സഹായി

SFI GEC PALAKKAD

8-08-19
Thursday

~~Active and Passive elemen~~

Active and Passive elements

Active elements - supply

Transistor

Passive elements - Receive

$\underbrace{\text{Resistor, Inductor, Capacitor}}_{\text{store and dessipate}}$

Resistor → R Unit ohm Ω

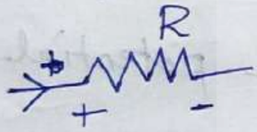
Inductor → L Henry H

Capacitor → C Farad F

Current Flow → +ve to -ve
Higher potential to lower

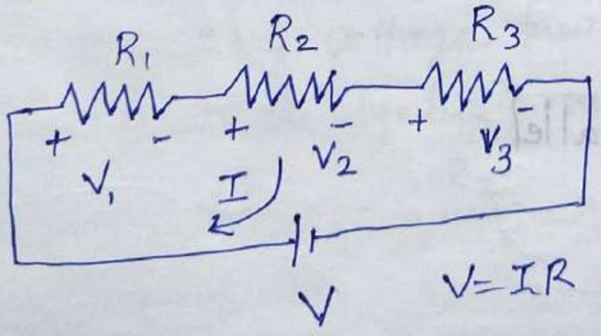
Voltage rise → -ve to +ve

Voltage drop → +ve to -ve



→ Voltage drop

Resistors in Series



$V = IR$

$V - V_1 - V_2 - V_3 = 0$

$V - IR_1 - IR_2 - IR_3 = 0$

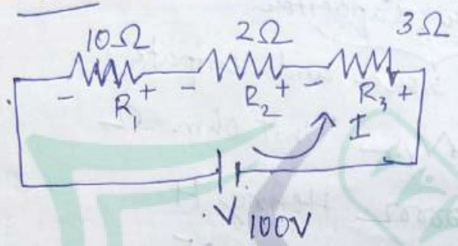
$V - I(R_1 + R_2 + R_3) = 0$

$V = I(R_1 + R_2 + R_3)$

$V = I R_{equivalent}$

$\boxed{I = V / R_{equivalent}}$

Resistor in Series



$R_1 = 10\Omega$

$R_2 = 2\Omega$

$R_3 = 3\Omega$

$R_{eq} = R_1 + R_2 + R_3$

$= 10\Omega + 2\Omega + 3\Omega = 15\Omega$

$V = -100V$

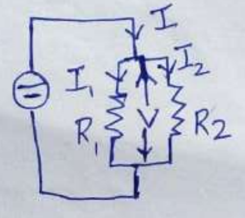
$I = V/R$

$I = \frac{-\cancel{100}\,20}{\cancel{15}\,3} = -6.66\,A$

Current will always flow from higher potential to lower potential

So, $I = 6.66\,A$

Resistors in Parallel



$I = I_1 + I_2$

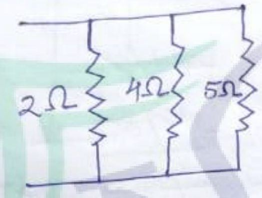
$I = \frac{V}{R_1} + V/R_2$

$$I = V\left[\frac{1}{R_1} + \frac{1}{R_2}\right]$$

$$I = V\left[\frac{R_1 + R_2}{R_1 R_2}\right]$$

$$V = I\left[\frac{R_1 R_2}{R_1 + R_2}\right]$$

? Determine the total resistance for the following network.



$R_1 = 2\Omega$

$R_2 = 4\Omega$

$R_3 = 5\Omega$

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$\frac{1}{R} = \frac{1}{2} + \frac{1}{4} + \frac{1}{5} = 0.95$$

$$\frac{10+5+4}{20}$$

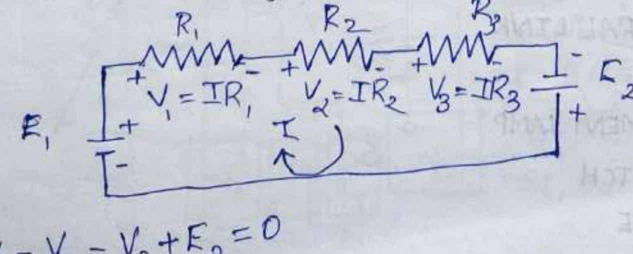
$$R = \frac{1}{0.95} = 1.053\ \Omega$$

17-08-2019

Kirchoff's laws

Kirchoff's Voltage law (KVL)

Kirchow's voltage law states that for any closed path in a network, the algebraic sum of all the voltages is zero.



$V \propto I$

$V = IR$

$$E_1 - V_1 - V_2 - V_3 + E_2 = 0$$

$$E_1 + E_2 = V_1 + V_2 + V_3$$

$$E_1 + E_2 = I(R_1 + R_2 + R_3)$$

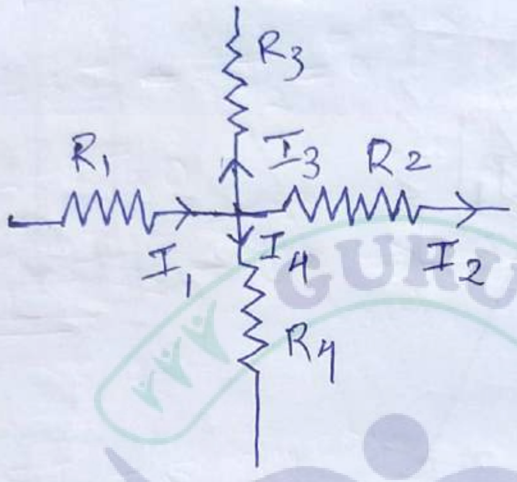
Kirchoff's Current Law (KCL)

Current law states that at the junction of circuit elements the algebraic sum of all the currents will be equal to zero.

or

Current law states that sum of currents entering a junction is equal to sum of the current leaving the junction.

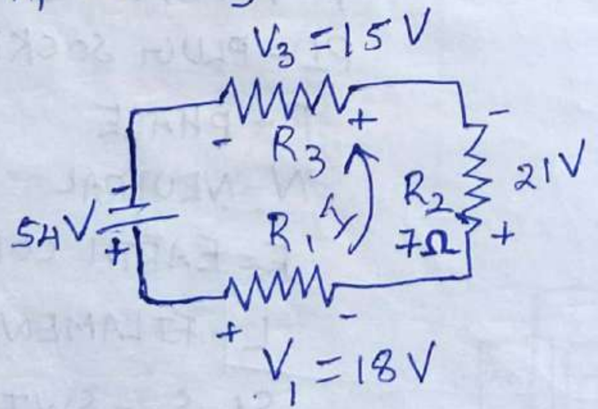
eg:



$$I_1 = I_3 + I_4 + I_2$$

? For the following circuit,

1) determine V_2 Using KVL
2) Determine I
3) Find R_1 and R_3



1) $E_1 + E_2 = I(R_1 + R_2 + R_3)$ $E_1 = 54V$

$54 = 18V + V_2 + 15V$

$54V = 33V + V_2$

$V_2 = 54 - 33 = \underline{\underline{21V}}$

$V_1 = 18V$ $R_2 = 7\Omega$

2) ~~$V_1 = IR_1$~~

~~18~~ $V_2 = 21V$

$V_2 = IR_2$

$21 = I \times 7$

$7I = 21$

$I = \frac{21}{7} = \underline{\underline{3A}}$

(3) $V_1 = IR_1$

$V_1 = 18V$

$I = 3$

~~18 =~~ $R_1 = V_1/I$

$R_1 = \frac{18}{3} = \underline{\underline{6\Omega}}$

$V_3 = IR_3$

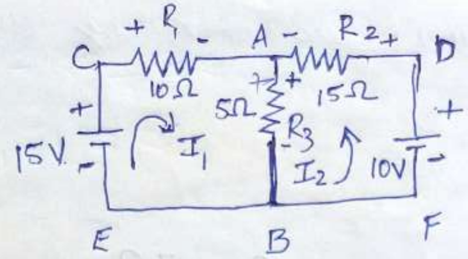
$I = 3A$

$V_3 = 15V$

$R_3 = \frac{V_3}{I} = \frac{15}{3} = \underline{\underline{5\Omega}}$

Q? For the following circuit find the currents in the resistors R_1, R_2 and R_3.

8.



~~I_1~~ ~~$V = I(R_1 + R_2$~~

A ~~loop 1~~ loop 1

~~15 + 10~~ $15 - \cancel{I} 10I_1 - 5(I_1 + I_2) = 0$

$15 - 10I_1 - 5I_1 + 5I_2 = 0$

$15 - 15I_1 - 5I_2 = 0$

$15 = 15I_1 + 5I_2 \rightarrow (1) \Rightarrow 3 = 3I_1 + I_2 - (1)$

~~Loop~~ 2

$10 - \cancel{I_2} 15\cancel{I}_2 - 5(I_2 + I_1) = 0$

$10 - 15\cancel{I}_2 - 5I_2 - 5I_1 = 0$

$10 - 20I_2 - 5I_1 = 0$

$10 = 20I_2 + 5I_1 \Rightarrow 2 = 4I_2 + I_1 - (2)$

~~$3I_1 + I_2 = 3 \quad \times 4 \quad 12I_1 + 4I_2 = 12$~~ $3I_1 + I_2 = 3$

~~$4I_2 + I_1 = 2 \quad \times 3 \quad 12I_2 +$~~ $I_1 + 4I_2 = 2$

$1 - 12$

$3I_1 + I_2 = 3$

$- \; 3I_1 + 12I_2 = 6$

$-11I_2 = -3$

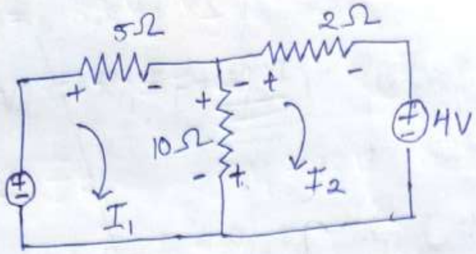
$I_2 = \frac{+3}{+11} = \frac{3}{11}$ //

$3I_1 = \frac{33-3}{11} = \frac{30}{11}$

$I_1 = \frac{30}{11}/3 \quad \frac{\cancel{30}^{10}}{11} \times \frac{1}{\cancel{3}} = \frac{10}{11}$ //

$3I_1 + \frac{3}{11} = 3 \qquad 3I_1 = 3 - \frac{3}{11}$

1. ~~Find the cur~~ For the following circuit find the current in resistors R_1, R_2, R_3.



loop 1

$10 - 5I_1 - 10(I_1 - I_2) = 0$

$10 - 5I_1 - 10I_1 + 10I_2 = 0$

$10 - 15I_1 + 10I_2 = 0$

$10 = 15I_1 - 10I_2$ — ①

loop 2

$-4 - 10(I_2 - I_1) - 2I_2 = 0$

$-4 - 10I_2 + 10I_1 - 2I_2 = 0$

$-4 - 12I_2 + 10I_1 = 0$

$-4 = 12I_2 - 10I_1$ — ②

$15I_1 - 10I_2 = 10$

$-10I_1 + 12I_2 = -4$

$3I_1 - 2I_2 = 2$

$-5I_1 + 6I_2 = -2$

$10 + -6$

$-10 + 18$

$$\begin{aligned} 15I_1 - 10I_2 &= 10 \\ + \; -15I_1 + 18I_2 &= -6 \\ \hline 0 + 8I_2 &= 4 \end{aligned}$$

$I_2 = \frac{4}{8} = \frac{1}{2} = 0.5\,A$

$3I_1 - 2 \times \frac{1}{2} = 2$

$3I_1 - 1 = 2$

$3I_1 = 2 + 1 = 3$

$I_1 = 1A$

$5(I_1 - I_2) = 0$

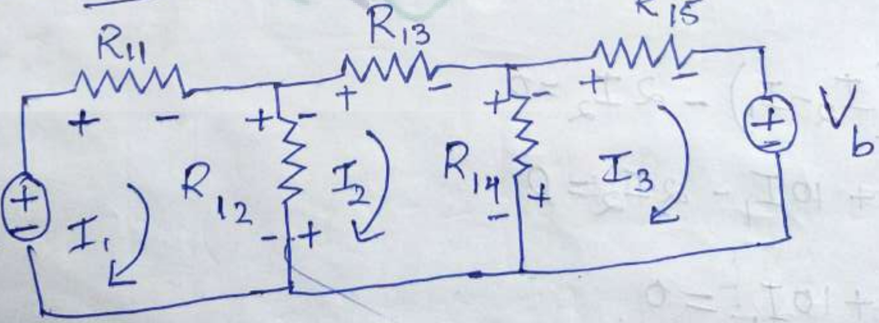
$5\cancel{(1 - 0.5) = 0}$ $\quad 5(1 - 1/2) = 0$

$5 \times \cancel{0.5} =$ $\quad 5\left(\frac{2-1}{2}\right) = \cancel{0.5}\ 0$ $\quad$ - extra.

$5 \times \cancel{\frac{1}{2} = 0}$ $\quad 5/2 = 0$

$\cancel{5/2 = 0}$ $\quad I_1 - I_2 = 5/2\ A$

Mesh Analysis



Loop 1

$V_a - I_1R_{11} - R_{12}(I_1 - I_2) = 0$

Loop 1

$V_a - I_1 R_{11} - R_{12}(I_1 - I_2) = 0$

$V_a - I_1 R_{11} - I_1 R_{12} + I_2 R_{12} = 0$

$V_a - I_1(R_{11} + R_{12}) + I_2 R_{12} = 0$

$V_a = I_1(R_{11} + R_{12}) - I_2 R_{12}$ — ①

Loop 2

$-R_{12}(I_2 - I_1) - I_2 R_{13} - R_{14}(I_2 - I_3) = 0$

$-R_{12} I_2 + R_{12} I_1 - I_2 R_{13} - R_{14} I_2 + R_{14} I_3 = 0$

$-I_2(R_{12} + R_{13} + R_{14}) + R_{12} I_1 + R_{14} I_3 = 0$

$I_2(R_{12} + R_{13} + R_{14}) - R_{12} I_1 - R_{14} I_3 = 0$ — ②

Loop 3

$-\cancel{R_{14}} - V_b - R_{14}(I_3 - I_2) - I_3 R_{15} = 0$

$-V_b - R_{14} I_3 + R_{14} I_2 - I_3 R_{15} = 0$

$-V_b - I_3(R_{14} + R_{15}) + R_{14} I_2 = 0$

$-V_b = I_3(R_{14} + R_{15}) - R_{14} I_2$ — ③

This equation can be put in a matrix form as

$$\begin{bmatrix} V_a \\ 0 \\ -V_b \end{bmatrix} = \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} \begin{bmatrix} R_{11}+R_{12} & -R_{12} & 0 \\ -R_{12} & R_{12}+R_{13}+R_{14} & -R_{14} \\ 0 & -R_{14} & R_{14}+R_{15} \end{bmatrix}$$

By Applying Cramer's rule,

determinant $\Delta = \begin{bmatrix} R_{11}+R_{12} & -R_{12} & 0 \\ -R_{12} & R_{12}+R_{13}+R_{14} & -R_{14} \\ 0 & -R_{14} & R_{14}+R_{15} \end{bmatrix}$

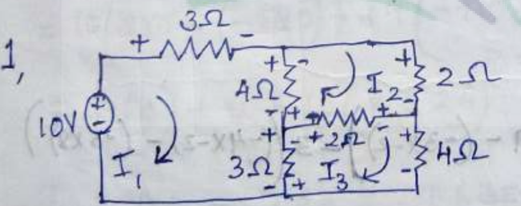
$\Delta_1 = \begin{bmatrix} V_a & -R_{12} & 0 \\ 0 & R_{12}+R_{13}+R_{14} & -R_{14} \\ -V_b & -R_{14} & R_{14}+R_{15} \end{bmatrix}$

$\Delta_2 = \begin{bmatrix} R_{11}+R_{12} & V_a & 0 \\ -R_{12} & 0 & -R_{14} \\ 0 & -V_b & R_{14}+R_{15} \end{bmatrix}$

$\Delta_3 = \begin{bmatrix} R_{11}+R_{12} & -R_{12} & V_a \\ -R_{12} & R_{12}+R_{13}+R_{14} & 0 \\ 0 & -R_{14} & -V_b \end{bmatrix}$

$I_1 = \frac{\Delta_1}{\Delta}$, $I_2 = \frac{\Delta_2}{\Delta}$, $I_3 = \frac{\Delta_3}{\Delta}$

1,



-3-4-3

Loop 1

$10 - 3I_1 - 4(I_1 - I_2) - 3(I_1 - I_3) = 0$

$10 - 3I_1 - 4I_1 + 4I_2 - 3I_1 + 3I_3 = 0$

$10 - \cancel{6I} 10I_1 + 4I_2 + 3I_3 = 0 \qquad 10 = 10I_1 - 4I_2 - 3I_3$

Loop - 2

$$-2I_2 - 2(I_2 - I_3) - 4(I_2 - I_1) = 0 \qquad -2-2-4$$

$$-2I_2 - 2I_2 + 2I_3 - 4I_2 + 4I_1 = 0$$

$$-8I_2 + 2I_3 + 4I_1 = 0$$

$$8I_2 - 2I_3 - 4I_1 = 0 \quad -(2)$$

-2-4-3

Loop - 3

$$-2(I_3 - I_2) - 4I_3 - 3(I_3 - I_1) = 0$$

$$-2I_3 + 2I_2 - 4I_3 - 3I_3 + 3I_1 = 0$$

$$-9I_3 + 2I_2 + 3I_1 = 0$$

$$9I_3 - 2I_2 - 3I_1 = 0$$

$$\begin{bmatrix} 10 \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} \begin{bmatrix} 10 & -4 & -3 \\ -4 & 8 & -2 \\ -3 & -2 & 9 \end{bmatrix}$$

$$\Delta = \begin{bmatrix} 10 & -4 & -3 \\ -4 & 8 & -2 \\ -3 & -2 & 9 \end{bmatrix}$$

$$10(8\times9 - (-2\times-2)) + 4(-4\times9 - (-3\times-2)) - 3((-4\times-2) - (-3\times8))$$

$$10(72-4) + 4(-36-6) - 3(8+24)$$

$$680 - 168 - 96 = \underline{416}$$

Δ

$$\Delta_1 = \begin{bmatrix} 10 & -4 & -3 \\ 0 & 8 & -2 \\ 0 & -2 & 9 \end{bmatrix}$$

$$\Delta_1 = 10\left(8\times 9-(-2\times -2)\right) + 4\left((0\times 9) - (0\times -2\right) - 3\left(0\times -2 - (0\times 8)\right)$$

$$= 10(72-4) + 4(0) - 3(0) = \underline{\underline{680}}$$

$$\Delta_2 = \begin{bmatrix} 10 & 10 & -3 \\ -4 & 0 & -2 \\ -3 & 0 & 9 \end{bmatrix}$$

$$= 10\left(0\times 9 - (0\times -2\right) - 10\left(-4\times 9 - (-3\times -2)\right) + 3\left(-4\times 0 - (-3\times 0)\right]$$

$$= 10(0) - 10(-36-6)$$

$$= \underline{\underline{420}}$$

$$\Delta_3 = \begin{bmatrix} 10 & -4 & 10 \\ -4 & 8 & 0 \\ -3 & -2 & 0 \end{bmatrix}$$

$$= 10\left(8\times 0 - (-2\times 0)\right) + 4\left(-4\times 0 - (-3\times 0\right) + 10\left(-4\times -2 - (-3\times 8)\right)$$

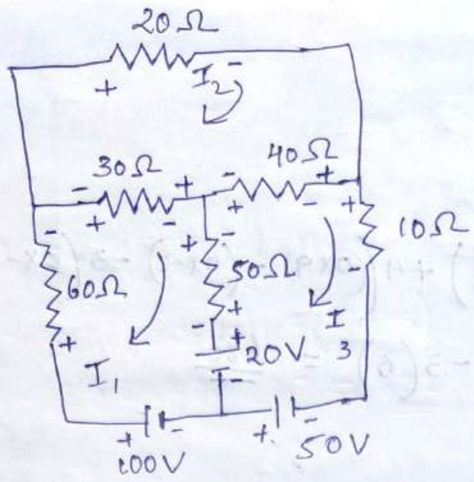
$$= 10(0) + 0 + 10(8+24) = \underline{\underline{320}}$$

$$I_1 = \frac{\Delta 1}{\Delta} = \frac{680}{416} = \underline{\underline{1.635\ A}}$$

$$I_2 = \frac{\Delta 2}{\Delta} = \frac{420}{416} = \underline{\underline{1.0096}}\ A$$

$$I_3 = \frac{\Delta 3}{\Delta} = \frac{320}{416} = 0.\underline{\underline{769\ A}}$$

2)



$-60-30-50$

Loop 1

$100 - 60I_1 - 30(I_1 - I_2) - 50(I_1 - I_3) = 0$

$100 - 60I_1 - 30I_1 + 30I_2 - 50I_1 + 50I_3 = 0$

$100 - 140I_1 + 30I_2 + 50I_3 = 0$

$100 = 140I_1 - 30I_2 - 50I_3 \quad -①$

Loop-2

$-20I_2 - \cancel{40(I_2 - I_3)}$

Loop 1

$-20 + 100 - 60I_1 - 30(I_1 - I_2) - 50(I_1 - I_3) = 0$

$80 - 60I_1 - 30I_1 + 30I_2 - 50I_1 + 50I_3 = 0$

$80 - 140I_1 + 30I_2 + 50I_3 = 0$

$80 = 140I_1 - 30I_2 - 50I_3 \quad -①$

$-20-40-30$

Loop -2

$-20I_2 - 40(I_2 - I_3) - 30(I_2 - I_1) = 0$

$-20I_2 - 40I_2 + 40I_3 - 30I_2 + 30I_1 = 0$

$-90I_2 + 40I_3 + 30I_1 = 0$

$$90I_2 - 40I_3 - 30I_1 = 0 \quad -(2)$$

$$-50-40-10$$

Loop-3

$$50 + 20 - 50(I_3 - I_1) - 40(I_3 - I_2) - 10I_3 = 0$$

$$70 - 50I_3 + 50I_1 - 40I_3 + 40I_2 - 10I_3 = 0$$

$$70 - 100I_3 + 50I_1 + 40I_2 = 0$$

$$70 = 100I_3 - 50I_1 - 40I_2 \quad -(3)$$

$$\begin{bmatrix} 80 \\ 0 \\ 70 \end{bmatrix} = \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} \begin{bmatrix} 140 & 30 & 50 \\ -30 & -90 & -40 \\ -50 & 40 & 100 \end{bmatrix}$$

$$\Delta = \begin{bmatrix} 140 & 30 & -50 \\ -30 & -90 & -40 \\ -50 & 40 & 100 \end{bmatrix} = \cancel{-7400} = 140(-90\times100 - (40\times-40))$$

$$-30(-30\times100 - (-50\times-40)) - 50(-30\times40 - (-50\times-90)$$

$$= -30(-3000 - 2000) - 50(-1200 - 4500) + 140(-9000 + 1600)$$

$$= -30\times-5000 - 50\times-5700 + 140(-7400$$

$$= 150000 + 285000 - 285000$$

$$=$$

$$\begin{bmatrix} 80 \\ 0 \\ 70 \end{bmatrix} = \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} \begin{bmatrix} 140 & -30 & -50 \\ -30 & 90 & -40 \\ -50 & -40 & 100 \end{bmatrix}$$

$$\begin{bmatrix} 8 \\ 0 \\ 7 \end{bmatrix} = \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} \begin{bmatrix} 14 & -3 & -5 \\ -3 & 9 & -4 \\ -5 & -4 & 10 \end{bmatrix}$$

$$\Delta = \begin{bmatrix} 14 & -3 & -5 \\ -3 & 9 & -4 \\ -5 & -4 & 10 \end{bmatrix}$$

$$= 14\left((9\times10)-(-4\times-4)\right)+3\left((-3\times10)-(-5\times-4)\right)-5\left((-3\times-4)-(-5\times9)\right)$$

$$= 14(90-16)+3(-30-20)-5(12+45)$$

$$= 1036-150-\cancel{2700}\ 285 = \underline{\underline{601}}$$

$$\Delta_1 = \begin{bmatrix} 8 & -3 & -5 \\ 0 & 9 & -4 \\ 7 & -4 & 10 \end{bmatrix}$$

$$= 8\left((9\times10)-(-4\times-4)\right)+3\left((0\times10)-(7\times-4)\right)-5\left((0\times-4)-(7\times9)\right)$$

$$= 8(90-16)+3(0+28)-5(0-63)$$

$$= 592+84+318 = \underline{\underline{991}}$$

$$\Delta_2 = \begin{bmatrix} 14 & 8 & -5 \\ -3 & 0 & -4 \\ -5 & 7 & 10 \end{bmatrix}$$

$$= 14\left((0\times10)-(7\times-4)\right)-8\left((-3\times10)-(-5\times-4)\right)-5\left((-3\times7)-(0\times-5)\right)$$

$$= 14(0+28)-8(-30-20)-5(-21)$$

$$= 392+400+105 = \underline{\underline{897}}$$

$$\Delta_3 = \begin{bmatrix} 14 & -3 & 8 \\ -3 & 9 & 0 \\ -5 & -4 & 7 \end{bmatrix}$$

12×45

$\therefore 2 \cdot 45$

$2 \times 45 \; 12$

$$= 14\left((9\times7)-(-4\times0)\right)+3\left((-3\times7)-(-5\times0)\right)+8\left((-3\times-4)-(-5\times9)\right)$$

$$= 14(63)+3(-21)-8(12+45) = 882-63+456 = \cancel{363}\ 1275$$

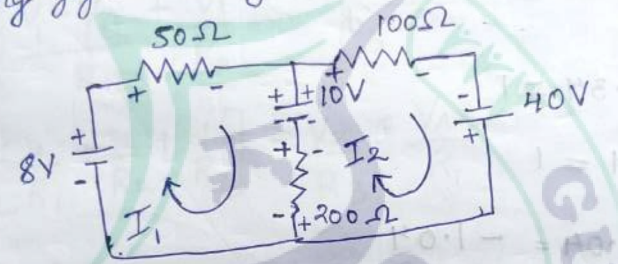
$$I_1 = \frac{\Delta_1}{\Delta} = \frac{991}{601} = 1.64 \text{ A}$$

$$I_2 = \frac{\Delta_2}{\Delta} = \frac{897}{601} = 1.49 \text{ A}$$

$$I_3 = \frac{\Delta_3}{\Delta} = \frac{\cancel{363}}{\cancel{601}} = \cancel{0.60 \text{ A}} \quad 2.12 A$$

$$\frac{1275}{601}$$

7, Determine the power dissipated in all the three resistors in the following figure using Mesh current Analysis.



Loop 1

$$-10 - 200(I_1 - I_2) + 8 - 50 I_1 = 0$$

$$\cancel{-10+8-50}$$

$$-2 - 200 I_1 + 200 I_2 - 50 I_1 = 0$$

$$-2 - 250 I_1 + 200 I_2 = 0$$

$$-2 = 250 I_1 - 200 I_2 \quad — (1) \qquad -1 = 125 I_1 - 100 I_2$$

Loop-2

$$40 - 200(I_2 - I_1) + 10 - 100 I_2 = 0$$

$$50 - 200 I_2 + 200 I_1 - 100 I_2 = 0$$

$$50 - 300 I_2 + 200 I_1 = 0$$

$$50 = 300 I_2 - 200 I_1 \quad - (2) \qquad 1 = 6 I_2 - 4 I_1$$

$125 I_1 - 100 I_2 = -1$

$-4 I_1 + 6 I_2 = 1$

$P = V \cdot I$

$V = IR$

$P = I^2 R$

$-500 I_1 + 400 I_2 = 4$

$-500 I_1 + 750 I_2 = 125$

$125 \times 036 = 750$

$0 + -350 I_2 = -121$

$400 - 750 I_2$

$I_2 = \frac{-121}{-350} = \underline{0.34}\ A$

$-4 I_1 + 6 \times 0.34 = 1$

$-4 I_1 + 2.04 = 1$

$-4 I_1 = 1 - 2.04 = -1.04$

$I_1 = \frac{+1.04}{+4} = \underline{0.26}\ A$

Power dissipated in $50\,\Omega$ resistors $= I^2 R$

$= (0.26)^2 \times 50 = \underline{3.38\ W}$

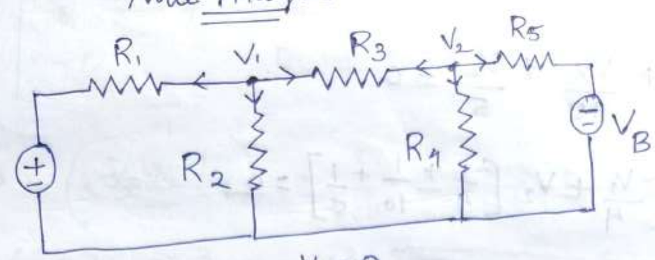
Power dissipated in $100\,\Omega$ resistor $= I_1^2 R$

$= (0.34)^2 \times 100 = \underline{5.78\,W} = \underline{11.56\ W}$

Power dissipated in $200\,\Omega$ resistor $= (I_2 - I_1)^2 R$

$= \underline{1.28\ W}$

Node Analysis



$V_3 = 0$

Node 1

$$\frac{V_1 - V_A}{R_1} + \frac{V_1}{R_2} + \frac{V_1 - V_2}{R_3} = 0$$

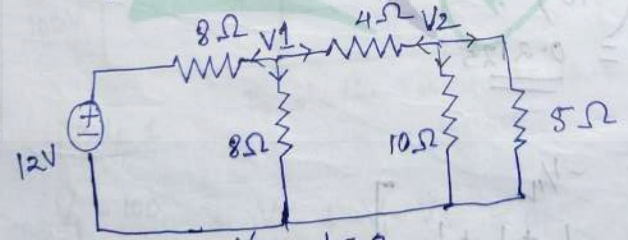
$$V_1\left[\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right] - \frac{V_2}{R_3} = \frac{V_A}{R_1}$$

Node-2

$$\frac{V_2 - V_1}{R_3} + \frac{V_2}{R_4} + \frac{V_2 - V_B}{R_5} = 0$$

$$-\frac{V_1}{R_3} + V_2\left[\frac{1}{R_3} + \frac{1}{R_4} + \frac{1}{R_5}\right] = \frac{V_B}{R_5}$$

?



Find the current through 5Ω resistor using node Analysis.

Node 1

$$\frac{V_1 - 12}{8} + \frac{V_1}{8} + \frac{V_1 - V_2}{4} = 0 \qquad V_1\left[\frac{1}{8} + \frac{1}{8} + \frac{1}{4}\right] - \frac{V_2}{4} = \frac{12}{8} \quad -(1)$$

Node - 2

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

$$\cancel{V_2\left(\tfrac{1}{2}\right.} \; -\frac{V_1}{4} + V_2\left[\frac{1}{4} + \frac{1}{10} + \frac{1}{5}\right] = 0$$

$$[I] = \frac{[V]}{[R]} = [V] \times \frac{1}{[R]}$$

$$\begin{bmatrix} 12/8 \\ 0 \end{bmatrix} = \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} \begin{bmatrix} \frac{1}{8} + \frac{1}{8} + 1/4 & -1/4 \\ -1/4 & \frac{1}{4} + \frac{1}{10} + 1/5 \end{bmatrix}$$

$$\Delta = \begin{bmatrix} \frac{1}{8} + \frac{1}{8} + \frac{1}{4} & -1/4 \\ -1/4 & \frac{1}{4} + \frac{1}{10} + \frac{1}{5} \end{bmatrix}$$

$$\frac{1}{8} + \frac{1}{8} + \frac{1}{4} \times \frac{1}{4} + \frac{1}{10} + \frac{1}{5} - \left(\frac{-1}{4} \times -\frac{1}{4}\right)$$

$$= 0.5 \times 0.55 - \left(\frac{1}{16}\right)$$

$$= 0.275 - 0.0625 = \underline{\underline{0.2125}}$$

$$\Delta_1 = \begin{bmatrix} \cancel{12/8}\ 3/2 & -1/4 \\ 0 & \frac{1}{4} + \frac{1}{10} + \frac{1}{5} \end{bmatrix}$$

$$3/2 \times \frac{1}{4} + \frac{1}{10} + \frac{1}{5} - \left(0 \times -1/4\right) = \cancel{0.21}\ \ \cancel{0.675}\ \ \underline{0.825}$$

$$\Delta_2 = \begin{bmatrix} \frac{1}{8}+\frac{1}{8}+\frac{1}{4} & \frac{3}{2} \\ -\frac{1}{4} & 0 \end{bmatrix}$$

$$= 0 - \left(\frac{3}{2} \times -\frac{1}{4}\right)$$

$$= -\left(\frac{-3}{8}\right) = \frac{3}{8} = \underline{\underline{0.375}}$$

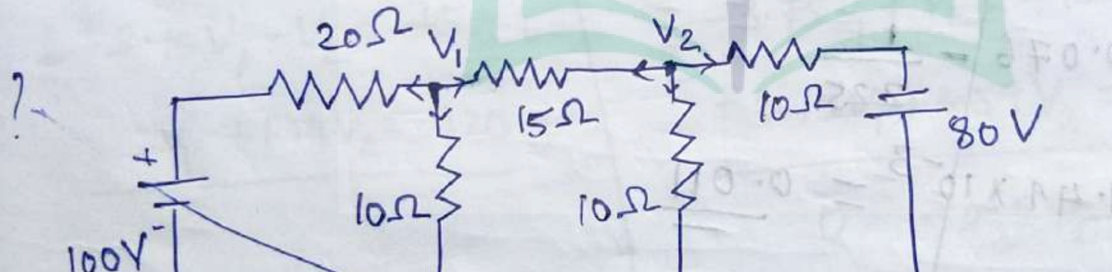
$$\cancel{I_1 = V_1 = \frac{\Delta 1}{\Delta} = \frac{0.825}{0.2125} =} \qquad V_1 = \frac{\Delta 1}{\Delta} = \frac{0.825}{0.2125} = \underline{\underline{3.88\,V}}$$

$$V_2 = \frac{\Delta_2}{\Delta} = \frac{0.375}{0.2125} = \underline{1.76\,V}$$

$$I_2 = \frac{V_2}{5}$$

$$I_2 = \frac{1.76}{5} = \underline{\underline{0.352}}\ A$$

7.



Find the current through 15Ω Resistor

Node 1

$$\frac{V_1 - 100}{20} + \frac{V_1}{10} + \frac{V_1 - V_2}{15} = 0$$

$$V_1\left(\frac{1}{20} + \frac{1}{10} + \frac{1}{15}\right) - \frac{V_2}{15} = 5 \quad -(1)$$

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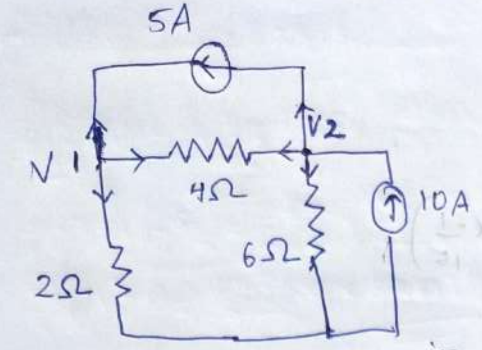
7.



Find the node voltage in the following circuit.

Node 1

$$\frac{V_1}{2} + \frac{V_1 - V_2}{4} - 5 = 0$$

$$V_1\left[\frac{1}{2} + \frac{1}{4}\right] - \frac{V_2}{4} = 5 \quad - (1)$$

Node-2

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

$$-\frac{V_1}{4} + V_2\left(\frac{1}{6} + \frac{1}{4}\right) = 5 \quad - (2)$$

$$0.75V_1 - \frac{V_2}{4} = 5$$

$$3V_1 - V_2 = 20 \quad -(1)$$

$$-\frac{V_1}{4} + 0.416\,V_2 = 5$$

$$-V_1 + 1.664\,V_2 = 20$$

$$3V_1 - V_2 = 20$$

$$-V_1 + 1.664V_2 = 20$$

$-3V_1 + V_2 = -20$ $\qquad\qquad\qquad 1 - 4.992$

$-3V_1 + 4.992V_2 = 60$ $\qquad\qquad\qquad -20-60$

$0 + -3.992V_2 = -80$

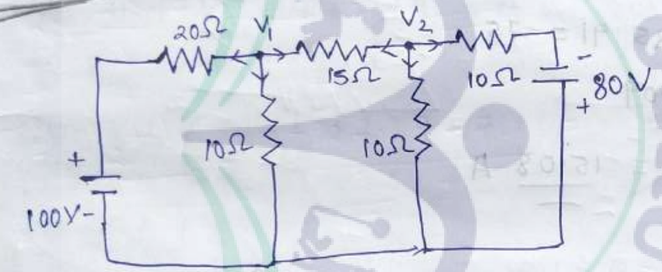
$V_2 = \frac{-80}{-3.992} = \underline{20.04\ V}$

V_1: $-3V_1 + 20 = -20$

$-3V_1 = -20-20 = -40$

$V_1 = \frac{-40}{-3} = \underline{13.33\ V}$

7



Node - 1

$\frac{V_1 - 100}{20} + \frac{V_1}{10} + \frac{V_1 - V_2}{15} = 0$

$V_1\left(\frac{1}{20} + \frac{1}{10} + \frac{1}{15}\right) - \frac{V_2}{15} = \frac{100}{20}\ 5$ — ①

Node - 2

$\frac{V_2 - V_1}{15} + \frac{V_2}{10} + \frac{V_2 + 80}{10} = 0$

$\frac{-V_1}{15} + V_2\left(\frac{1}{15} + \frac{1}{10} + \frac{1}{10}\right) = -8$ - ②

$0.217V_1 + \frac{V_2}{15} = 5$

$3.255V_1 - V_2 = 75 - ①$

$3.255V_1 - V_2 = 75 \quad \times -1$

$-V_1 + 4.05V_2 = -120 \quad \times 3.255$

$= -3.255V_1 + V_2 = -75$

$-3.255V_1 + 13.18V_2 = -390.6$

$0 \quad -12.18V_2 = 315.6$

$V_2 = \frac{315.6}{-12.18} = -25.91$ A

$-3.255V_1 + \cancel{2} - 25.91 = -75$

$-3.255V_1 = -49.09$

$V_1 = \frac{-49.09}{-3.255} = 15.08$ A

$I = \frac{V_2 - V_1}{15} = \frac{-25.91 - 15.08}{15} = 2.73$ A

$-\frac{V_1}{15} + 0.27V_2 = -8$

$-V_1 + 4.05V_2 = -120 - ②$

$-V_1 + 4.05 \times -25.91 = -120$

$-V_1 \cancel{+} -104.93 = -120$

$-V_1 = -120 + 104.93$

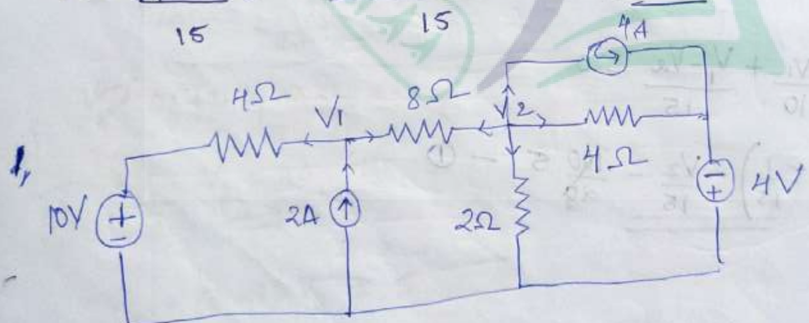
$1 - 13.18$

$= -$

$-75 + 390.6$

$-75 + 25.91$

1,



Find the node voltages of the given circuit

Node - 1

$$\frac{V_1-10}{4} \cancel{+20} - 2 + \frac{V_1 - V_2}{8} = 0$$

$$\frac{-10-8}{4} = \frac{-18}{4}$$

$$V_1\left(\frac{1}{4}+\frac{1}{8}\right) - \frac{10}{4} - 2 - \frac{V_2}{8} = 0$$

$$V_1\left(\frac{1}{4}+\frac{1}{8}\right) \cancel{-18} - \frac{V_2}{8} \cancel{=0} = \cancel{\frac{18}{4}}\ \frac{9}{2} \quad (1)$$

Node - 2

$$\cancel{\frac{V_2}{2} + 4 + 4 + 3\ \frac{V_2+4}{4} = 0}$$

$$\frac{V_2 - V_1}{8} + \frac{V_2}{2} + 4 + \frac{V_2+4}{4} = 0$$

$$-\frac{V_1}{8} + V_2\left(\frac{1}{8}+\frac{1}{2}+\frac{1}{4}\right) + 4 + 1 = 0$$

$$1 - 21$$

$$-\frac{V_1}{8} + V_2\left(\frac{1}{8}+\frac{1}{2}+\frac{1}{4}\right) = -5$$

$$-36 + 120$$

$$0.375V_1 - \frac{V_2}{8} = \frac{9}{2} \quad - (1)$$

$$\frac{9}{2} \times \cancel{8}^{4}$$

$$-\frac{V_1}{8} + 0.875V_2 = -5 \quad - (2)$$

$$3V_1 - V_2 = 36 \quad = \quad -3V_1 + V_2 = -36$$

$$-V_1 + 7V_2 = -40 \qquad -3V_1 + 21V_2 - 120$$

$$0 \quad -20V_2 = 84$$

$$V_2 = \frac{84}{-20} = -4.2\ V$$

$$-3V_1 - 4.2 = -36$$

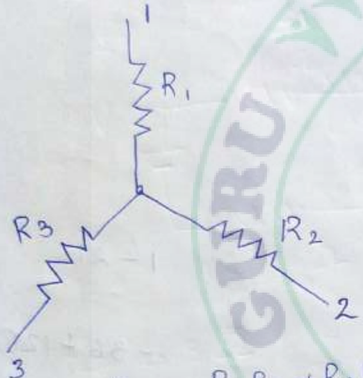
$$-3V_1 = -36 + 4.2$$

$$-3V_1 = -31.8$$

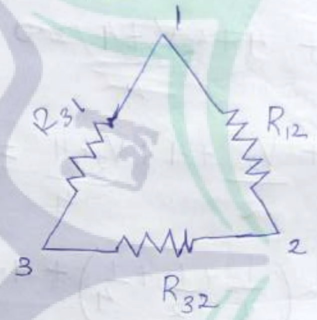
$$V_1 = \frac{-31.8}{-3} = \underline{\underline{10.6\ V}}$$

Star-Delta Conversion

Star



Delta



$$R_{12} = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_3}$$

$$R_{32} = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_1}$$

$$R_{31} = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_2}$$

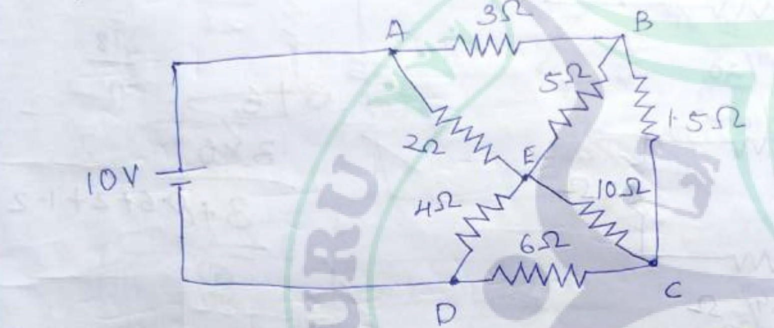
Delta-Star Conversion

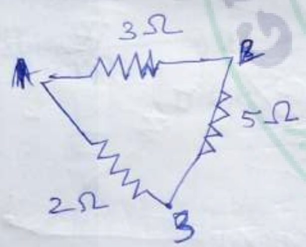
$$R_1 = \frac{R_{12} \times R_{31}}{R_{12} + R_{32} + R_{31}}$$

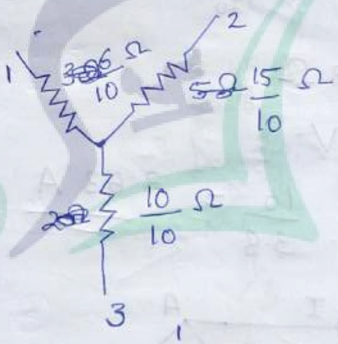
$$R_2 = \frac{R_{12} \times R_{32}}{R_{12} + R_{32} + R_{31}}$$

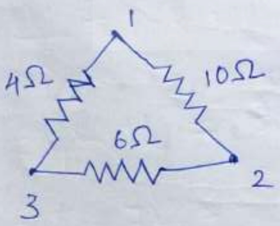
$$R_3 = \frac{R_{31} \times R_{32}}{R_{12} + R_{32} + R_{31}}$$

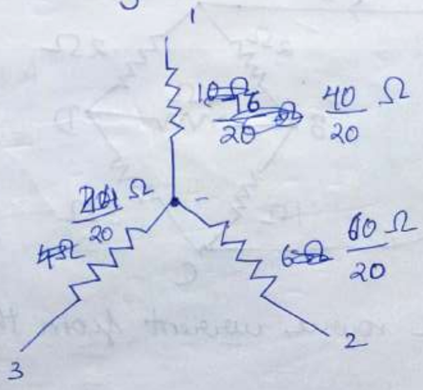
?. Using star-delta transformations, Calculate the I drawn from the battery in the following.



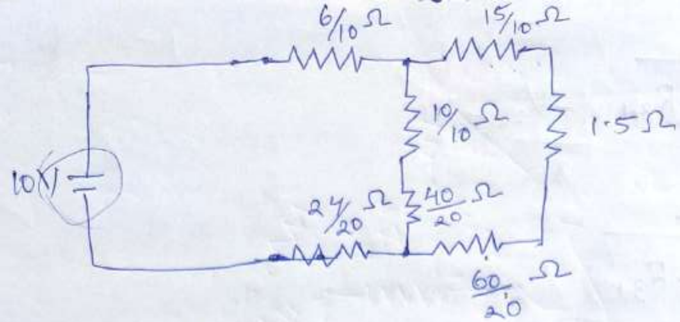






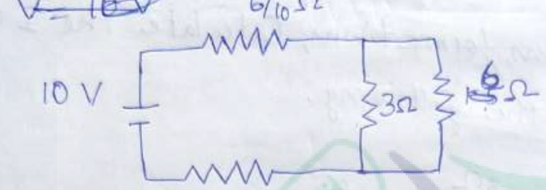


Δ ⅄



$4.5 + 1.5 = 6$

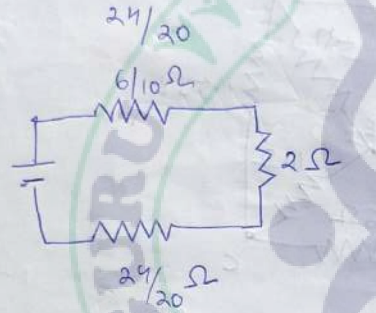
$\cancel{V = 10V}$



$\frac{18}{9}$

$\frac{3\times 6}{3+6}$

$0.6 + 2 + 1.2$

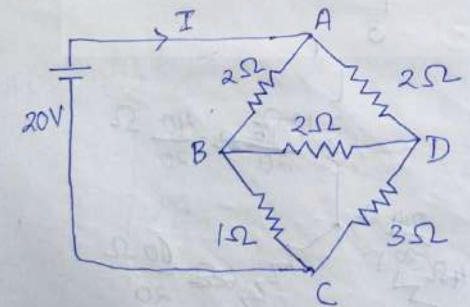


$R = 3.8\ \Omega$

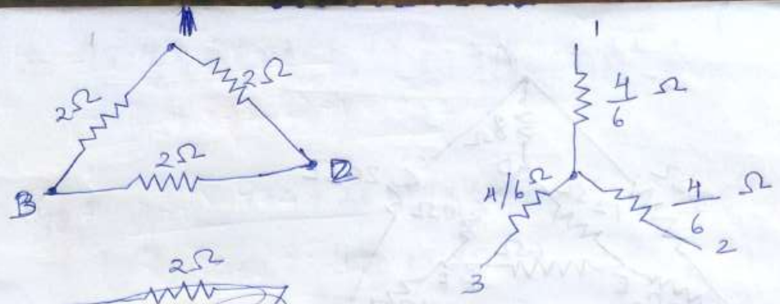
$V = 10\ V$

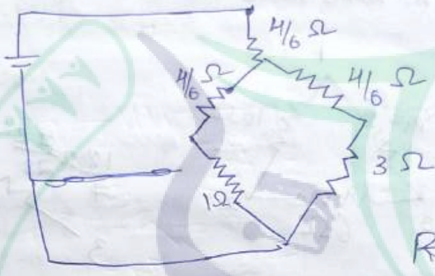
$I = V/R = \frac{10}{3.8} = \underline{2.63\ A}$

?



Find the source current from the given circuit.

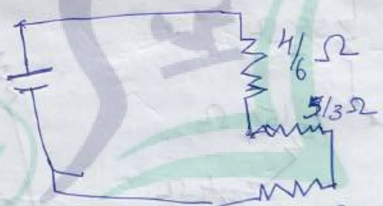




~~$R = 0.625\,\Omega$~~

~~$I = 5/0.6$~~ 1.6

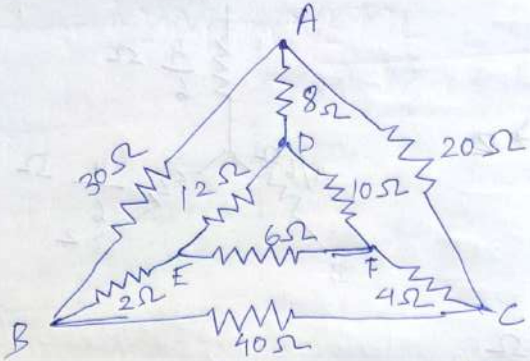
~~$I = V/R = \frac{20}{0.625} =$~~



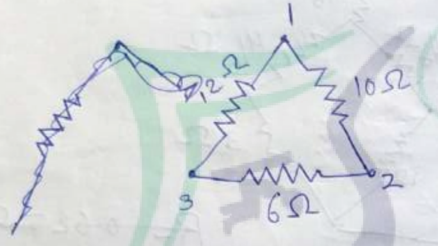
$R = 1.145 + 2/3 = \underline{1.812\,\Omega}$

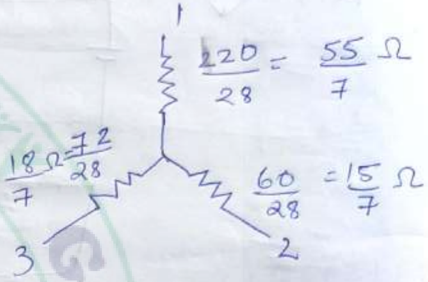
$I = V/R = \frac{20}{1.812} = \underline{11.03\,A}$

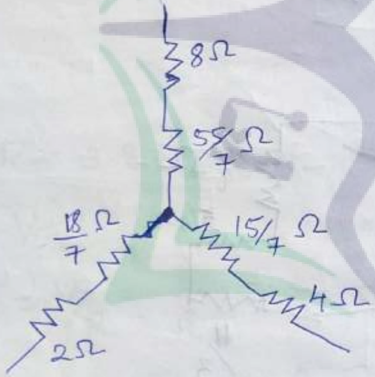
?

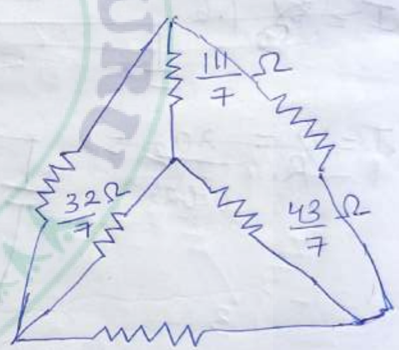


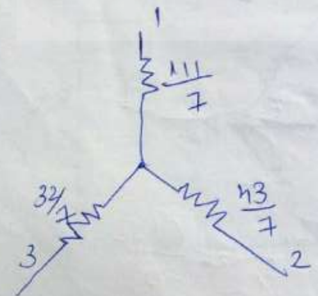
Find equivalent resistance across AB

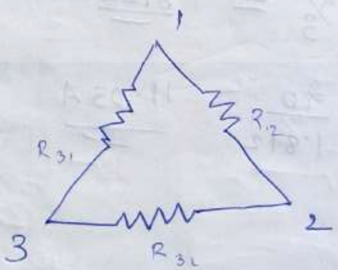










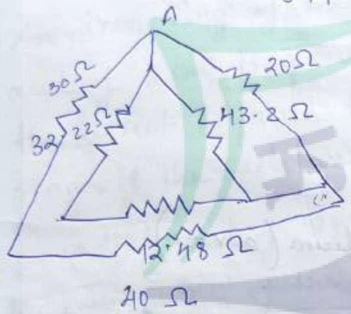


$$R_{12} = \frac{\frac{111}{7} \times \frac{43}{7} + \frac{43}{7} \times \frac{32}{7} + \frac{32}{7} \times \frac{111}{7}}{34/7}$$

$= \frac{97.4 + 28.08 + 72.4}{4.57} = \underline{43.2}\ \Omega$

$R_{32} = \frac{97.4 + 28.08 + 72.4}{15.85} = \underline{12.48\ \Omega}$

$R_{13} = \frac{97.4 + 28.08 + 72.4}{6.14} = 32.22\ \Omega$



Equivalent resistance across $= \frac{30 \times 32.22}{30 + 32.22} = \underline{15.53\ \Omega}$