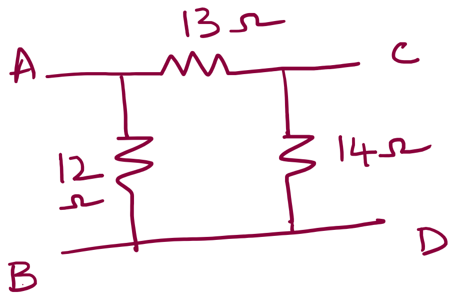
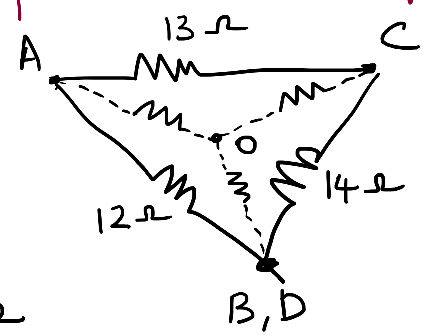
Delta-Star transformation

1) compute the Y equivalent



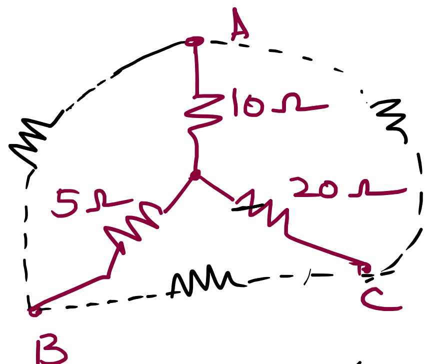


$$R_{AO} = \frac{13 \times 12}{(13+12+14)} = 4\,\Omega$$

$$R_{BO} = \frac{12 \times 14}{(13+12+14)} = 4.307\,\Omega$$

$$R_{CO} = \frac{13 \times 14}{(13+12+14)} = 4.66\,\Omega$$

2) Star - delta



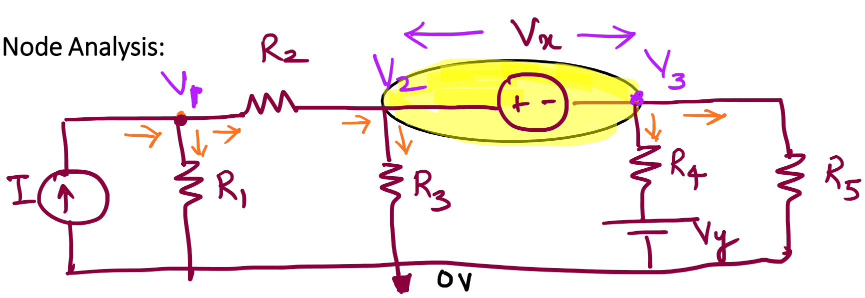
$\Rightarrow$ $R_{AB} = 17.5\,\Omega$

$R_{BC} = 35\,\Omega$

$R_{CA} = 70\,\Omega$

$$R_{AB} = \frac{(5 \times 10 + 10 \times 20 + 20 \times 5)}{20} = 17.5\,\Omega$$

Super Node Analysis:



Two adjacent nodes connected by a Voltage source are reduced to a single node &

$V_x = V_2 - V_3$ — ① V_1, V_2, V_3 .

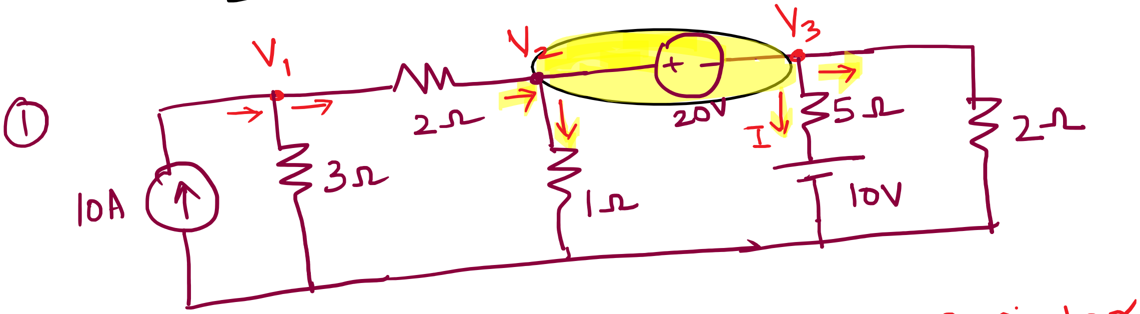
$$V_x = V_2 - V_3 \quad \text{— (1)}$$

V_1, V_2, V_3 are reduced to a single node & KCL is applied

$$I = \frac{V_1}{R_1} + \frac{(V_1 - V_2)}{R_2} \quad \text{— (2)}$$

$$\frac{(V_1 - V_2)}{R_2} = \frac{V_2}{R_3} + \frac{V_3}{R_5} + \frac{(V_3 - V_4)}{R_4} \quad \text{— (3)}$$

(1)



Compute current through 5Ω Resistor

$$10 = \frac{V_1}{3} + \frac{(V_1 - V_2)}{2} \quad \text{— (1)}$$

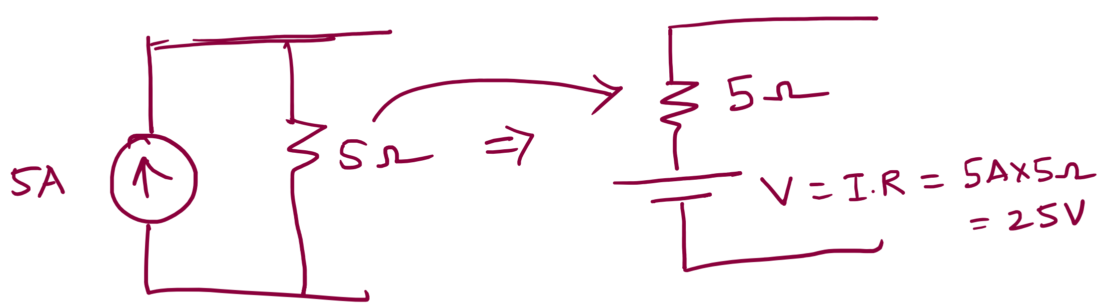
$$V_2 - V_3 = 20 \quad \text{— (2)}$$

$$\left(\frac{V_1 - V_2}{2}\right) = \frac{V_2}{1} + \frac{(V_3 - 10)}{5} + \frac{V_3}{2} \quad \text{— (3)} \Rightarrow \text{Supernode Analysis}$$

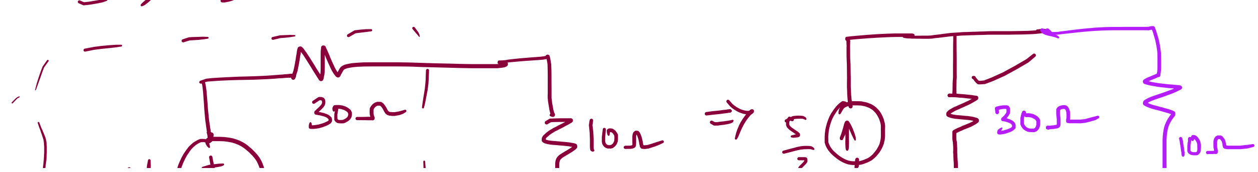
$$V_3 = -8.42V$$

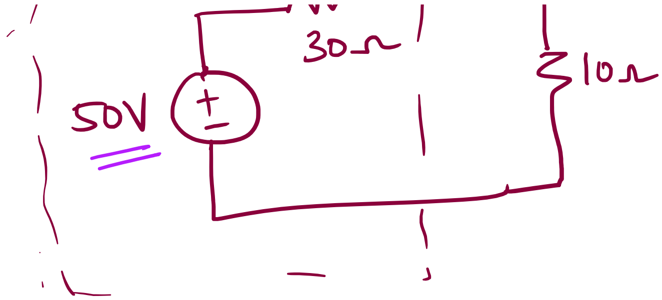
$$I_{5\Omega} = \frac{(V_3 - 10)}{5} = \underline{\underline{-3.68 A}}$$

(2)

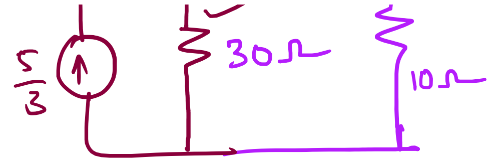


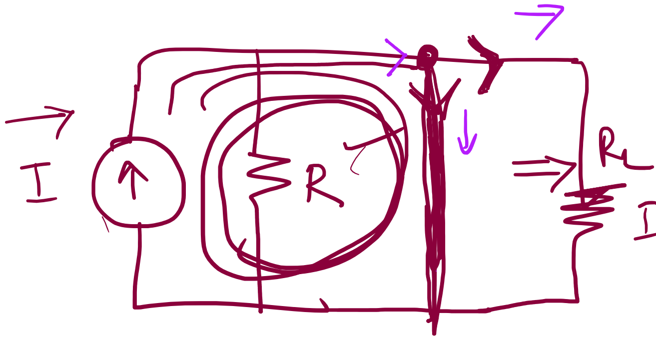
$I \Rightarrow V_{source}$



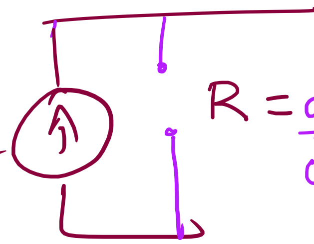


$\Rightarrow$





Ideal

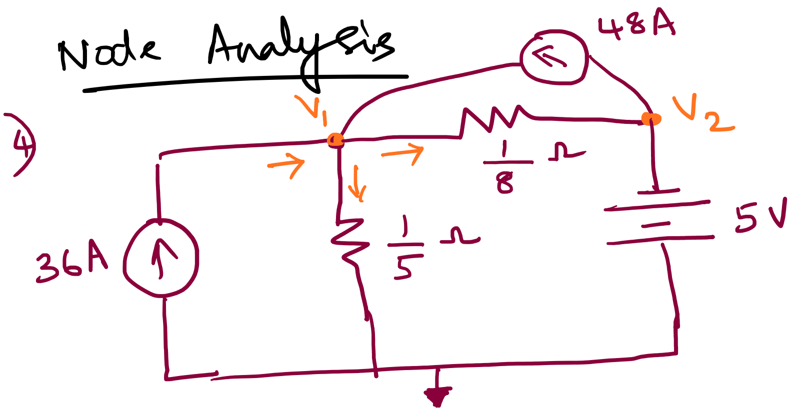


$R = \underline{\underline{\infty}}$

o.c

$\underline{\underline{R = 0}}$

Node Analysis



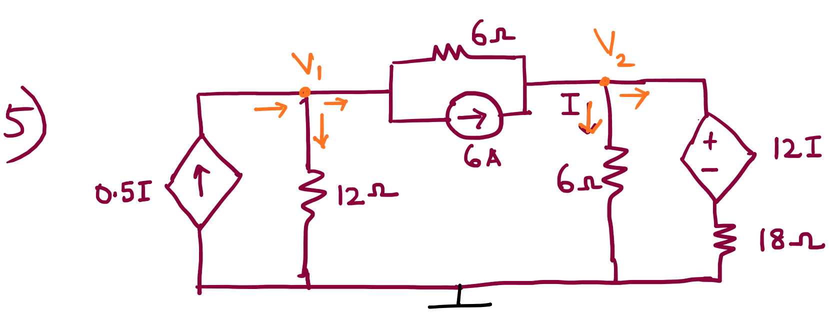
$V_1 = ??$

$V_2 = ??$

$V_2 = -5V$

$$36 + 48 = \frac{V_1}{(1/5)} + \frac{(V_1 - (-5))}{1/8}$$

$$84 = 5V_1 + 8V_1 + 40 \Rightarrow \boxed{\begin{aligned} V_1 &= 3.38\,V \\ V_2 &= -5\,V \end{aligned}}$$



$I = \overset{V_1}{\bullet}\!\!-\!\!\underset{R}{\mathrm{W}}\!\!-\!\!\overset{V_2}{\bullet}$

$= \frac{V_1 - V_2}{R}$

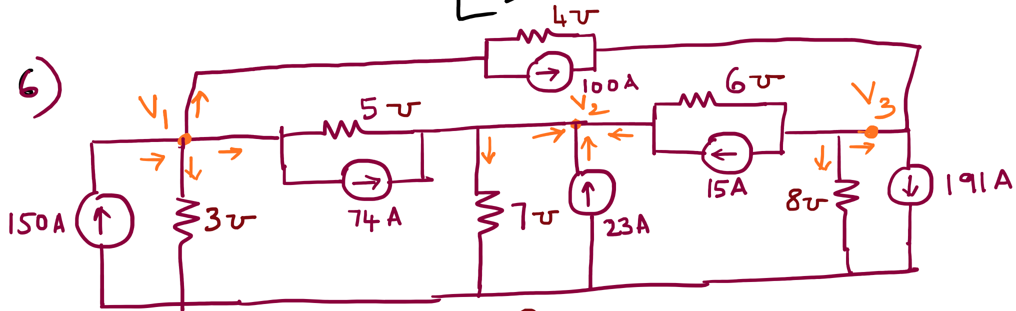
$$0.5I = \frac{V_1}{12} + \underbrace{\frac{(V_1 - V_2)}{6} + 6} \quad — (1)$$

$$\frac{(V_1 - V_2)}{6} + 6 = \frac{V_2}{6} + \frac{(V_2 - 12I)}{18} \quad — (2)$$

$$I = \frac{V_2}{6} \quad — (3)$$

$$\boxed{V_1 = -6V \;;\; I = 3A \quad V_2 = 18V}$$

6)



3 S
↳ siemens or Conductance unit
℧

@ V1: $150 = 3V_1 + \underbrace{(V_1 - V_2)5 + 74} + \underbrace{(V_1 - V_3) \cdot 4 + 100}$

$$12V_1 - 5V_2 - 4V_3 = -24 \quad — (1)$$

@ V_2: $23 + \underbrace{(V_1 - V_2)5 + 74} + \underbrace{(V_3 - V_2)6 + 15} = V_2(7)$

$$-5V_1 + 18V_2 - 6V_3 = 112 \quad — (2)$$

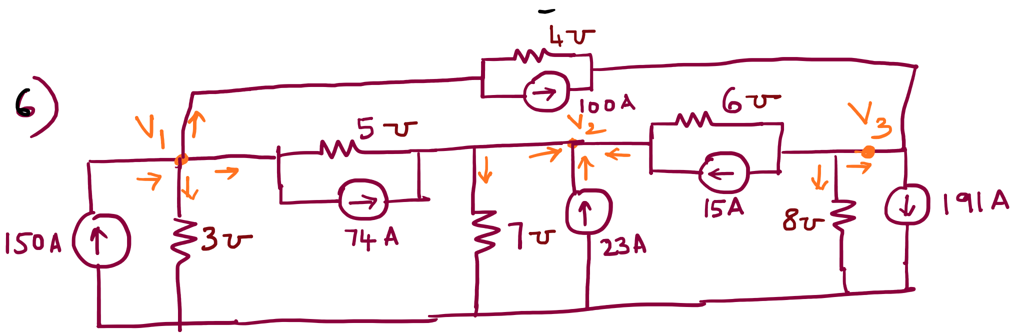
@ V_3: $\underbrace{(V_1 - V_3)4 + 100} = 191 + 8V_3 + \underbrace{(V_3 - V_2)6 + 15}$

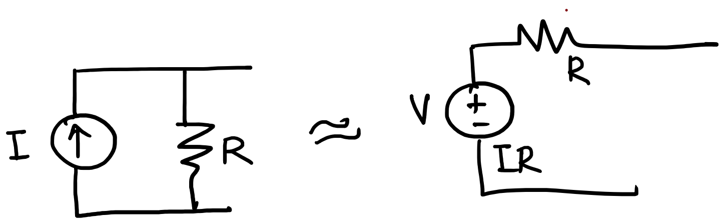
$$-4V_1 - 6V_2 + 18V_3 = -106 \quad — (3)$$

$$\boxed{V_1 = -2V \;;\; V_2 = 4V \;;\; V_3 = -5V}$$

REDUCING THE ABOVE SYSTEM USING SOURCE TRANSFORMATION

6)





Source transformation