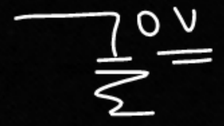
CONCEPT OF GROUND

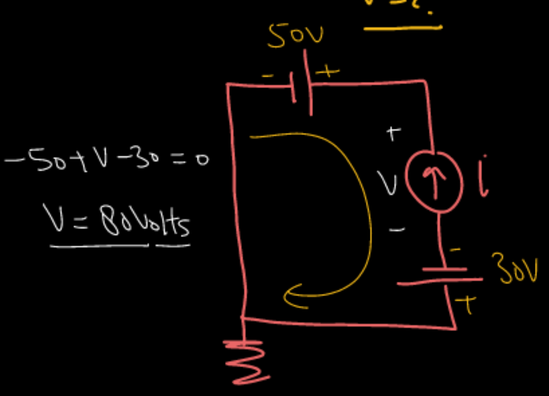


- Carry fault current, in case of insulation breakdown.
- Some current always flows through ground path due to capacitive and inductive coupling etc.
- For safety concerns against leakage on residual currents via low impedance path.
- While phase/ neutral connected to main power wiring, earth may be connected to body of the equipment.
- Though both neutral and ground are made grounded, they should no be mixed.

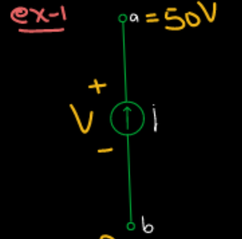
- ref Vol., will never affect Potential difference, but node Vol. definately chged.

Ex-

Find the current in each element ?



ex-1



50−(−30)=V

V=80V

ex-2

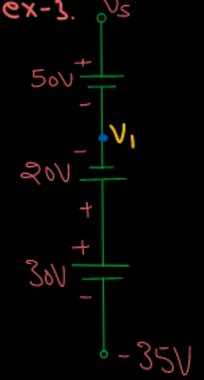
(V_S = −20V. Hs)

V_b = ?

V_b = 20V

V_b = 0V

ex-3.



Soln -

Potential diff. ⇒

$V_1 - (-35) = -20 + 30$

$V_1 + 35 = 10$

$(V_1 = -25 \text{ Volts})$

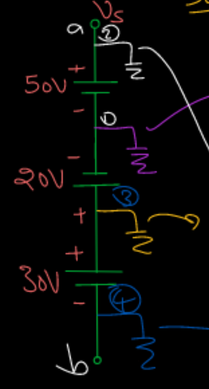
$\Rightarrow V_S - V_1 = +50$

$V_S - (-25) = 50$

$\therefore V_S = 25$ Volts

The value of V_S is — Volts

Soln



V_S ⇒ node Vol.

$V_S = 50V$

$V_S = 0V$

$V_S - 0 = 50 - 20$

$V_S = 30V$.

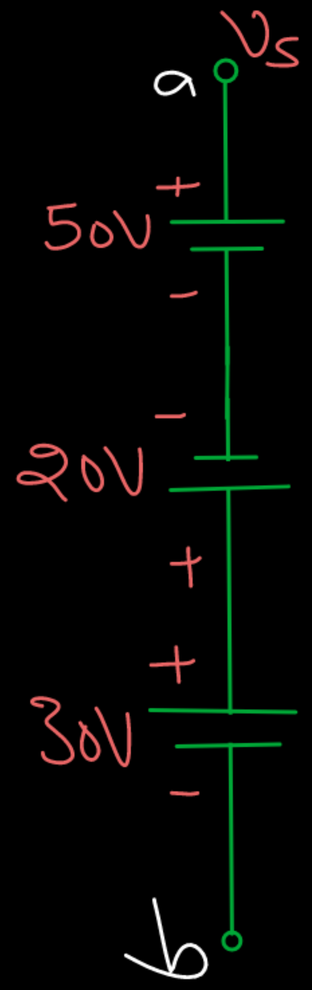
$V_S - 0 = +50 - 20 + 30$

$V_S = 60$ Volts

⇒ ex- Find the Vol. at node "a"

a) 0V ✓ b) 50V

c) 30V d) 60V

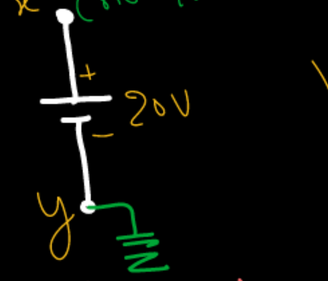


Node voltage

⇒ The Vol. at a perticular junction, is called node Vol.

⇒ "node Vol. is also called potential difference" (Wrong)

⇒

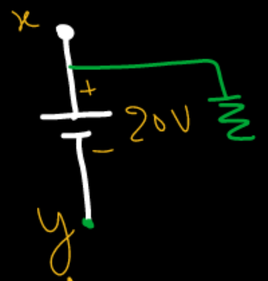


$V_x = ?$

$[V_x = 20V]$

* to calculate node Vol, one refercence point is mandatory in the ckt.

⇒

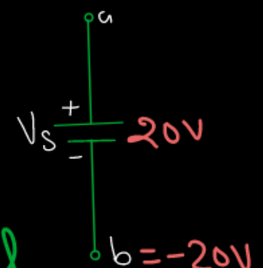


$V_x = 0$ Volts

⇒ Therefore, we can say, node Vol. will affect w.r.t. ref. Vol. location.

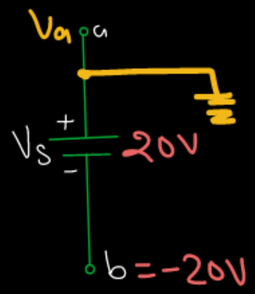
ex-1. $V_a = ?$

a) 40V b) 20V c) 0V d) 20V.



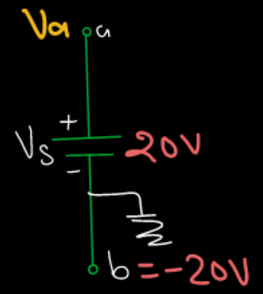
Soln ⇒ in the given qustion, ref. Point is not given. So- ---

case (I) $V_a = 0$ Volts



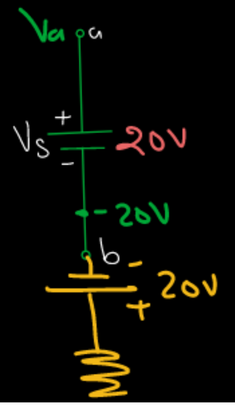
case (II)

$V_a = 20V$.



case (III) $V_a - (-20) = 20$

$V_a = 0V$



Potential difference

Ex- calculate Vab in each case.

i) 

Soln- let $V_x > V_y$

$V_x - V_y = +20 - 30 + V_{ab}$

$10 - (-10) = -10 + V_{ab}$

$[V_{ab} = 30 \text{ Volts}]$

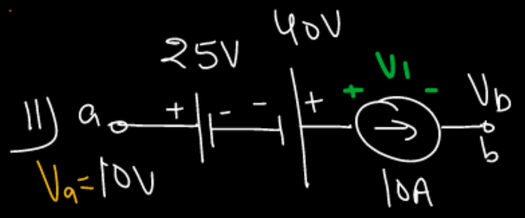
2nd way let $V_y > V_x$.

$V_y - V_x = -V_{ab} + 30 - 20$

$-10 - 10 = -V_{ab} + 10$

$-30 = +V_{ab}$

$\therefore V_{ab} = 30V.$

ii) 

$V_{ab} = ?$

⇒ let Vol. across current Source $= V_1$

let $V_a > V_b$.

$V_a - V_b = 25 - 40 + V_1$

$\boxed{V_{ab} = (-15 + V_1)}$

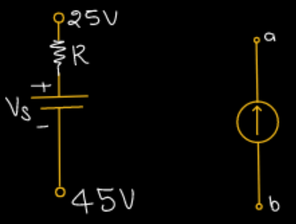
OR $10 - V_b = V_1 - 15$

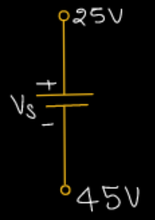
$\boxed{(25 - V_1) = V_b.}$

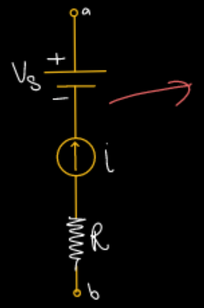
Current calculation in Circuit

* to calculate cnent, we require potential diff.
* Potential difference means, Vol. diff in b/w two nodes.
* Through (R, L, C), we can determine cnent by ohms law or other method.

but cnent through Vol. Source, can't determine by ohms law.







let $V_a > V_b$

$\longrightarrow -i$

let $V_b > V_a$

$\longrightarrow +i$

ex- Already cnent given.

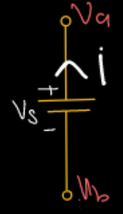
① let $V_a > V_b$

$\longrightarrow -I.$

② let $V_b > V_a$

$\longrightarrow +I$

ex- Assme cnent Thrayh V. Source.



① $V_a > V_b$

$\longrightarrow -i$

② $V_b > V_a$

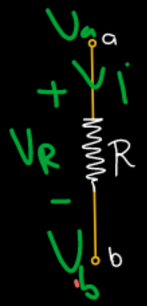
$\longrightarrow +i$

ex-1. cment throgh "R" will be.

Soluⁿ- let $V_a > V_b$.

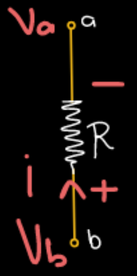
We know that, in resistor current always flow from high potential to low potential.

$\Rightarrow V_a - V_b = V_R$



$\therefore i = \left(\frac{V_a - V_b}{R}\right)$ Amp.

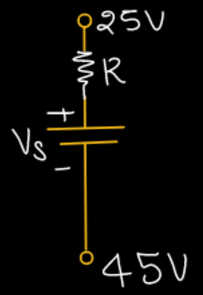
2nd way :- let $V_b > V_a$.



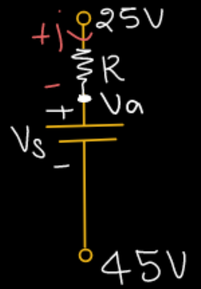
$i = \left(\frac{V_b - V_a}{R}\right)$ Amp.

⇒ ex-2, cnent throyh veris =-?

Solu^{n}: to calculate, cnent- we req. Potential d.ff. across veris.



⇒ let (25 > Va).



$\therefore i = \frac{(25 - Va)}{R}$

$\therefore i = \left(\frac{25 - Vs - 45}{R}\right)$ Amp.

By P.D.

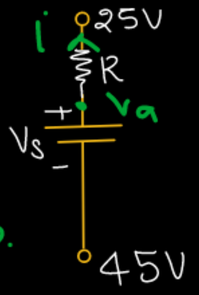
$Va - 45 = Vs$

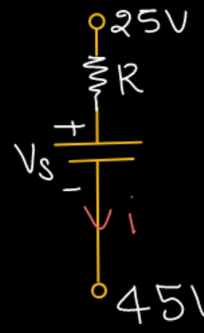
$Va = (Vs + 45)$

2nd way- $Va > 25$.

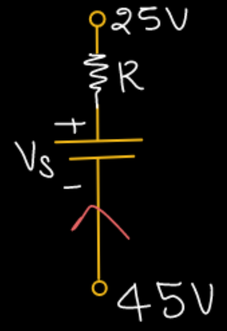
$\therefore i = \frac{Va - 25}{R}$

$i = \frac{(Vs + 45) - 25}{R}$ Amp.





$i = \left(\frac{25 - 45 - Vs}{R}\right)$.

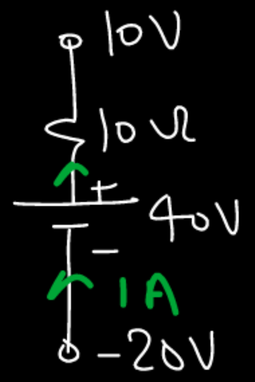


$i = \left(\frac{45 - 25 + Vs}{R}\right)$ Amp.

Ex- Find the cuent in each case ?

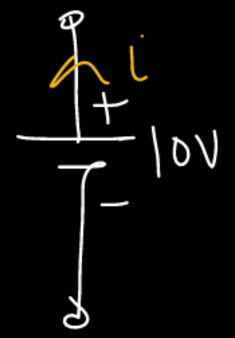
① 

$$i = \frac{10-(-20)}{10} = 3A$$

② 

$$\frac{10-(-20)-40}{10} = i$$

$$i = -1A$$

③ 

$i = ?$

we can't calculte

④ 

$(i = 10A)$

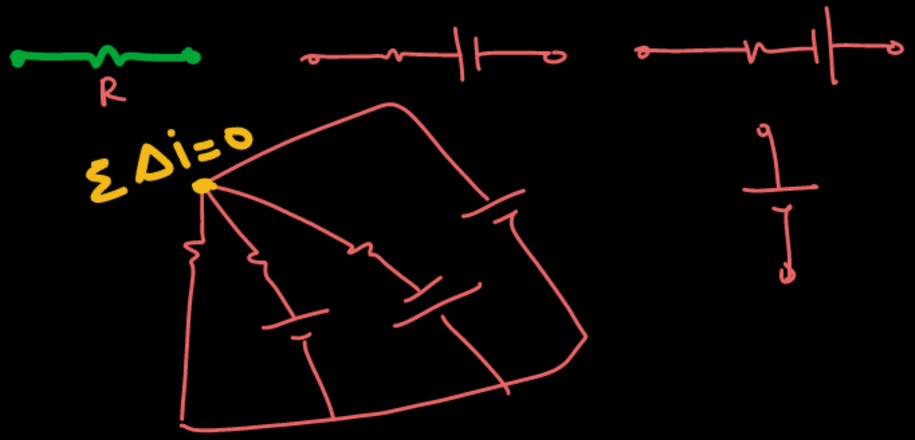
KIRCHOFF'S CURRENT LAW (KCL)

KEYPOINTS :

- "works on the principle of charge conservation"
- $(\sum \Delta i = 0)$ based on conservation of charge.
- $i = \frac{dq}{dt}$
- Valid for linear-time invariant system.
- To calculate node voltage, it is mandatory to take reference point.
- Always assume an unknown voltage across the dependent/independent current source, before solving the circuit either by KCL or KVL or any other method.
- Nodal analysis = KCL + ohm's law.

$[\Sigma \Delta i = 0]$,

$(i_1+i_2+i_3+i_5+i_6 = i_4)$

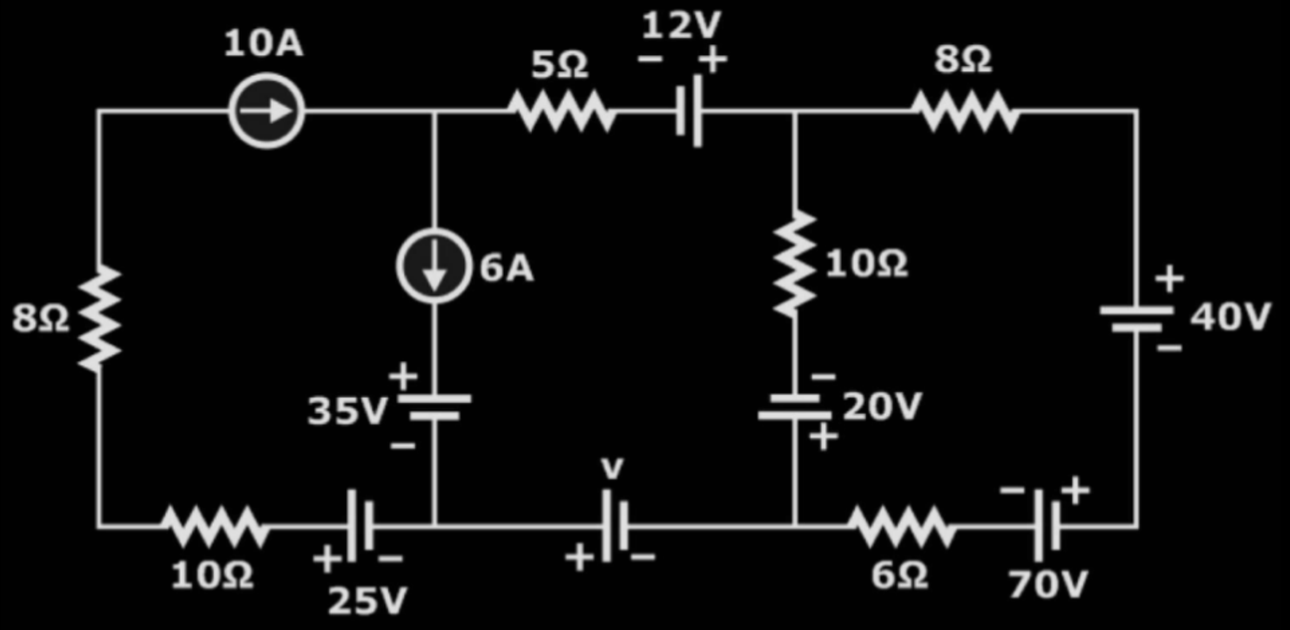


STEPS FOR NODAL ANALYSIS

- Identify all the essential nodes., and define Vol. for each node.
- Select one of the node as a reference node. i.e. ground. ①
- Apply KCL to each labelled node.
- Assume the voltage to be higher/lower at the node, we are applying KCL at.
- If a current source is given anywhere in the circuit, assume a voltage across that current source.
- If an ideal independent or dependent voltage source is present, without any series resistance in between two nodes, always assume a current through these sources.
- Once all the node voltages are known, we can calculate anything like current, power, energy etc.

Ex-1

Write down KCL equations for each Node



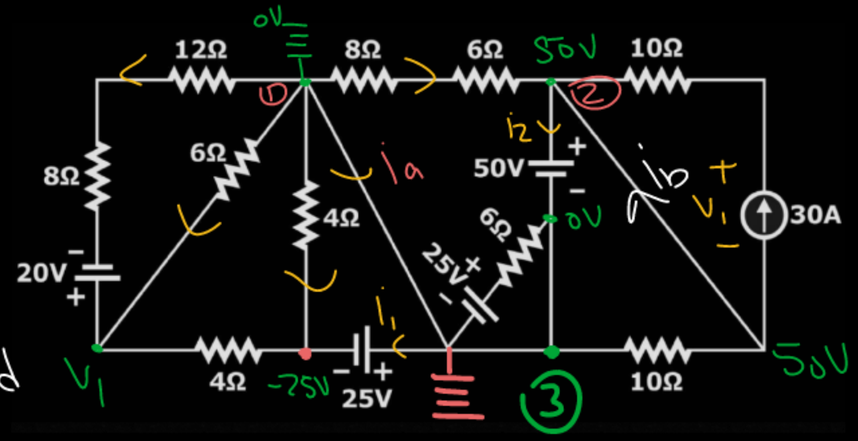
Ex-2

Write down KCL equations for each Node

⇒ KCL at node ①

Let -Vol. at node ① is the highest vol. of ckt.

* node ①, is connected with 5 arm.



$$\frac{0-V_1}{6} + \frac{0-V_1+20}{20} + \frac{0-(-25)}{4} + \frac{0-50}{14} + i_a = 0$$

KCL at node (2).

let node 2, Vol. is highest Vol. of ckt.

$$\frac{50-0}{14} + i_2 - 30 - i_b = 0$$

Ex-3

Write down KCL equations for each Node