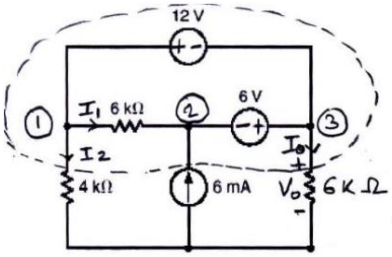
1)



KCL at supernode : $6m = I_2 + I_o$

$$\frac{V_1}{4K} + \frac{V_3}{6K} = 6m$$

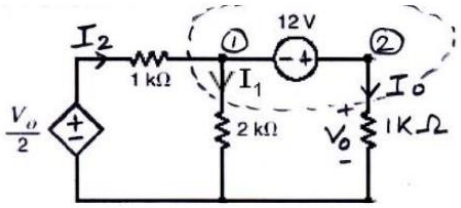
$$3V_1 + 2V_3 = 72$$

$$V_1 - V_3 = 12$$

$$3V_1 + 2V_3 = 72$$
$$V_1 - V_3 = 12$$

$$V_1 = 19.2 \ V$$
$$V_3 = 7.2 \ V$$

$$V_o = V_3 = 7.2 \ V$$



KCL at supernode : $I_2 = I_1 + I_o$

$$\frac{\frac{V_o}{2} - V_1}{1K} = \frac{V_1}{2K} + \frac{V_2}{1K}$$

$$V_o = V_2$$

$$\frac{\frac{V_2}{2} - V_1}{1K} = \frac{V_1}{2K} + \frac{V_2}{1K}$$

$$V_2 - 2V_1 = V_1 + 2V_2$$

$$\boxed{3V_1 + V_2 = 0}$$

$$V_2 - V_1 = 12$$

$$\boxed{-V_1 + V_2 = 12}$$

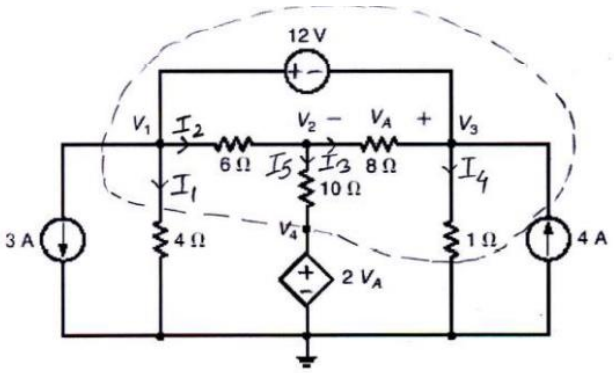
$$3V_1 + V_2 = 0$$
$$-V_1 + V_2 = 12$$

$$V_1 = -3V \qquad V_2 = 9\ V$$

$$V_0 = V_2 = 9V$$

$$V_0 = 9\ V$$

2)



KCL at ②: $I_2 = I_5 + I_3$

$$\frac{V_1 - V_2}{6} = \frac{V_2 - V_4}{10} + \frac{V_2 - V_3}{8}$$

$$5V_1 - 5V_2 = 3V_2 - 3V_4 + 3.75V_2 - 3.75V_3$$

$$\boxed{5V_1 - 11.75V_2 + 3.75V_3 + 3V_4 = 0}$$

KCL at supernode: $3 + I_1 + I_5 + I_4 = 4$

$$\frac{V_1}{4} + \frac{V_2 - V_4}{10} + \frac{V_3}{1} = 1$$

$$5V_1 + 2V_2 - 2V_4 + 20V_3 = 20$$

$$\boxed{5V_1 + 2V_2 + 20V_3 - 2V_4 = 20}$$

$$V_1 - V_3 = 12$$

$$V_4 = 2V_A$$

$$V_A = V_3 - V_2$$

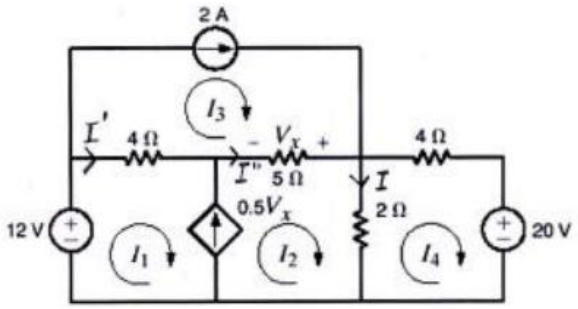
$$V_4 = 2(V_3 - V_2)$$

$$\boxed{-2V_2 + 2V_3 - V_4 = 0}$$

$$5V_1 - 11.75V_2 + 3.75V_3 + 3V_4 = 0$$
$$5V_1 + 2V_2 + 20V_3 - 2V_4 = 20$$
$$V_1 + 0V_2 - V_3 + 0V_4 = 12$$
$$0V_1 - 2V_2 + 2V_3 - V_4 = 0$$

$$V_1 = 9.68\ V$$
$$V_2 = 1.45\ V$$
$$V_3 = -2.32\ V$$
$$V_4 = -7.54\ V$$

3)



KCL: $I_1 = I' + I_3$

$I' = I_1 - I_3$

KCL: $I + I_4 = I_2$

$I = I_2 - I_4$

KCL: $I'' + I_3 = I + I_4$

$I'' = -I_3 + I_4 + I_2 - I_4$

$I'' = I_2 - I_3$

KCL: $I_2 = 0.5V_x + I_1$

$-I_1 + I_2 - 0.5V_x = 0$

$V_x = -I''(5) = -5(I_2 - I_3)$

$V_x = -5I_2 + 5I_3$

$-I_1 + I_2 - 0.5(-5I_2 + 5I_3) = 0$

$\boxed{-I_1 + 3.5I_2 - 2.5I_3 = 0}$

$I_3 = 2A$

KVL: $4I_4 + 20 + 2(-I) = 0$

$4I_4 - 2(I_2 - I_4) = -20$

$\boxed{-2I_2 + 16I_4 = -20}$

KVL: $12 = 4I' + 5I'' + 4I_4 + 20$

$4(I_1 - I_3) + 5(I_2 - I_3) + 4I_4 = -8$

$4I_1 + 5I_2 - 9I_3 + 4I_4 = -8$

$\boxed{4I_1 + 5I_2 + 4I_4 = 10}$

$-I_1 + 3.5I_2 - 2.5I_3 = 0$

$-2I_2 + 6I_4 = -20$

$4I_1 + 5I_2 + 4I_4 = 10$

$I_3 = 2A$

$-I_1 + 3.5I_2 = 5$

$-2I_2 + 6I_4 = -20$

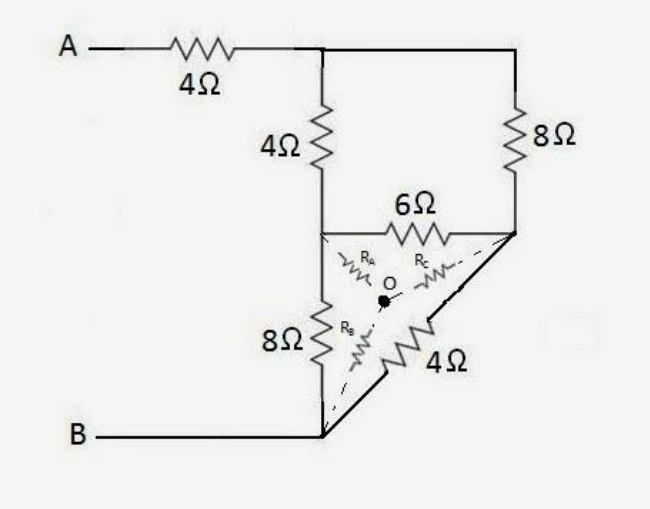
$4I_1 + 5I_2 + 4I_4 = 10$

$I_1 = 2.46A$

$I_2 = 2.13A$

$I_4 = -2.62A$

4)



$$R_A = \frac{8 \cdot 6}{8 + 6 + 4}$$

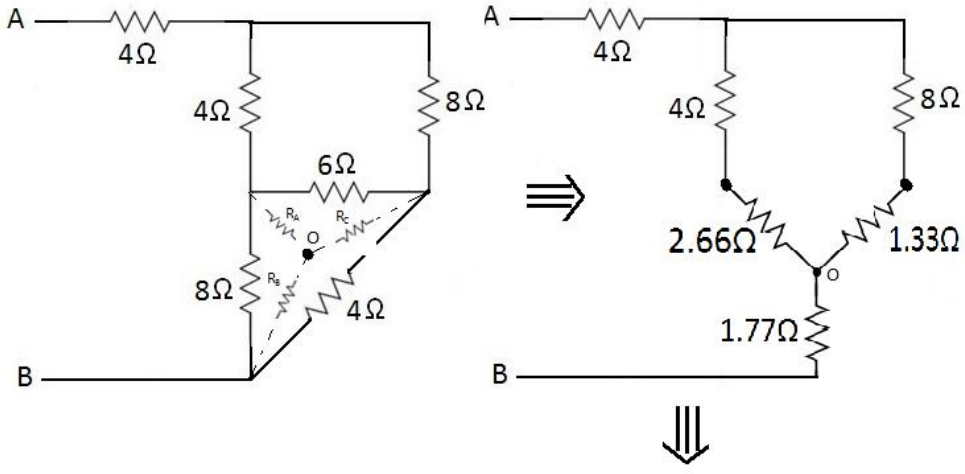
$$R_A = 2.66\Omega$$

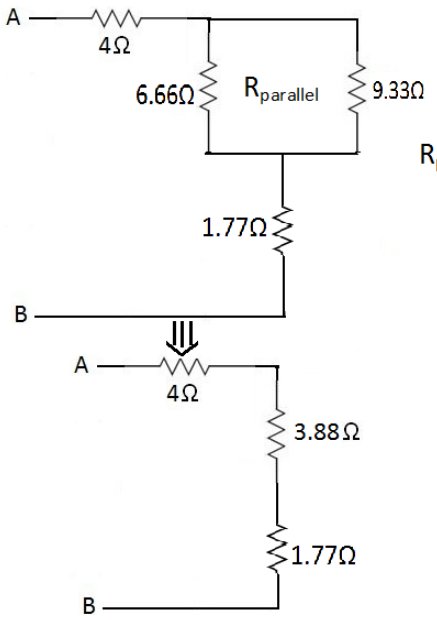
$$R_B = \frac{8 \cdot 4}{8 + 6 + 4}$$

$$R_B = 1.77\Omega$$

$$R_C = \frac{6 \cdot 4}{8 + 6 + 4}$$

$$R_C = 1.33\Omega$$

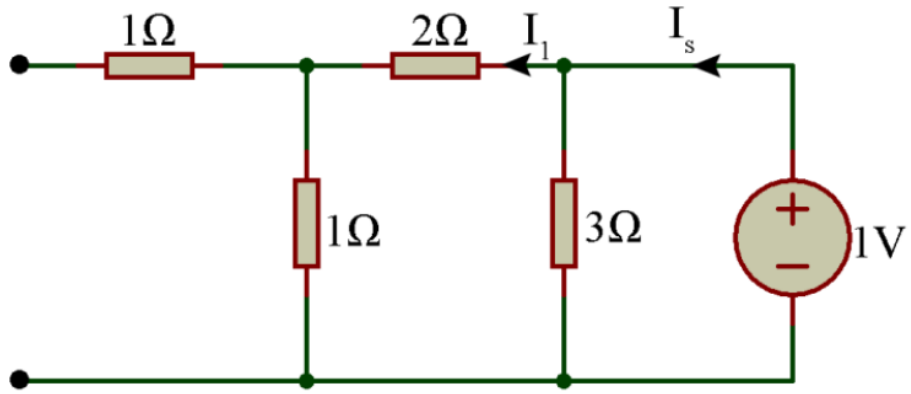




$$R_{parallel} = \frac{6.66 \times 9.33}{6.66+9.33} = 3.88\Omega$$

So, R_{AB} ($R_{equivalent}$) = $R_1 + R_2 + R_3 = 4\Omega + 3.88\Omega + 1.77\Omega = 9.65\Omega$

5) Kill the current source and calculate I_1;

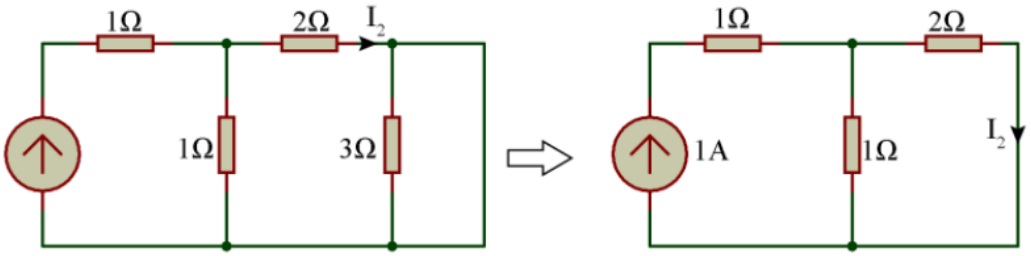


$$I_s = \frac{1V}{[(1+2)||3]\Omega} = \frac{1}{1.5}A$$

$$I_1 = I_s \frac{3}{3+2+1} = \frac{1}{1.2} \times \frac{3}{6} = \frac{1}{3}A$$

(by current division)

Now, kill the voltage source and calculate I_2;



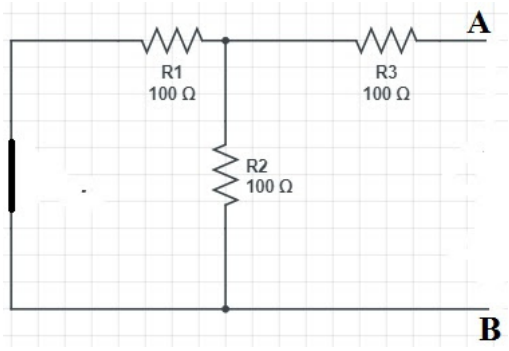
(current follows the easiest path)

$$I_2 = 1 \times \frac{1}{1+2} = \frac{1}{3}A$$

(by current divider)

$$I = (I_1 - I_2) = \frac{1}{3} - \frac{1}{3} = 0$$

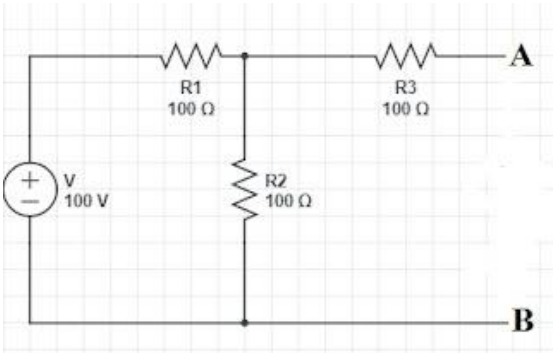
6) Step 1: Remove the load and kill the voltage source;



So, resistance across A and B (R_{eq}) is;

$R_{eq} = R_1 \,||\, R_2 + R_3 = 150$ ohms.

Step 2: Calculate V_{oc} across A and B;

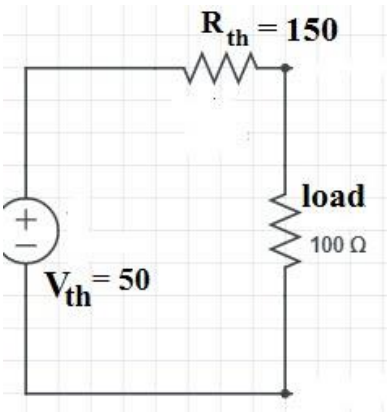


(Voltage divider)

$$V_{th} = \frac{VR_2}{R_1 + R_2}$$

$$V_{th} = \frac{100 \times 100}{100 + 100} = \frac{100 \times 100}{200} = 50$$

Step 3: Draw the Thevenin equivalent circuit;



Find I now, which is the current flowing through the load;

$$I = \frac{V_{th}}{R_{th} + R_{load}}$$

$$I = \frac{50}{150 + 100} = \frac{50}{250} = 0.2A$$