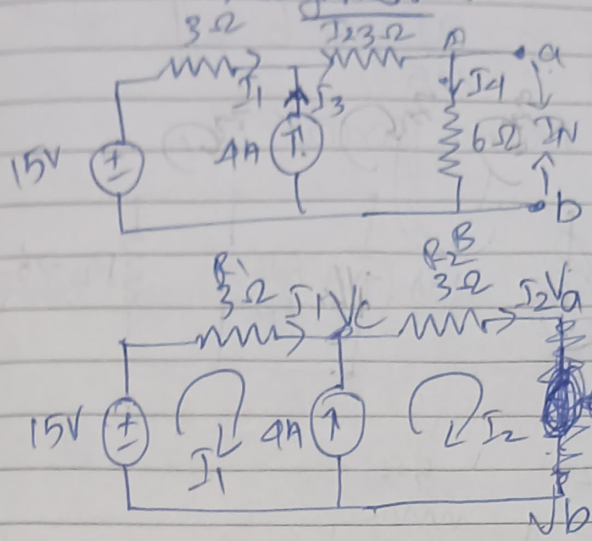
16/23

Assignment - 1

4)



$-15 + 3I_1 + 3I_2 + 6I_2 = 0$

$3I_1 + 9I_2 = 15$

$I_1 + 3I_2 = 5 \quad -(1)$

$I_2 - I_1 = 4$

$(-)I_1 \; (+)I_2 = (+)4$

$2I_2 = 9$

$I_2 = 9/2$

$= 4.5$ //

$I_1 = 5 - 4.5$

$I_1 = 0.5$ //

$I_N = I_2 = 4.5A$ //

$I_1 + 4 = I_2$

$\frac{15 - V_C}{3} + 4 = \frac{V_C - V_A}{3} \Rightarrow 4 = \frac{V_C - V_A - 15 + V_C}{3}$

$12 = 2V_C - V_A - 15$

$2V_C - V_A = 27$

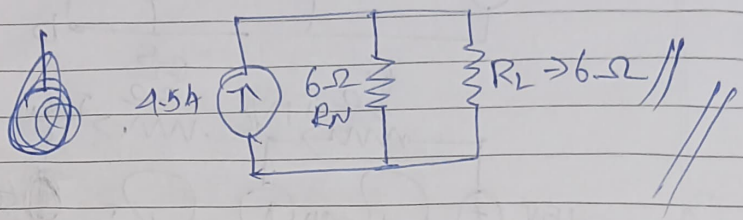
$V_A = V_C$ as there is no current flow through 3Ω(R3) due to open end at Va & Vb.

$V_A = V_C = 27$ //

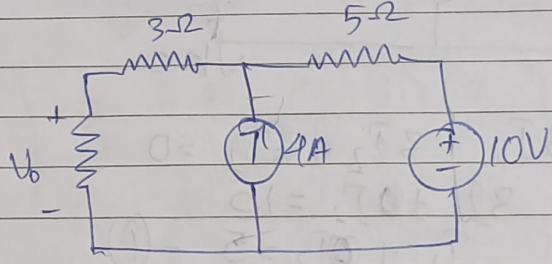
I_N, R_N

$R_N = \frac{V_{TH}}{I_N} \Rightarrow \frac{27}{4.5} \Rightarrow 6\,\Omega$ //

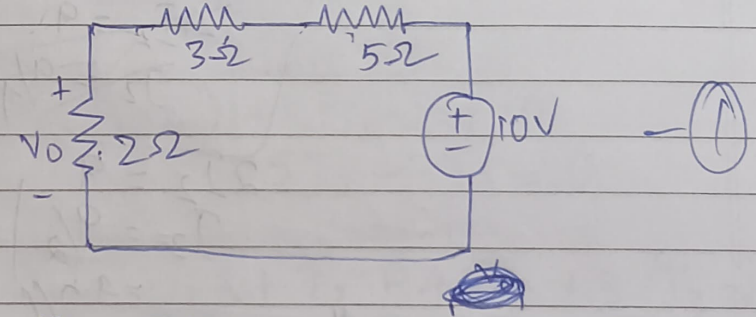
∴ Norton circuit is,



8)



Short circuit Current Source

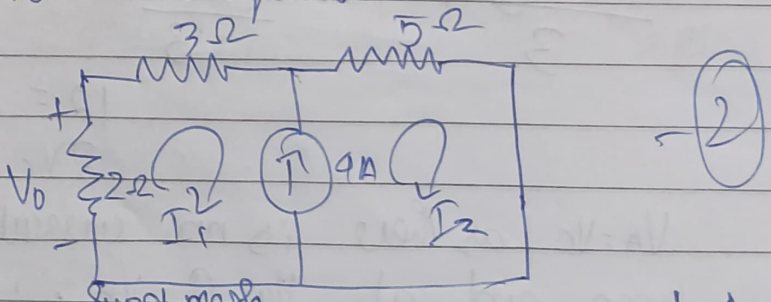


$-10 + 5I_1 + 3I_1 + 2I_1 = 0$

$10I_1 = 10$

$I_1 = 1A$

Short circuit Voltage Source



$2I_1 + 3I_1 + 5I_2 = 0$

$5I_1 + 5I_2 = 0$

$I_1 + I_2 = 0$

$A = I_2 - I_1$

$I_2 = A + I_1$

$V_0 = -1.06\,V$ //

$I_1 = -I_2$

$I_2 = 4 - I_2$

$2I_2 = 4$

$I_2 = 2$

$I_1 = -2(-1)$

$I_1 = 2$

Total $I = -(-2) + 1 = 3A$

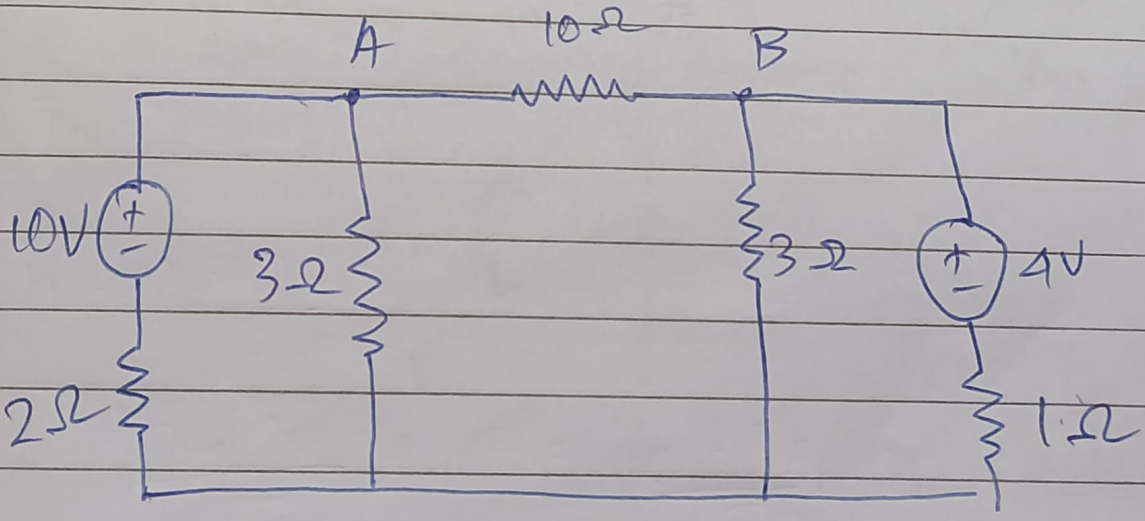
↓ -ve due to opposite direction in diagram (2) to diagram (1)

$V = I \times R$

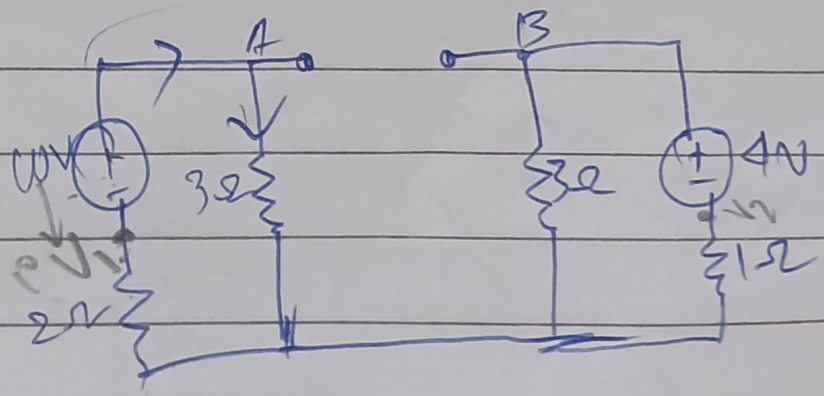
$= 3 \times 2$

$= 6\,V$ //

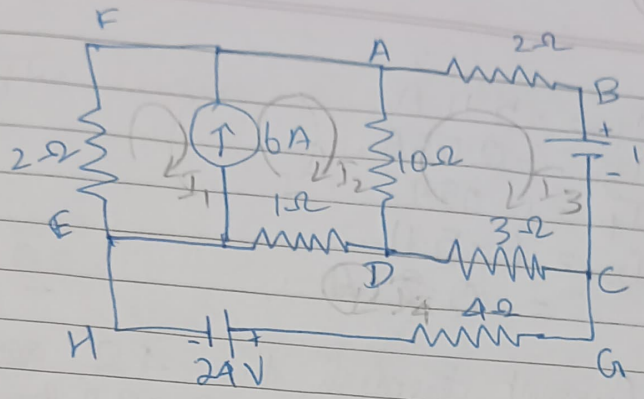
7)



To Find V_{TH}



b)



$I_2 - I_1 = 6$ — (1) $\Rightarrow I_2 = 6 + I_1$ — (5)

Loop in supermesh: $2I_1 + 10(I_2 - I_3) + 1(I_2 - I_4) = 0$

$2I_1 + 11I_2 - 10I_3 - I_4 = 0$ — (2)

Loop I_3: $10(I_3 - I_2) + 2I_3 + 10 + 3(I_3 - I_4) = 0$

$15I_3 - 10I_2 - 3I_4 = -10$ — (3)

Loop I_4: $\Rightarrow 24 + 1(I_4 - I_2) + 3(I_4 - I_3) + 4I_4 = 0$

$24 + 8I_4 - I_2 - 3I_3 = 0$

$8I_4 - I_2 - 3I_3 = -24$ — (4)

(5) in (2)

$\Rightarrow 2I_1 + 11(6 + I_1) - 10I_3 - I_4 = 0$

$2I_1 + 66 + 11I_1 - 10I_3 - I_4 = 0$

$13I_1 - 10I_3 - I_4 = -66$ — (6)

(5) in (3)

$\Rightarrow 15I_3 - 10(6 + I_1) - 3I_4 = -10$

$= 15I_3 - 60 - 10I_1 - 3I_4 = -10$

$= 15I_3 - 10I_1 - 3I_4 = 50$ — (7)

(5) in (4) $\Rightarrow 8I_4 - (6 + I_1) - 3I_3 = 0$

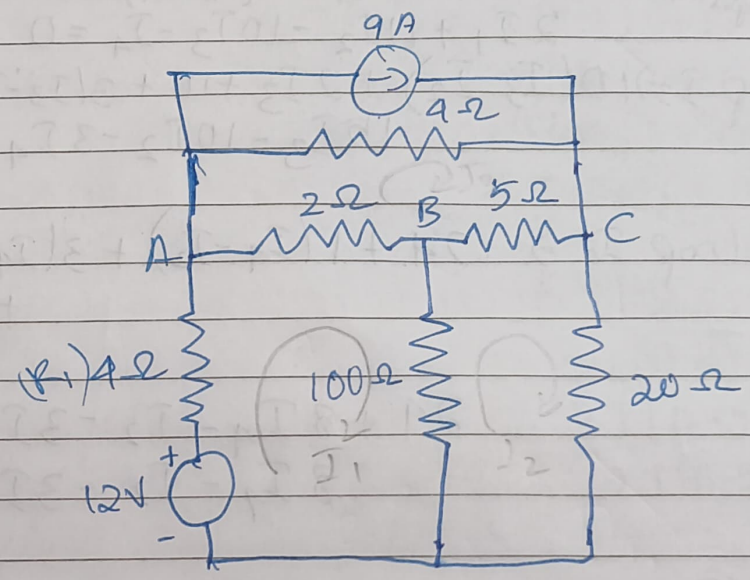
$8I_4 - 6 - I_1 - 3I_3 = 0$

$8I_4 - I_1 - 3I_3 = 6$ — (8)

$I_1 = -5.11\ A$
$I_3 = -0.05A$
$I_4 = 0.08A$
$I_2 = 6 - 5.11$
$= 0.89A$

The Current through the 4Ω resistor is 0.08A //

5)



In loop 1, $-12 + 4I_1 + 2(I_1 - I_3) + 100(I_1 - I_2) = 0$

$106I_1 - 2I_3 - 100I_2 = 12$

$53I_1 - 50I_2 - I_3 = 6$ — (1)

In loop 2, $10(I_2 - I_1) + 5(I_2 - I_3) + 20I_2 = 0$

$35I_2 - 10I_1 - 5I_3 = 0$ — (2)

In loop 3, $2(I_3 - I_1) + 4(I_3 - 9) + 5(I_3 - I_2) = 0$

$\Rightarrow 11I_3 - 2I_1 - 5I_2 = 36$ — (3)

$I_1 = 0.95\ A$, $I_2 = 0.81\ A$, $I_3 = 3.81\ A$

= 0.14

The current through the 12V source is 0.95A

At node A,

$$\frac{V_A - 12}{4} + \frac{V_A - V_B}{2} + \frac{V_A - V_C}{4} = 0$$

$$V_A - 12 + 2V_A - 2V_B + V_A - V_C = 0$$

$$4V_A - 2V_B - V_C = 12 \quad - (1)$$

At node B,

$$\frac{V_B - V_A}{2} + \frac{V_B - V_C}{5} + \frac{V_B}{100} = 0$$

$$\frac{5V_B - 5V_A + 2V_B - 2V_C}{10} + \frac{V_B}{100} = 0$$

$$50V_B - 50V_A + 20V_B - 20V_C + V_B = 0$$

$$71V_B - 50V_A - 20V_C = 0 \quad - (2)$$

At node C,

$$\frac{V_C}{20} + \frac{V_C - V_B}{5} + \frac{V_C - V_A}{4} = 0$$

$$V_C + 4V_C - 4V_B + 5V_C - 5V_A = 0$$

$$10V_C - 5V_A - 4V_B = 0 \quad - (3)$$

$$V_A = 9.88V, V_B = 9.91V, V_C = 8.7V$$

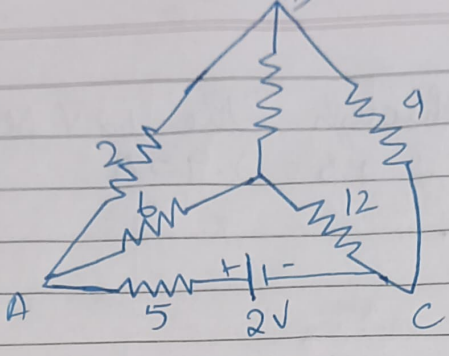
Voltage across 5Ω $= V_B - V_C$

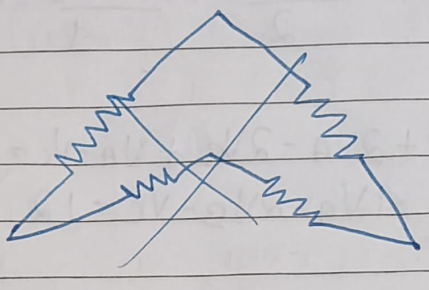
$$= 9.91 - 8.7$$

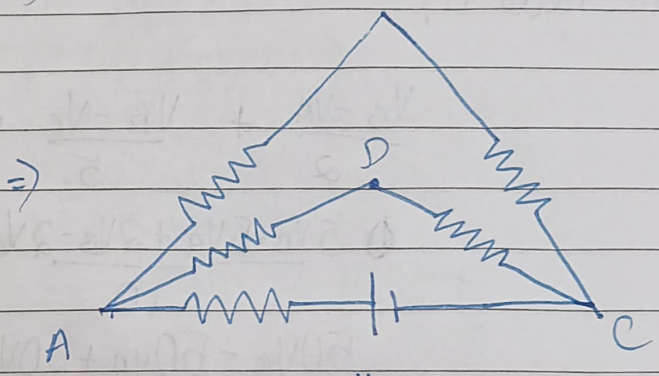
$$(R_1) \quad = 0.71V$$

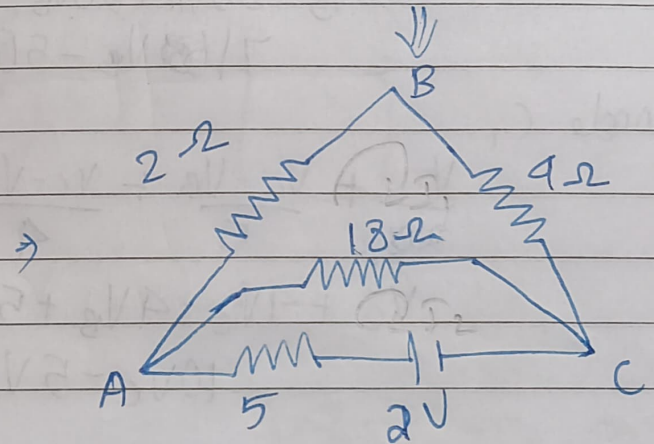
Current across 4Ω $= \frac{12 - 9.88}{4} = 0.53A$

4)









In loop 1 $\Rightarrow$ $6I_1 + 18(I_1 - I_2) = 0$

$24I_1 - 18I_2 = 0$

$4I_1 - 3I_2 = 0$

In loop 2 $\Rightarrow$ $18(I_2 - I_1) - 2 + 5I_2 = 0$

$23I_2 - 18I_1 = 2$

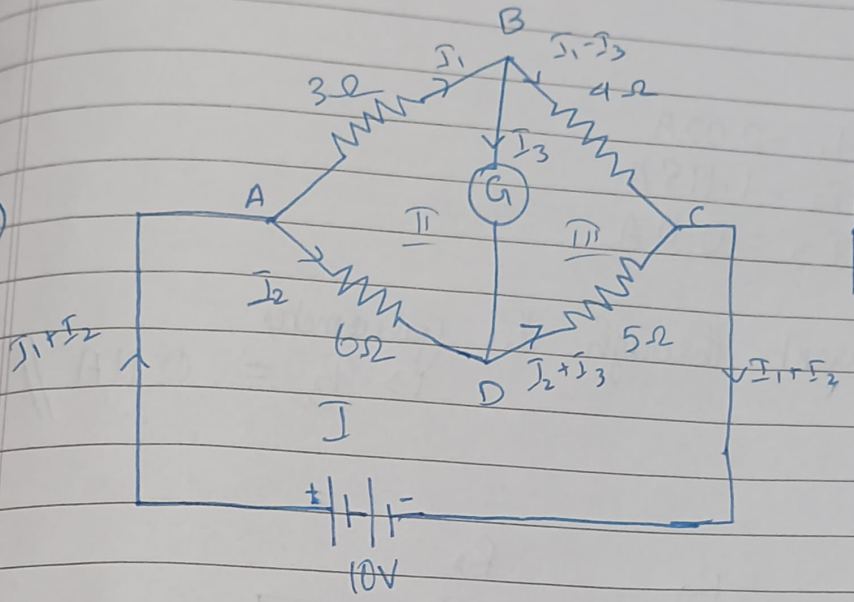
$I_1 = 0.15A$, $I_2 = 0.21A$

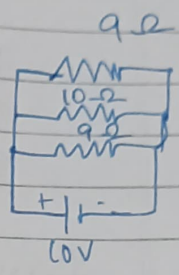
Current across 18Ω i.e DC is $= I_2 - I_1$

$= 0.21 - 0.15$

$= 0.06A$ //

3)





In loop II,

$3I_1 + 10I_3 - 6I_2 = 0$

In loop III,

$4(I_1 - I_3) - 5(I_2 + I_3) - 10I_3 = 0$

$4I_1 - 5I_2 - 19I_3 = 0$

In loop I, -10 +

Total resistance in ABCD

$$\frac{1}{Req} = \frac{1}{9} + \frac{1}{10} + \frac{1}{9} = \frac{2}{9} + \frac{1}{10}$$

$$= \frac{20+9}{90}$$

$$Req = \frac{90}{29} = 3.1\Omega$$

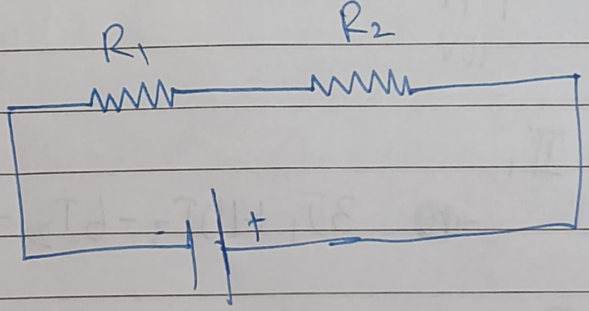
In loop I_1,

$$-10 + 3.1(I_1 + I_2) = 0$$
$$3.1I_1 + 3.1I_2 = 10$$

$I_1 = 2.02A$
$I_2 = 1.198A$
$I_3 = 0.11A$

Current through the galvanometer
$\Rightarrow I_3 = 0.11A$ //

2)



$$\frac{1}{R_1} = \frac{1}{2} + \frac{1}{1}$$
$$\frac{1}{R_1} = \frac{1+2}{2} \Rightarrow R_1 = \frac{2}{3} \text{ //} = 0.66\,\Omega$$

$$\frac{1}{R_2} = \frac{1}{4} + \frac{1}{8} + \frac{1}{2.66} \Rightarrow \frac{3}{8} + \frac{1}{2.66}$$
$$\frac{1}{R_2} = \frac{2.66 \times 3 + 8}{2.66 \times 8}$$

$$R_2 = \frac{21.28}{15.98}$$
$$= 1.33\,\Omega$$

Total Resistance $= R_1 + R_2$

$= 0.66 + 1.33$

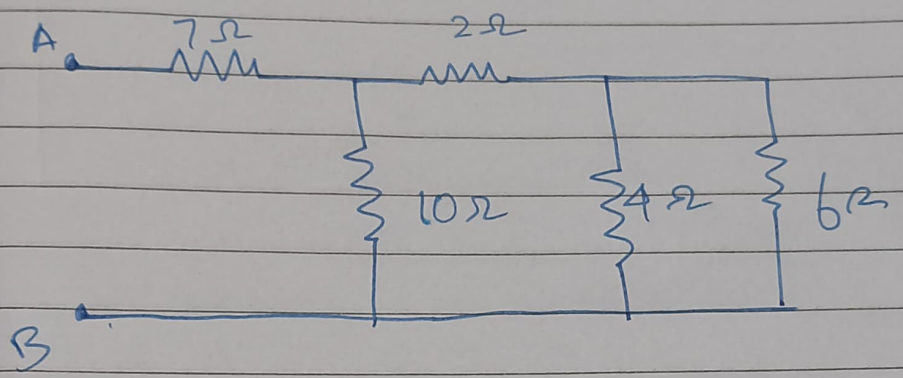
$= 1.99\ \Omega$

$I = \frac{V}{R} = \frac{10}{1.99} = 5.02\ A$

$P = VI = 10 \times 5.02$

$= 50.2$ watts //

D)



$R_{eq} = \frac{6 \times 4}{6+4} = \frac{24}{10} = 2.4\ \Omega$

$= 2.4 + 2 = 4.9\ \Omega$

$R_{eq} = \frac{4.9 \times 10}{14.9} = \frac{49}{14.9} = 3.05\ \Omega$

Total $R = 3.05 + 7 = 10.05\ \Omega$ //

(1) $V_L = 400V$

$Z = 8 + j6\ \Omega$

$$V_{PH} = \frac{V_L}{\sqrt{3}} = \frac{400}{\sqrt{3}} = 230.9V$$

In Star Connection $I_{PH} = I_L$,

$$I_{PH} = \frac{V_{PH}}{Z_{PH}}$$

$$= \frac{230.9}{10\angle 36.8}$$

$$= 23.09\angle -36.8$$

$$I_{PH} = 23.09\ A //$$

$\therefore I_L$ (i.e) Line current is also $23.09\ A //$