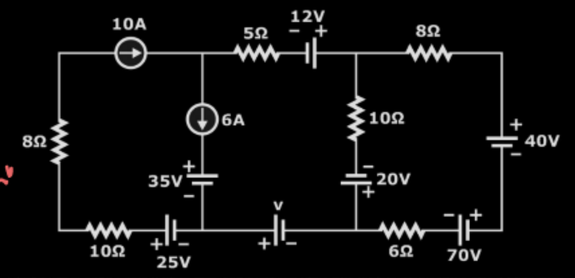

USE CODE (Y503)
FOR PAID COURSES OF
GATE 2024
EE/EC/ME/CE

Ex. Write down all necessary kcl Equations for given Circuit



Soluⁿ :→

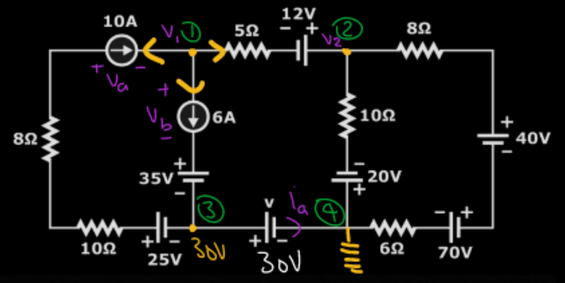
I) take a ref. Point, in the ckt "anywhere"

II) Identify the no. of necessary nodes.

① Nodal Analysis, at node ①

KCL at node ①

⇒ let V_1 is the highest Vol. of ckt.



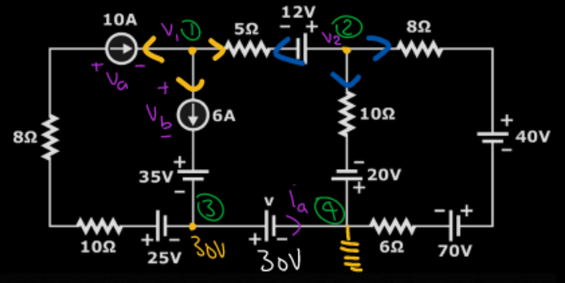
$$\frac{-10+6+V_1-V_2+12}{5}$$

$$\left(\frac{V_1-V_2+12}{5}\right) = 4$$

$V_1 - V_2 + 12 = 20$ OR $\boxed{V_1 - V_2 = 8 \quad (1)}$

⇒ KCL at node (2):-

let – V_2 is highest Vol. of ckt.

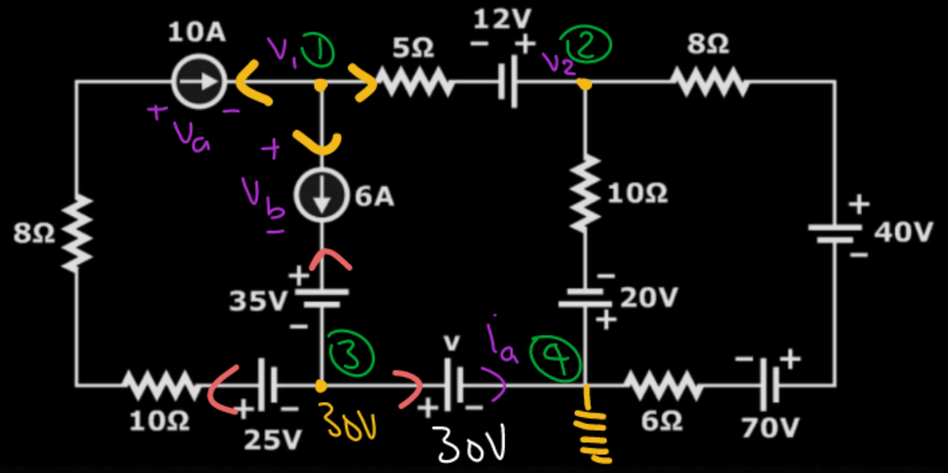


$$\frac{V_2-V_1-12}{5} + \frac{V_2+20}{10} +$$

$$\frac{V_2-40-70}{14} = 0 \quad (11)$$

⇒ KCL at node ③.

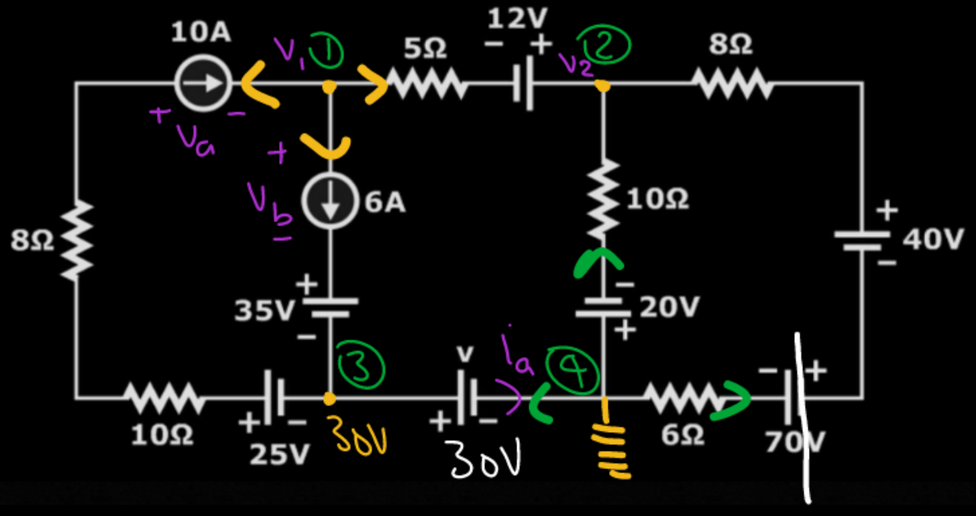
let, Vol. at node (3) is the highest Vol. of ckt.



$$+10-6+i_a=0$$

⇒ KCL at node ④

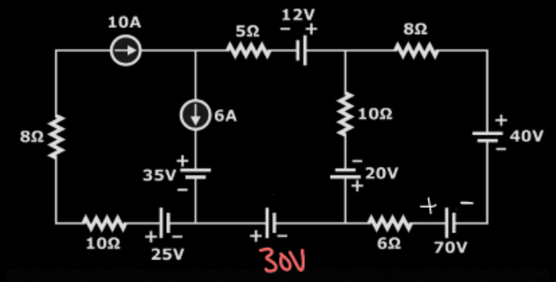
let, Vol. at node (4) is the highest Vol. of ckt.



$$-i_a+\left(\frac{0-V_2-20}{10}\right)+\left(\frac{0-V_2+70+40}{14}\right)=0 \quad (1V)$$

Ex.calculate power delivered by both current sources in given Circuit

By use of (KCL + ohm's)



P.D, for Va.

$V_2 - 30 = -V_a - 80 + 25 - 80$

$7.92 - 30 + 160 - 25 = -V_a$

$\therefore V_a = -112.92\,V$

$P_{6A}\big|_{del.} = 6 \times 57.08$

$= 342.48\,W$

$\therefore P_{10A}\big|_{del.} = 112.92 \times 10$

$= 1129.2\,W$

Soln:→ $P_{10A} = (10 \times V_a)\,W$

$P_{6A} = (V_b \times 6)\,W$

By P.D

$\Rightarrow V_2 + 0.08 = 20 - 12$

$V_2 = 8 - 0.08$

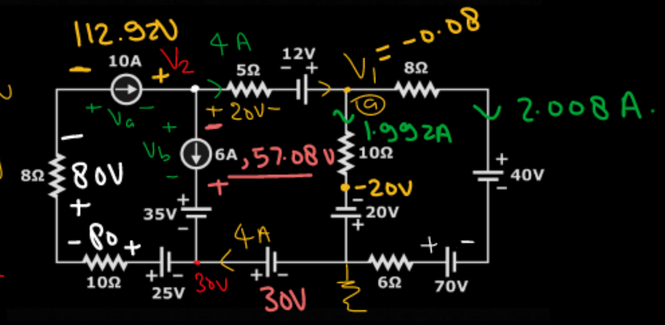
$= 7.92\,V$

By P.D ⇒

$V_2 - 30 = V_b + 35$

$7.92 - 30 - 35 = V_b$

$[V_b = -57.08\,Volts]$



KCL at node ①.

let - Vol. at node ① is highest Vol. of ckt.

$-4 + \frac{V_1 + 20}{10} + \frac{V_1 - 90 + 70}{14} = 0$

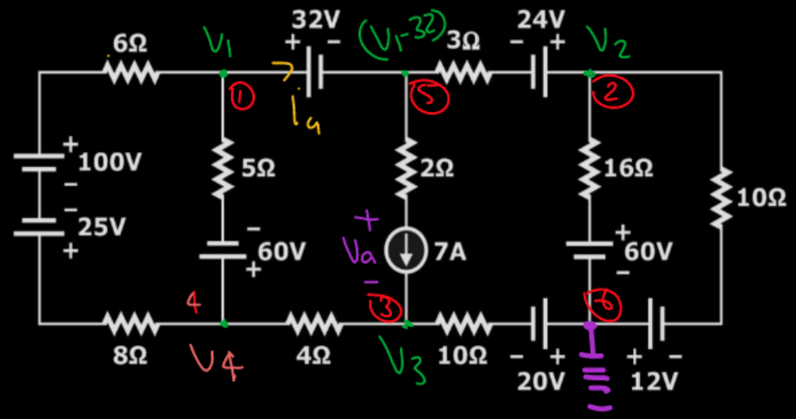
$V_1\left(\frac{1}{10} + \frac{1}{14}\right) - 4 + 2 + \frac{30}{14} = 0$

$V_1(0.171428) = -0.14285$

$V_1 = -0.083329\,Volts$

$[V_1 = -0.08\,Volts]$

Ex.Write down all necessary kcl Equations for given Circuit



Soln :- KCL at node ① :⇒

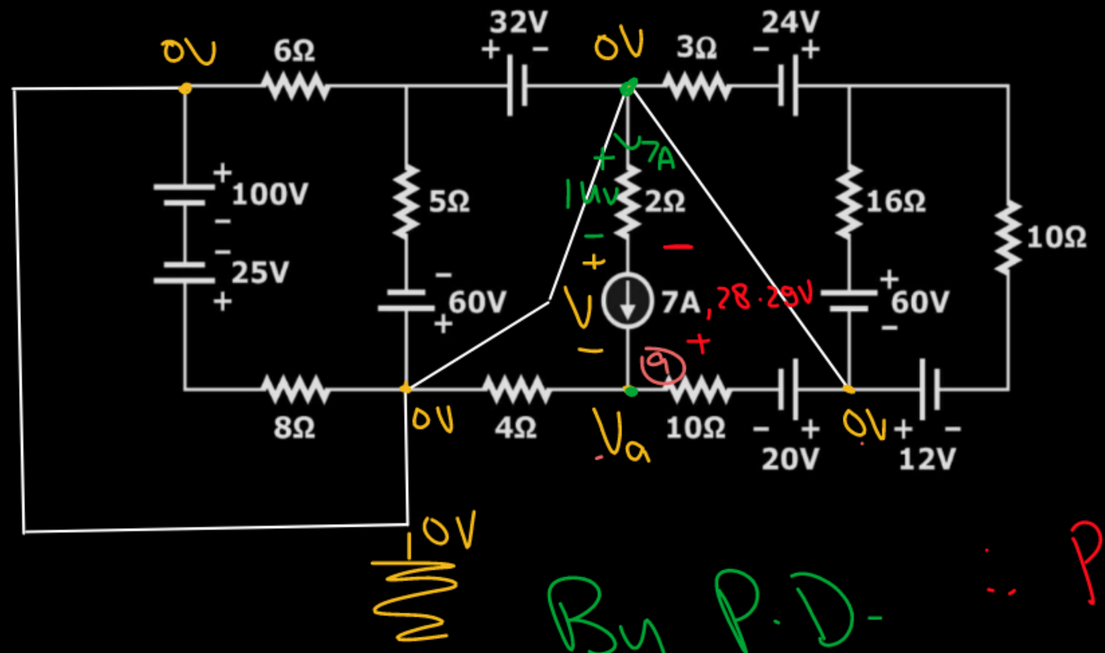
let, V_1 is the highest Vol. of ckt.

$$\left[\frac{V_1-V_4-100+25}{14}+\frac{V_1-V_4+60}{5}+i_a=0\right] \text{①}$$

, KCL eqn for node ⑥

$$\frac{0-V_3-20}{10}+\left(\frac{0-V_2+60}{16}\right)+\left(\frac{0-V_2-12}{10}\right)=0.$$

Ex.calculate power delivered by current sources in given Circuit



Soln: ref. Vol. will affect node Vol, not potential diff.

KCL at node (a)

$$\frac{V_a}{4} + \frac{V_a + 20}{10} - 7 = 0$$

$$V_a\left(\frac{1}{4} + \frac{1}{10}\right) = 5.$$

$$V_a = 14.29 \text{ Volts}$$

By P.D.

$$V_a - 0 = -V - 14$$

$$14.29 + 14 = -V.$$

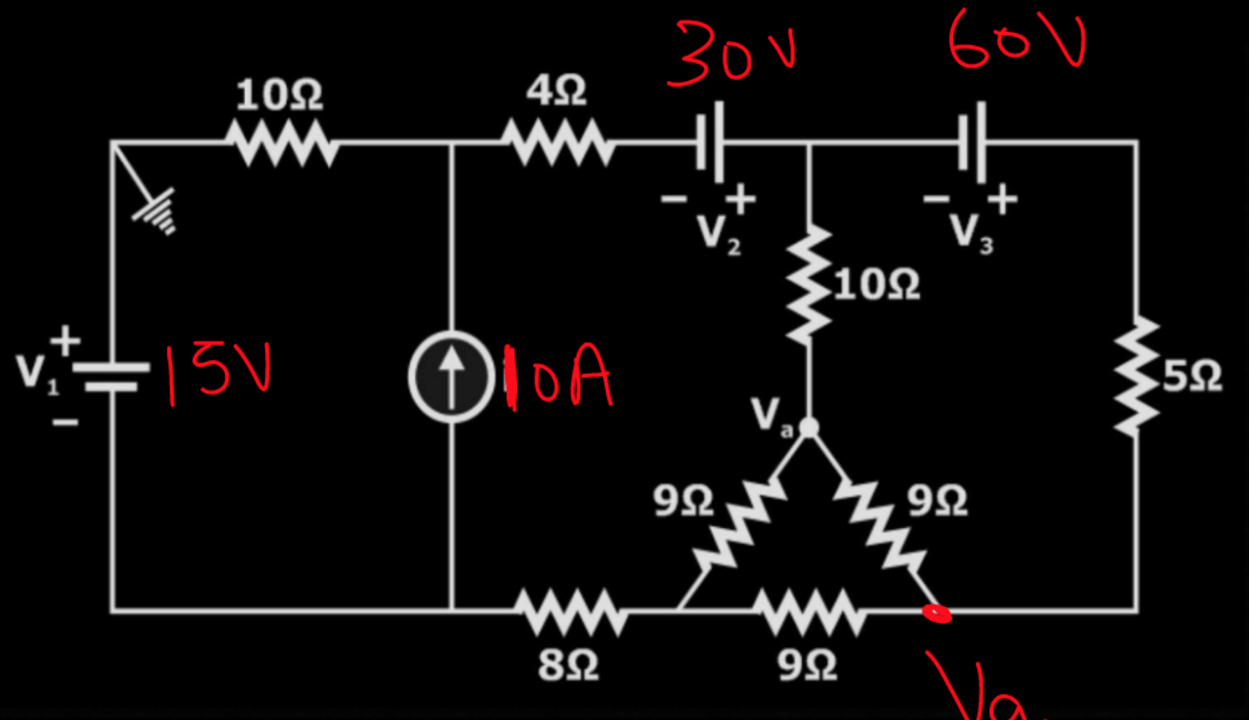
$$\therefore V = -28.29 \text{ Volts}$$

$$\therefore P_{c.s.} = 7 \times 28.29 = 198 \text{ W}$$

ex-

$V_a = ?$

(2 mints)



KIRCHOFF'S VOLTAGE LAW

KEYPOINTS :

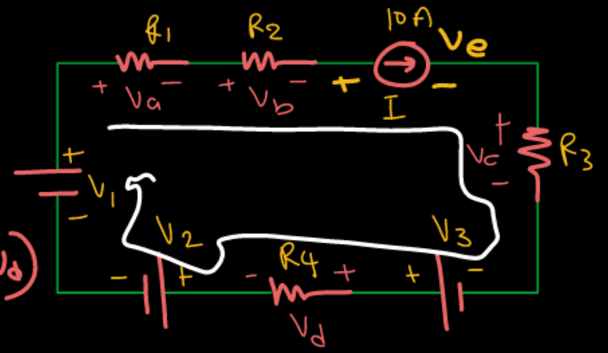
$\sum \Delta i \Big|_{node/junction} = 0$ $\quad \sum \Delta V \Big|_{mesh/loop} = 0$

- $\sum \Delta v = 0$, based on conservation of energy.
- $v = dw/dq$. $\Rightarrow V = dw/dq$.
- Valid for linear – time invariant system.
- Taking ground is not a mandatory condition.
- Always assume an unknown current through the dependent/independent voltage source, before solving the circuit either by KCL or KVL or any other method.
- Mesh analysis = KVL + ohm's law.

$\Rightarrow$ KVL :-

$-V_1 + V_a + V_b + V_c - V_3 + V_d + V_2 + V_e = 0$

$(V_a + V_b + V_c + V_e + V_2 + V_d) = (V_1 + V_3)$



$\left[\sum \Delta V \Big|_{mesh/loop} = 0\right]$

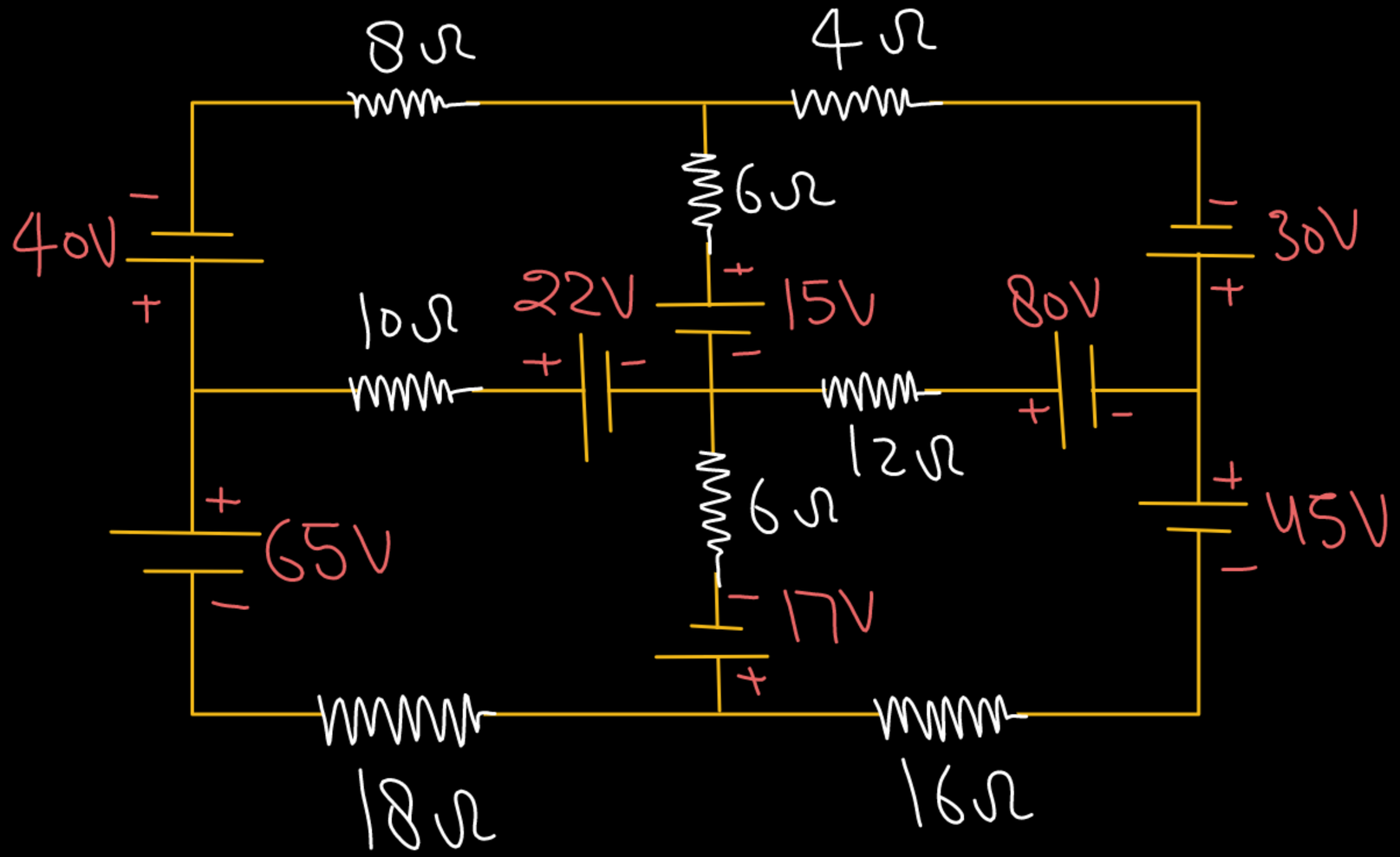
Stepe to apply KVL

1. Find out necessary mesh or loop in the Circuit
2. Assume Current for every (mesh or loop) in the (clockwise/anticlockwise) direction.
3. Assume unknown Voltage across every Current source.
4. The (mesh/loop) in which KVL is applying , consider that mesh/loop current is the highest Current of Circuit

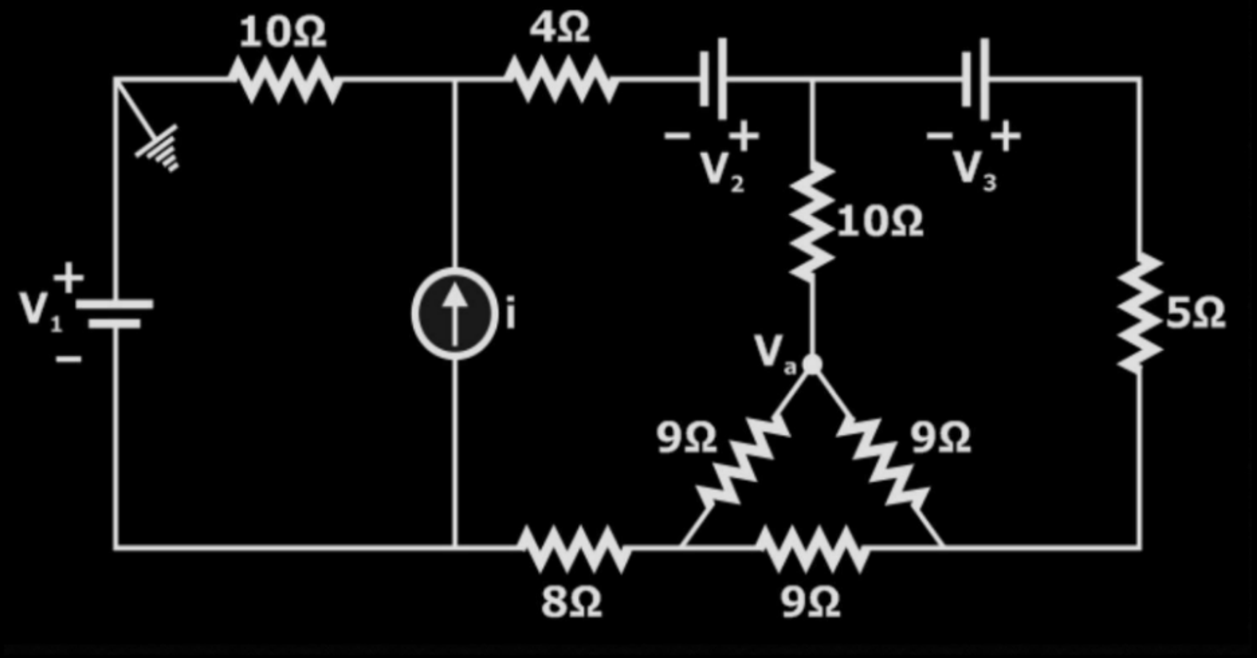
TYPES OF MESH ANALYSIS

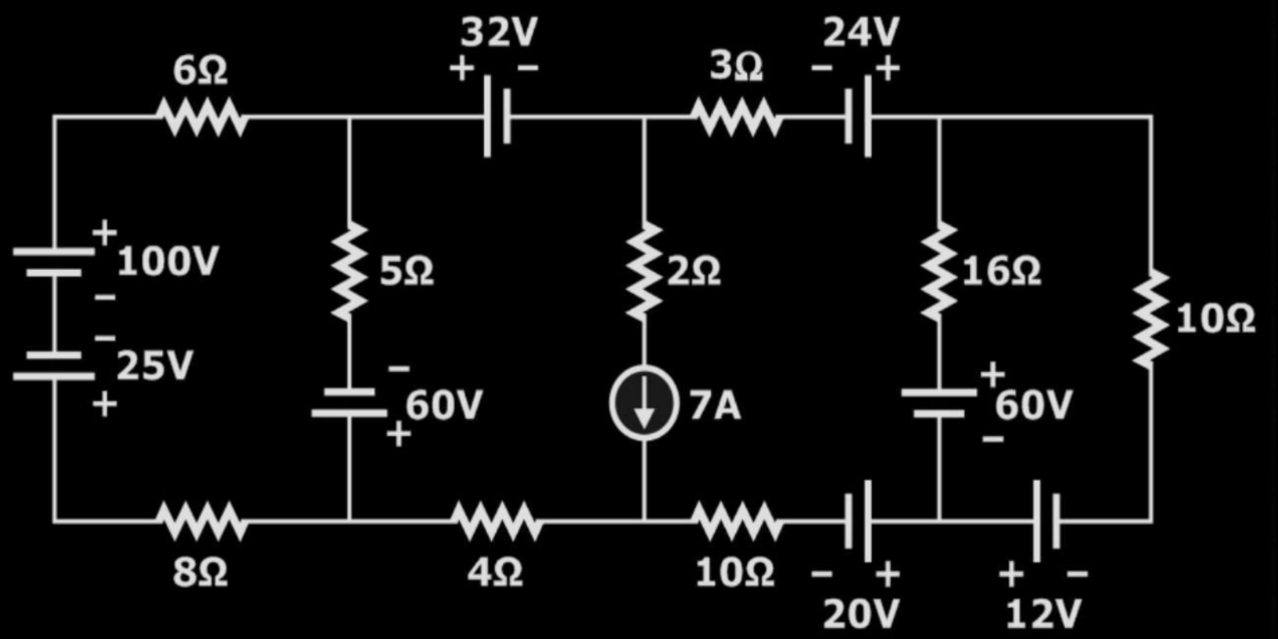
1. (Mesh/loop) Current method.
2. Branch Current method

Mesh/Loop


8Ω
4Ω
6Ω
40V
30V
22V
15V
80V
10Ω
12Ω
6Ω
65V
45V
17V
18Ω
16Ω

Ex. Write down aall possible necessary KVL Equations .




6Ω
32V
3Ω
24V
100V
25V
5Ω
60V
2Ω
7A
16Ω
60V
10Ω
8Ω
4Ω
10Ω
20V
12V