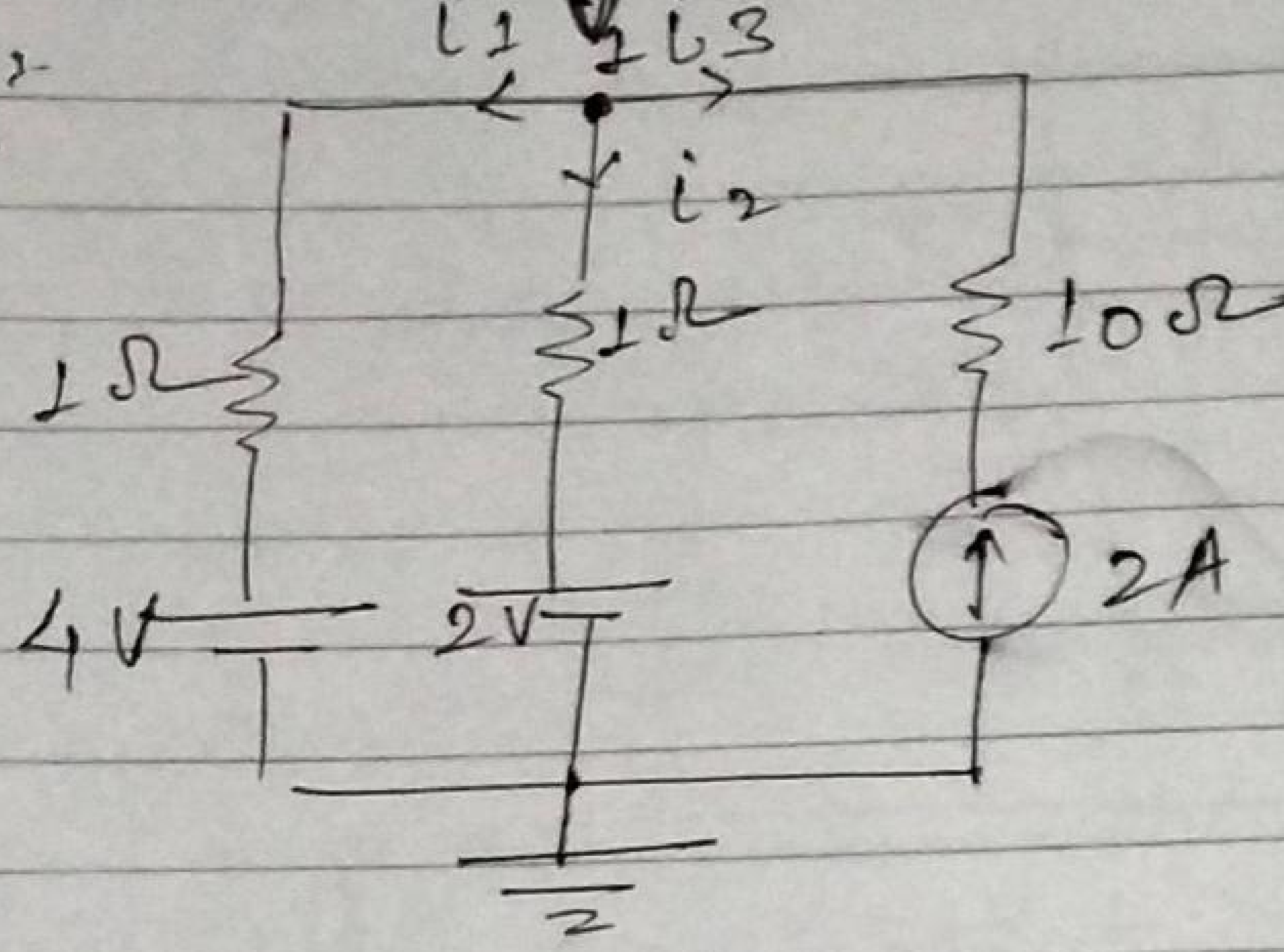
(1) + (2) $\quad 2I_2 = 4$ $\quad \boxed{I_2 = 2A}$ $\quad \boxed{I_1 = 0 A}$

Nodal Analysis :-

Procedure :-

* Identify total no of nodes.
* Asign the voltage at each node, one of the node is taken as the reference Node. (OR datum) And the reference Node potential should be equal to the ground potential.
* Develop KCL eq^ns for each non reference node.
* By solving KCL eq^ns find node voltages.

Ques :-



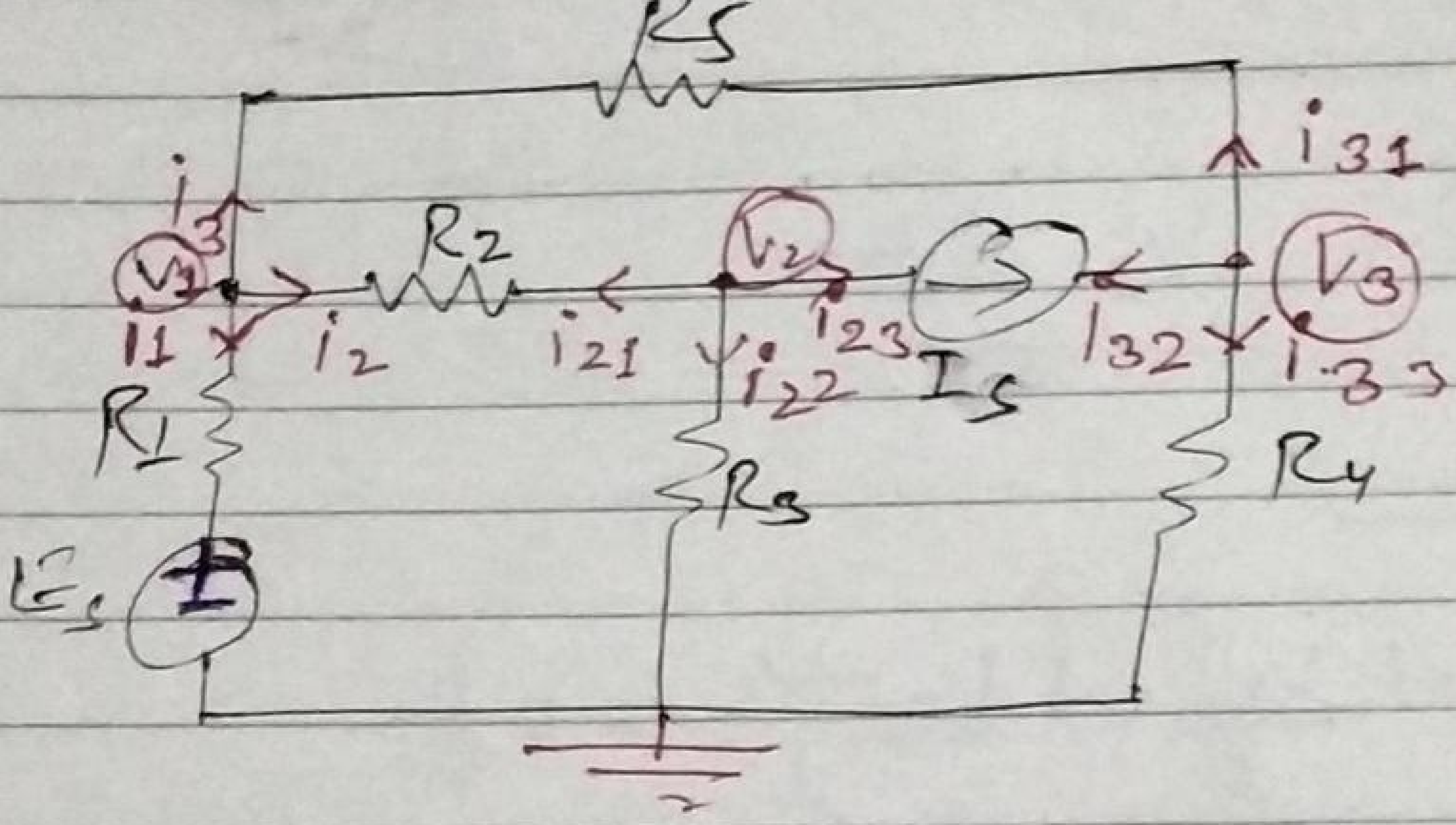
$i_1 + i_2 + i_3 = 0$

$\frac{(V_1 - 0) - 4}{1} + \frac{(V_1 - 0) - 2}{1} - 2 = 0$

$2V_1 - 4 - 2 - 2 = 0$

$\boxed{V_1 = 4V}$

Ques :-



Node1 :-

$i_1 + i_2 + i_3 = 0$

$\frac{(V_1 - 0) - E_s}{R_1} + \frac{(V_1 - V_2)}{R_2} + \frac{V_1 - V_3}{R_5} = 0$

Node2 :-

$i_{21} + i_{22} + i_{23} = 0$

$\frac{V_2 - V_1}{R_2} + \frac{V_2 - 0}{R_3} + I_s = 0$

Node 3 :- $i_{31} + i_{32} + i_{33} = 0$

$\frac{V_3 - V_1}{R_5} - I_s + \frac{V_3 - 0}{R_4} = 0$

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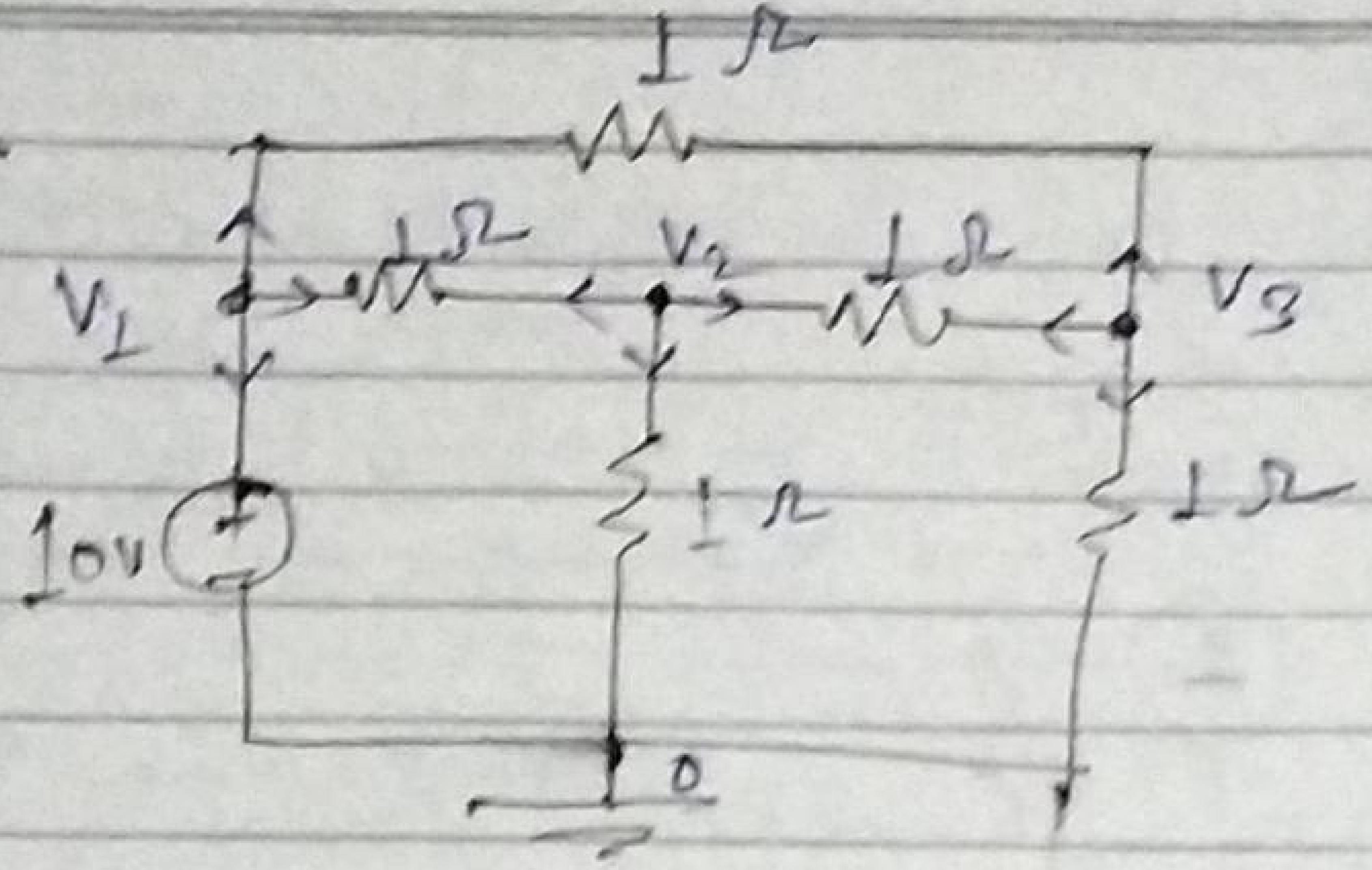
Ques



$$\cancel{\frac{V_1-0}{}-10 \qquad \frac{V_1-V_2}{1}+\frac{V_1-V_2}{1}=0}$$

At Node ①:- $V_1 = 10V$

At Node ②:-

$$\frac{V_2-10}{1}+\frac{V_2}{1}+\frac{V_2-V_3}{1}=0$$

$$3V_2 - V_3 = 10 \text{ ——— } ①$$

At Node ③:-

$$\frac{V_3-10}{1}+\frac{V_3-V_2}{1}+\frac{V_3}{1}=0$$

$$-V_2 + 3V_3 = 10 \text{ ——— } ②$$

① × 3 + ②

$8V_2 = 40\,V$

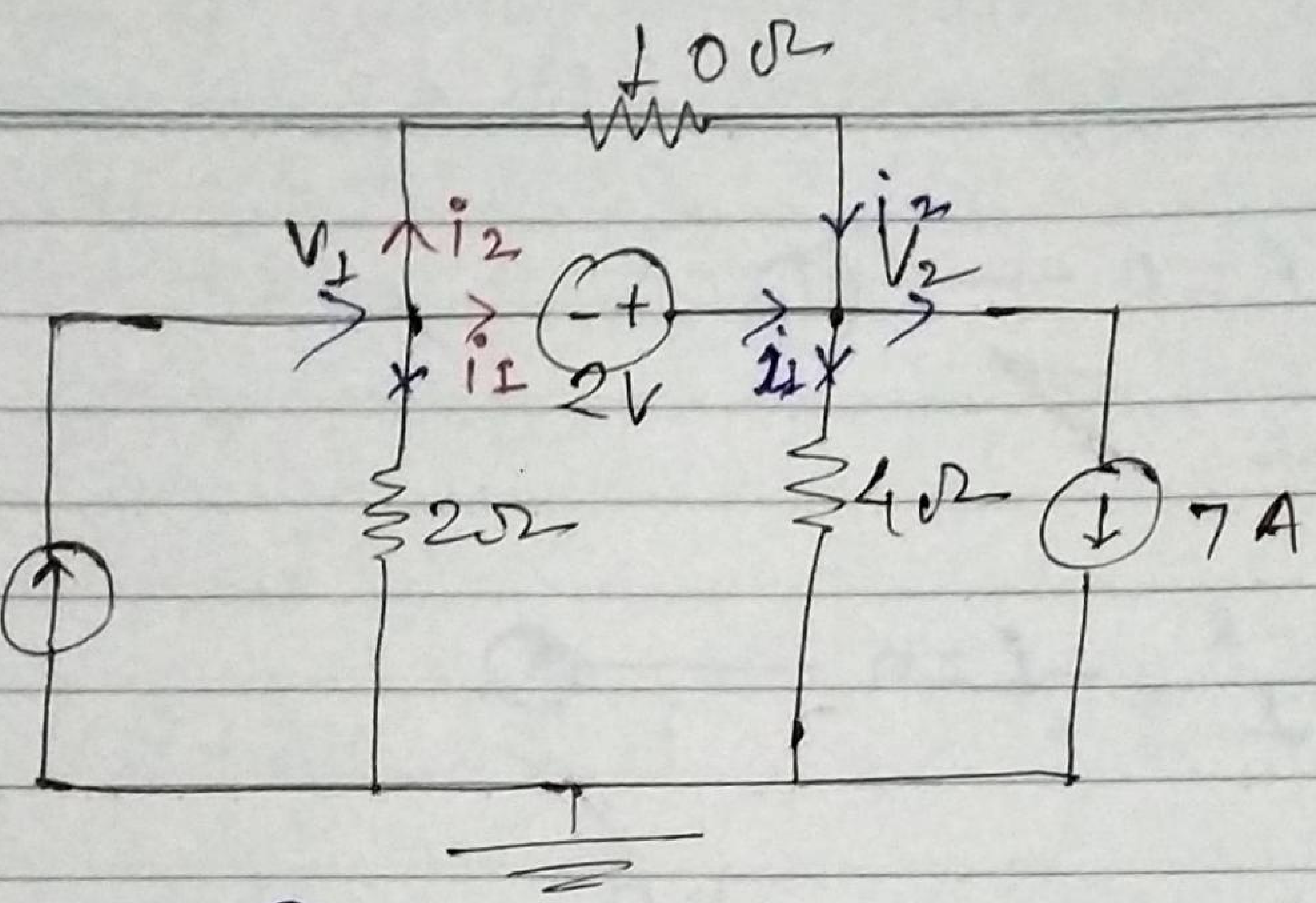
$\boxed{V_2 = 5\,V}$

$-5 + 3V_3 = 10$

$3V_3 = 15$

$\boxed{V_3 = 5\,V}$

Ques :-



At Node ① :-

$$-2 + \frac{V_1}{2} + i_1 + i_2 = 0 \quad \text{——— ①}$$

At Node ② :-

$$-i_2 - i_1 + \frac{V_2}{4} + 7 = 0 \quad \text{——— ②}$$

① + ②

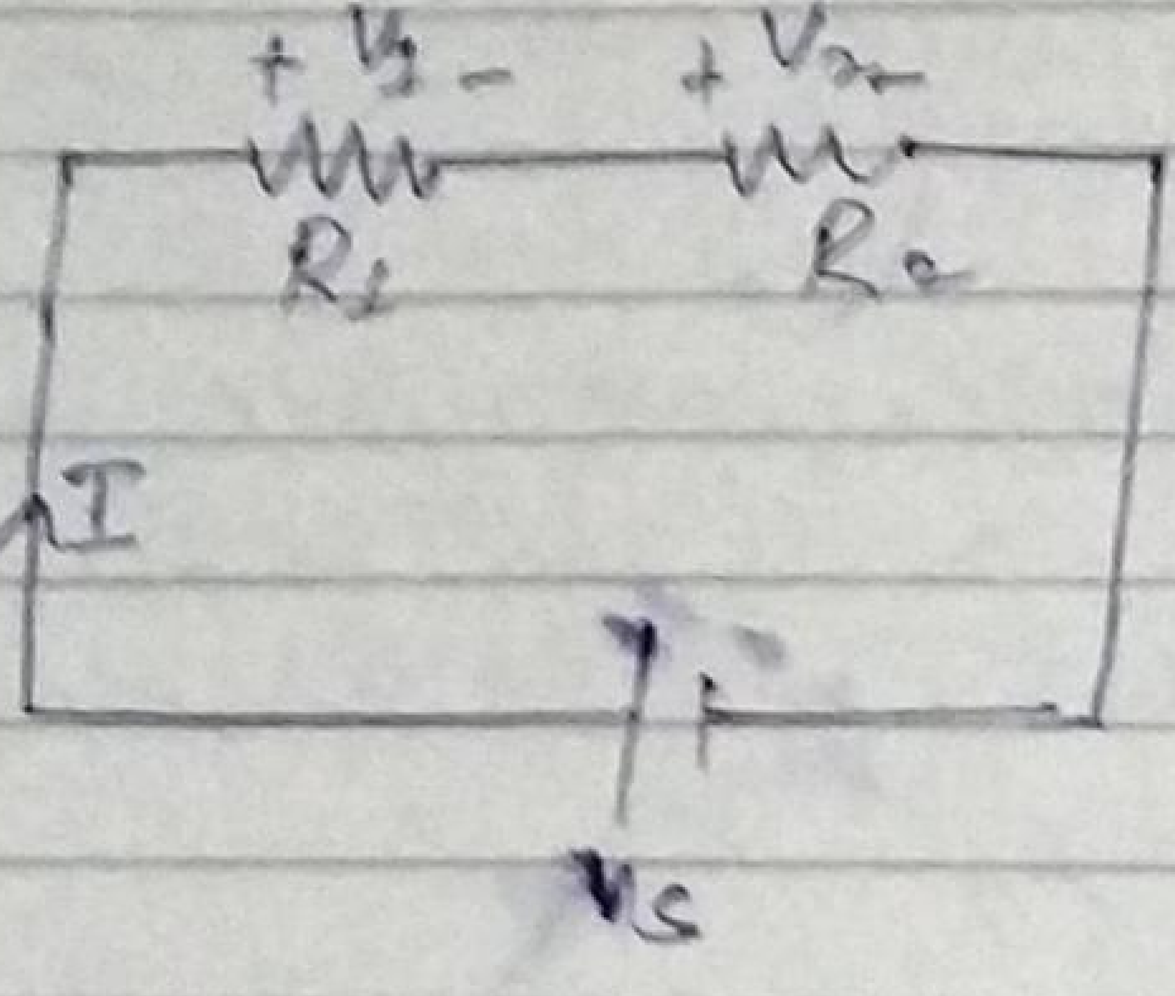
$$\underbrace{-2 + \frac{V_1}{2}}_{\text{from first Node}} + \underbrace{\frac{V_2}{4} + 7}_{\text{from second Node}} = 0 \rightarrow \text{Super Node eq}^n \text{ ①}$$

and from the ckt —

$$V_2 - V_1 = 2 \quad \text{——— ②}$$

$\therefore$ $V_1 = -7.33V$ $V_2 = -5.33V$

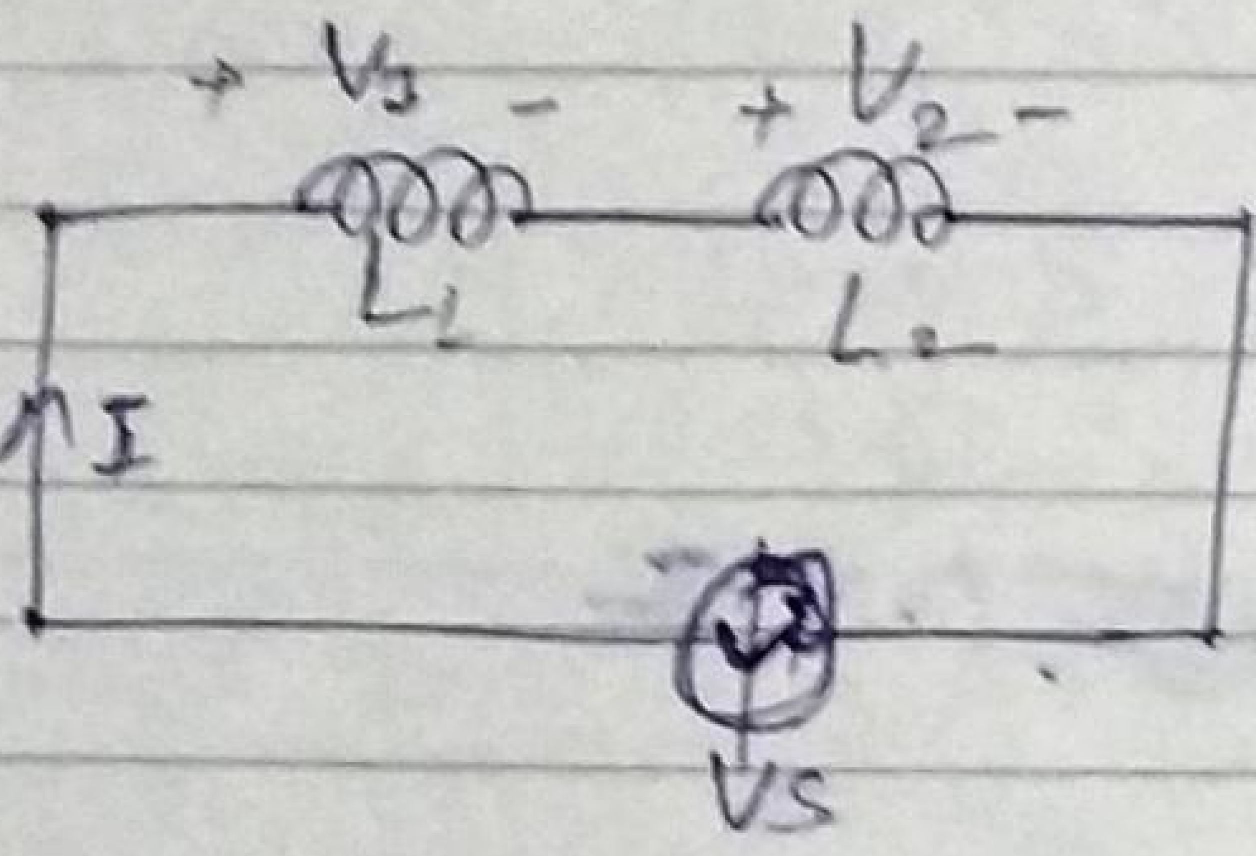
Voltage Division in Series Combination :-



$$R_{eq} = R_1 + R_2$$

$$V_1 = V_s \cdot \frac{R_1}{R_1 + R_2}$$

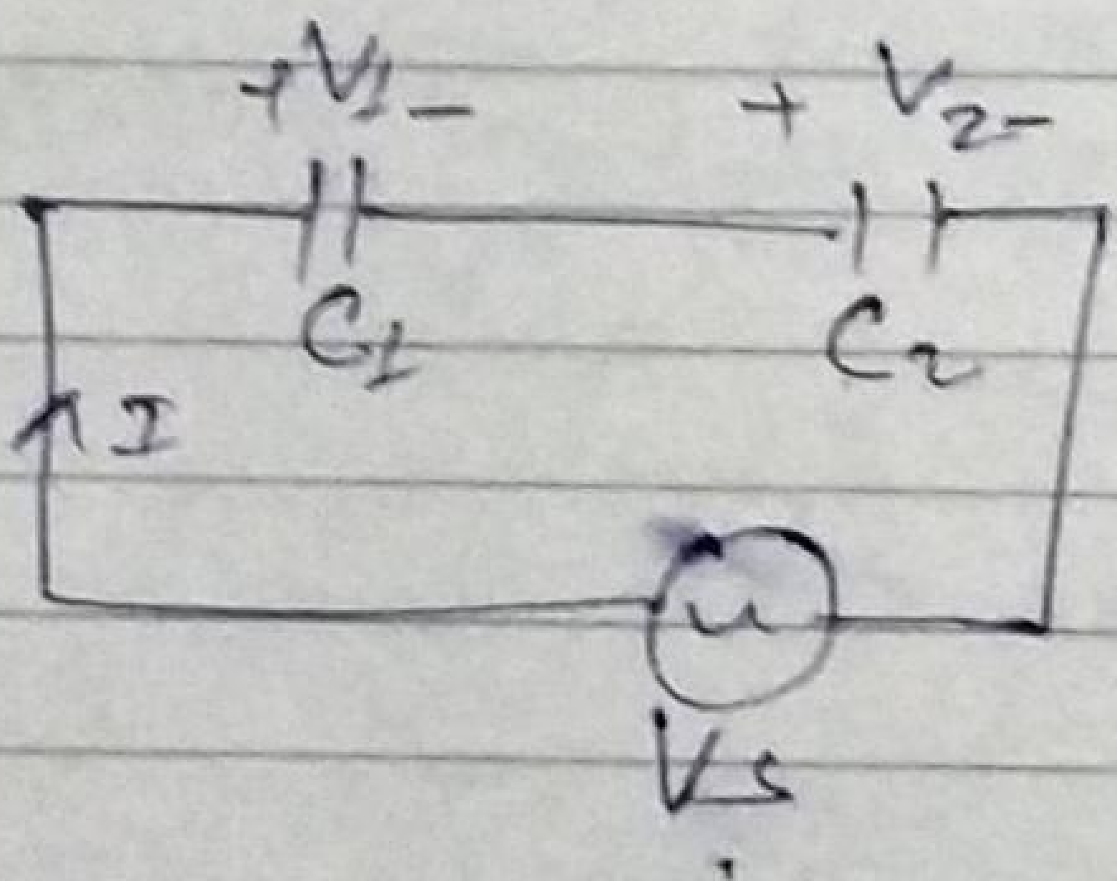
$$V_2 = V_s \cdot \frac{R_2}{R_1 + R_2}$$



$$L_{eq} = L_1 + L_2$$

$$V_1 = V_s \left(\frac{L_1}{L_1 + L_2} \right)$$

$$V_2 = V_s \left(\frac{L_2}{L_1 + L_2} \right)$$



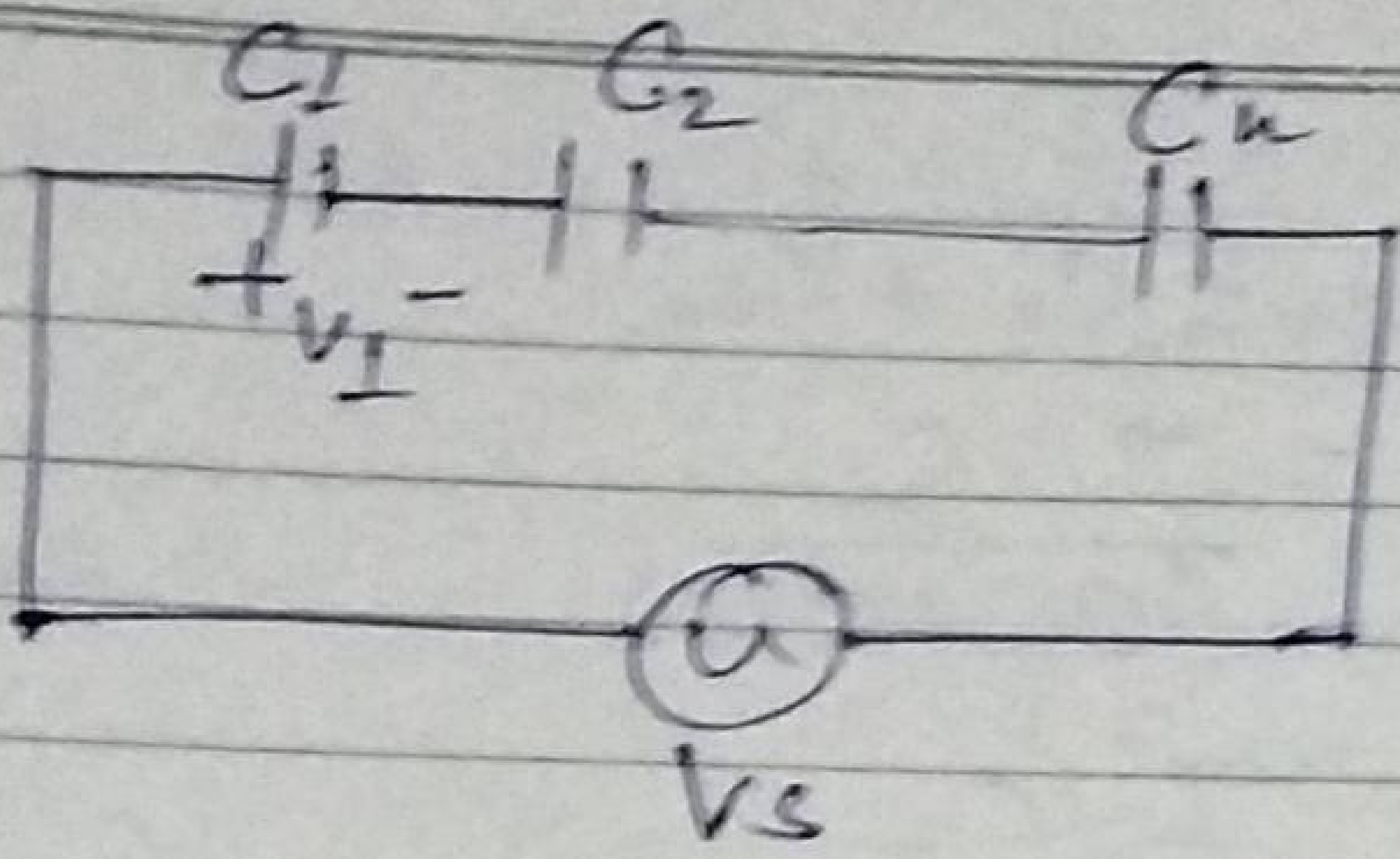
$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}$$

$$V_1 = V_s \cdot \frac{C_2}{C_1 + C_2}$$

$$V_2 = V_s \cdot \frac{C_1}{C_1 + C_2}$$

$$V_1 = V_s \cdot \frac{\frac{1}{j\omega C_1}}{\frac{1}{\cancel{j\omega} C_1} + \frac{1}{\cancel{j\omega} C_2}} = \frac{V_s\, \cancel{C_1} C_2}{C_1 + C_2} \left(\frac{1}{\cancel{C_1}} \right)$$

$$\boxed{V_1 = V_s \frac{C_2}{C_1 + C_2}}$$

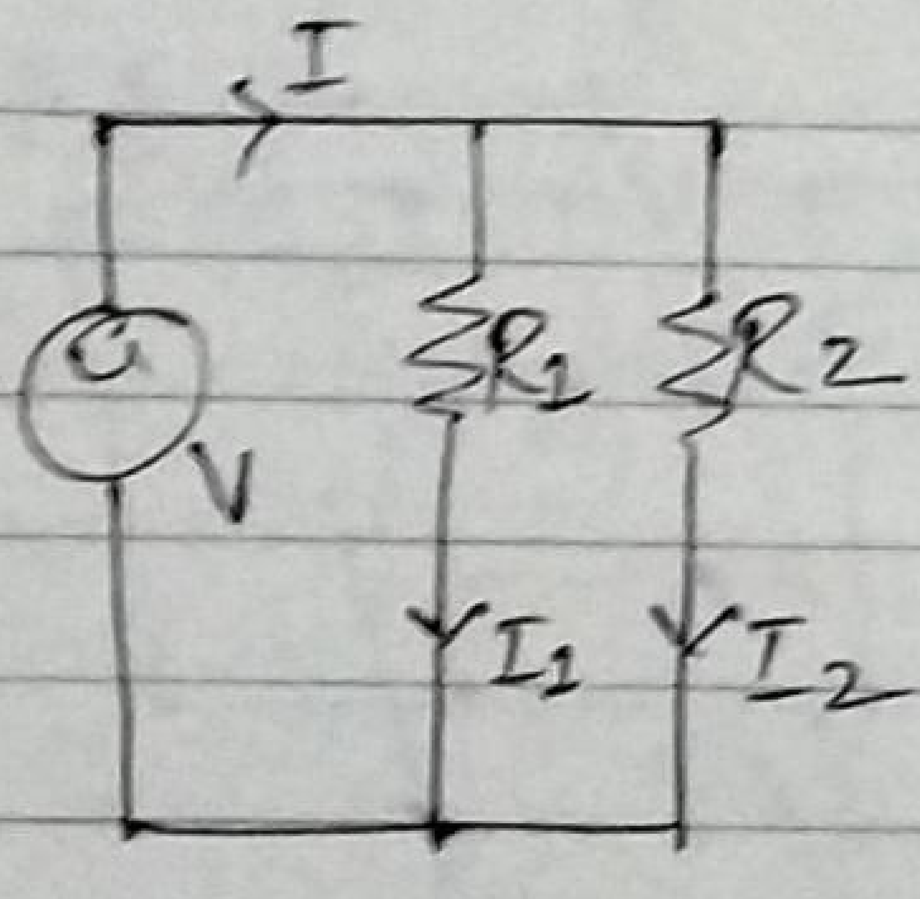


$$V_1 = V_s \cdot \frac{\frac{1}{C_1}}{\left[\frac{1}{C_1}+\frac{1}{C_2}+\dots+\frac{1}{C_n}\right]}$$

$$V_1 = \frac{V_s}{\left(\frac{1}{\cancel{j\omega} C_1}+\frac{1}{\cancel{j\omega} C_2}+\dots+\frac{1}{\cancel{j\omega} C_n}\right)} \times \frac{1}{\cancel{j\omega} C_1}$$

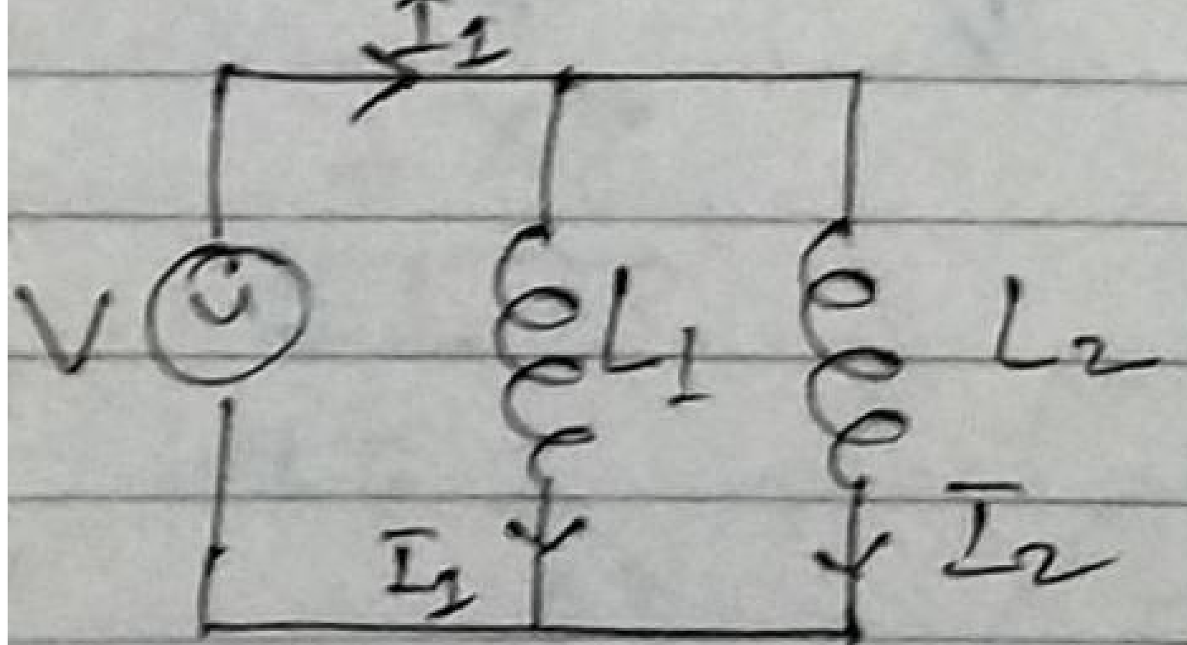
$$\boxed{\frac{1}{C_{eq}} = \frac{1}{C_1}+\frac{1}{C_2}+\dots\frac{1}{C_n}}$$

Parallel Combination in Current Division:-



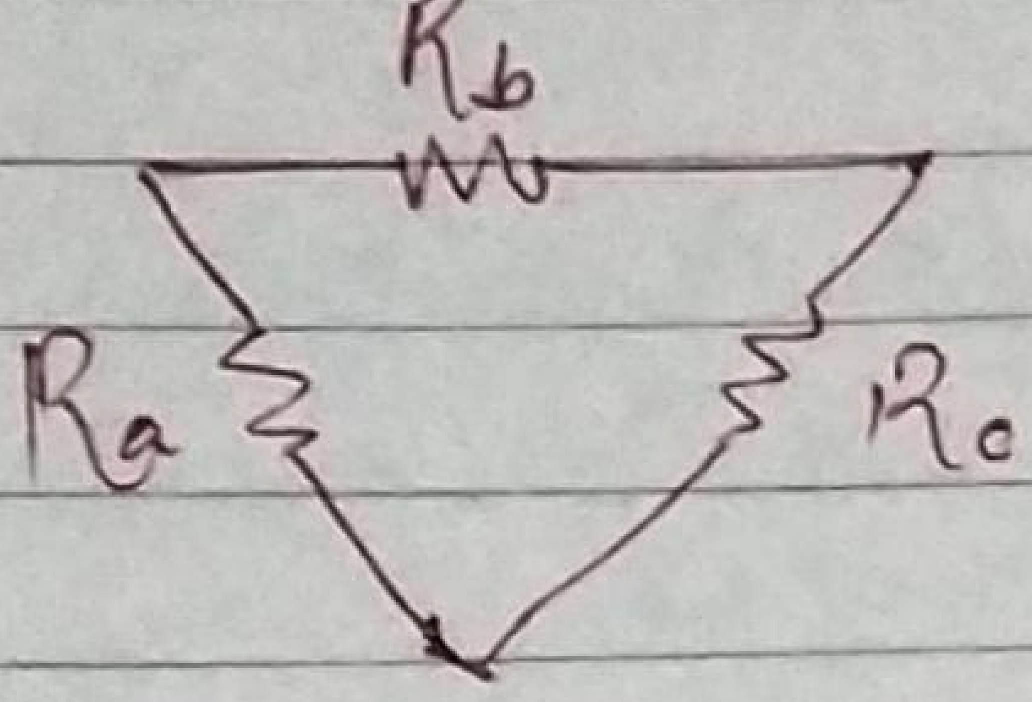
$$\frac{1}{R_{eq}} = \frac{1}{R_1}+\frac{1}{R_2}$$

$$I_1 = \frac{I \cdot R_2}{R_1+R_2} \qquad I_2 = \frac{I \cdot R_1}{(R_1+R_2)}$$

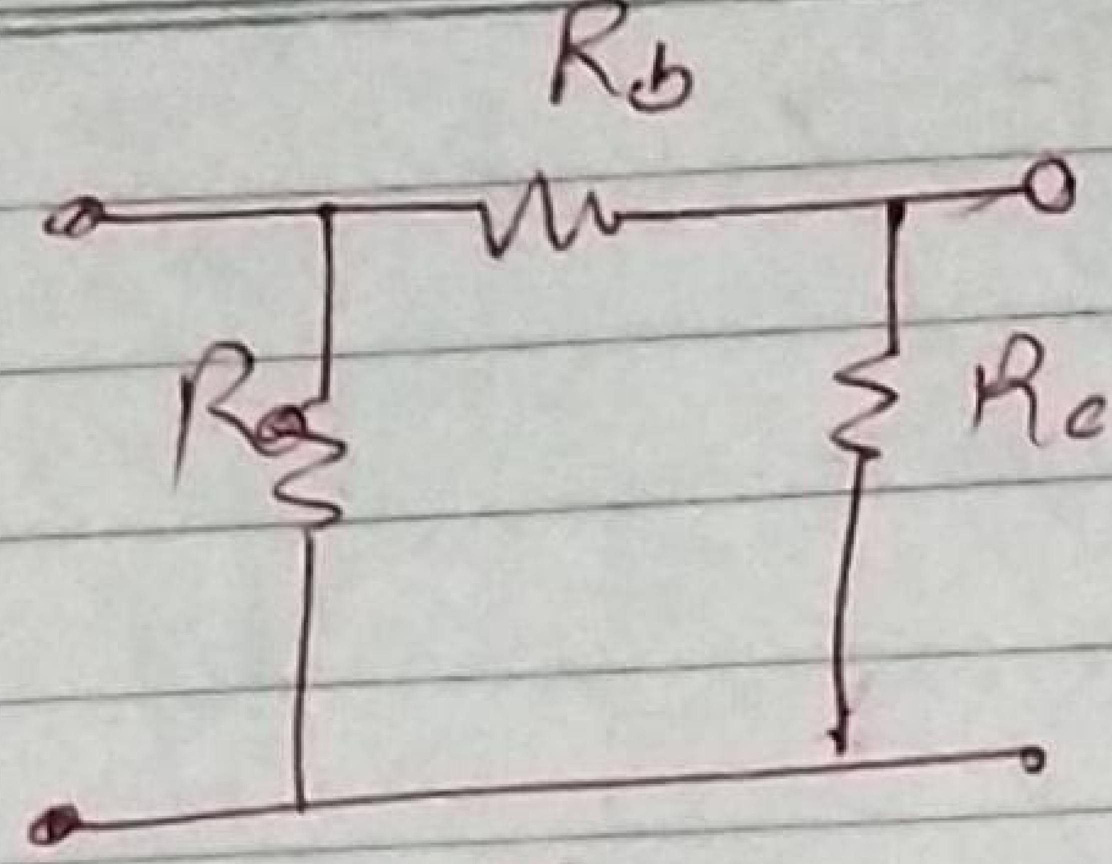


$$\frac{1}{L_{eq}} = \frac{1}{L_1}+\frac{1}{L_2}$$

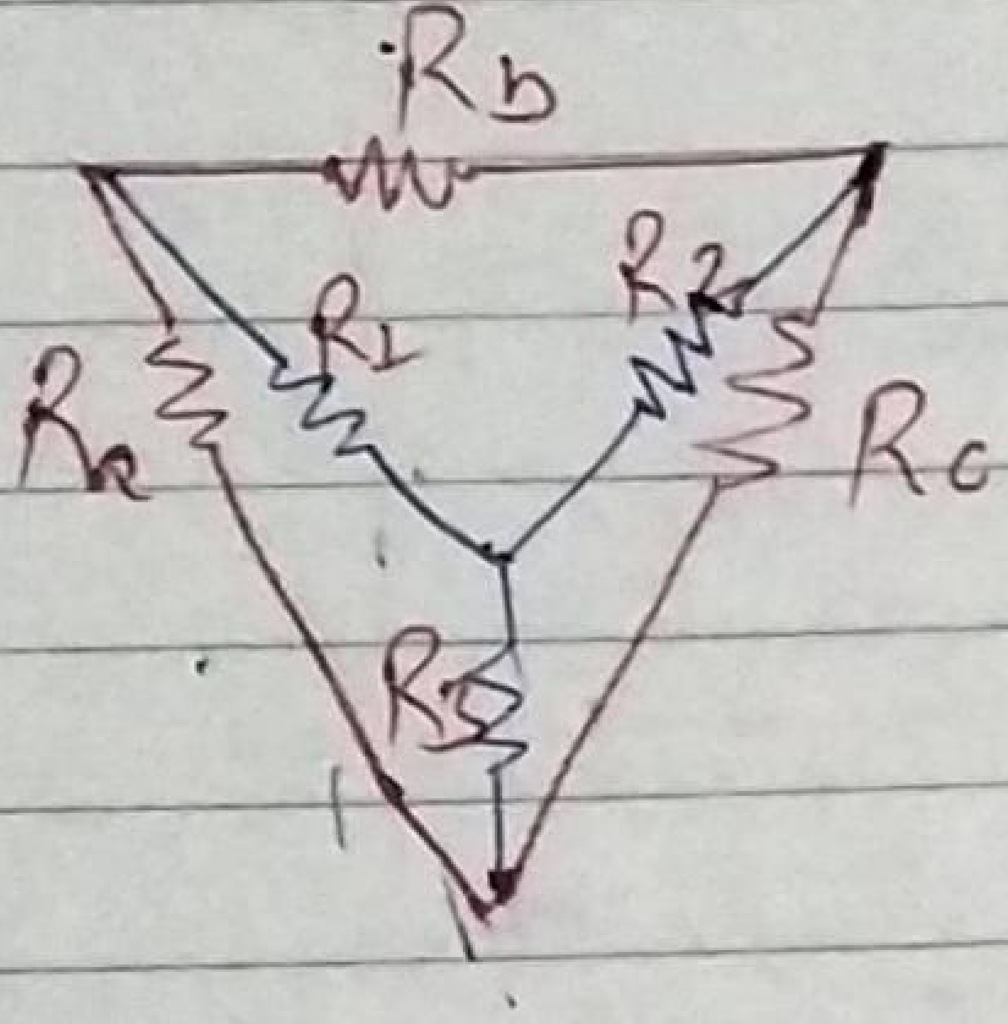
$$\boxed{I_1 = \frac{I \cdot L_2}{L_1+L_2}} \qquad \boxed{I_2 = I \cdot \frac{L_1}{L_1+L_2}}$$



DELTA



π



Delta to Star :-

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

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

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

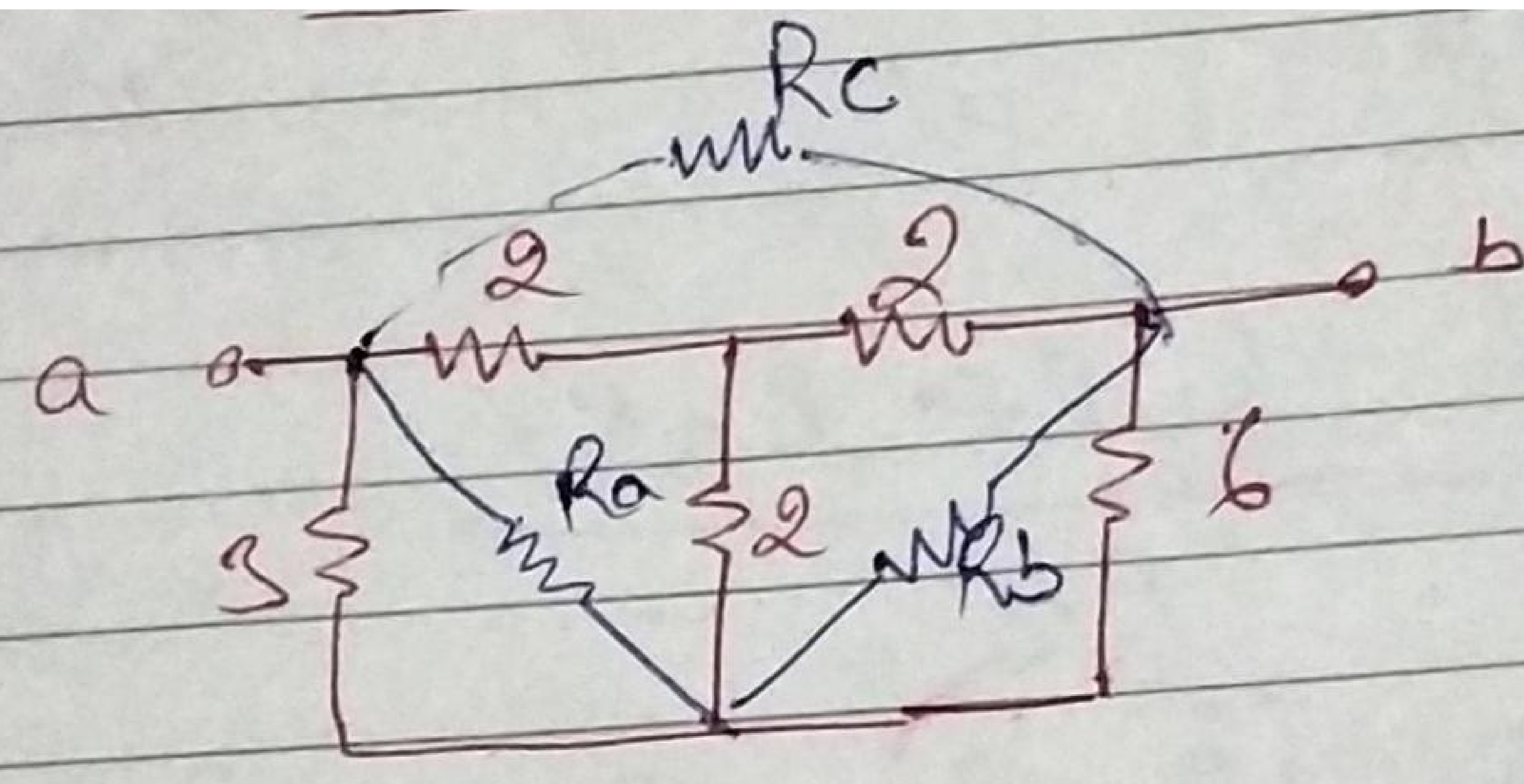
Star to Delta :-

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

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

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

Ques



Star to Delta

$$R_a = \frac{2\times2 + 2\times2 + 2\times2}{2} = 6\,\Omega$$

$$R_b = \frac{2\times2 + 2\times2 + 2\times2}{2} = 6\,\Omega$$

and, $R_c = 6\,\Omega$

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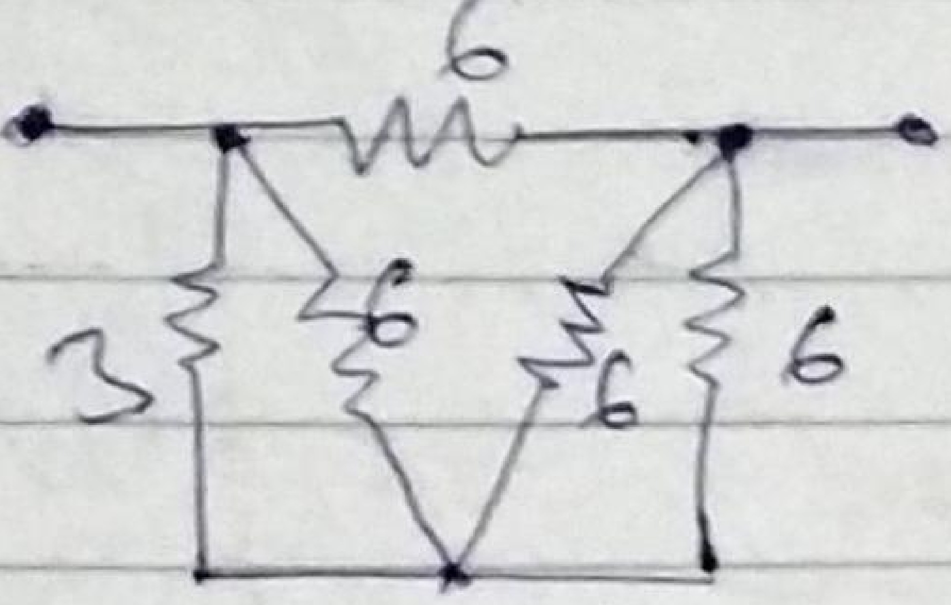
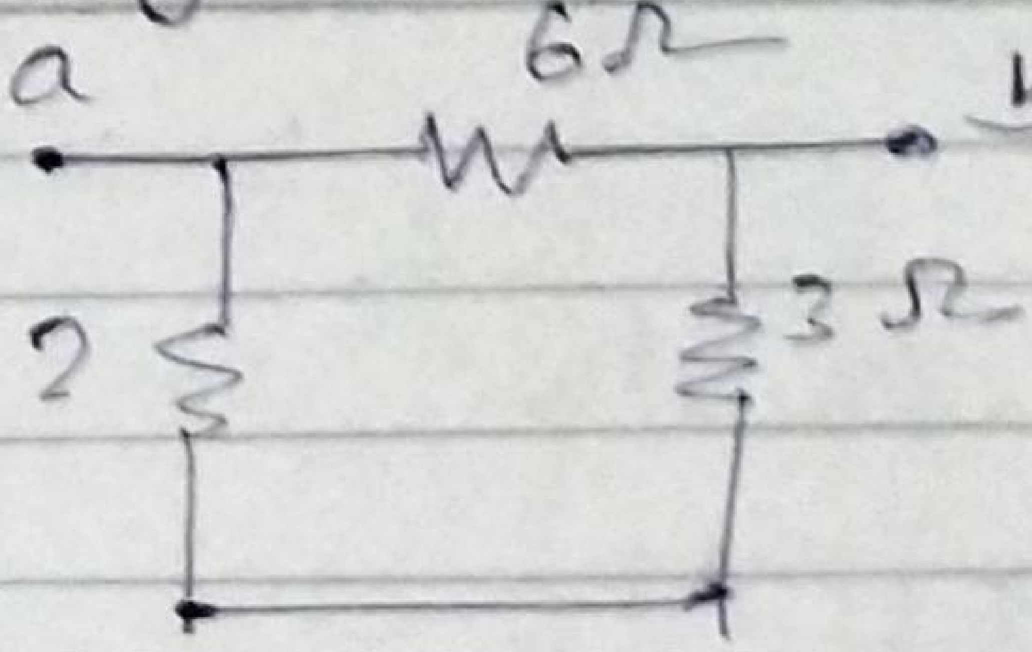
NOTE:- (1) when **Resistors** of equal value transform from star to Delta the resistance value **increases** by **3 times** (and same of **Inductance**) ~~& capacitances~~)

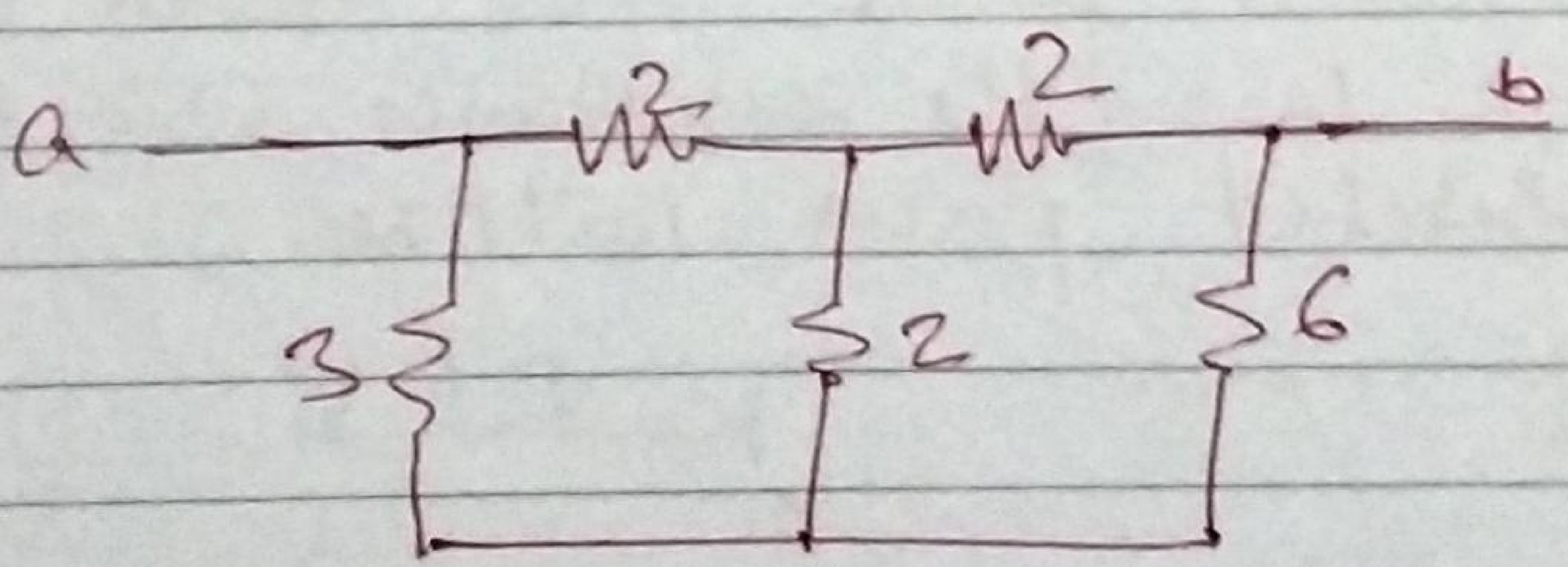
(2) when **capacitors** of equal value transformed from Y to Delta the capacitance value decreases by **3** times.



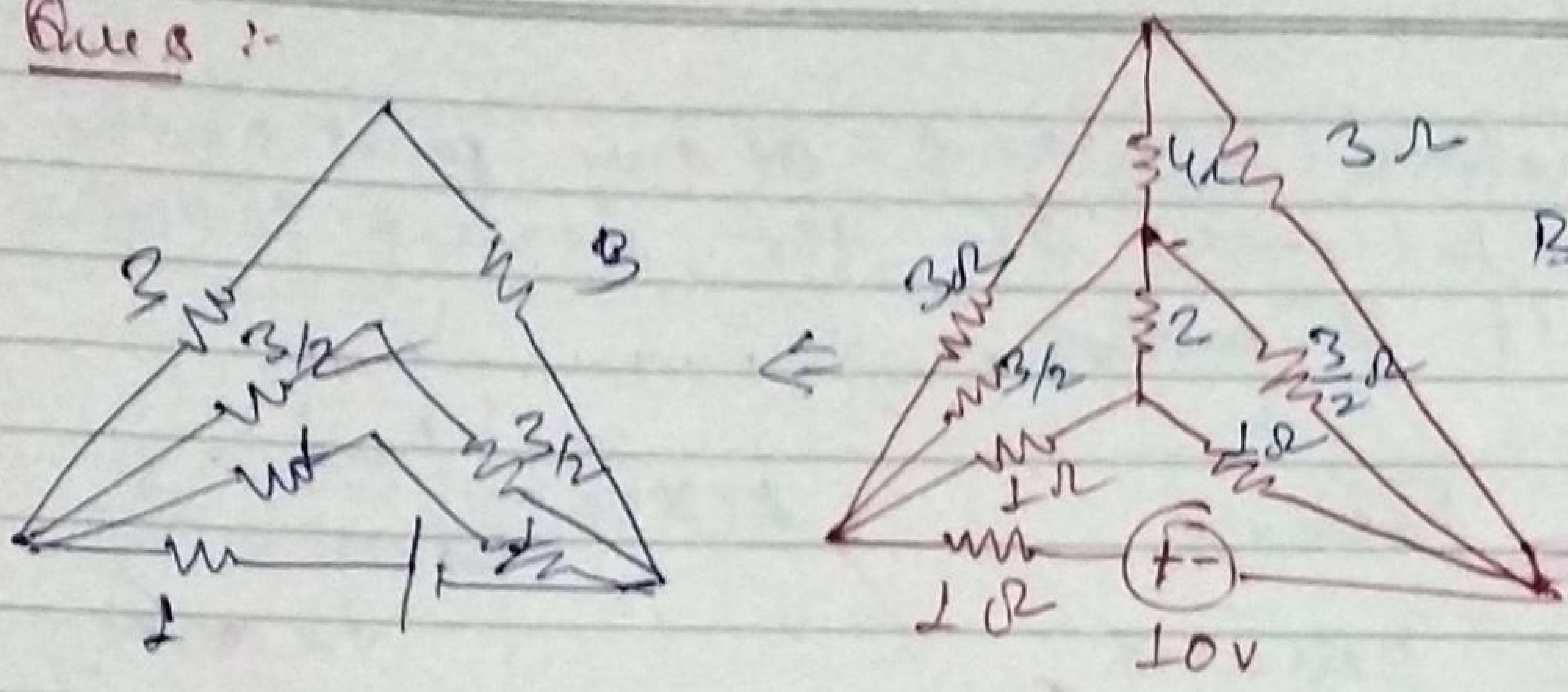


$$R_{ab} = 6 \parallel (2+3) \Rightarrow 6 \parallel 5 = \frac{6 \times 5}{6+5} = \frac{30}{11}\ \Omega$$

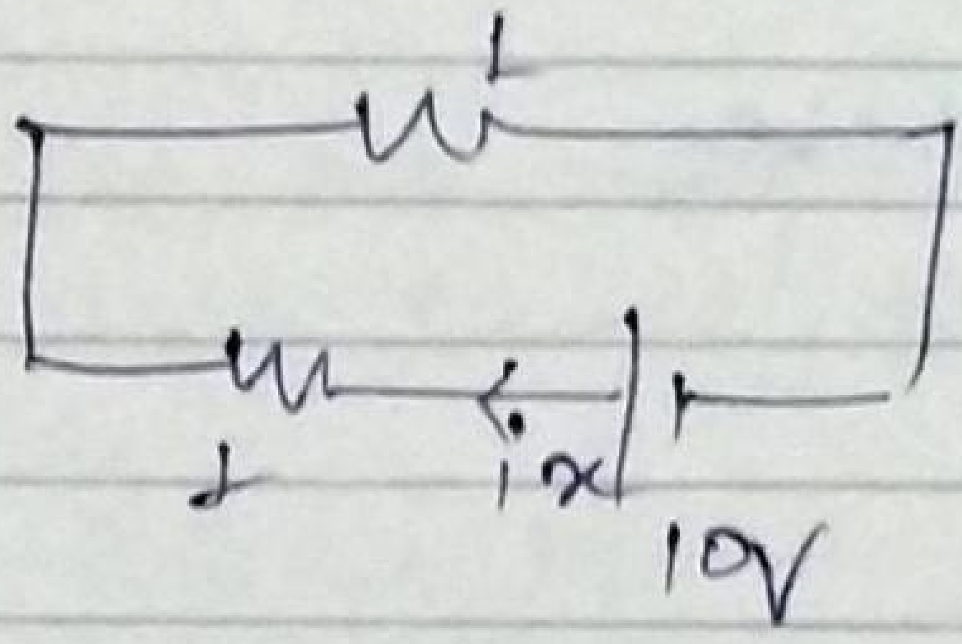
Delta to Star :



Ques :-



$6 \| 3 \| 2 = 2 \| 2 = 1\,\Omega$



$i_x = 5A$

Type of Elements :-

1. Active And Passive Elements:- Active Elements — when an elements ~~are~~ is capable of delivering energy for infinite time or capable of providing power gain than the element is called as active element. for eg:- Current source, voltage source, transistor, opamp etc

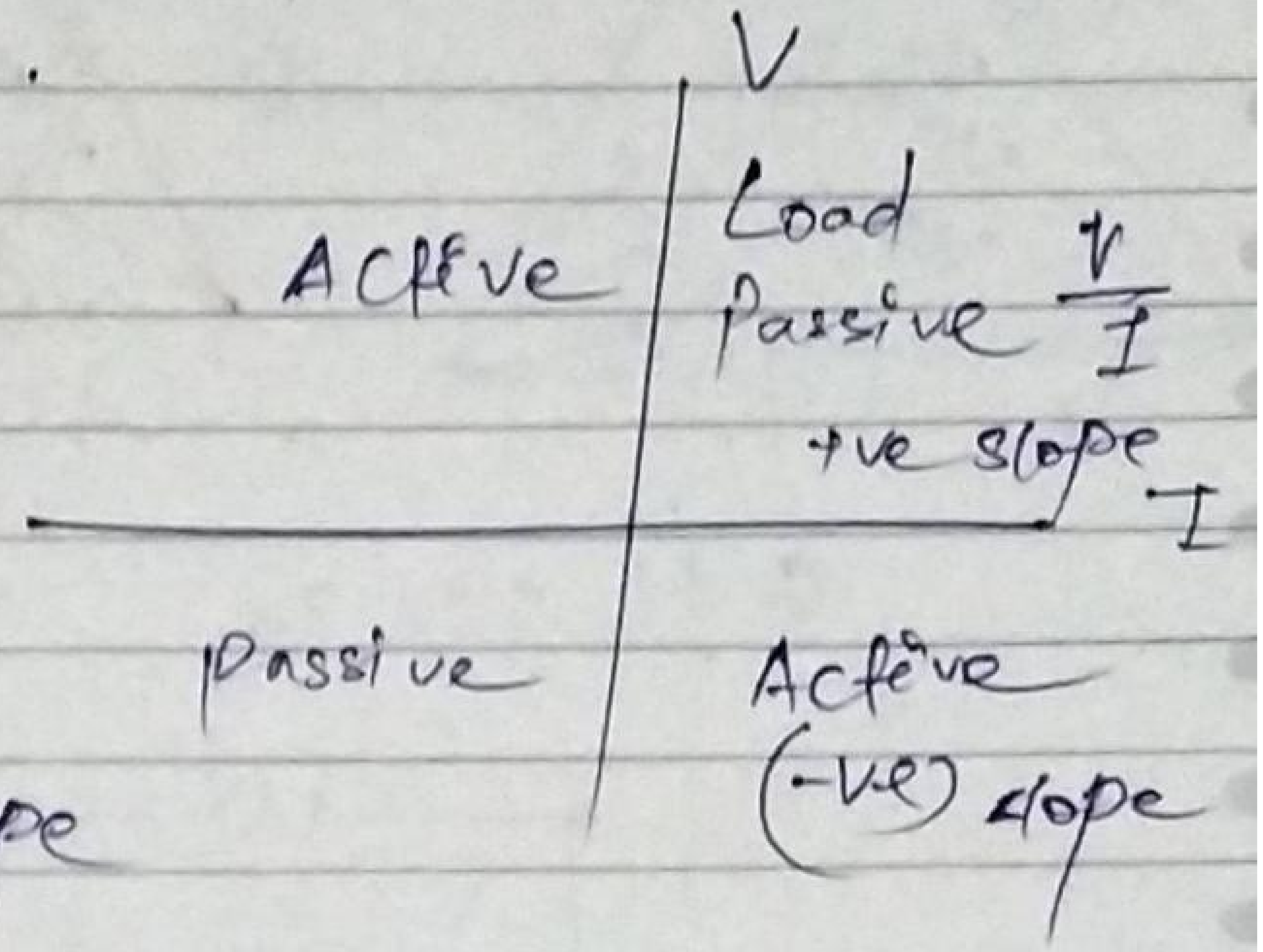
Passive Elements:- when an element is not capable of providing energy independently for an infinite time or not capable of providing power gain then the element is called passive element.

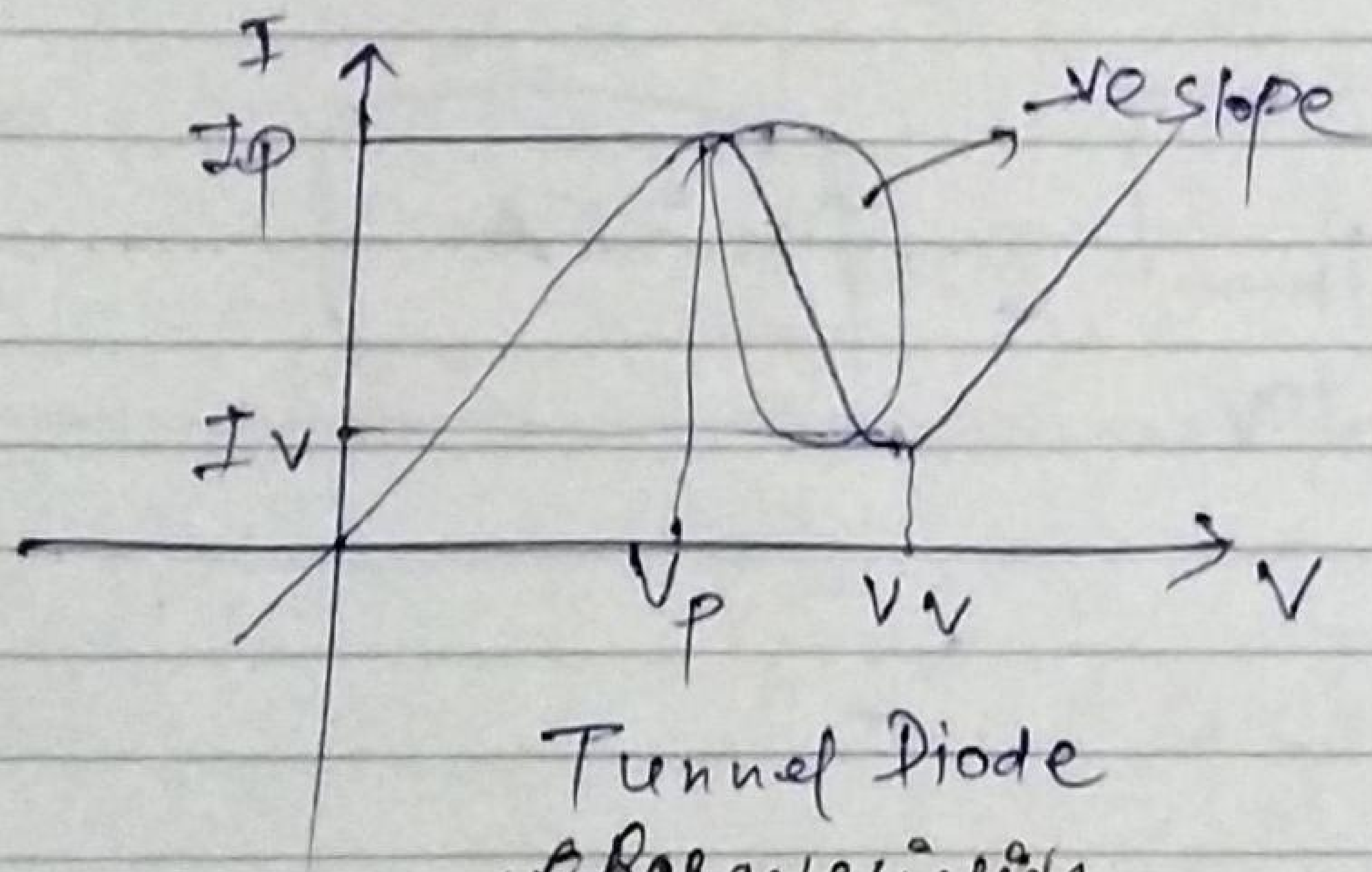
Eg:- Resistor, Inductor, Capacitor, Transformer.

* If Ratio of voltage to current at any point on the char. curve is (-)ve then the element is active otherwise it is passive.

$P = VI$ Passive

$P = -VI$ Delivered





Tunnel Diode characteristics

Bidirectional And unidirectional Element :-

* Bidirectional – when element properties and char. are independent of the direction of the current then the element is called as Bidirectional element.

~~Unidir~~ when element properties and char. depends upon the direction of the current then the element is called as unidirectional element.

* If the characteristic curve is similar in opposite quadrante then the element is bidirectional otherwise it is unidirectional.

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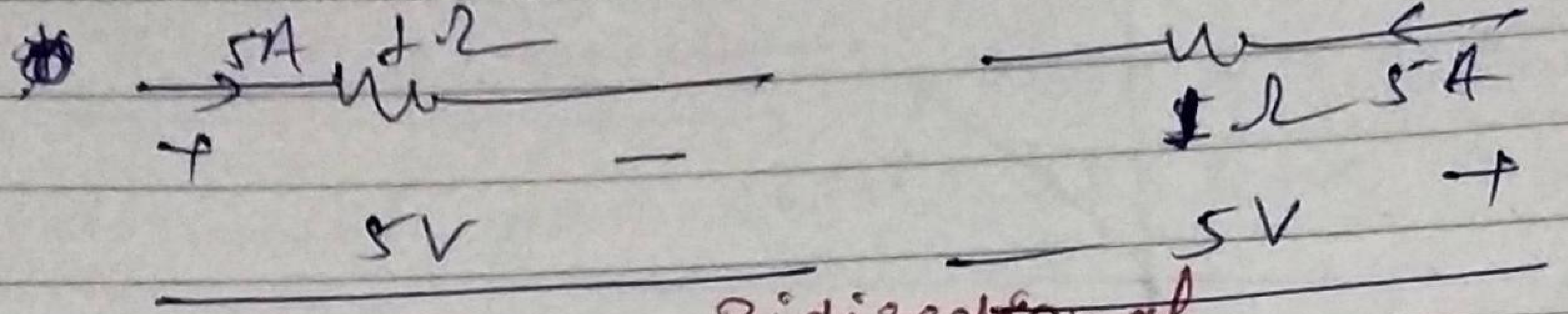
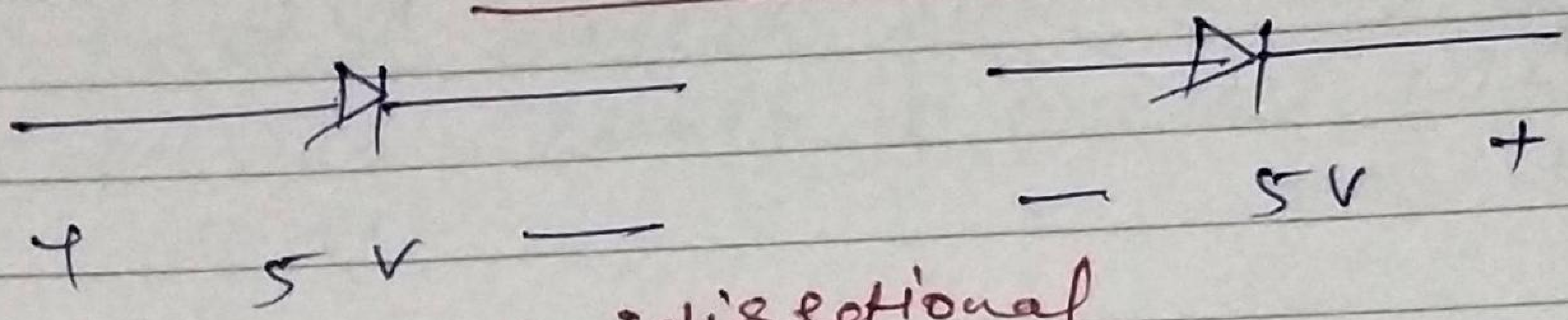


Bidirectional



unidirectional

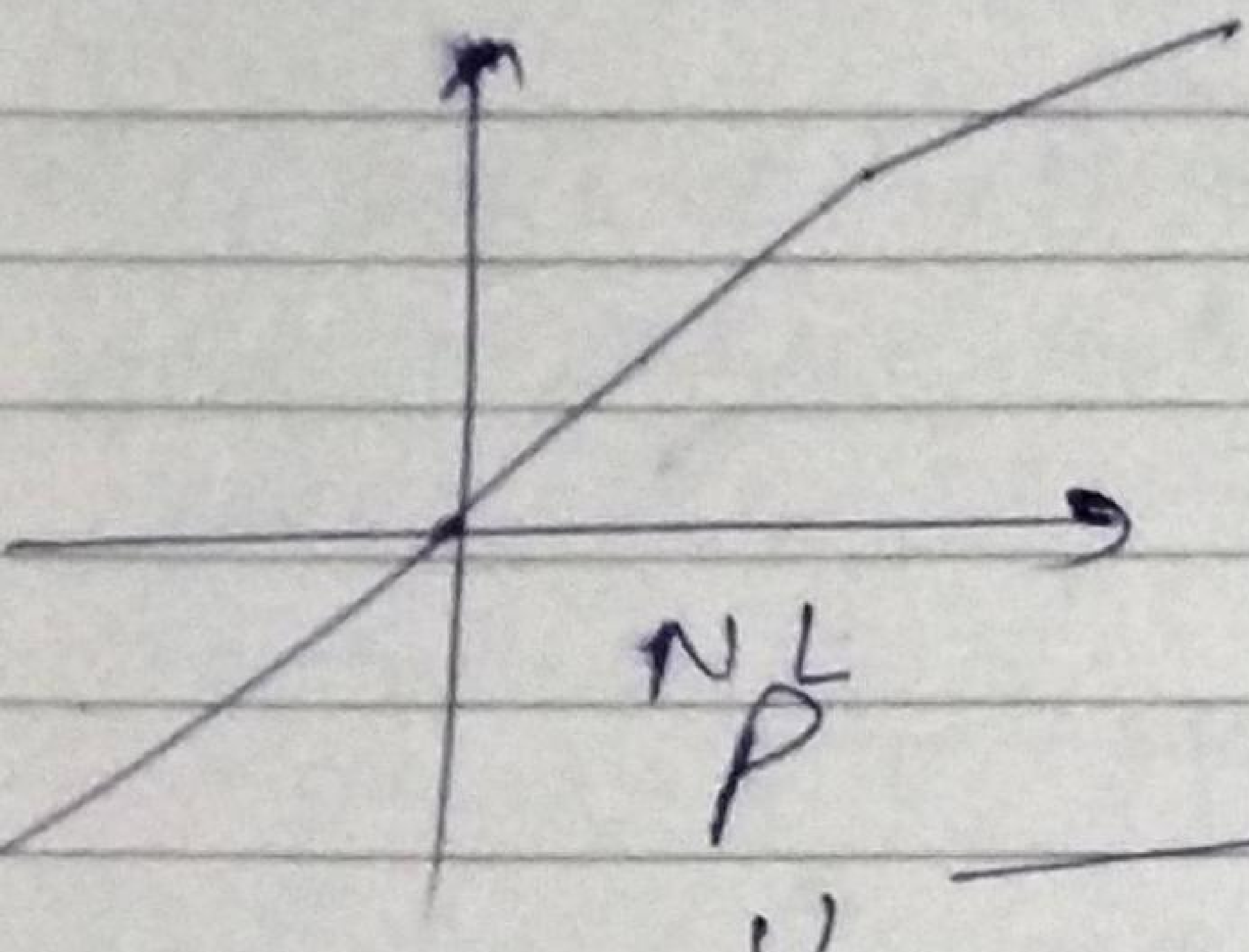
Lumped Elements :- are considered as the separate elements which are very small in size.

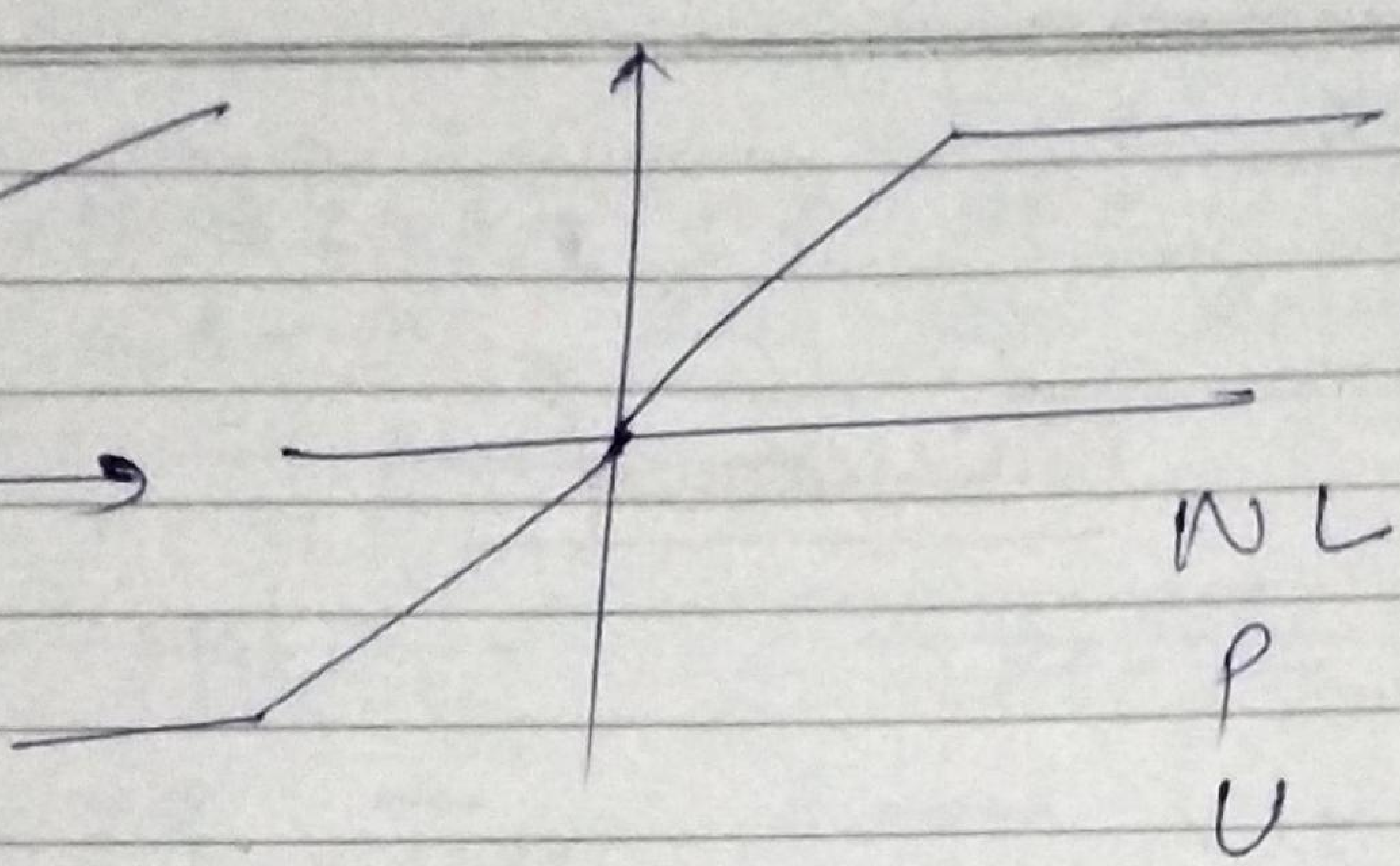
Distributed Elements — are electrically not separable.

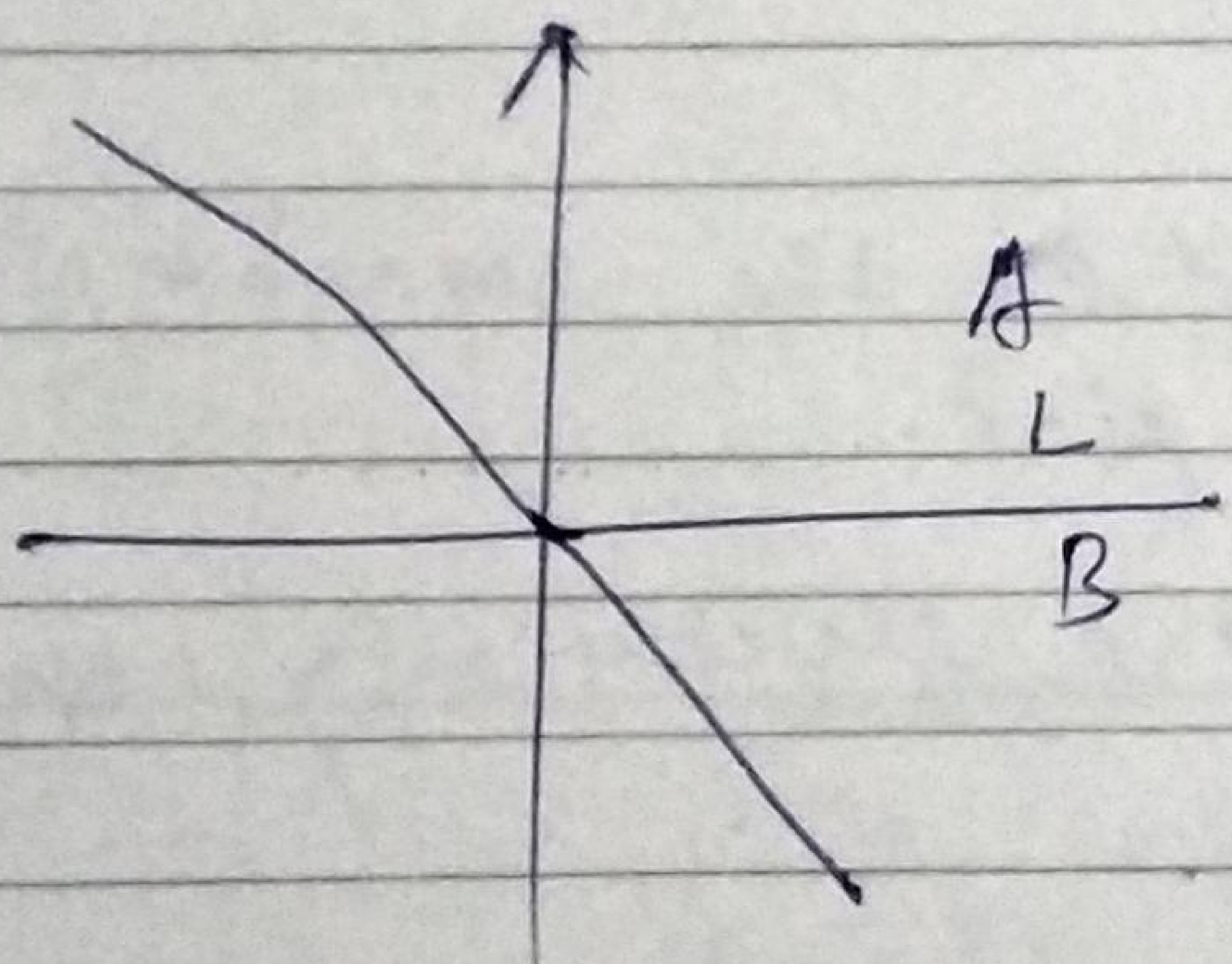
Linear And Non Linear Element :-

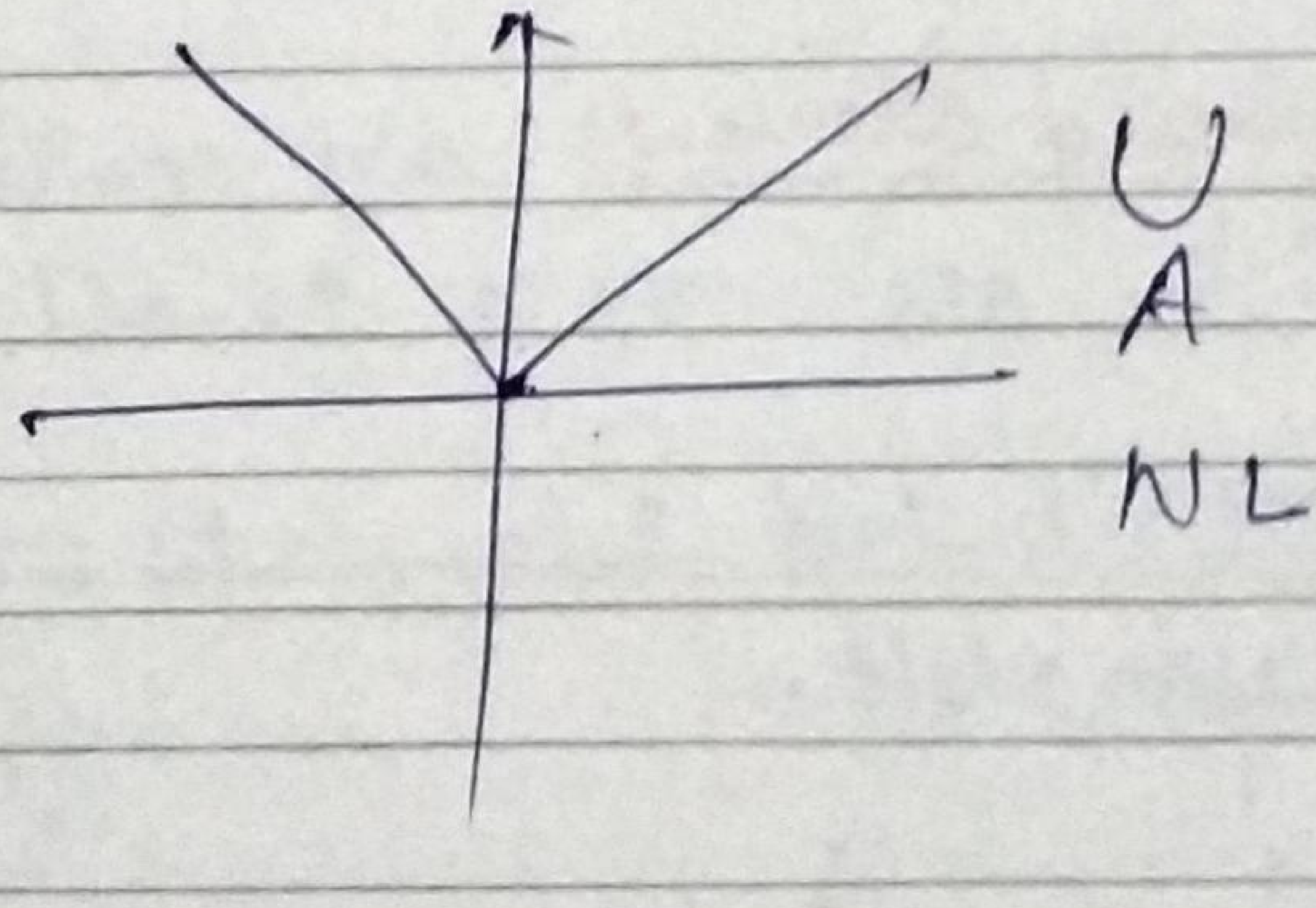
* Linearity is the property of an element is describing a linear relationship b/w excitation and response.

* Every Linear element must exibit bidirectional property.


N L
P
U


N L
P
U


A
L
B


U
A
N L