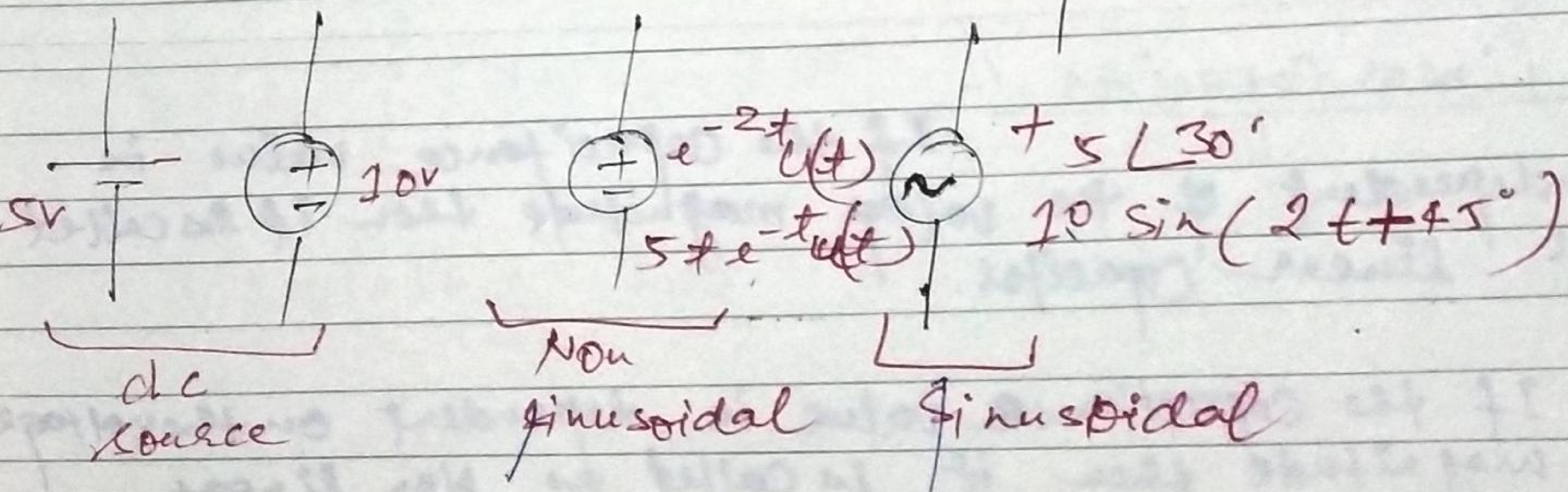
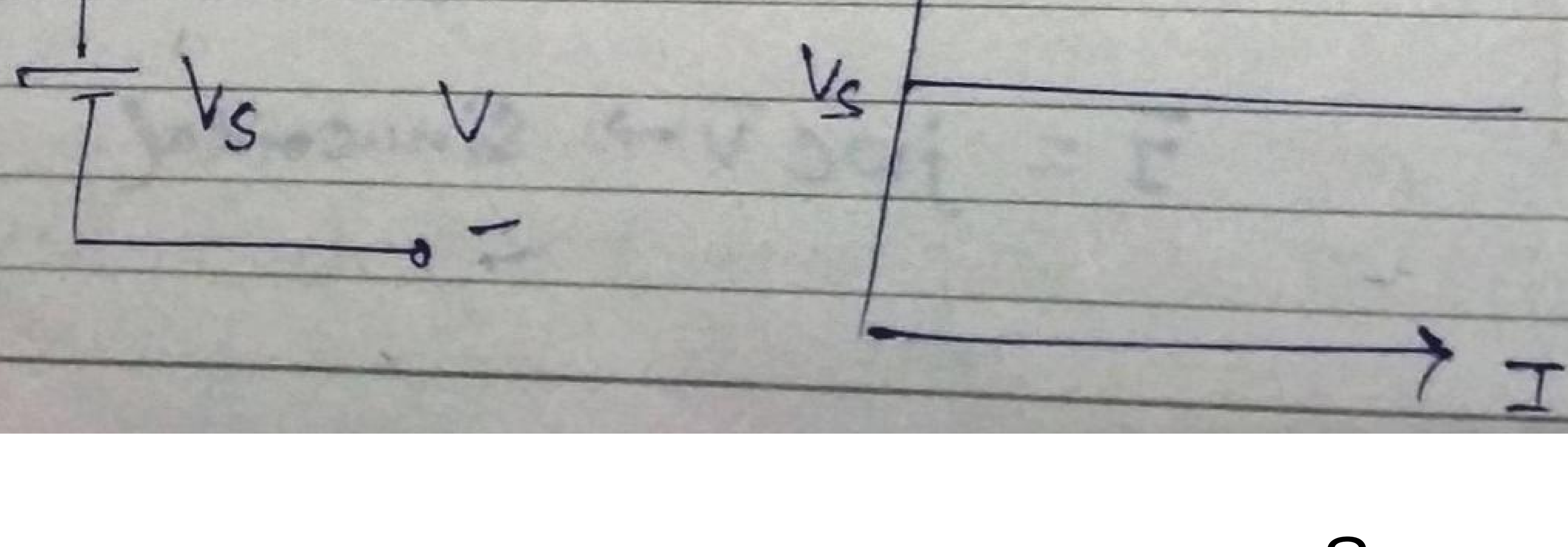
Sources :- * If the terminal voltage is completely independent of current or current is completely independent of voltage then the element is called an independent source.

* the element for which either the current or voltage depends upon the current or voltage ensure (some other else in the ckt) is called dependent source.

Ist Voltage Sources — Representation of independent voltage source

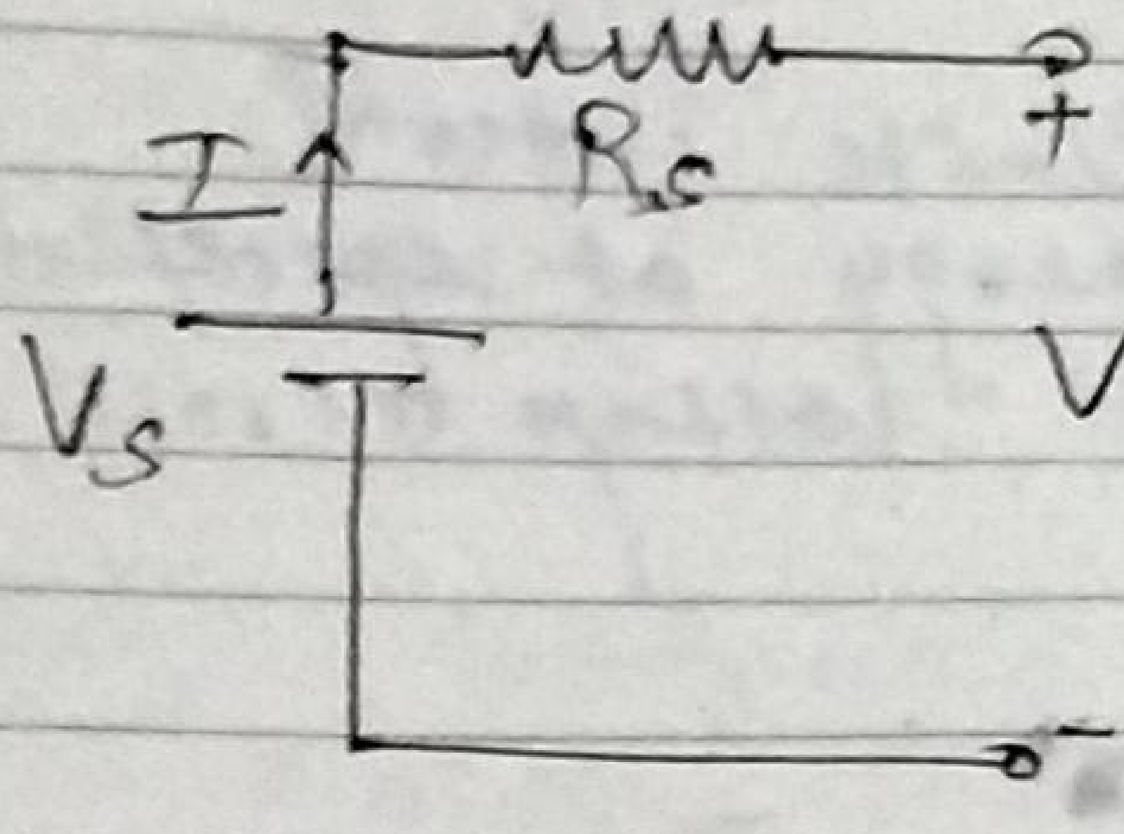


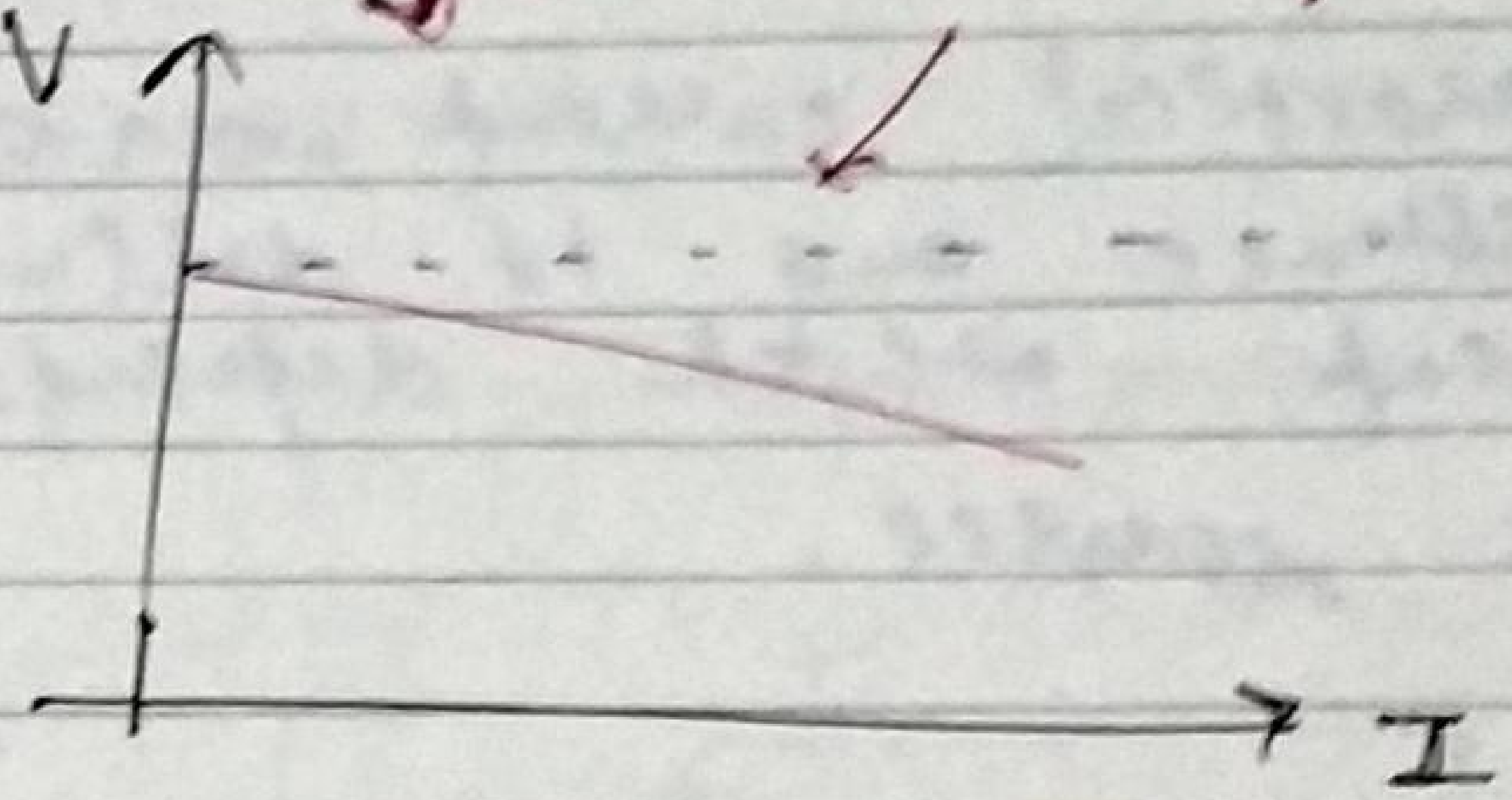
* Ideal voltage source has zero internal resistance and it delivers energy at specified voltage which is independent of the current delivers by the source.



* practical voltage source has some finite internal resistance and it delivers energy at specified voltage which depends on the current delivered by the source.

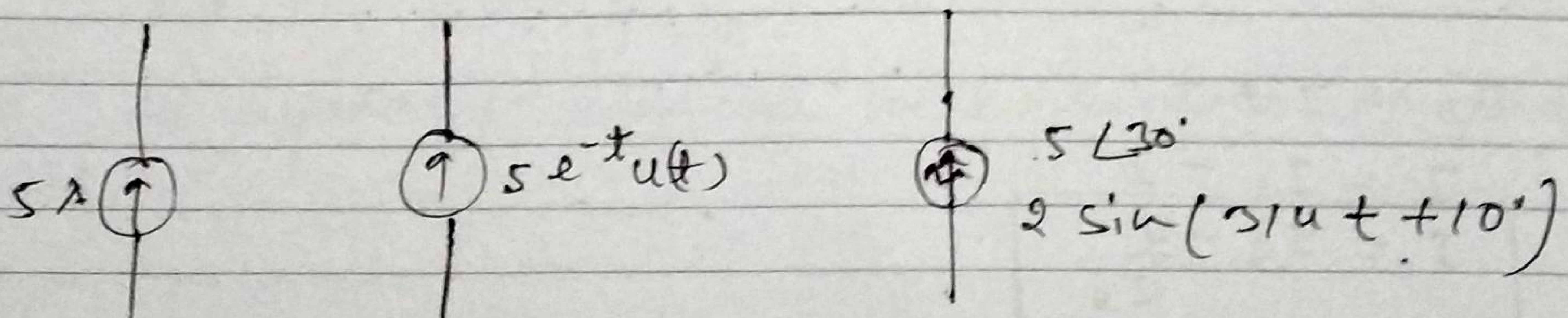
$$\downarrow V = V_s - I\uparrow R_e$$



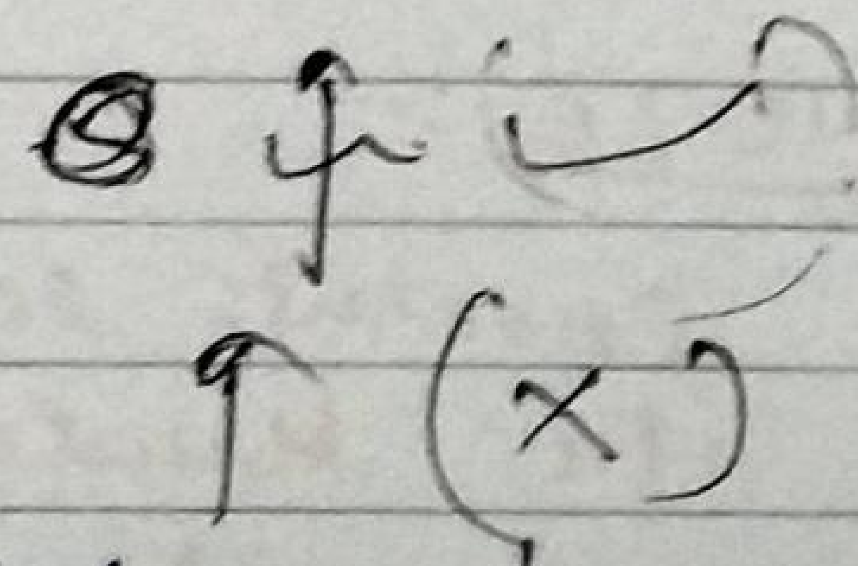


Practical voltage source.

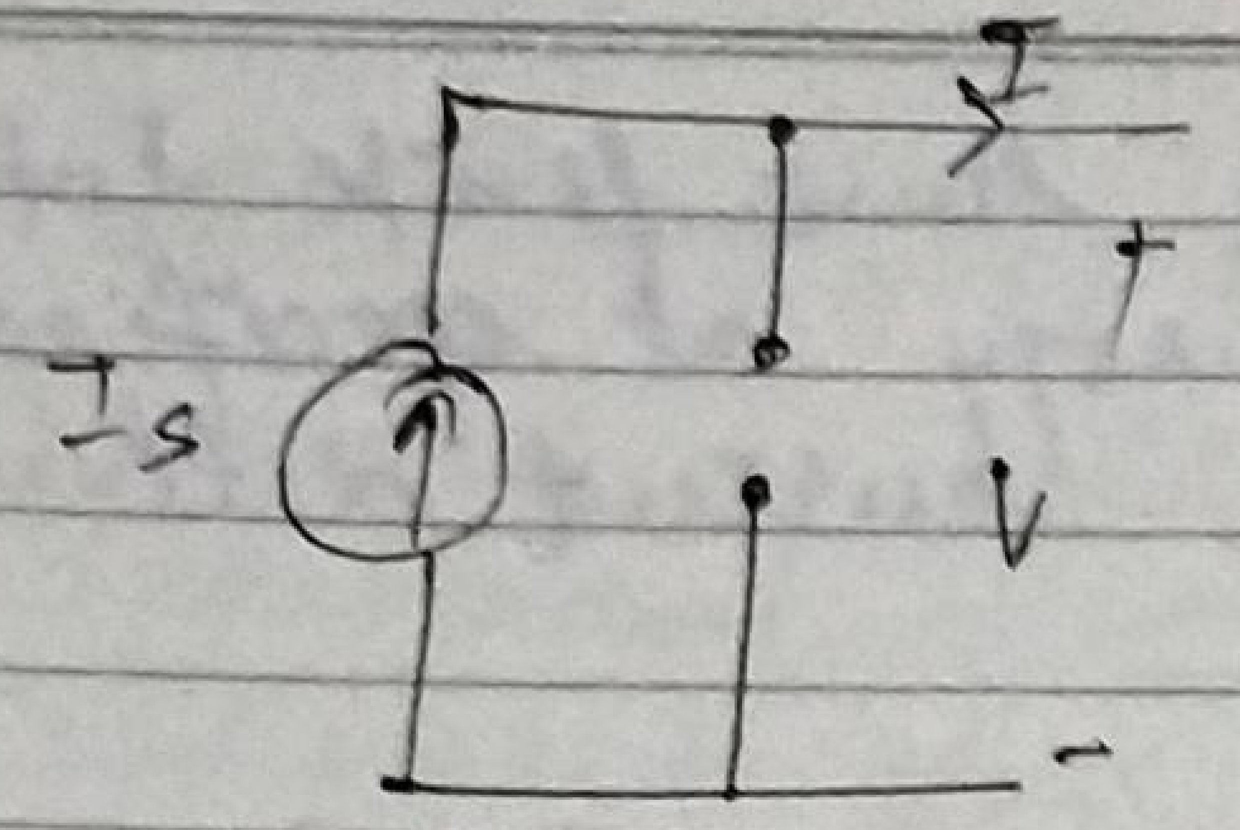
Current sources :-

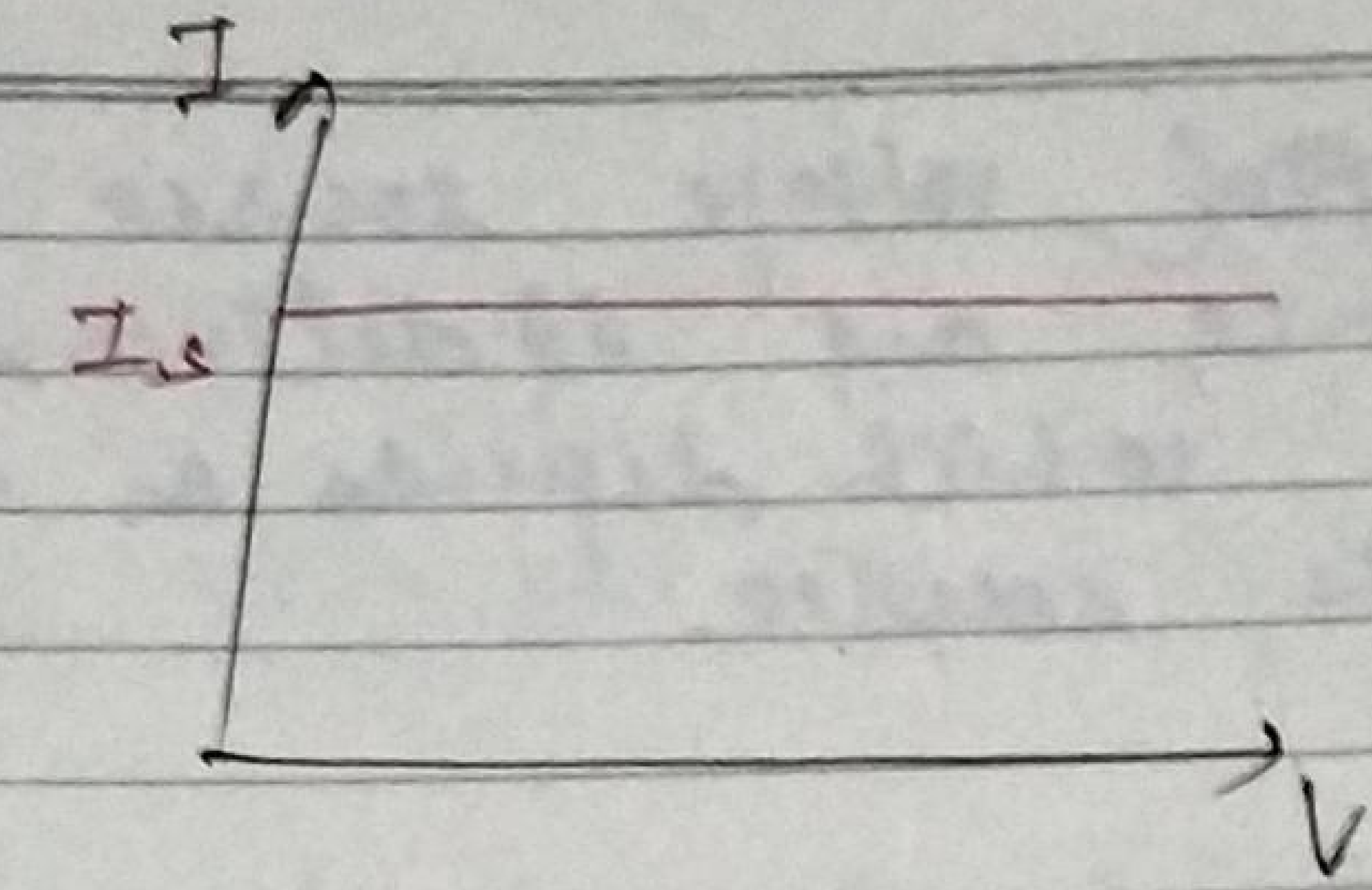


d.c. N.S. S.

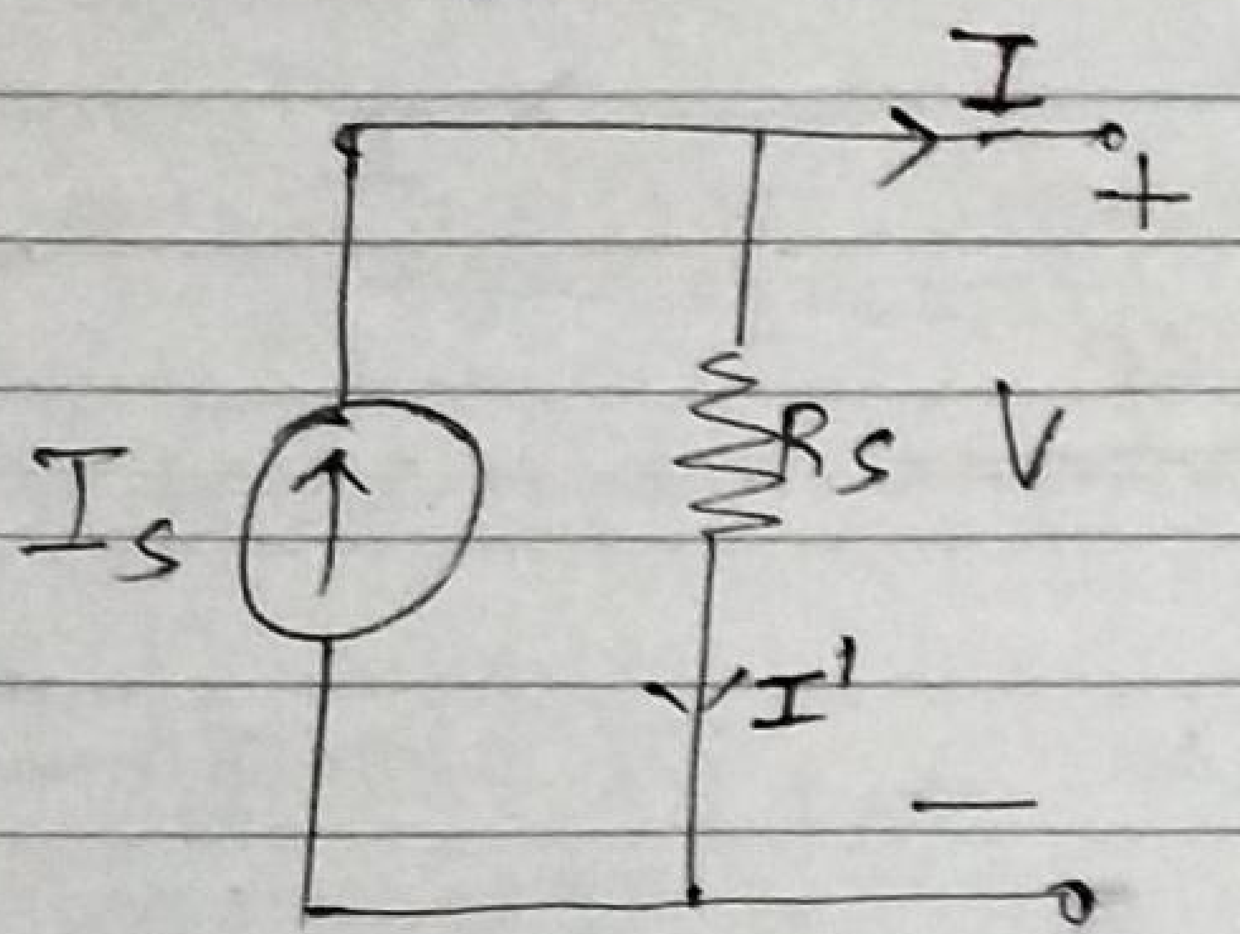


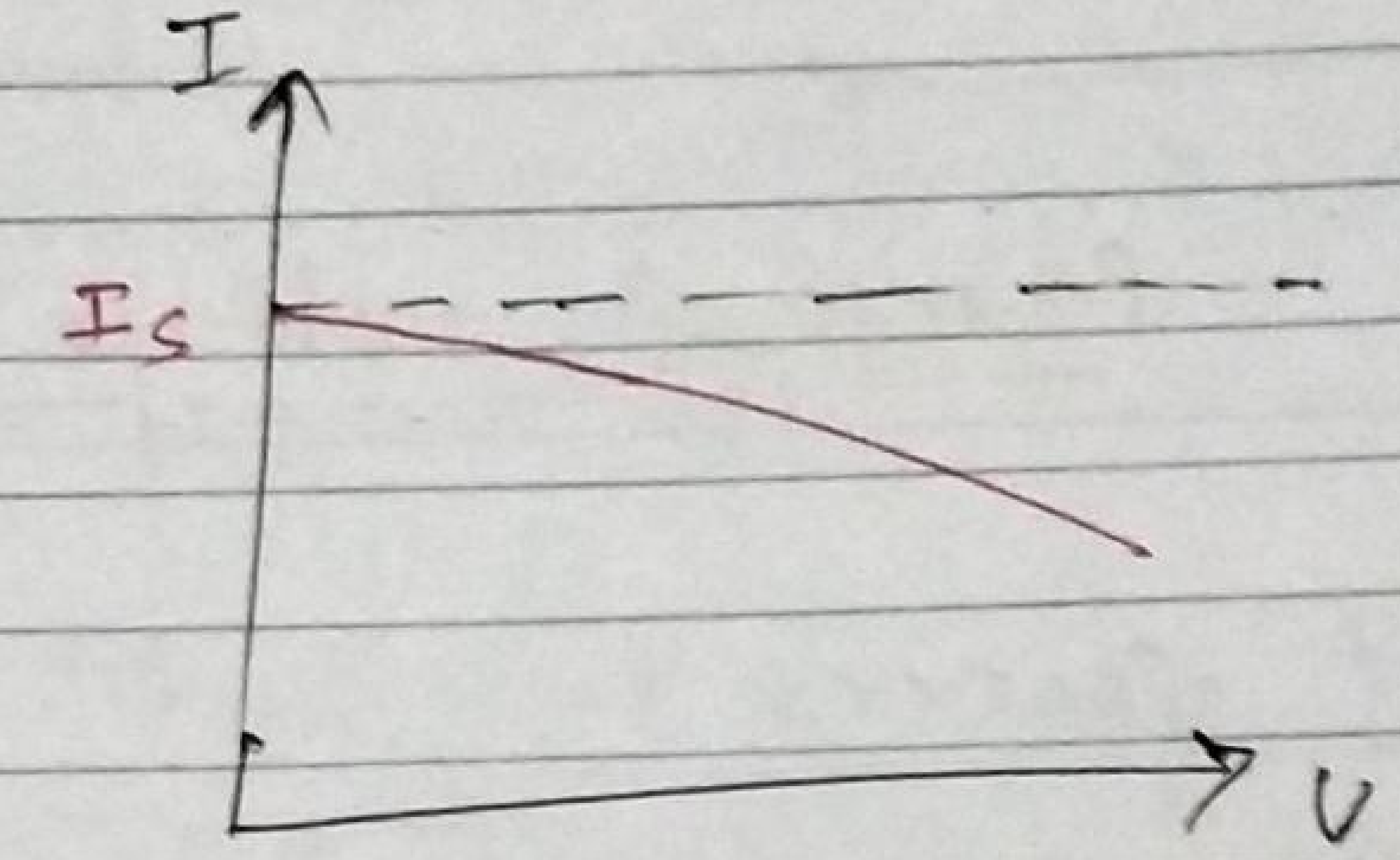
* for ideal current source internal resistance is infinite and it delivers energy at specified current which independent of the voltage across its terminals.





* practical current source has finite internal resistance and it delivers energy at specified current which depends on the voltage across the source.





$$I_s = I + I'$$

$$I = I_s - I'$$

$$\boxed{I = I_s - \frac{V}{R_s}}$$

NOTE :-

I. Current source does not have zero voltage across its terminals while providing the fixed current, it depends entirely on the ckt in which it is connected.

II) In the real time system only independent voltage source exist. To make calculation simple by source

Transformation Technique current source concept is introduced.

* By analysing an in electrical N/W using KVL and KCL equations the independent and dependent voltage and current sources are handled exactly in the same manner except in the following cases.

(I) Analysis of the ckt using superposition theorem

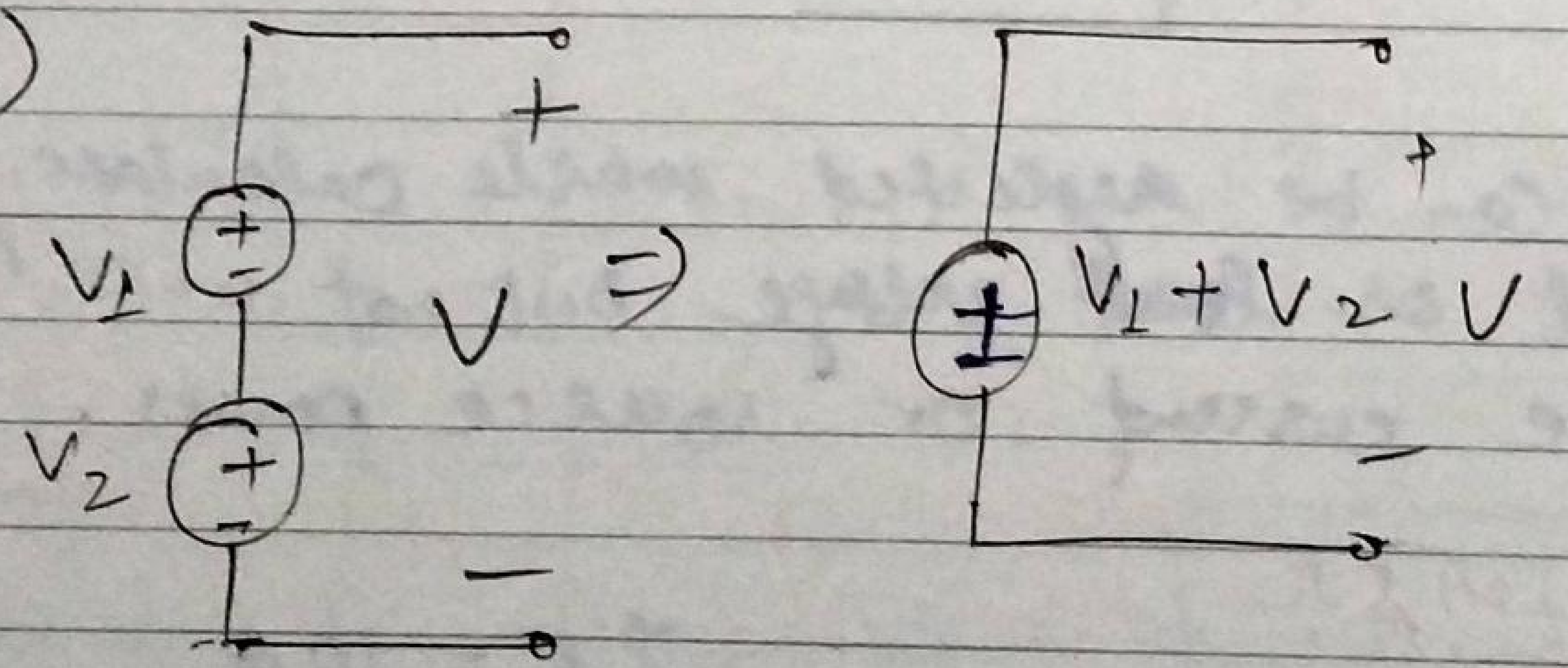
(II) Analysis of ckt using Thevenin's and Norton Theorem.

In such cases

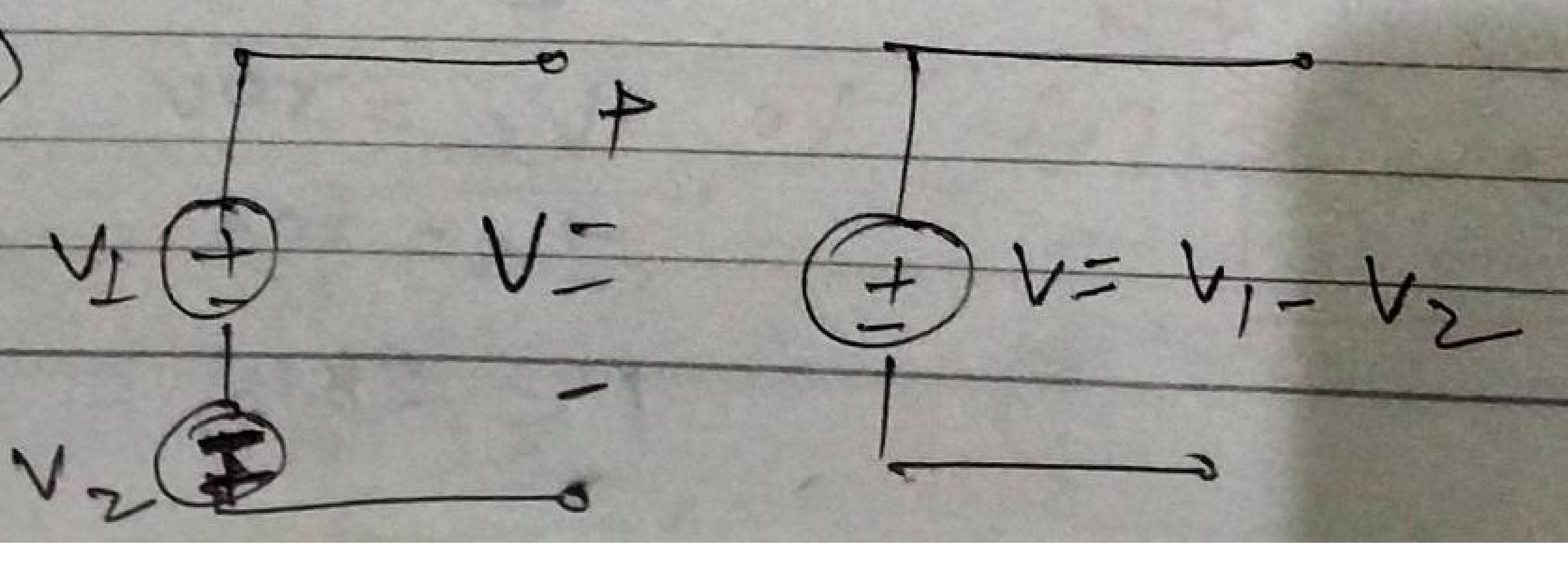
I) All independent current and voltage sources are replaced by their internal resistances.

II) All dependent sources will remain as they are.

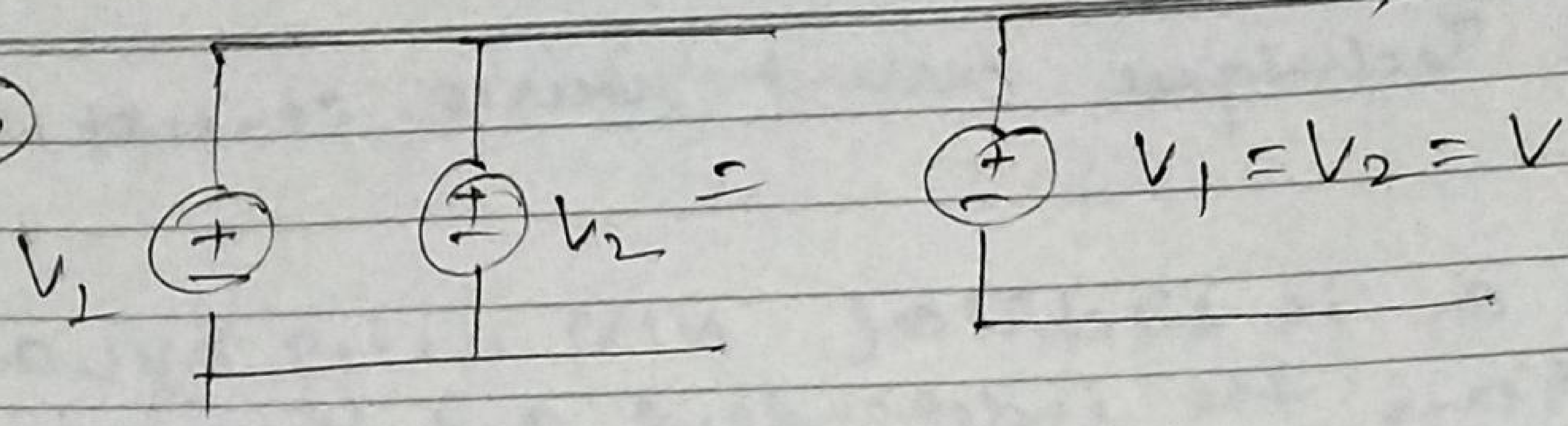
1)



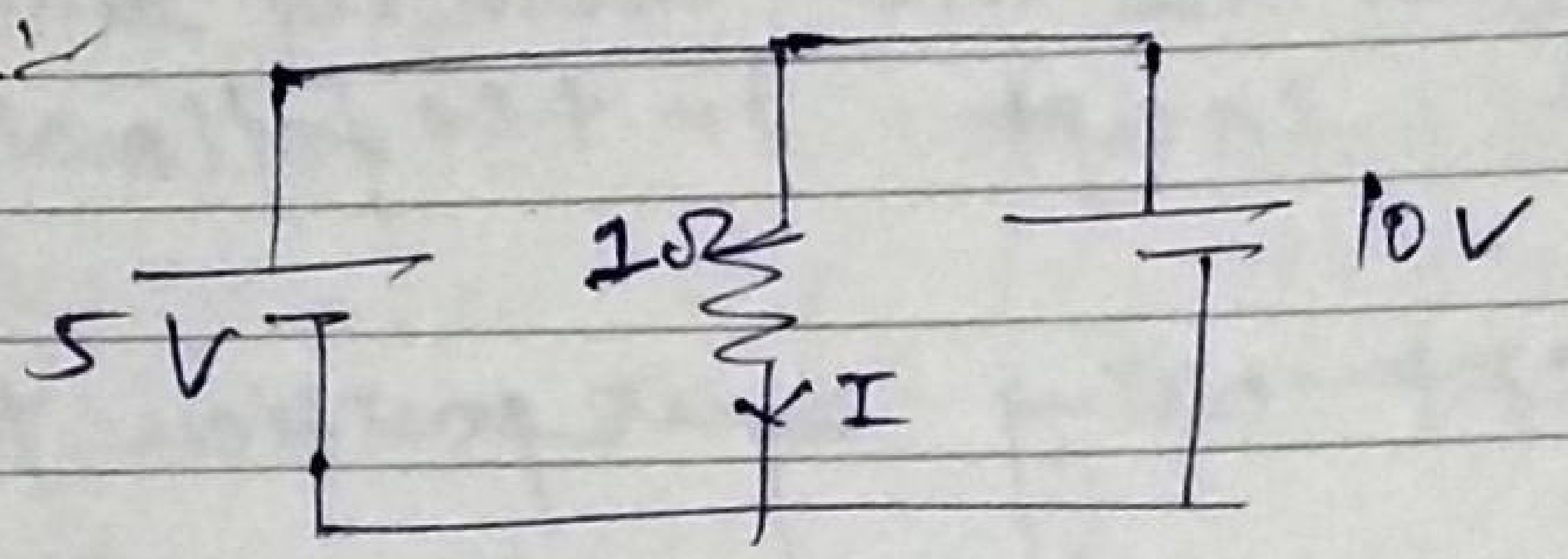
2)



③



Eg.:-



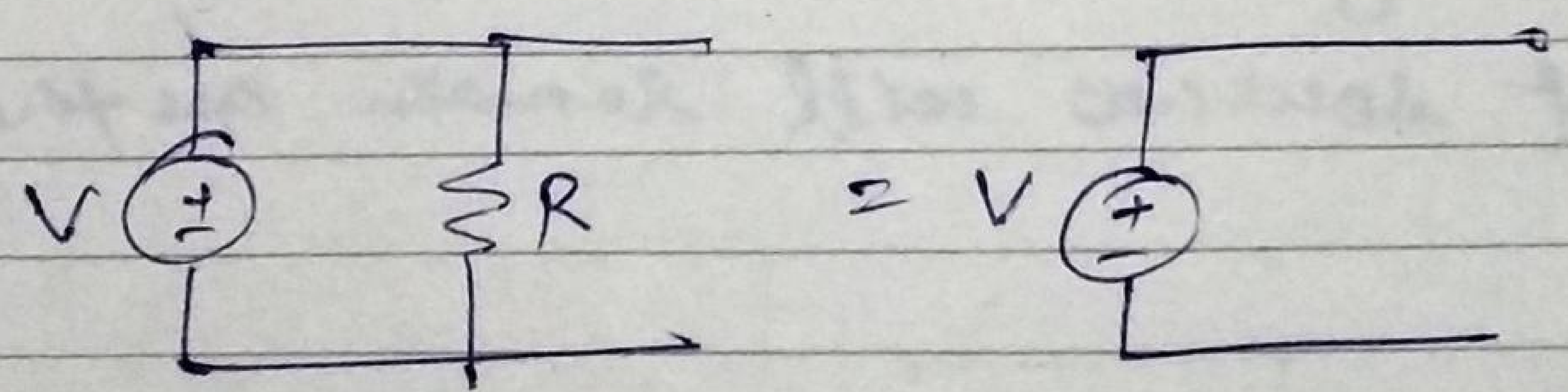
a) 5 A

b) 15 A

c) 10 A

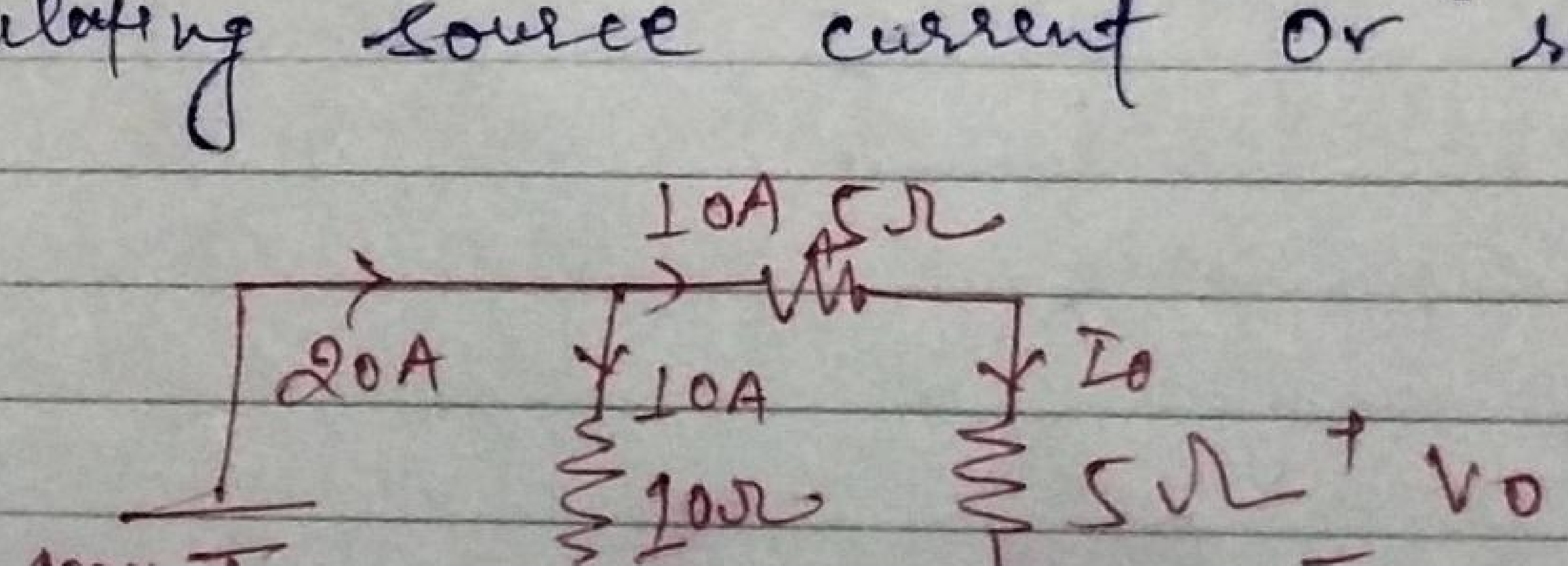
d) None (✓) Bcz these voltage should be same for varrifying KVL.

4)



The resistor R can be neglected while calculating either load current or load voltage but not while calculating source current or source power.

Eg :-



$I_L = 10A$

$V_L = 50V$

$I_s = 20A$

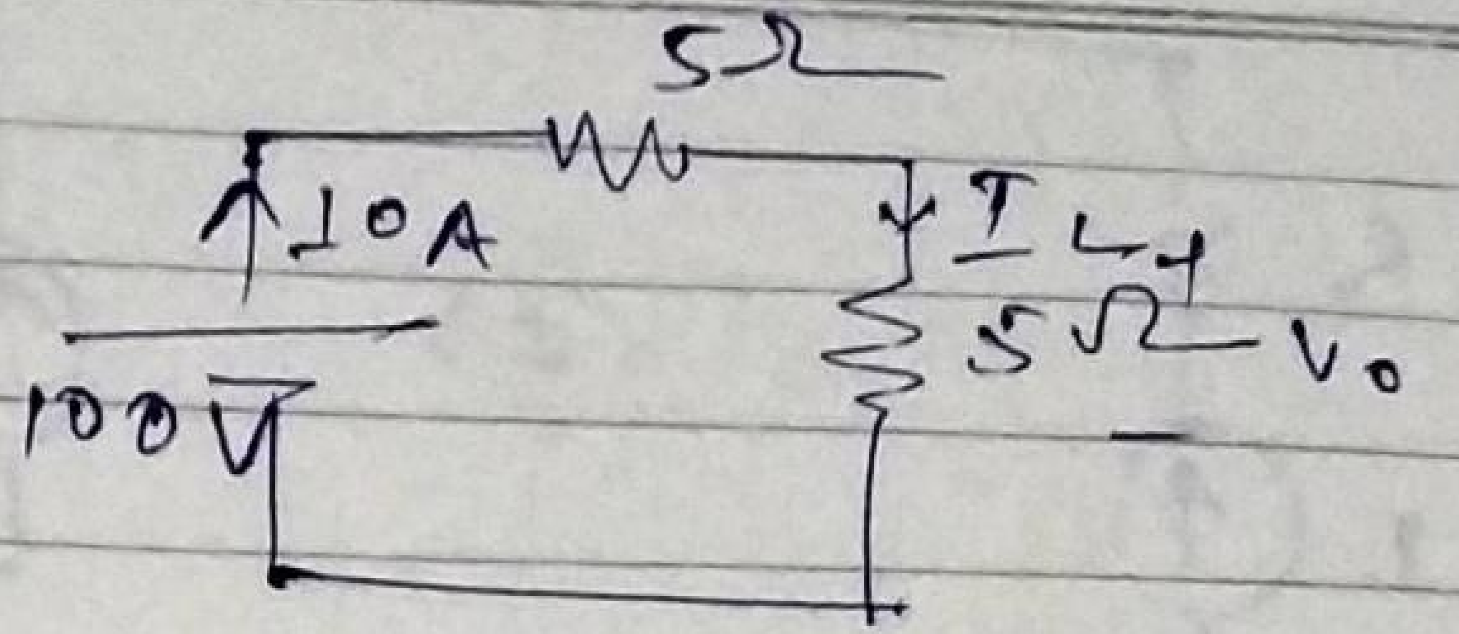
$P_s = 2kW$

$I_L = 10A$

$V_L = 50V$

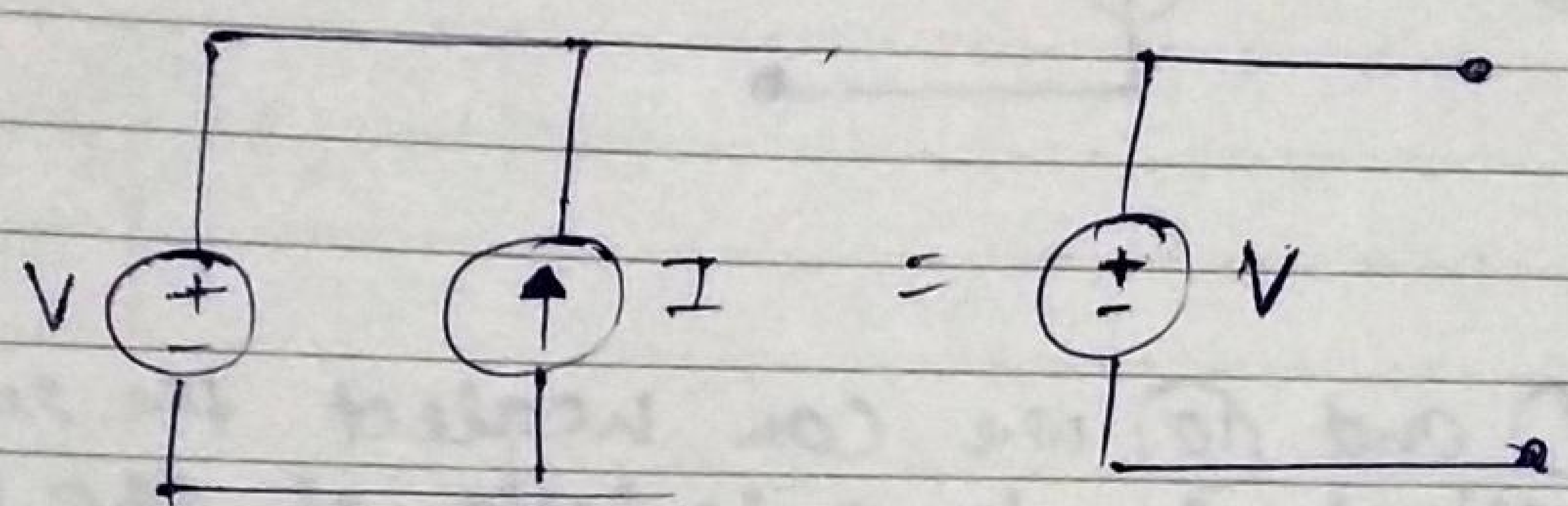
$I_s = 10A$

$P_s = 1kW$



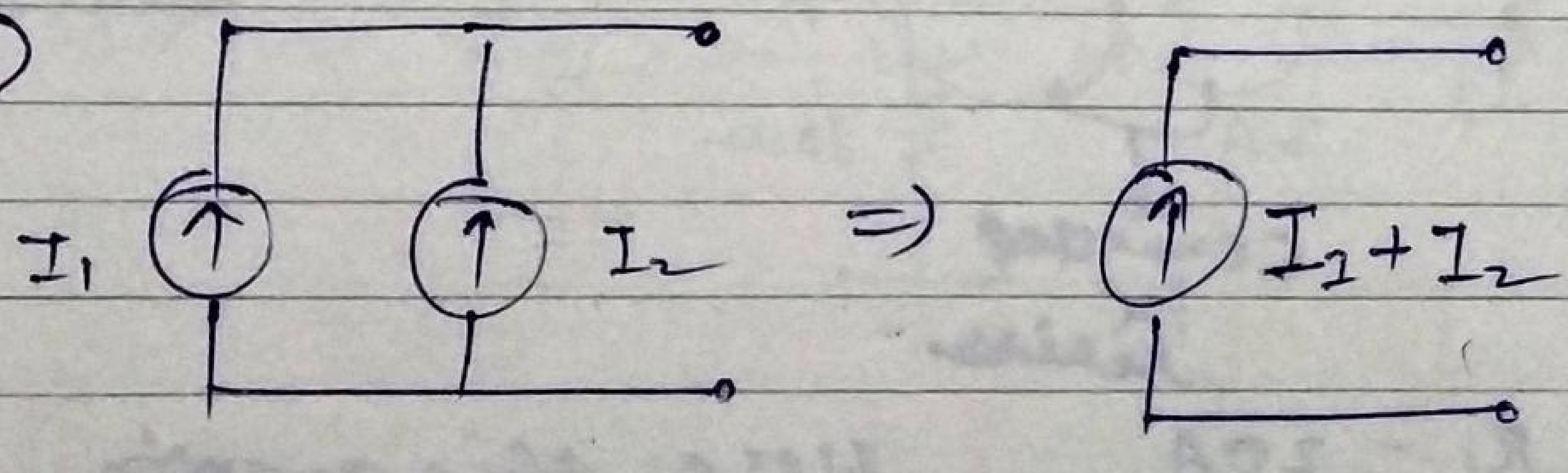
Hence when we neglect 10 Ω then load side calculation remains same but source side calculation will change.

5)

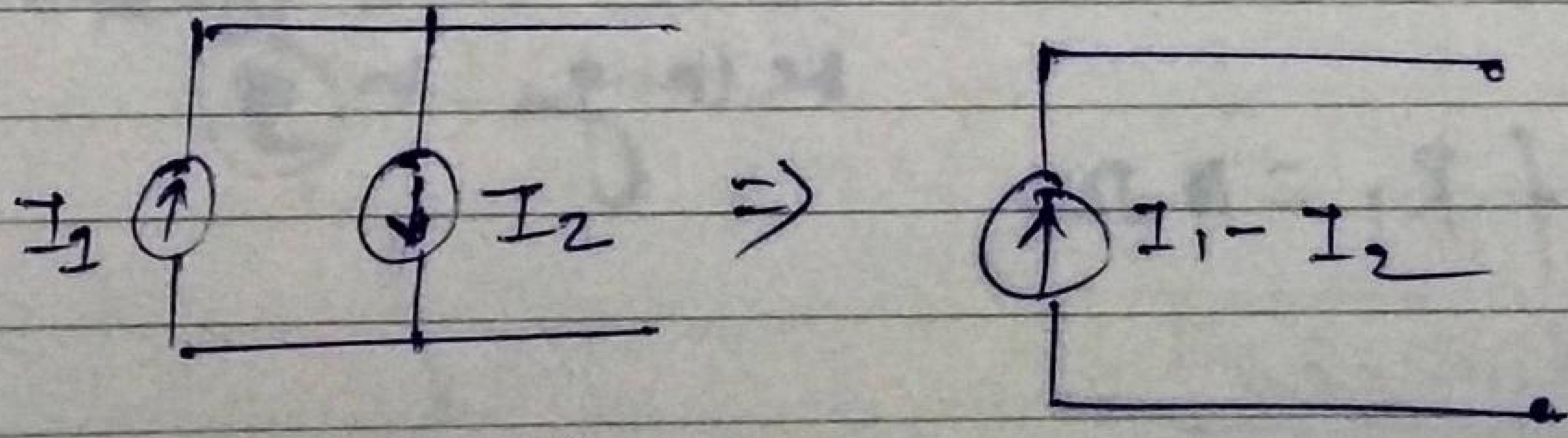


In the above ckt current source can be neglected while calculating either load current or load voltage but not for the calculation of source current or source power.

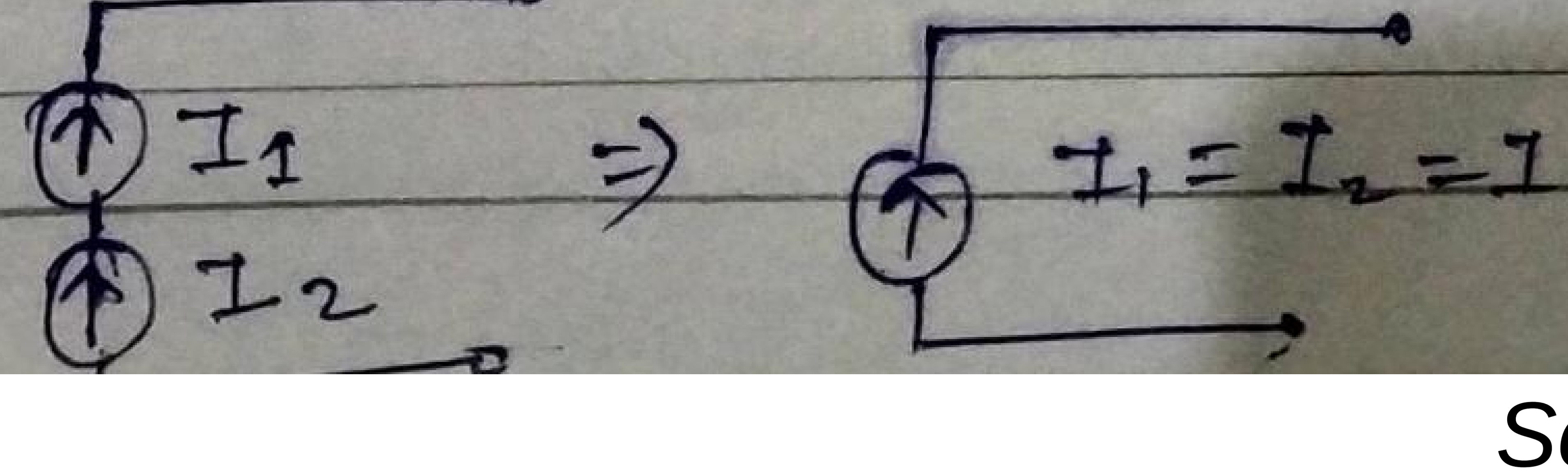
6)



7)



8)



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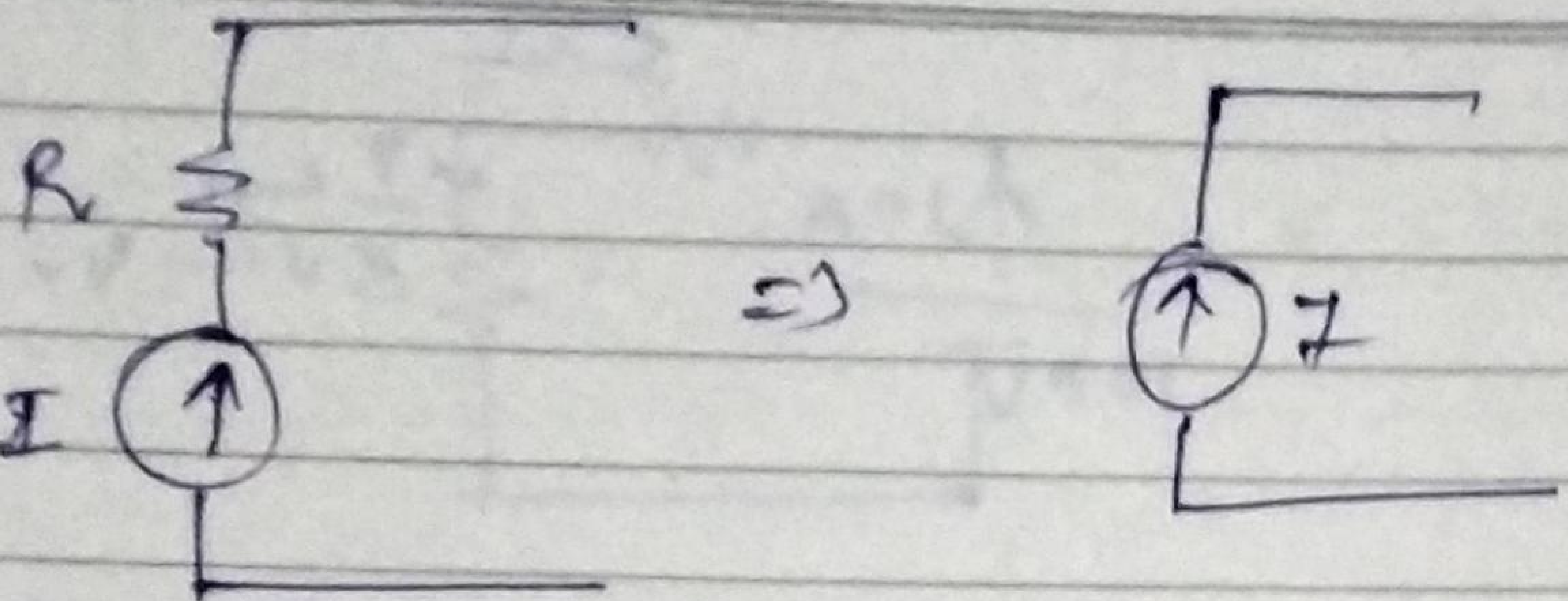
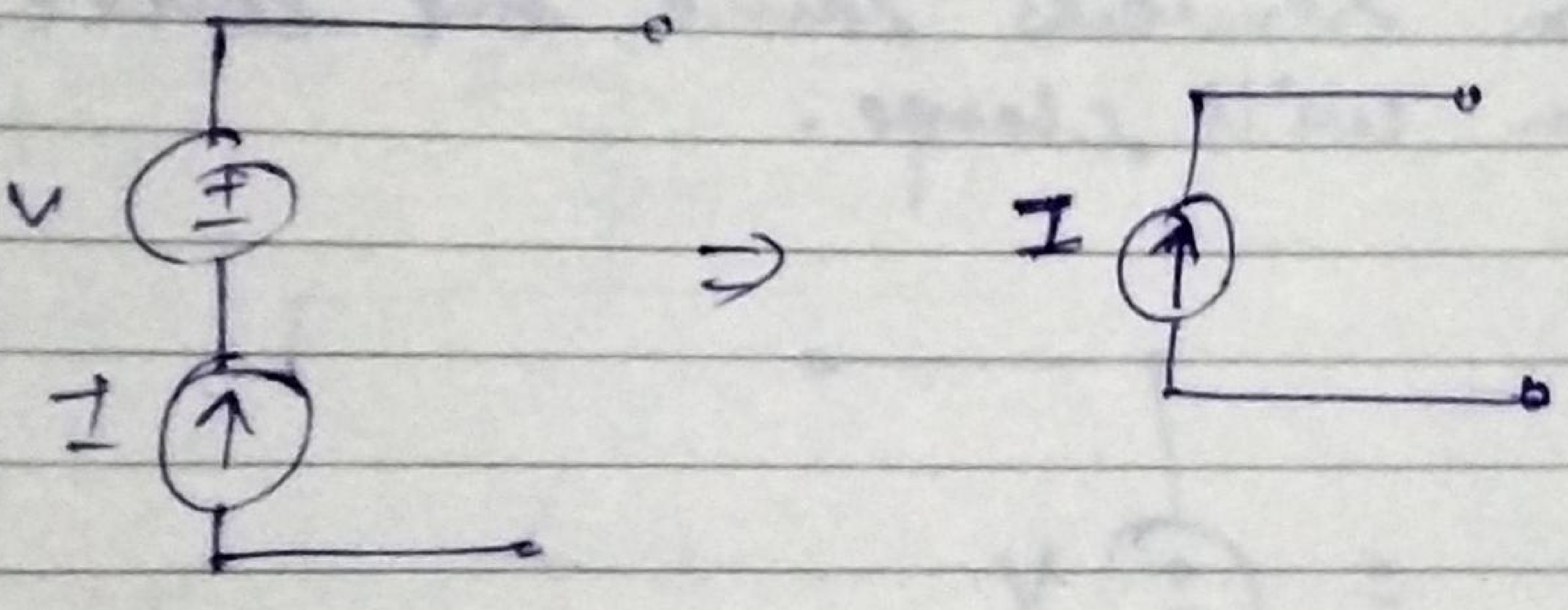
9

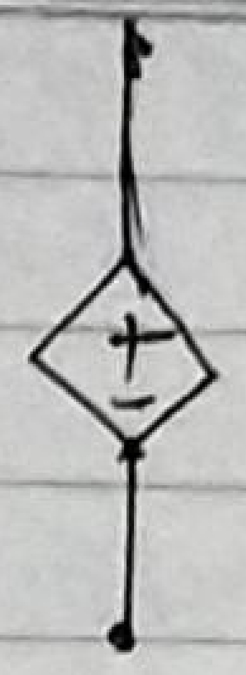


10



In the point 9 and 10 we can neglect the resistance and voltage respectively for the calculation of the load current or load voltage but not for the calculation of the voltage across the source or the power of the source.

Linearly dependent sources bcz
NO Non linear operator.


$v_x = Ai$


$v_x = BV$


$i_x = Ci$

CCVS

$\boxed{A = \Omega}$

VCVS

B = unitless

CCCS

C → unitless

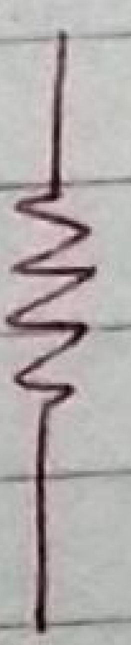

$i_x = Dv$

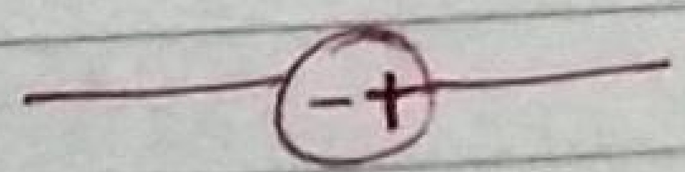
VCCS

D = ℧ siemens

01.09.18

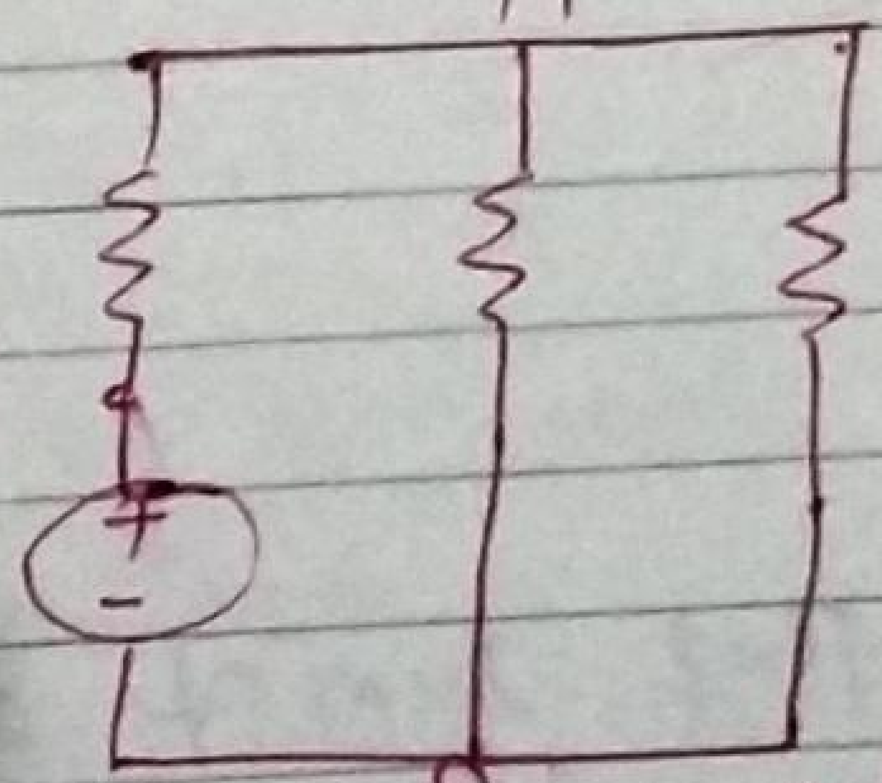
Branch: Branch is a single element or component in a ckt. If ~~severval~~ several element carry the same current they can also be referred as single branch.





(single Node)S

P1



$e = b - (N-1)$

P2 → Principal Node

Node: when two or more than two element are connected together in a common point then the common point is called as ~~principle~~ Node.

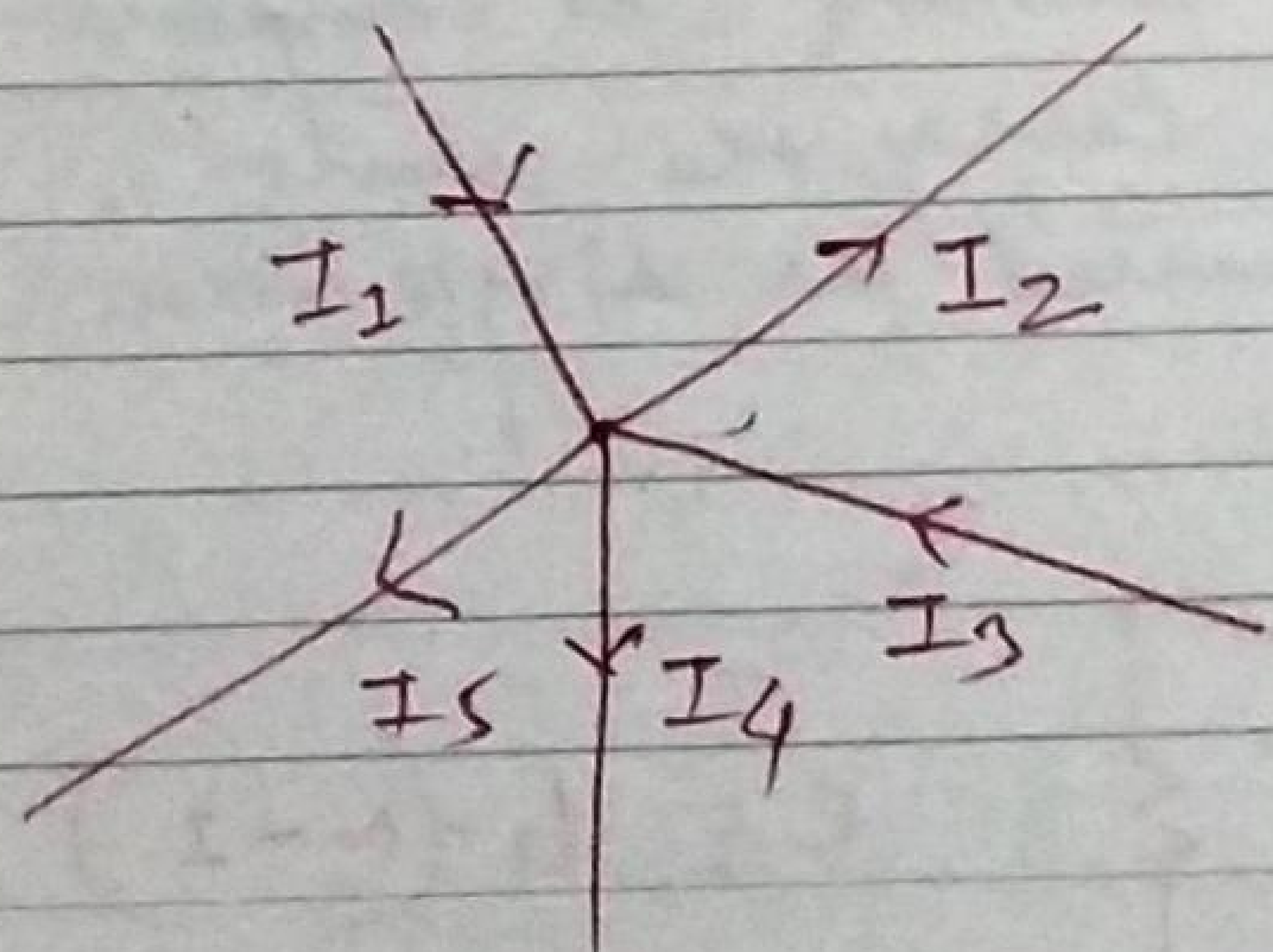
* when two elements are connected together then the common points it is called as ~~single~~ simple Node.

* when more than two element are connected together then the common point is called as principal Node and at this Node current division takes place.

KCL:-

KCL states that algebric sum of the currents entering a node (or meeting at the point) is zero.

* Outgoing current is considered as -ve and incomming current is considered as +ve.
* It is based on the Law of conservation of charge.



$I_1 - I_2 + I_3 - I_4 - I_5 = 0$

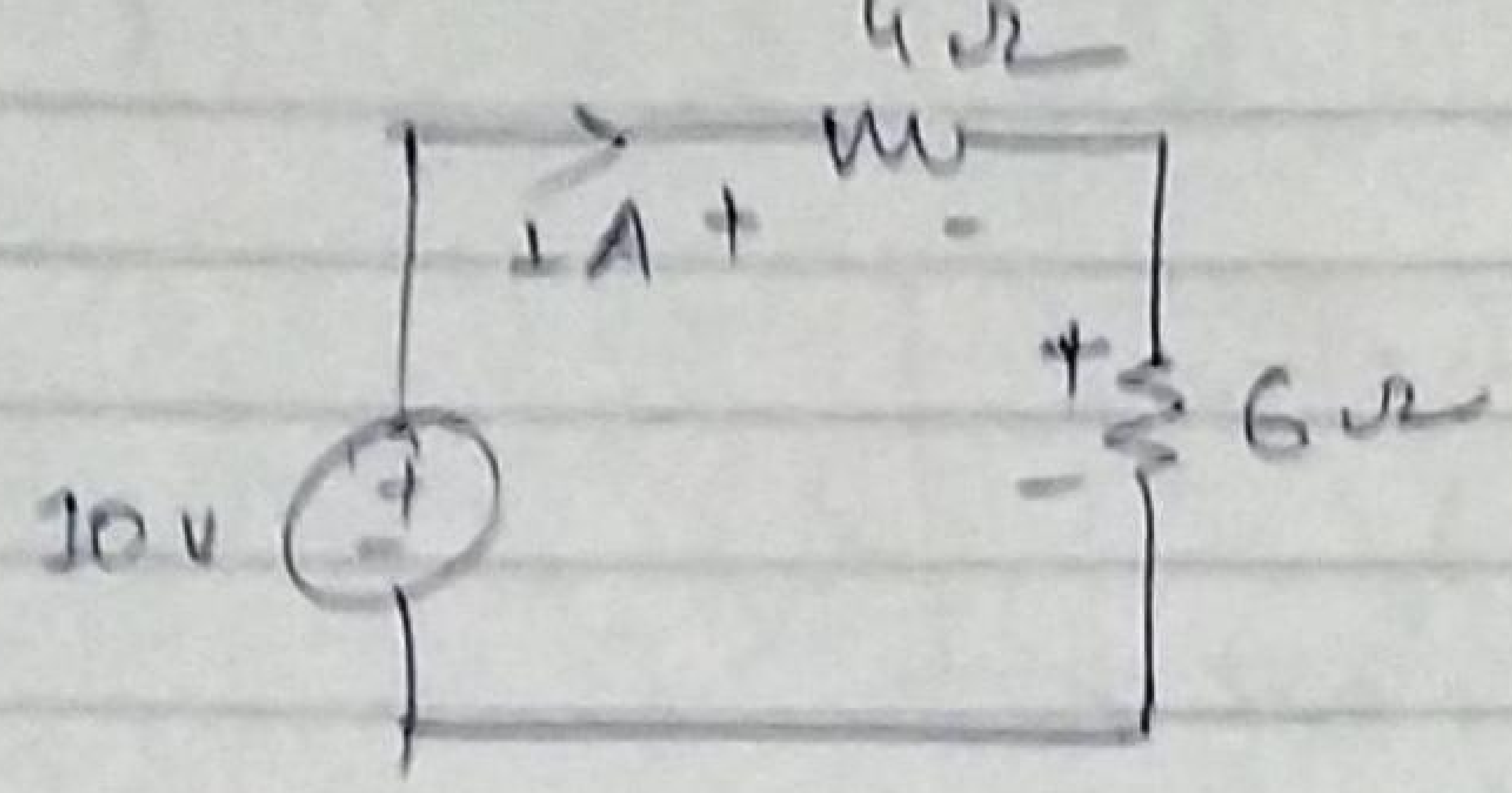
KVL:-

It states that sum of all the voltages in a close loop is zero.

* It is based on the law of conservation of energy.

Standard Notation :-

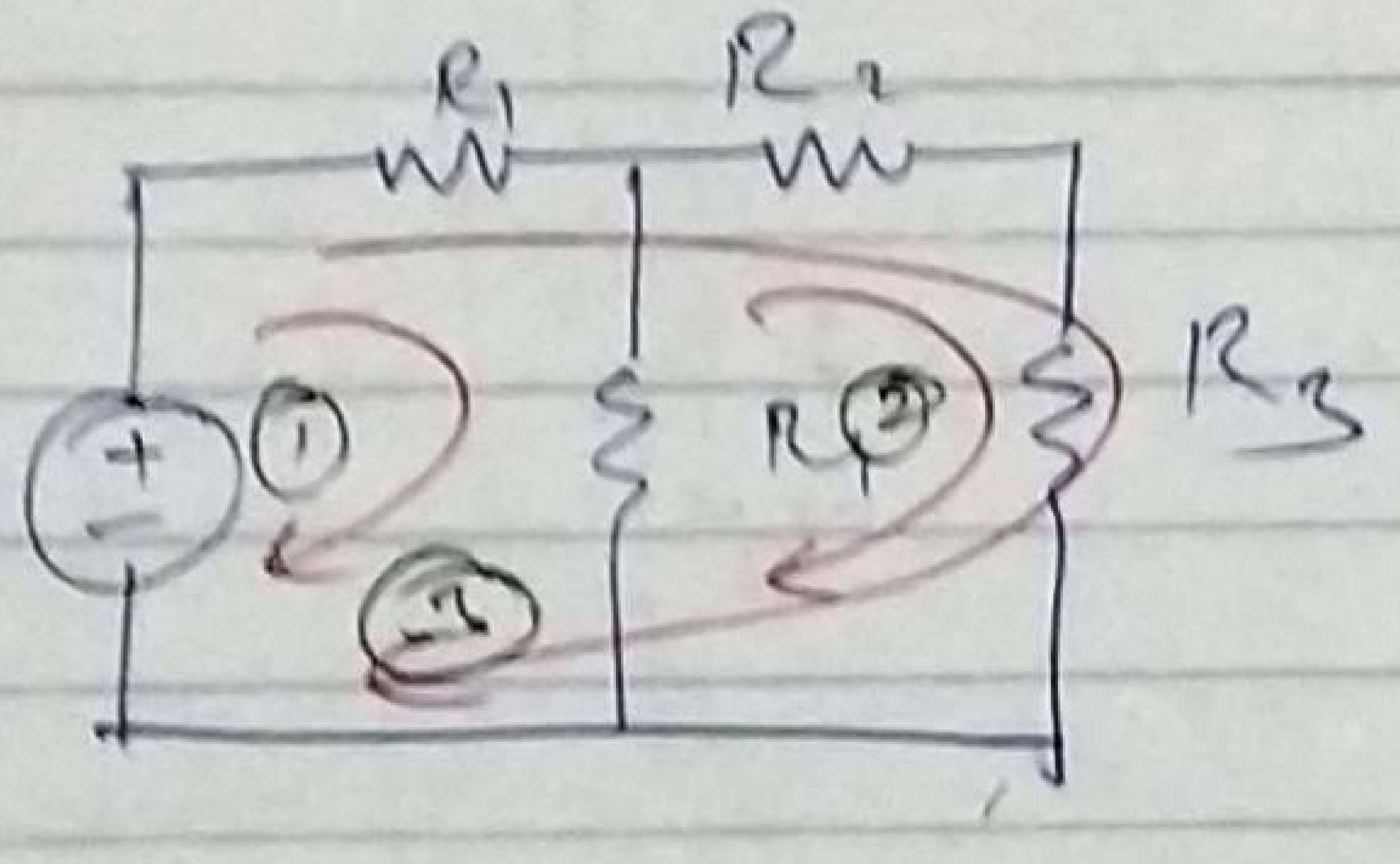
In a loop rise in potential is considered is (−ve) and drop in potential is considered (+ve).



$$-10 + 4 + 6 = 0$$

Mesh Analysis :-

+ Mesh is a loop which does not contain any inner loop.
* It is applicable only for the planar N/ws and planar N/w is one that can be drawn in a plane with no branches crossing one another.



Loops

1 2 3

Mesh

1 2

Procedure

* Identify total no of mesh.
* Assign mesh current
* Develop KVL eqn for each mesh.
* Solve eqn to solve loop current.

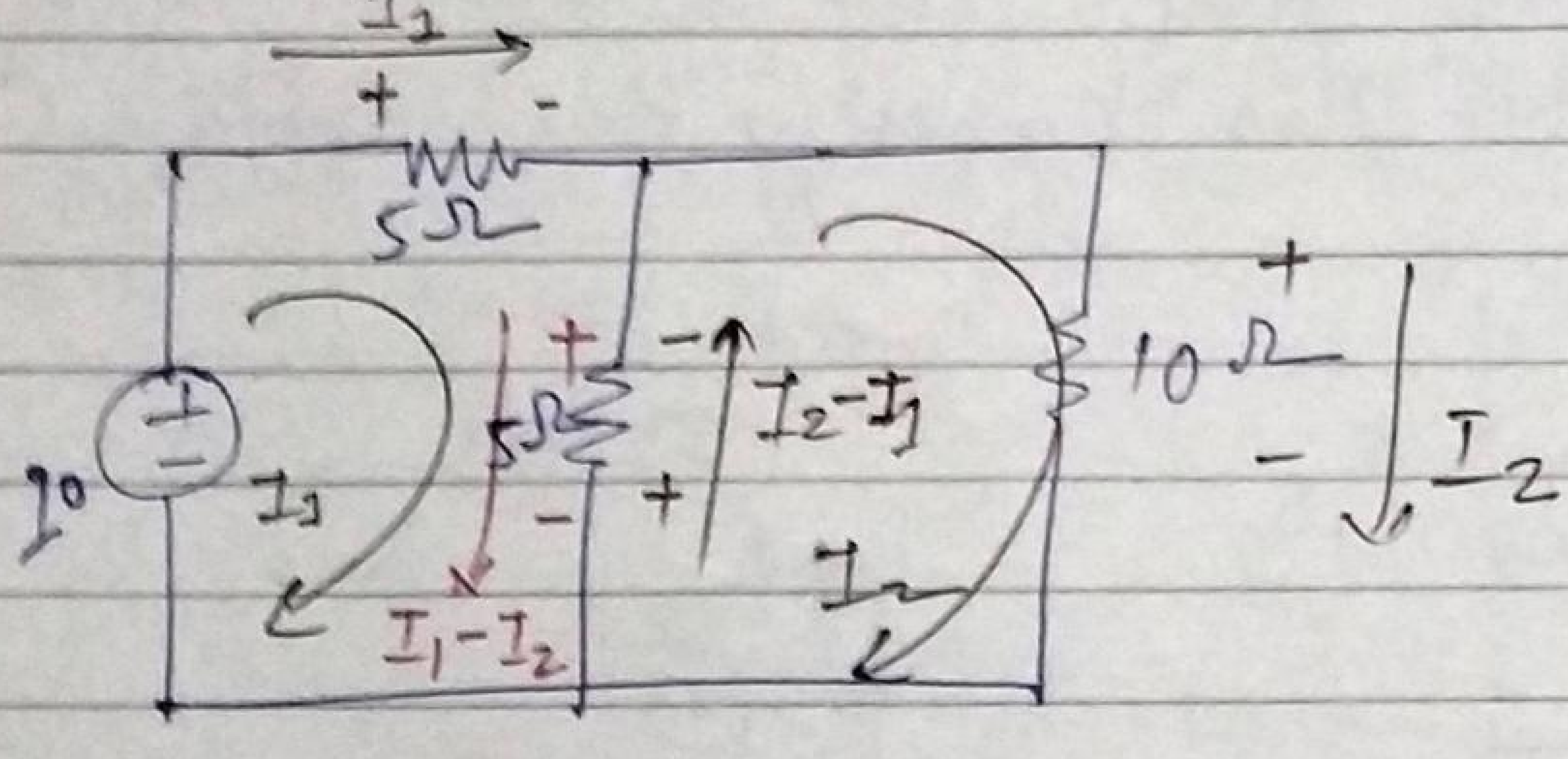
Note:

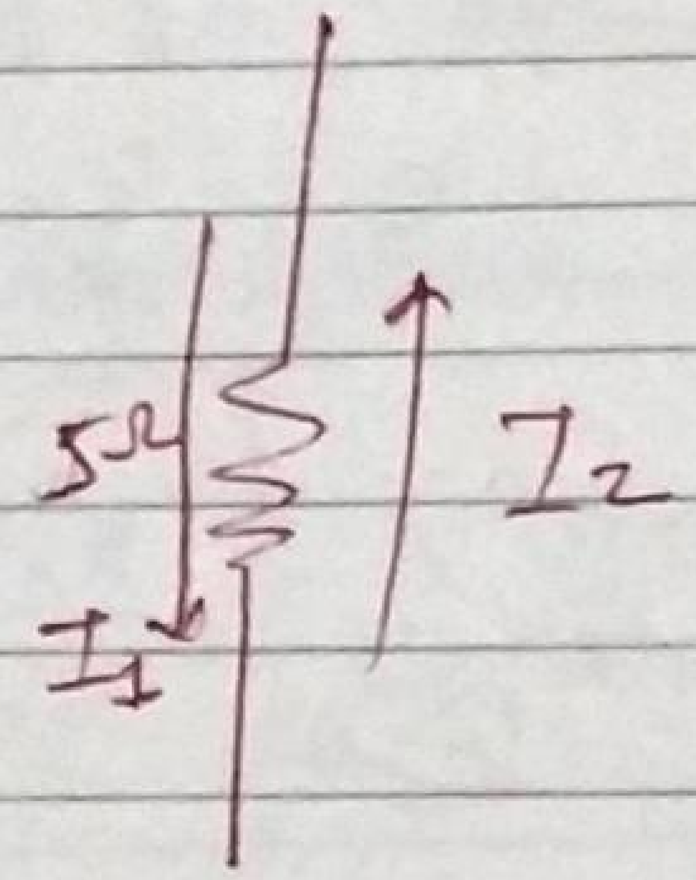
The direction of mesh current can be taken in any direction clk wise or anticlk wise. But taking clk wise direction gives the simpler analysis.

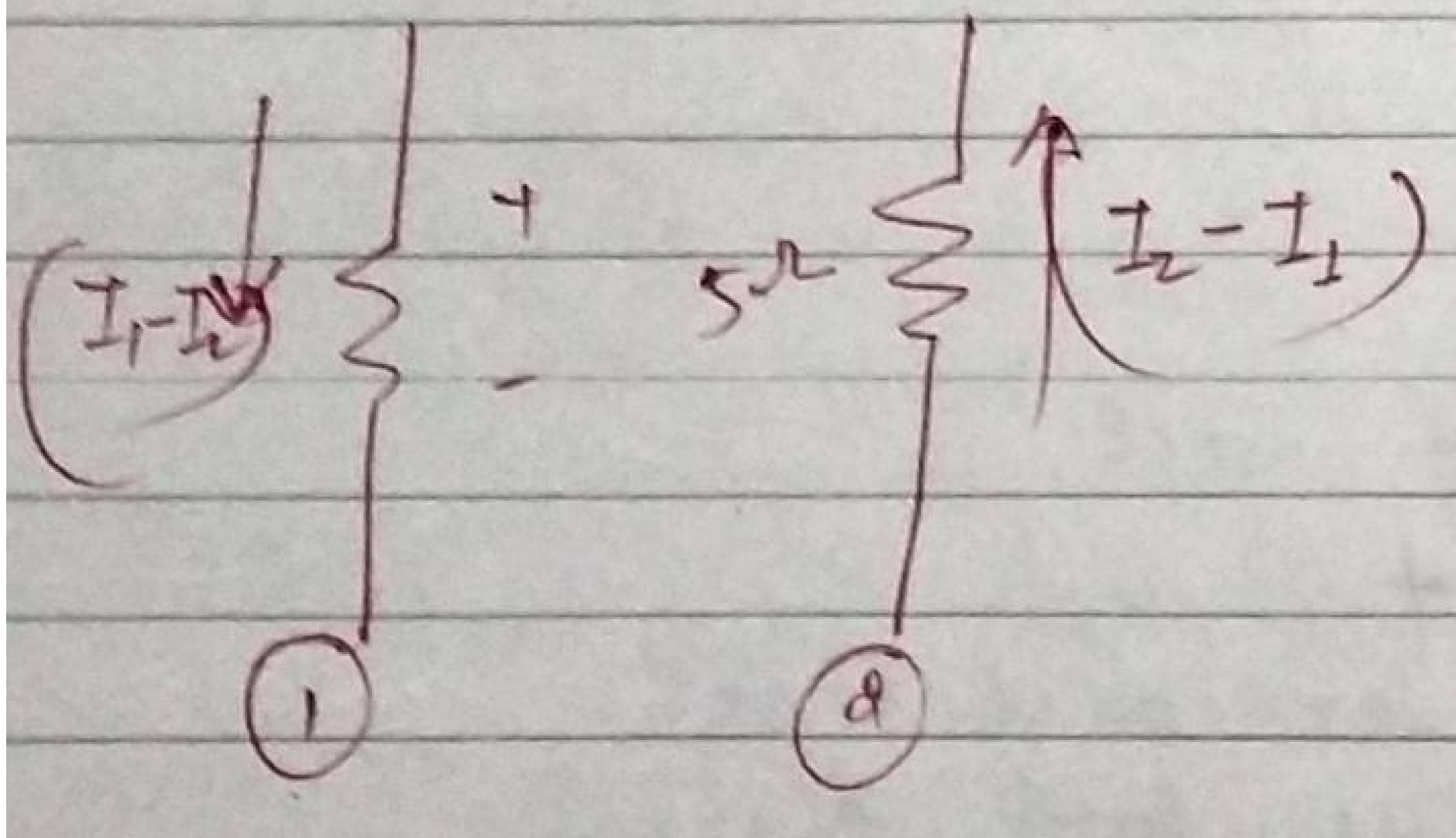
$$\boxed{\begin{aligned} \text{No of eq}^n &= \text{No of Meshes} \\ &= \underbrace{b}_{\text{Total No of Branches}} - (N-1) \end{aligned}}$$

$N \rightarrow$ Total no of nodes

Ques: Using Mesh analysis find the power loss in the 10 Ω resistor.







Loop 1 :-

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

$$10I_1 - 5I_2 = 10$$

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

Loop 2 :-

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

$-5I_1 + 15 I_2 = 0$

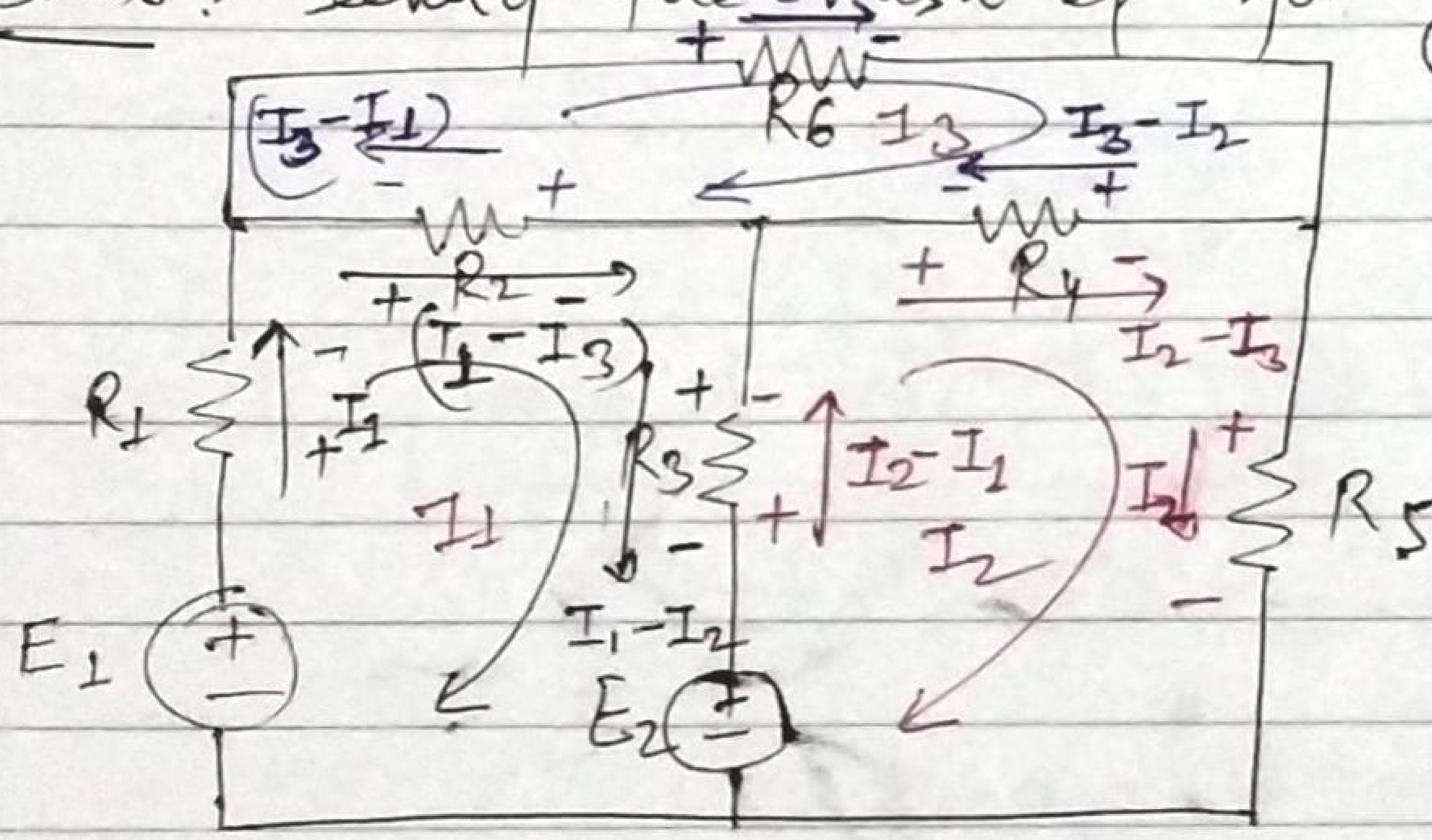
$-I_1 + 3 I_2 = 0$ —— (2)

(1) + 2 × (2)

$5 I_2 = 2$ $\boxed{I_2 = \frac{2}{5} A}$

$P_{10} = I_2^2 \cdot (10) = \frac{4}{25} \times 10 \boxed{= \frac{40}{25} W}$

Ques :- Develop the mesh eqⁿ for given N/W :-



loop 1 :-

$-E_1 + I_1 R_1 + (I_1 - I_3) R_2 + (I_1 - I_2) R_3 + E_2 = 0$

loop 2 :-

$I_2 R_5 - E_2 + (I_2 - I_1) R_3 + (I_2 - I_3) R_4 = 0$

loop 3 :-

$I_3 R_6 + (I_3 - I_2) R_4 + (I_3 - I_1) R_2 = 0$

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