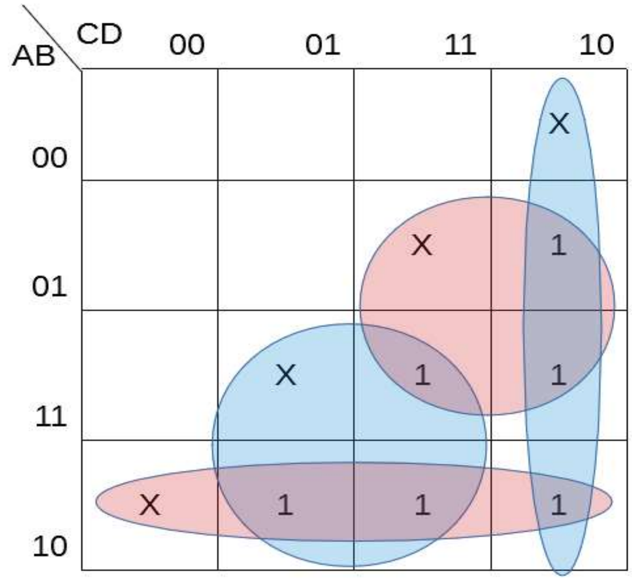
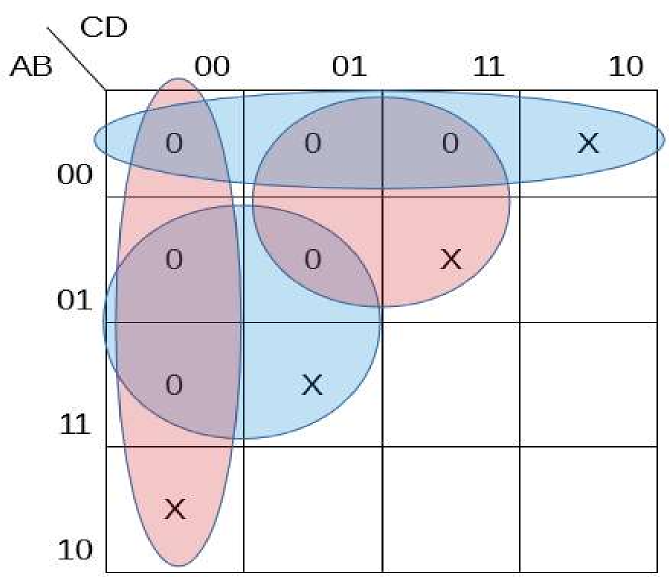
Sol-1. $F(A,B,C,D) = \sum(6,9,10,11,14,15) + d(2,7,8,13)$

(a) : Minimal SOP form



Solution 1 :
Using red regions $A\bar{B} + BC$
Or
Solution 2 :
Using blue regions $C\bar{D} + AD$

(b) : Minimal POS form



Solution 1 :
Using blue regions $(A + B)(\bar{B} + C)$
Or
Solution 2 :
Using red regions $(C + D)(A + \bar{D})$

Sol.2:

A) <u>For Thevenin equivalent circuit:</u>

By Source transformation of 1A source,

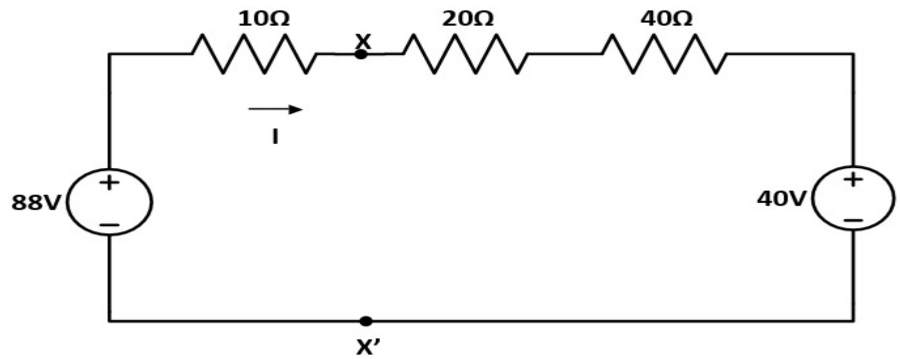


Fig. 1_1

$$\Rightarrow I = \frac{88 - 40}{10 + 20 + 40} = 0.6857A$$

Voltage across X X' = $V_{XX'}$ = 88 – 10 I

= 88 – 10 x 0.6857 = 81.143 V⇒**V_{TH} = $V_{THEVENIN}$ = $V_{XX'}$ = 81.143 V.**

For R_{TH} : Deactivating the independent sources,

⇒ 20 Ω + 40 Ω = 60Ω

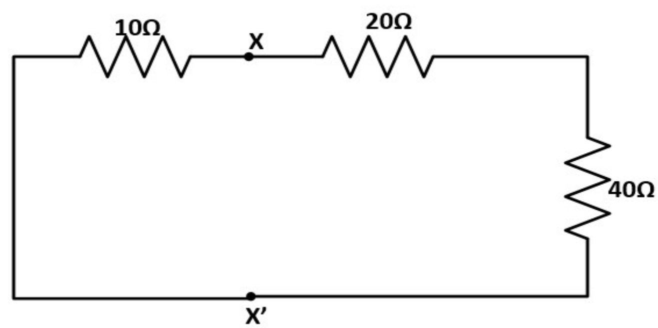


Fig. 1_2

⇒R_{TH} = 10 ‖ 60 = 8.57 Ω.

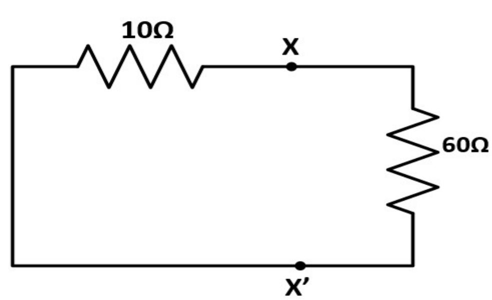
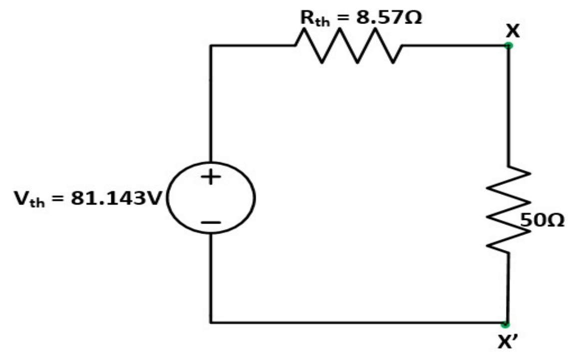


Fig. 1_3

Thevenin Equivalent Circuit:



Voltage across xx' = $V_{TH} \frac{50}{50+8.57}$

$= 81.143 \frac{50}{50+8.57}$ = **69.27 V.**

Fig. 1_4

B) <u>For Norton's equivalent circuit:</u>

Using Source transformation of 1A source,

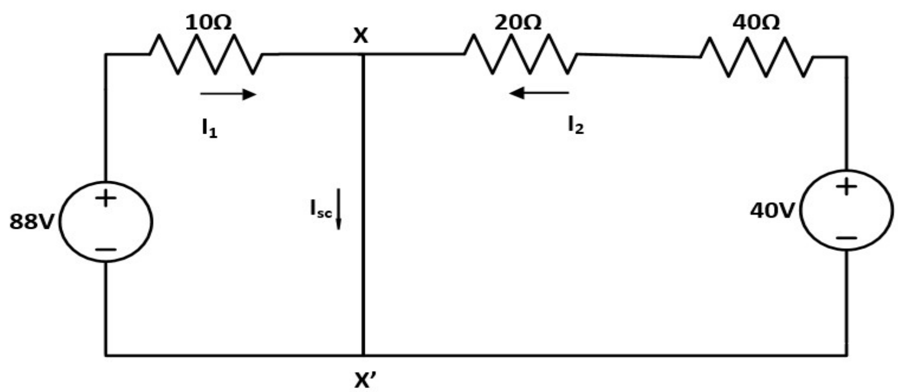


Fig. 1_5

[$V_{xx'} = 0$, as shortcircuit]

Now, Loop I ⇒ $88 - 10\,I_1 = 0$

or, $\mathbf{I_1 = 8.8}$ **A.**

Loop II ⇒ $40 - I_2 \times 60 = 0$

or, $\mathbf{I_2 = 0.67}$ **A**

Now $I_{SC} = I_1 + I_2 =$ **9.47 A**

R_{NORTON} = R_N

$\Rightarrow 20\,\Omega + 40\,\Omega = 60\Omega$

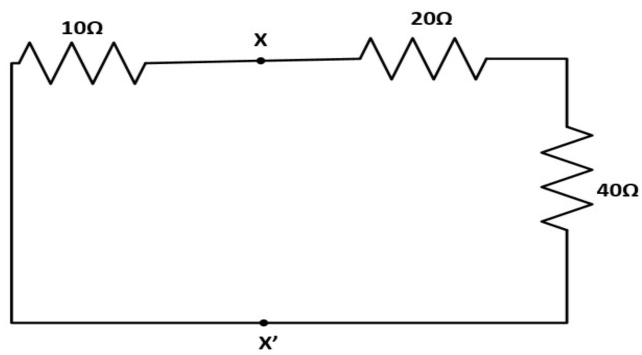


Fig. 1_6

$\Rightarrow R_{TH} = 10 \parallel 60 = 8.57\,\Omega.$

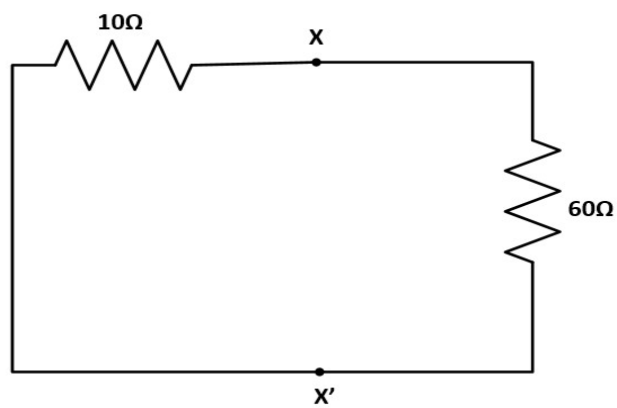


Fig. 1_7

∴ Norton equivalent circuit is ,

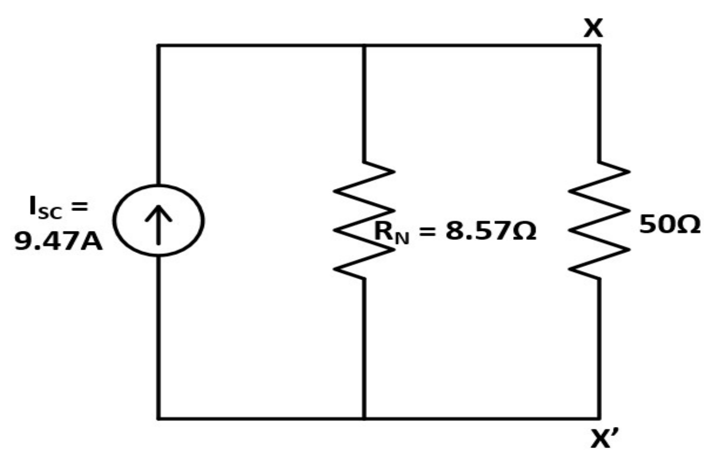


Fig. 1_8

Voltage across xx' $= I_{SC}\,\frac{8.57}{(8.57+50)} \times 50 =$ **69.27 V.**

Sol-3. Two supernodes are to be established as shown in Fig.2. From inspection it is clear that,

$$V_1 = -12V \qquad (1)$$

At node 2

$$\frac{V_2 - V_1}{0.5} + \frac{V_2 - V_3}{2} = 14 \qquad (2)$$

At 3-4 supernode

$$0.5\mathrm{V}_x = \frac{V_3 - V_2}{2} + \frac{V_4}{1} + \frac{V_4 - V_1}{2.5} \qquad (3)$$

The two voltage relations are

$$\mathrm{V}_3 - V_4 = 0.2V_y \qquad (4)$$

and

$$0.2V_y = 0.2(V_4 - V_1) \qquad (5)$$

Finally for the dependent current source

$$0.5V_x = 0.5(V_2 - V_1) \qquad (6)$$

Substituting 0.5Vx from eq.6 into eq.3, eliminates Vx and substituting 0.2Vy from eq.5 into eq.4 eliminates Vy.

Hence, the set of four equations is

$$-2V_1 + 2.5V_2 - 0.5V_3 = 14$$

$$0.1V_1 - V_2 + 0.5V_3 + 1.4V_4 = 0$$

$$V_1 = -12$$

$$0.2V_1 + V_3 - 1.2V_4 = 0$$

Solving above equations

$$\mathrm{V}_1 = -12V$$

$$V_2 = -4V$$

$$V_3 = 0V$$

$$V_4 = -2V$$

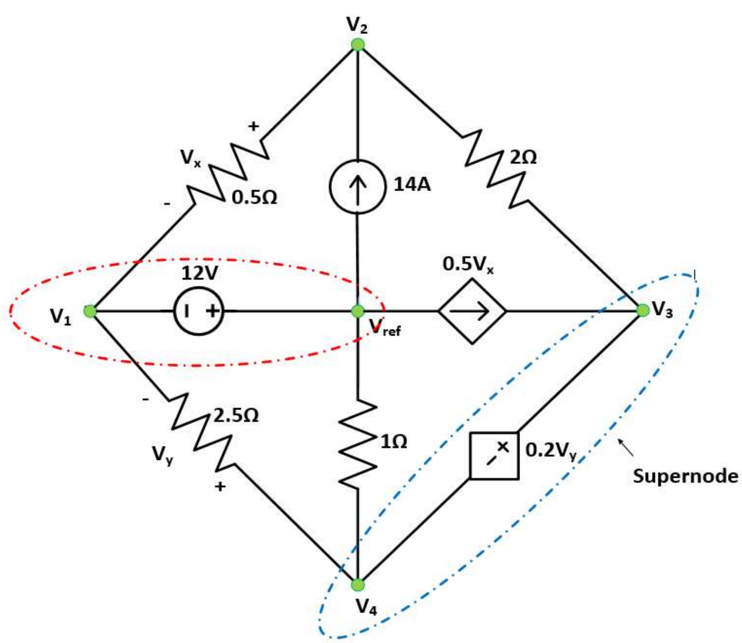


Fig.2 : Figure for Solution 2

Sol-4. We first need to replace the circuit by its Thevenin equivalent at terminals ***a*** and ***b*** The Thevenin resistance is found using the circuit shown in Fig.3.

Notice the 3kΩ and 1kΩ resistors are in parallel; so are 400Ω and 600Ω resistors. The two parallel combinations form a series combination with respect to terminals ***a*** and ***b***. Hence,

$$R_{th} = 3000||1000 + 400||600 = 990\Omega$$

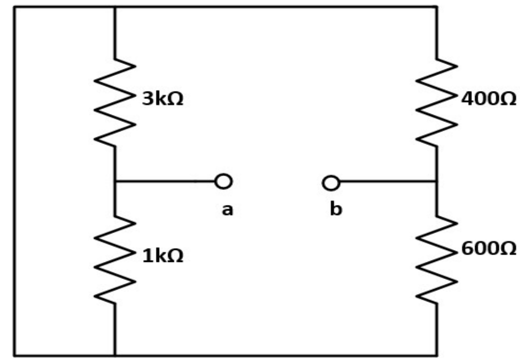


Fig.3

To find the Thevenin voltage, we consider the circuit in Fig.4. Using the voltage division principle gives

$$V_a = \frac{1000}{1000 + 3000} \times 220 = 55V$$

$$V_b = \frac{600}{600 + 400} \times 220 = 132V$$

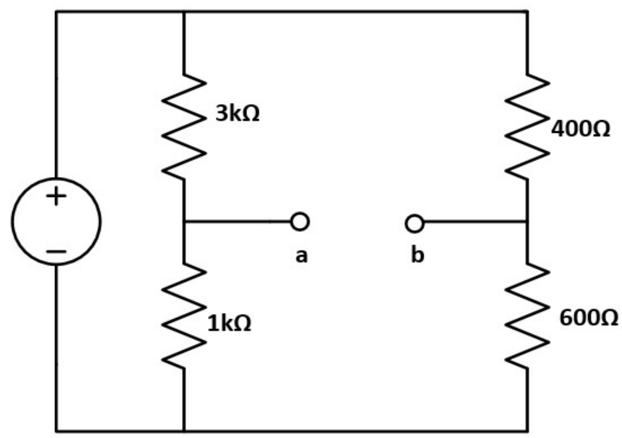


Fig.4

Applying KVL around loop ***ab*** gives

$$-V_a + V_{th} + V_b = 0$$

$$\Rightarrow V_{th} = V_a - V_b = 55 - 132 = -77V$$

Having determined the Thevenin equivalent, we find the current through the galvanometer using Fig.5.

$$I_G = \frac{V_{Th}}{R_{Th} + R_m} = \frac{-77}{990 + 40} = -74.76mA$$

The negative sign indicates that the current flows in the direction opposite to the one assumed, that is, from terminal ***b*** to terminal ***a***.

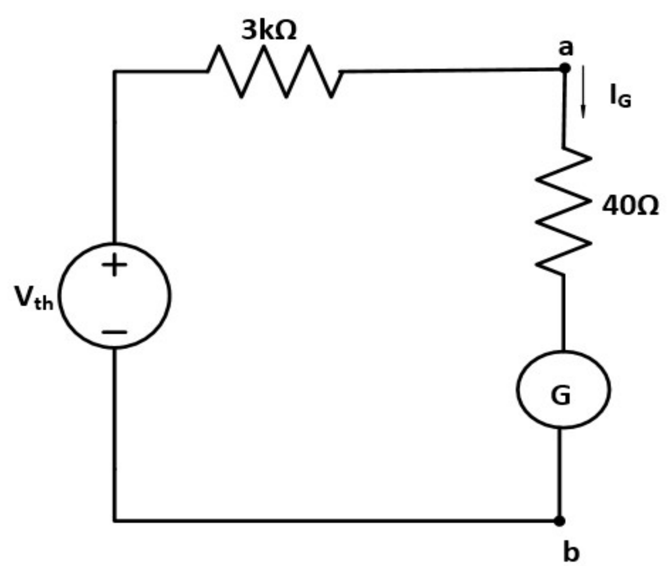


Fig.5