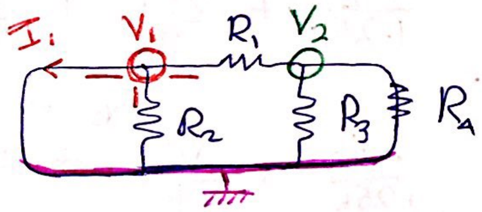
Chapter 4: Techniques of Circuit Analysis

(1)

- ☑ Nodal Analysis
- ☑ Mesh Analysis
- ☑ Source Transformation
- ☑ Super Position
- ☑ Thevenin's Circuit
- ☑ Norton's Circuit
- ☑ Maximum Power transfer

Nodal Analysis:-



To define Nodes:-

A node : a point that lines intersects

To use This technique :

→ You need to specify a Node where V is zero
Here it's colored in pink

→ other Nodes should gather 2 elements or more
And you should be able to find an equation for each current :

Ex : At V_1 You Can obtain:-

$$\frac{V_1 - V_2}{R_1} + \frac{V_1}{R_2} + I_1 = 0$$

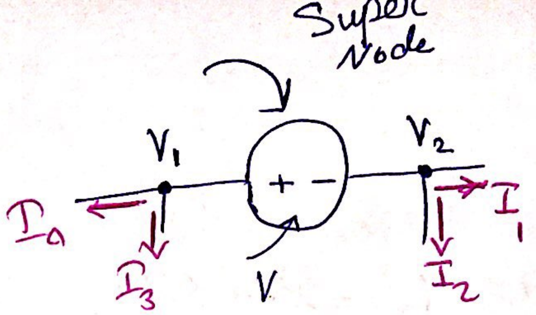
↳ I_1: You can't find it's equation

So This Node is useless

At V_2 You Can obtain:-

Remark:

Super Node



Here : $V_1 - V_2 = V$

- And you can't Combine The two Node in One Equation

The Eq.: $I_4 + I_3 + I_1 + I_2 = 0$

Mesh Analysis

To define Meshes

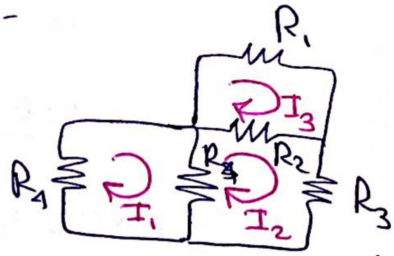
A mesh : A loop that Contains No other loops

To use this Technique :-

→ You need to Determine Meshes and Name them

→ use Kirchoff's voltage law:-

Here :-



At I_1 ↺ :-

$R_4(I_1) + (I_1 - I_2)R_4 = 0$ The Current of your current Mesh Comes first

At I_2 ↺

$R_3(I_2) + R_2(I_2 - I_3) + R_4(I_2 - I_1)$

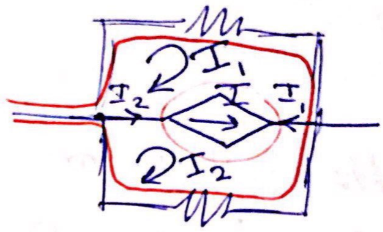
At I_3 ↺

$R_1 I_3 + R_2(I_3 - I_2)$

when a Resistance is between two meshes you Take The difference of Currents

Remark

Super Mesh



- It occurs when there is a Current Source Between two Meshes

$I_2 - I_1 = I$

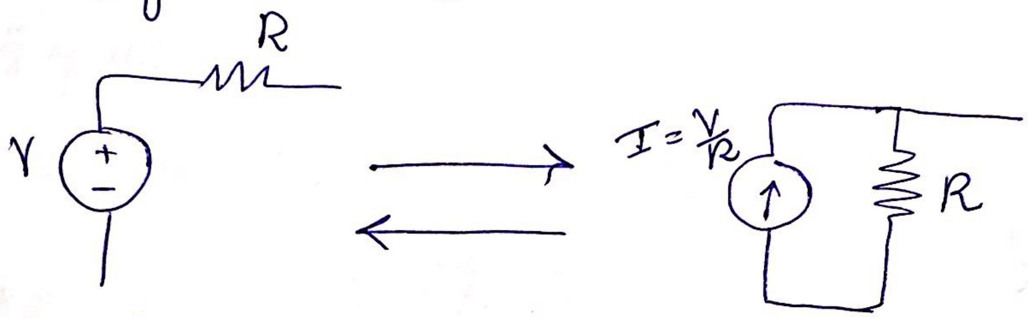
You Can Go in the Red path as shown

Sourca tranformatio

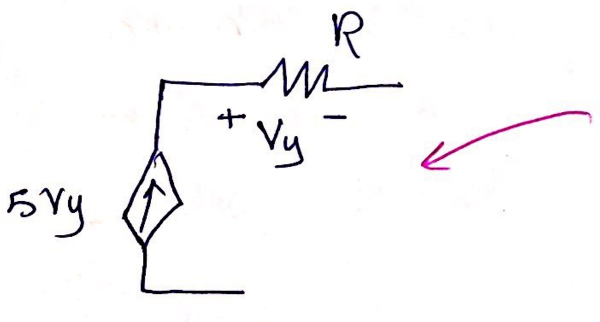
Voltage Soura + Resistance (Series) —— $I = (V/R)$ ——> Current Sourca + Resistance (Parallel)

<—— $V = (IR)$ ——

- R stays the same



- Remark: If the Voltage or Current Sourca are Dependant Then if the ~~Source~~ That it depends on is in The area of Transforming You Cannont Transfor



You Can't transfer this

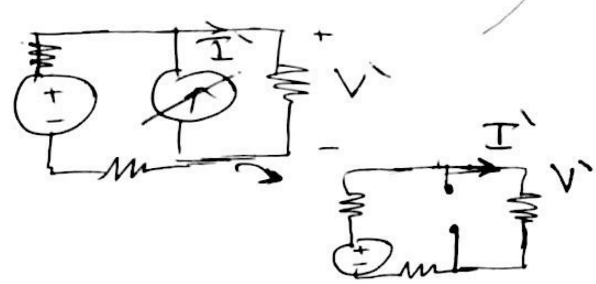
Super Position :

- Currents and Voltages Come from different Sources in the Circuit So you Can Kill one Source , find ~~that's~~ I and V Then Kill the other Source and find the others I and V

- If It's a <u>Voltage Source</u> You Can Kill it by Making a Short Circuit
- If it's a <u>Current Source</u> You Can Kill it by Making an Open Circuit

$$I = I' + I''$$
$$V = V' + V''$$

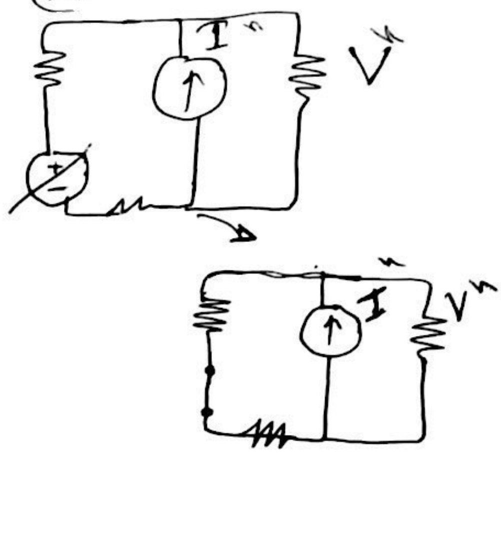
①



I' and V' are in ①

I'' and V'' are in ②

②



Ex:

Thevenin Circuit

↳ There are 3 Cases :-

1. Circuit Contains Only independent Sources

   $R_{th} = R_{eq}$ after killing all sources

   $V_{th} = V_{o.c}$

2. Circuit Contains dependent and independent Sources

   $R_{th} = \frac{V_{th}}{I_{s.c}}$

3. Circuit Contains only dependent Sources

   $R_{th} = \frac{V_T}{I_T}$ Dead Circuit

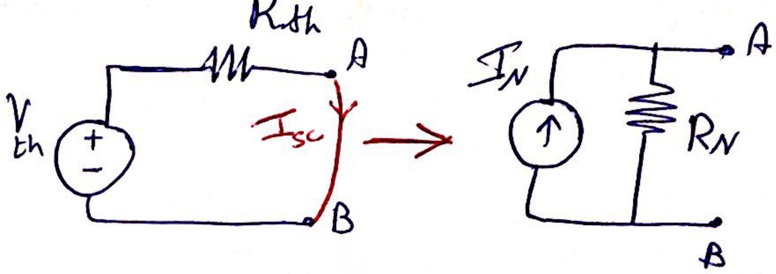
   V_{th} here $= 0$

- You put a V_T and you find I_T or you put I_T and you find V_T

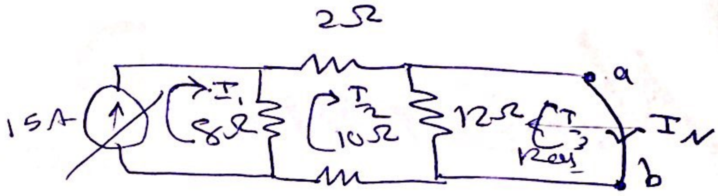
Norton Circuit

$I_{sc} = I_N$

- and R_N can be found depending on the case



Assesement Problem:- P 139.



$I_N = I_3$

$I_1 = 15A$

~~I_2~~

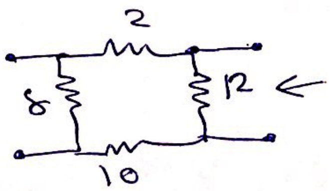
$8(I_2 - I_1) + 2I_2 + 12(I_2 - I_3) + 10I_2 = 0$

$12(I_3 - I_2) = 0$

$8(I_2 - 15) + 2I_2 + 12(I_2 - I_3) + 10I_2 = 0$

$32I_2 - 12I_3 = 120$

$R_N =$



$I_3 = I_2$

$32I_2 - 12I_2 = 120$

$I_2 = 6$

$I_3 = 6 = I_N$

Maximum Power transfer

$$P_{L max} = \frac{V_{th}^{2}}{4R_L}$$

$$R_L = R_{th}$$