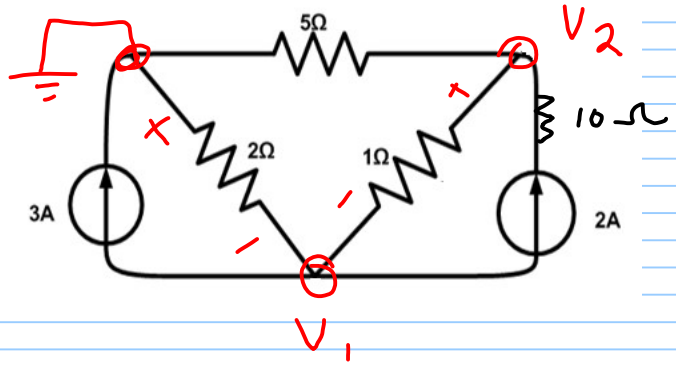
Note Title 9/30/2020

Ch 4 — Nodal method

$V_2 - V_1 = 5$ (2.5)

$-2.5 - V_1 = 5$



@ node V_1

All currents are out } OR all currents are IN }

I_{out} $\quad 3 + \frac{V_1}{2} + \frac{V_1 - V_2}{1} + 2 = 0$

$\Sigma I_{out} = 0$ OR $\Sigma I_{IN} = 0$

$(1.5)\ V_1 - V_2 = -5$ — ①

@ Node V_2

I_{out} $\quad -2 + \frac{V_2 - V_1}{1} + \frac{V_2}{5} = 0$

$-V_1 + 1.2\,V_2 = 2$ — ②

$V_1 = -5$ V

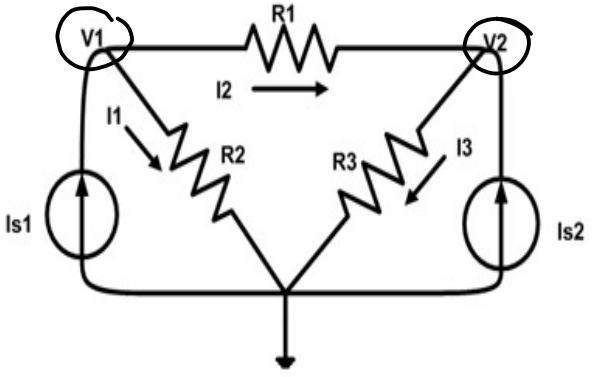
$V_2 = -2.5$ V

@ node V_1

$\left(\frac{1}{R_1} + \frac{1}{R_2}\right)V_1 - \left(\frac{1}{R_1}\right)V_2 = I_{s_1}$

@ node V_2

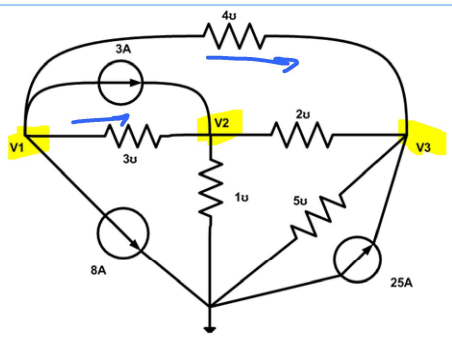
$-\left(\frac{1}{R_1}\right)V_1 + \left(\frac{1}{R_1} + \frac{1}{R_3}\right)V_2 = I_{s_2}$



@ node 1

$$\sum I_{out} = \sum I_{in}$$

$$7V_1 - 3V_2 - 4V_3 = -11 \quad (1)$$



@ node V_2

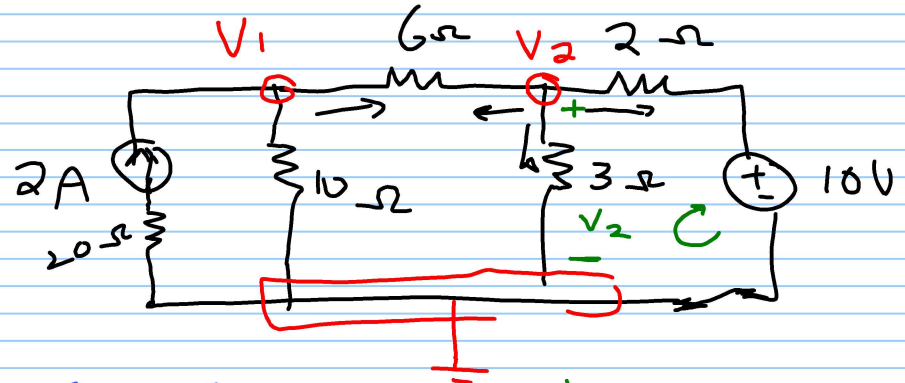
$$3(V_1 - V_2) + 4(V_1 - V_3) + 3 + 8 = 0$$

$$-(3)V_1 + (3+2+1)V_2 - (2)V_3 = 3 \quad (2)$$

@ node V_3

$$-4V_1 - 2V_2 + (5+2+4)V_3 = 25 \quad (3)$$

EX



$$\sum I_{out} = \sum I_{in}$$

node 1

$$-2 + \frac{V_1}{10} + \frac{V_1 - V_2}{6} = 0 \quad (1)$$

node 2

$$\sum I_{out} = 0$$

$$\frac{V_2 - V_1}{6} + \frac{V_2}{3} + \frac{V_2 - 10}{2} = 0 \quad (2)$$

KVL

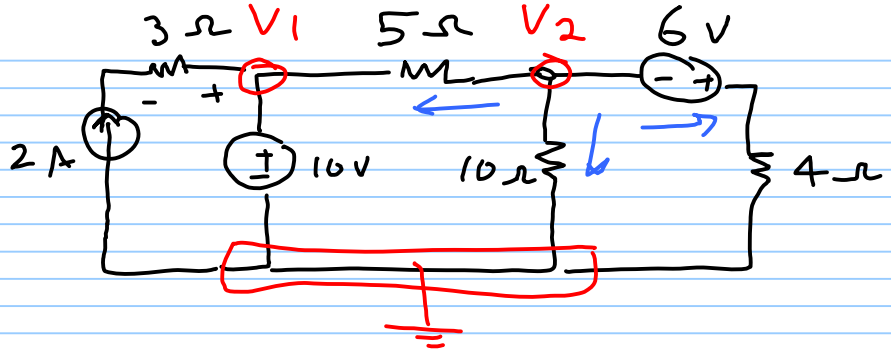
$$-V_2 + 2I_x + 10 = 0$$

$$-I_x = \frac{V_2 - 10}{2}$$

$V_1 =$ ——

$V_2 =$ —— ✓

EX1



A V

$(-2) + (V_1 - 10)$ ✗

$V_1 = 10\ V$ (ok)

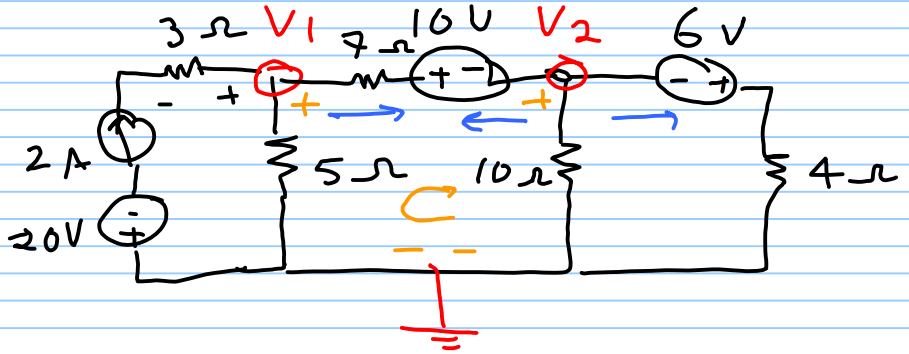
@ node V2

$$\frac{V_2 - V_1}{5} + \frac{V_2}{10} + \frac{V_2 + 6}{4} = 0$$

$$0.55 V_2 = 2 - 1.5$$

$$V_2 = \frac{0.5}{0.55} = 0.909 \text{ Volt}$$

EX1



$\Sigma I_{out} = Zero$

@ node V_1

$$-2 + \frac{V_1}{5} + \frac{V_1 - 10 - V_2}{7} = 0 \quad -(1)$$

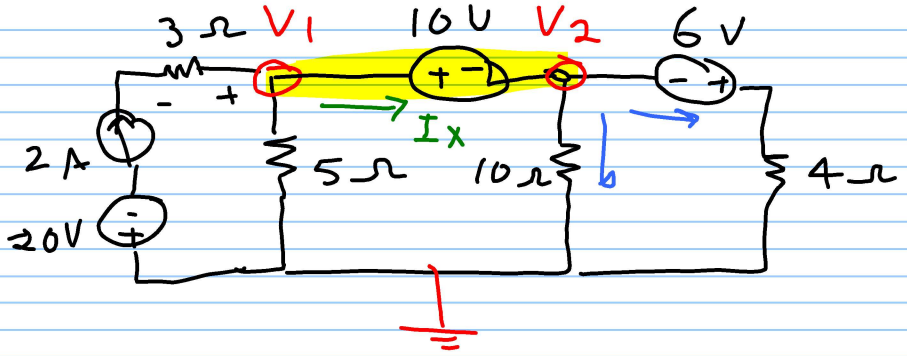
$$-V_1 + 7I_x + 10 + V_2 = 0$$

@ node V2

$$\frac{V_2 - V_1 + 10}{7} + \frac{V_2}{10} + \frac{V_2 + 6}{4} = 0 \quad -(2)'$$

Special case

EX



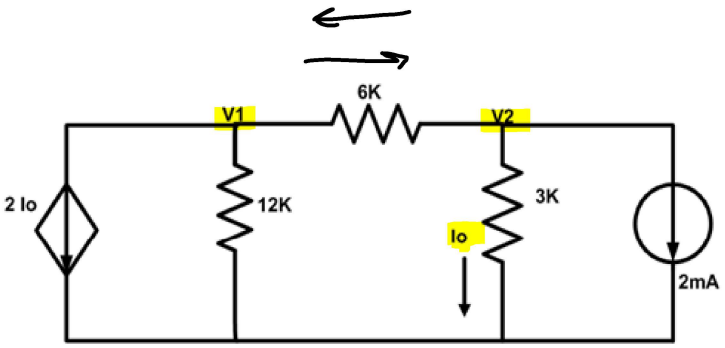
@ node V_1

$$-2 + \frac{V_1}{5} + I_x = 0$$

$$-2 + \frac{V_1}{5} + \frac{V_2}{10} + \frac{V_2 + 6}{4} = 0 \quad \text{— (1) KVL}$$

$$V_1 - V_2 = 10 \quad \text{— (2) KVL @ super node}$$

EX



$$I_o = \frac{V_2}{3k} \quad \text{— (1)}$$

@ node V_1

$$2I_o + \frac{V_1}{12k} + \frac{V_1 - V_2}{6k} = 0$$

$$2\left(\frac{V_2}{3k}\right) + \frac{V_1}{12k} + \frac{V_1 - V_2}{6k} = 0 \quad \text{— (1)}$$

@ node V_2

$$\frac{V_2 - V_1}{6k} + \frac{V_2}{3k} + 2mA = 0 \quad \text{— (2)}$$

$$V_1 = -\frac{24}{5}\,V \;,\; V_2 = \frac{12}{5}\,V$$

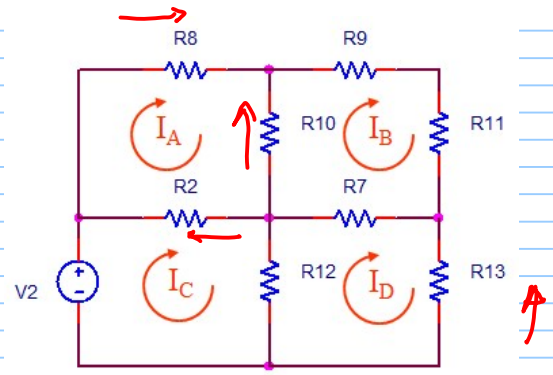
Mesh method

$I_{R_8} = I_A$

$I_{R_2} = I_A - I_C$

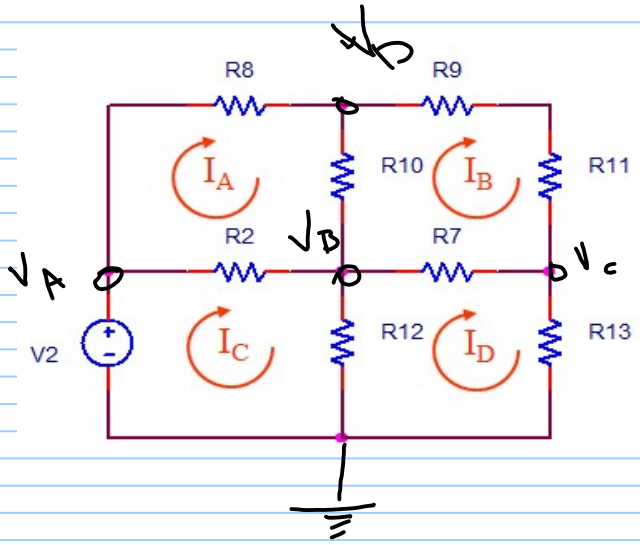
$I_{R_{13}} = -I_D$

$I_{R_{10}} = I_B - I_A$



4 equations

4 unknowns I_A, I_B, I_C & I_D



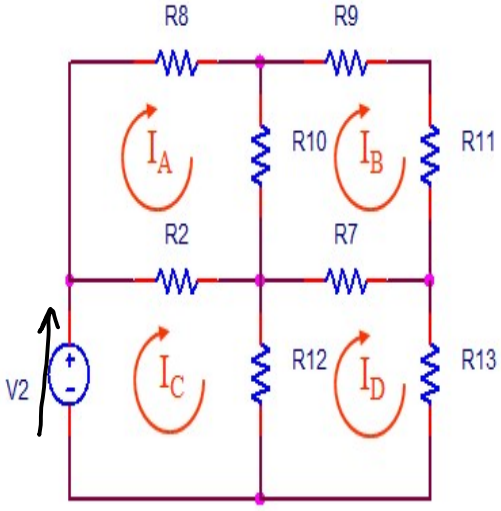
$V_A = V_2$

Nodal method

3 eqs

3 unknowns

V_B, C & D



Mesh KVL

$R_8 I_A + R_{10}(I_A - I_B) + R_2(I_A - I_C) = 0$

$(R_8 + R_{10} + R_2) I_A - R_{10} I_B - R_2 I_C = 0$ — (1)

$-(R_{10}) I_A + (R_{10} + R_9 + R_{11} + R_7) I_B$

$- 0 I_C - R_7 I_D = 0$ — (2)

$-V_2 + R_2(I_C - I_A) + R_{12}(I_C - I_D) = 0$

$(R_2 + R_{12}) I_C - R_2 I_A - R_{12} I_D = V_2$ — (3)

$$(R_{12}+R_7+R_{13})I_D - 0I_A - R_7 I_B - R_{12} I_C = 0 \quad - \textcircled{4}$$

EX

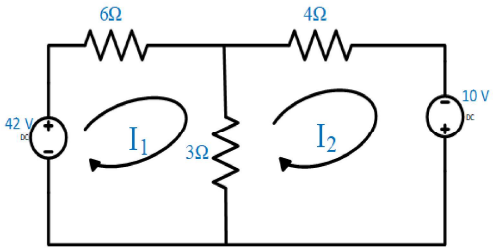


Figure3:example 1 of mesh analysis

$$-42 + 6I_1 + 3(I_1 - I_2) = 0$$

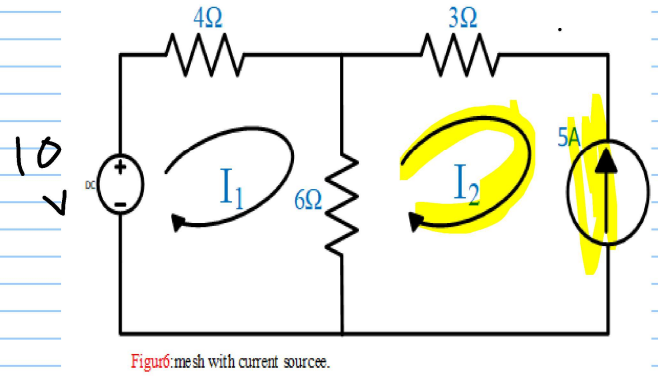
$$9I_1 - 3I_2 = 42 \quad -(1)$$

$$-3I_1 + 7I_2 = 10 \quad -(2)$$

$$6A, 4A$$

EX

$$I_2 = -5A \checkmark$$



Figur6:mesh with current sourcee.

$$-10 + 4I_1 + 6(I_1 - (-5)) = 0$$

$$I_1 = -2A \checkmark$$