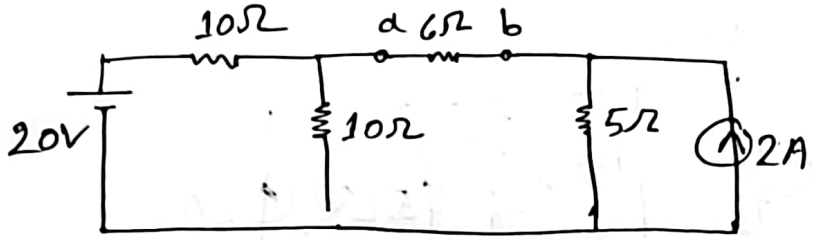
MD. Sohanur Rahman Shimul

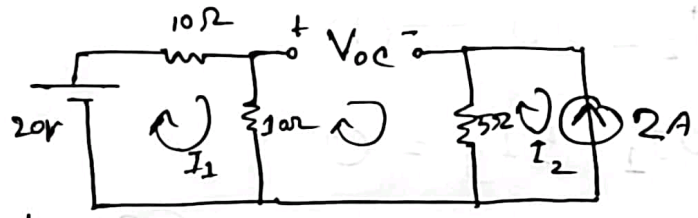
Assignment: 03

CSE250 Sec: 02

Q#1



finding V_{oc}:



from loop 2

$I_2 = -2A$

from loop 1:

$10I_1 + 10I_1 = 20$

$20I_1 = 20$

$\therefore I_1 = 1A$

$V_{oc} = 5 \times I_2 + 10 \times I_1$

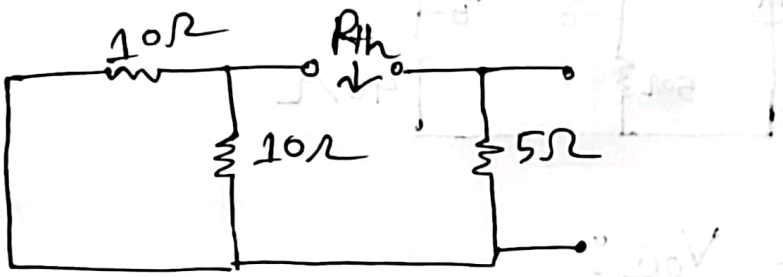
$= 5 \times (-2) + 10 \times 1$

$= 0\ V$

$\therefore V_{th} = V_{oc} = 0\ V$

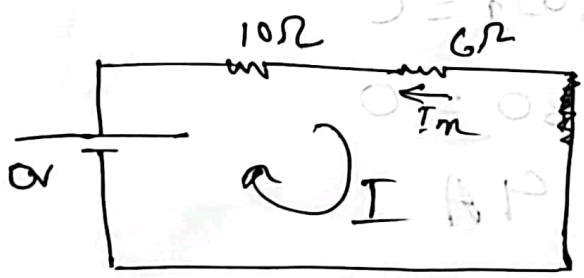
Finding R_{th} :-

As $V_{th} = 0V$ so, kill all the depended source.



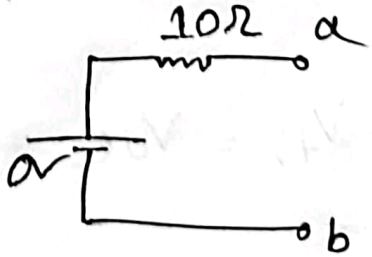
$$\therefore R_{th} = \{(10 \parallel 10) + 5\}\,\Omega$$
$$= 10\,\Omega$$

Now
Thevenin equivalent circuit :

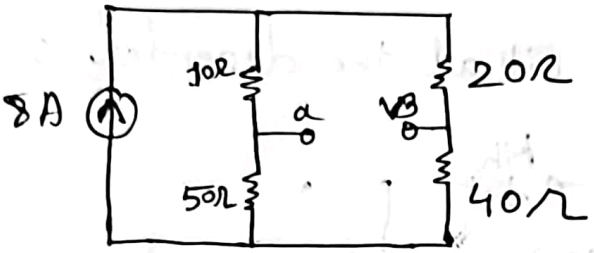


$$16I = 0$$
$$\therefore I = 0A$$

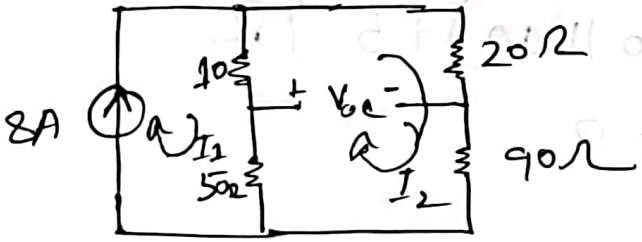
and, $I_n = -I$
$= 0A$ (Ans)



Q#2



finding V_{oc}:



$I_1 = 8\,A$

from loop 2:

$$120I_2 - 60I_1 = 0$$

$$120I_2 - 480 = 0$$

$$\therefore I_2 = 4\,A$$

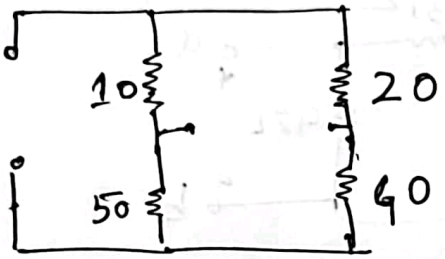
$$-V_{oc} + 20I_2 + 10I_2 - 10I_1 = 0$$

$$30I_2 - 10I_1 = V_{oc}$$

$$\therefore V_{oc} = 40\,V$$

$$\therefore V_{th} = V_{oc} = 40\,V$$

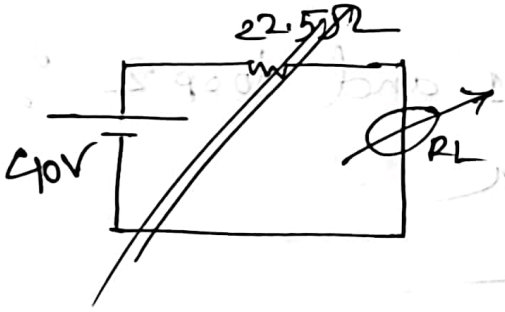
finding ~~Eq~~ R_{th}:

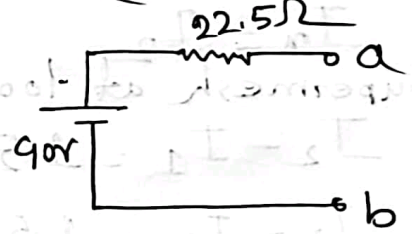


$$R_{eq} = (10+20) \,||\, (50+40)$$

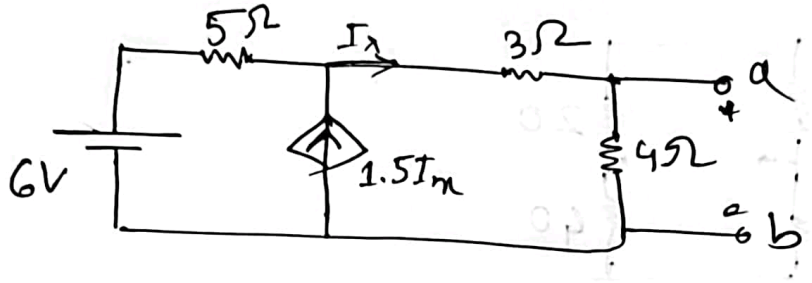
$$= 22.5\,\Omega$$

$$\therefore R_{th} = R_{eq} = 22.5\,\Omega \quad \text{(Ans)}$$

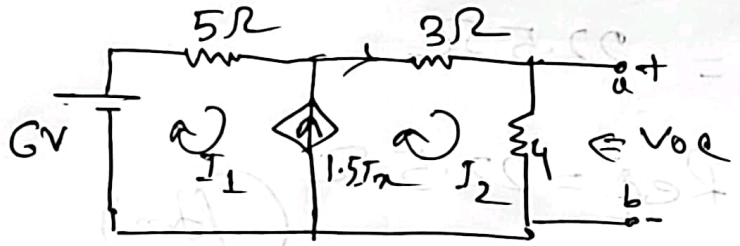




Q#3



finding V_{oc} :



$I_x = I_2$

Supermesh at loop 1 and loop 2 :

$I_2 - I_1 = 1.5 I_x$

$I_2 - I_1 = 1.5 I_2$

$I_2 - 1.5 I_2 - I_1 = 0$

$-I_1 - 0.5 I_2 = 0$ — (I)

$5 I_1 + 3 I_2 + 4 I_2 = 6$

$5 I_1 + 7 I_2 = 6$ — (II)

Solving equ (I), (II)

$I_1 = -2/3$ A

$I_2 = 4/3$ A

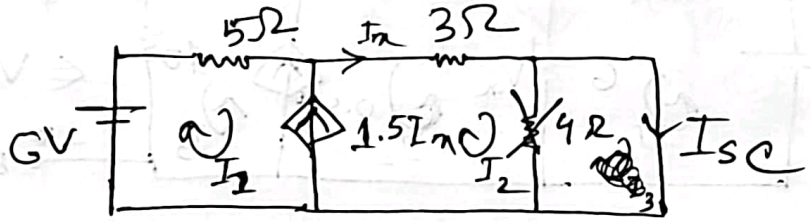
$V_{oc} = 4I_2$

$\therefore = 4 \times 4/3$

$= 5.33\ V$

$V_{th} = V_{oc} = 5.33\ V$ (Ans)

finding I_{sc}:



$I_{sc} = I_3$ $\qquad I_m = I_2$

$I_2 - I_1 = 1.5I_m$

$-I_1 - 0.5I_2 = 0$ —— (I)

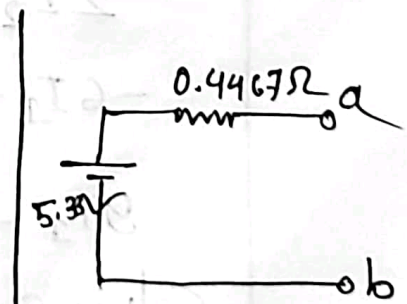
$5I_1 + 3I_2 - 4I_2 - 4I_3 = 6$ —— (II)

~~$5I_1 + 7I_2 = 4I_3$~~

solving equ (I), (II) $\Rightarrow$

$I_1 = -6\ A$

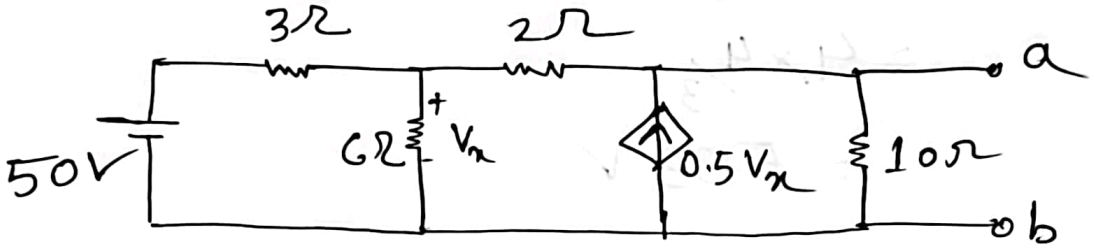
$I_2 = 12\ A$



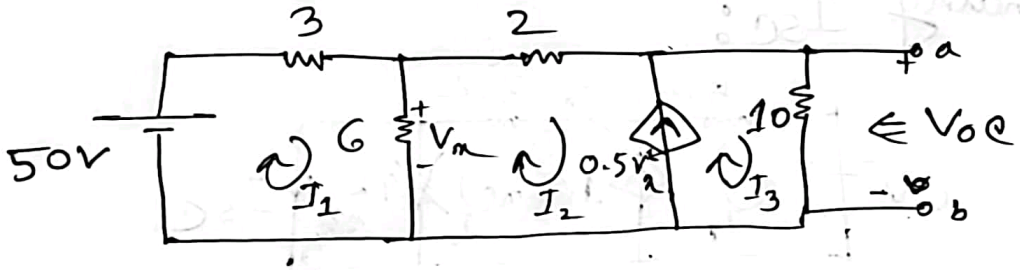
$\therefore R_{th} = \dfrac{V_{th}}{I_{sc}} = \dfrac{5.33}{12}\ \Omega$

$= 0.4467\ \Omega$ (Ans.)

Q#4



finding V_{oc}:



$I_3 - I_2 = 0.5V_x$ $\quad [V_x = 6(I_1 - I_2)]$

$I_3 - I_2 = 3(I_1 - I_2)$

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

$-3I_1 + 2I_2 + I_3 = 0$ —— (i)

$2I_2 + 10I_3 + 6I_2 - 6I_1 = 0$

$-6I_1 + 8I_2 + 10I_3 = 0$ —— (ii)

$9I_1 - 6I_2 = 50$ —— (iii)

Solving (i), (ii), (iii) $\Rightarrow$

$I_1 = -50/3$ A

$I_2 = -100/3$ A

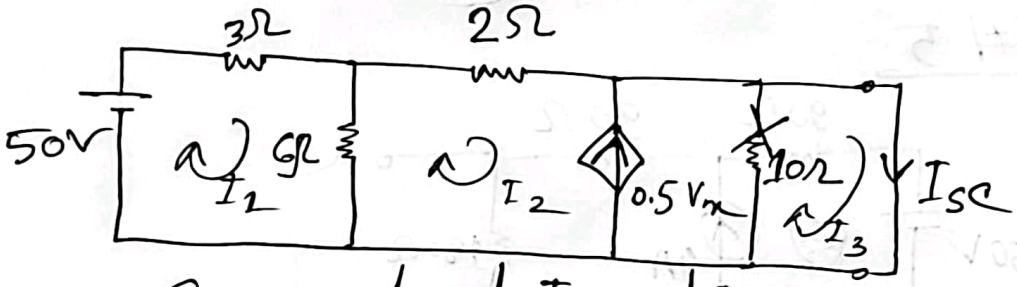
$I_3 = 50/3$ A

$V_{oc} = 10 I_3$

$= 10 \times 50/3$

$= 166.67\ V$

finding I_{sc}:



Supermesh at I_2 and I_3:

$I_3 - I_2 = 0.5 V_x$

$\Rightarrow -3I_1 + 2I_2 + I_3 = 0$ — (I)

$2I_2 + 6I_2 - 6I_1 = 0$

$-6I_1 + 8I_2 = 0$ — (II)

from loop 1:

$9I_1 - 6I_2 = 50$ — (III)

Solving equ (I), (II), (III) $\Rightarrow$

$I_1 = 100/9$

$I_2 = 25/3$

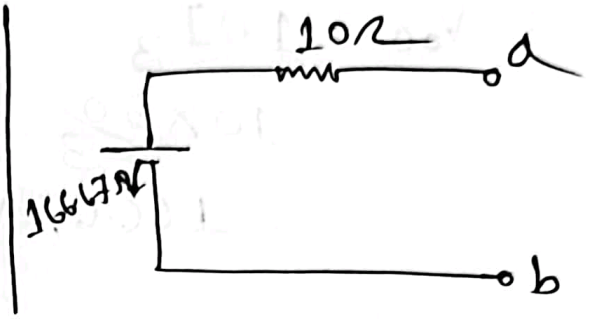
$I_3 = 50/3$

$I_{sc} = I_3 = \frac{50}{3} = 16.667\ A$.

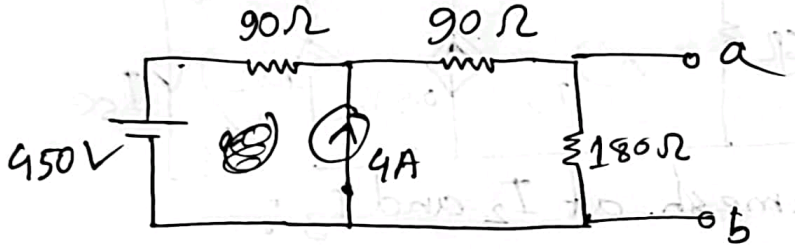
$\therefore R_{th} = \frac{V_{th}}{I_{sc}}$

$= \frac{166.67}{16.67}\ \Omega$

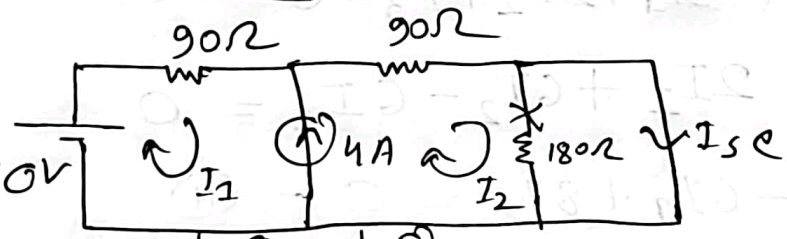
$= 10\ \Omega$ (Ans)



Q#5



finding I_{sc}:



from supermesh ① and ②

$I_2 - I_1 = 4$ — ①

and

$90I_1 + 90I_2 = 450$ — ②

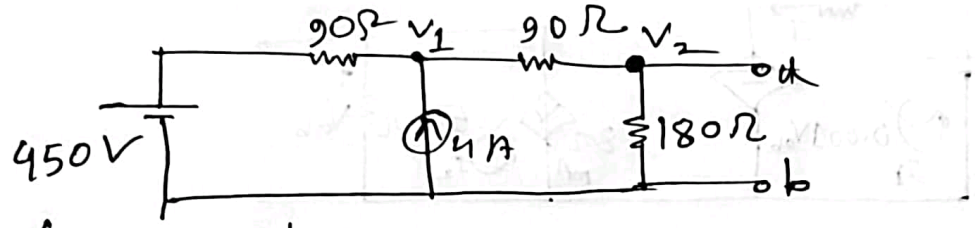
solving equ ① and ② ⇒

$I_1 = 0.5A$

$I_2 = 4.5A$

$I_N = I_{sc} = I_2 = 4.5\ A$ (Ans)

finding R_N :



from node 1 ⇒

$$\frac{V_1 - 450}{90} + \frac{V_1 - V_2}{90} - 4 = 0$$

$$\frac{V_1}{90} - 5 + \frac{V_1}{90} - \frac{V_2}{90} - 4 = 0$$

$$V_1\left(\frac{1}{90} + \frac{1}{90}\right) - V_2\left(\frac{1}{90}\right) = 9 \quad \text{— (I)}$$

from node 2 ⇒

$$\frac{V_2 - V_1}{90} + \frac{V_2}{180} = 0$$

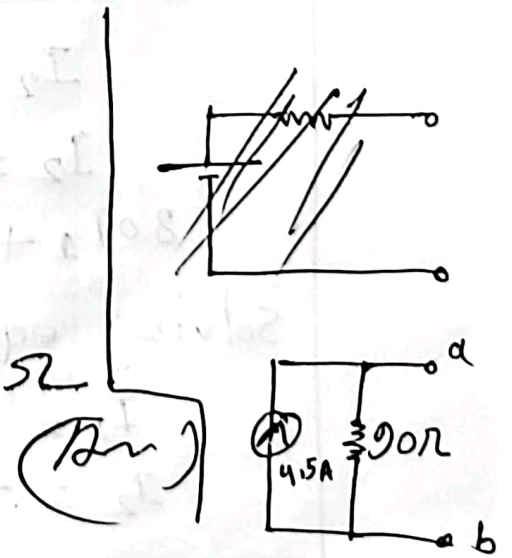
$$-\frac{V_1}{90} + V_2\left(\frac{1}{90} + \frac{1}{180}\right) = 0 \quad \text{— (II)}$$

Solving equ (I) and (II) ⇒

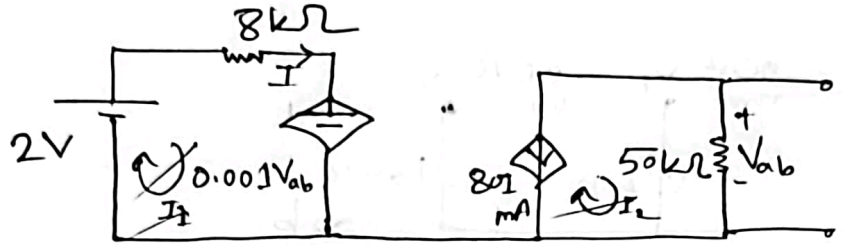
$$V_1 = 607.5\,V$$

$$V_2 = 40.5\,V$$

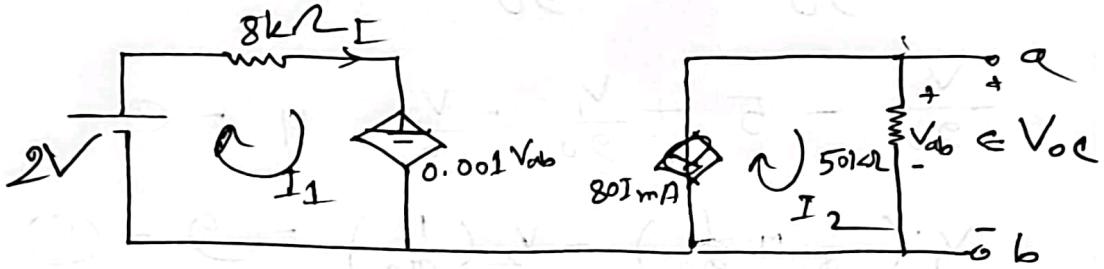
$$\therefore R_N = \frac{V_2}{I_N} = \frac{40.5}{4.5} = 9\,\Omega$$



Q#6 (as we have option to do (Thevenin / Norton) we will find V_{th} and R_{th}.



finding V_{oc}:



from loop 1

$$8I_1 + 0.001V_{ab} = 2 \qquad [V_{ab} = 50I_2]$$

$$8I_1 + 0.001(50I_2) = 2$$

$$8I_1 + 0.05I_2 = 2 \quad \text{---(I)}$$

from loop 2

$$I_2 = -80I \qquad [I = I_1]$$

$$I_2 = -80I_1$$

$$80I_1 + I_2 = 0 \quad \text{---(II)}$$

Solving equ (I) and (II) $\Rightarrow$

$$I_1 = 0.5\ mA$$

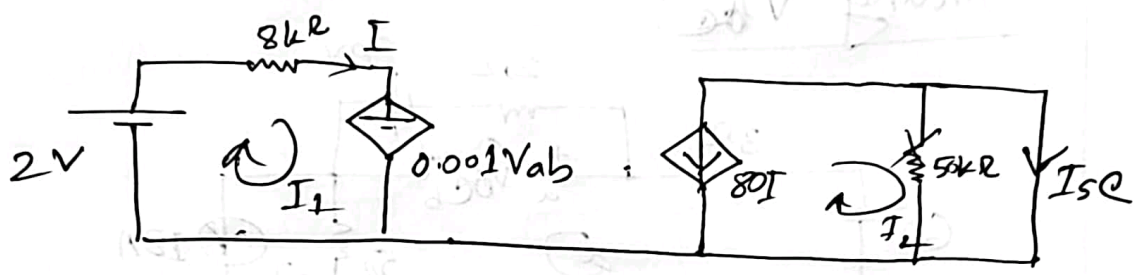
$$I_2 = -40\ mA$$

$V_{oc} = 50 \times -40$

$= -2000V$

$\therefore V_{th} = V_{oc} = -2000V$

finding I_{sc}:



from loop 1:

$8I_1 + 0.001 V_{ab} = 2$ $[\because V_{ab} = 0]$

$8I_1 = 2$

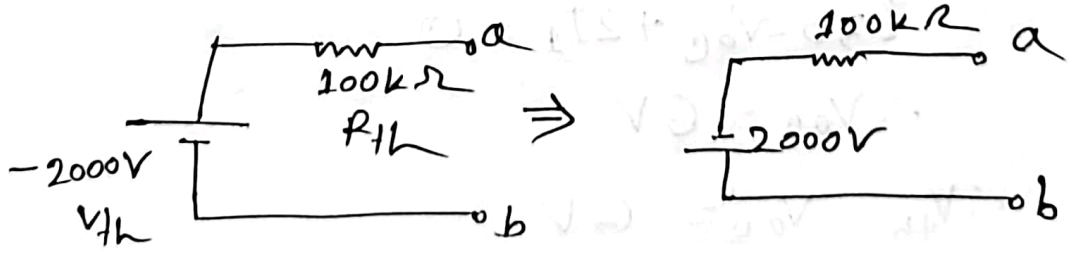
$\therefore I_1 = 0.25 mA$

from loop 2:

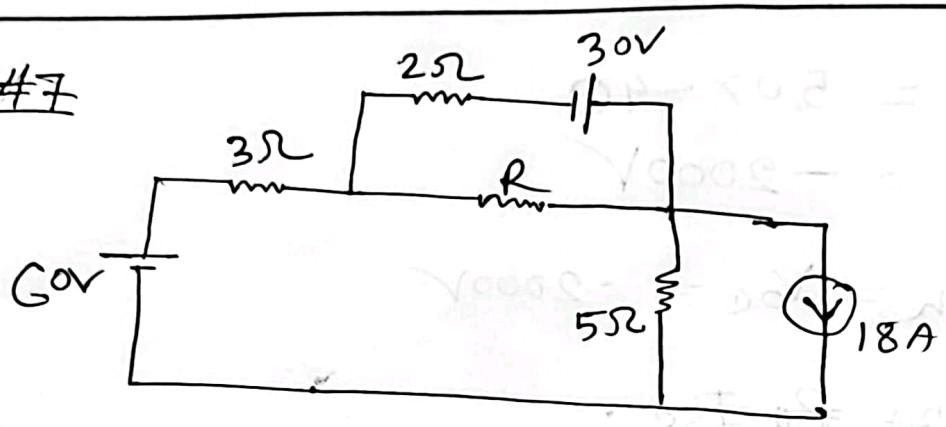
$I_2 = -80I$ $[\because I = I_1 = 0.25mA]$

$= -20 mA$

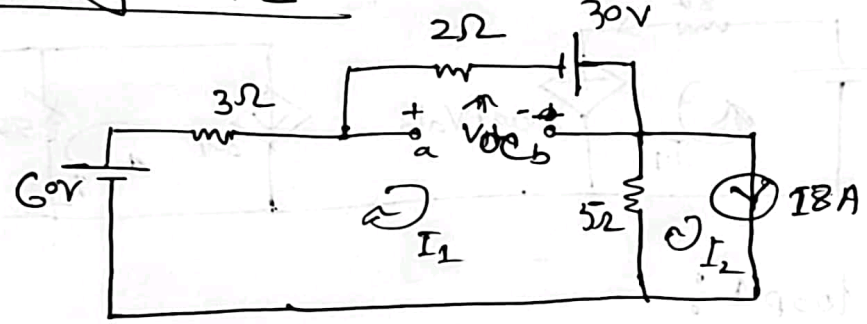
$\therefore R_{th} = \frac{V_{th}}{I_{sc}} = \frac{-2000}{-20} = 100k\Omega$



Q#7



finding V_{th}:



at loop 2

$I_2 = 18\ A$

at loop 1

$3I_1 + 2I_1 - 30 + 5I_1 - 5I_2 = 60$

$10I_1 - 5I_2 = 90$

$\therefore 10I_1 - 5 \times 18 = 90.$

$\therefore I_1 = 18\ A$

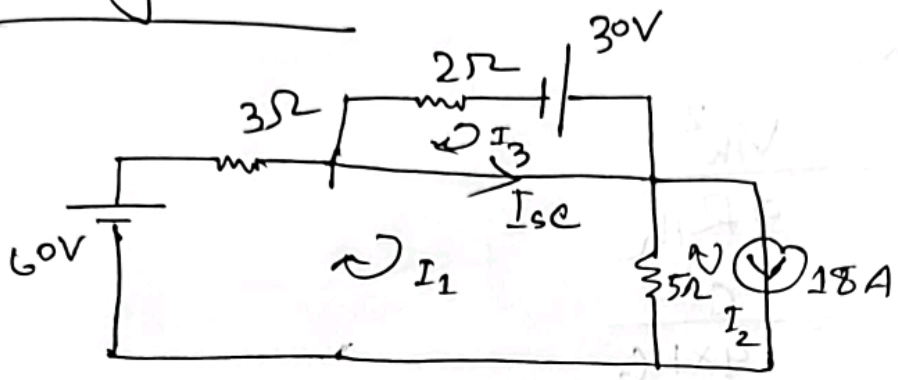
Now,

$-30 - V_{oc} + 2I_1 = 0$

$\therefore V_{oc} = 6V$

$\therefore V_{th} = V_{oc} = 6V$

finding I_{sc}:



at loop 1

$$8I_1 - 5I_2 = 60 \quad \text{—①}$$

at loop 2

$$I_2 = 18\ A$$

at loop 3

$$2I_3 = 30$$
$$\therefore I_3 = 15\ A$$

putting I_2 value at eqn ①

$$I_1 = 18.75\ A$$

$$\therefore I_{sc} = I_1 - I_3$$
$$= (18.75 - 15)\ A$$
$$= 3.75\ A$$

$$\therefore R_{th} = \frac{V_{th}}{I_{sc}} = \frac{6}{3.75} = 1.6\Omega$$

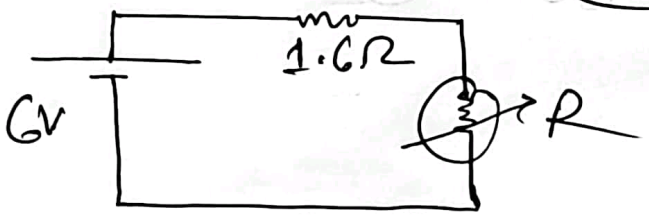
Now,
We know,

$$P_{max} = \frac{V_{th}^2}{4 R_{th}}$$

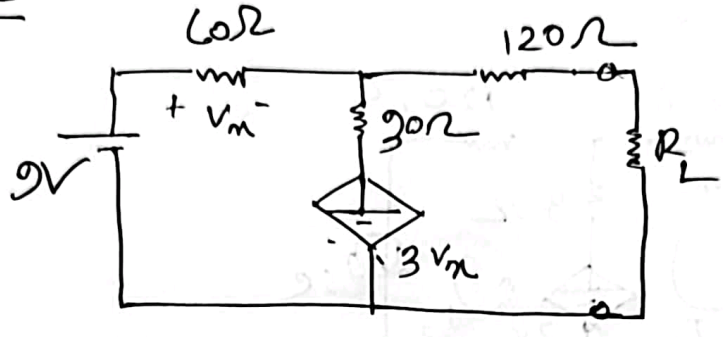
$$= \frac{6^2}{4 \times 1.6}$$

$$= 5.625\ W$$

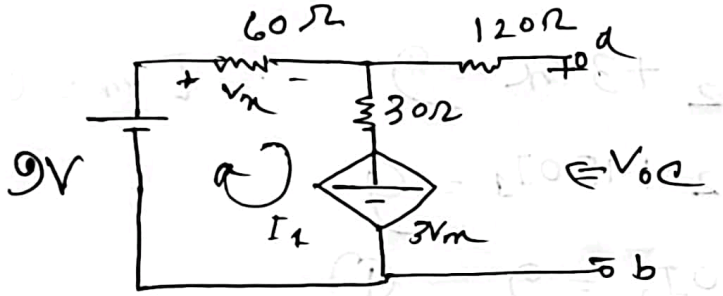
(Ans)



Q# 8



finding V_{oc}:



KVL at loop 1:

$$90I_1 + 3V_x = 9$$

$$90I_1 + 3(60I_1) = 9$$

$$90I_1 + 180I_1 = 9$$

$$\therefore I_1 = \frac{1}{30} A$$

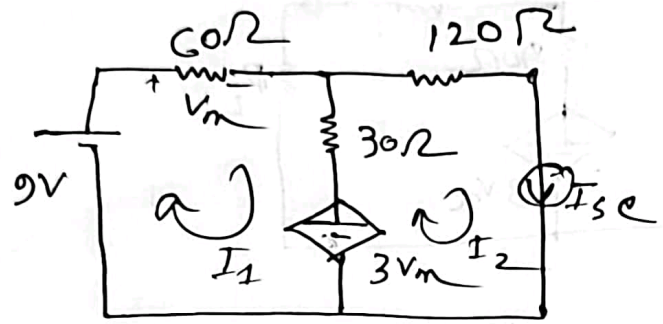
$$V_{oc} = 3V_x + 30I_1$$

$$V_{oc} = 3\left(60 \times \frac{1}{30}\right) + 30 \times \frac{1}{30}$$

$$= 6 + 1 = 7V$$

$$V_{th} = V_{oc} = 7V$$

finding I_{sc} :



at loop 1

$$90I_1 - 30I_2 + 3V_x = 9 \qquad [V_x = 60I_1]$$

$$90I_1 - 30I_2 + 180I_1 = 9$$

$$270I_1 - 30I_2 = 9 \quad \text{—— (i)}$$

at loop 2

$$150I_2 - 30I_1 - 3V_x = 0$$

$$150I_2 - 30I_1 - 180I_1 = 0$$

$$-210I_1 + 150I_2 = 0 \quad \text{—— (ii)}$$

solving eqn (i), (ii)

$$I_1 = 0.099\ A$$

$$I_2 = 0.0552\ A$$

$$I_{sc} = I_2 = 0.055\ A$$

$$\therefore R_{th} = \frac{V_{th}}{I_{sc}} = \frac{7}{0.0552} = 126.81\ \Omega$$

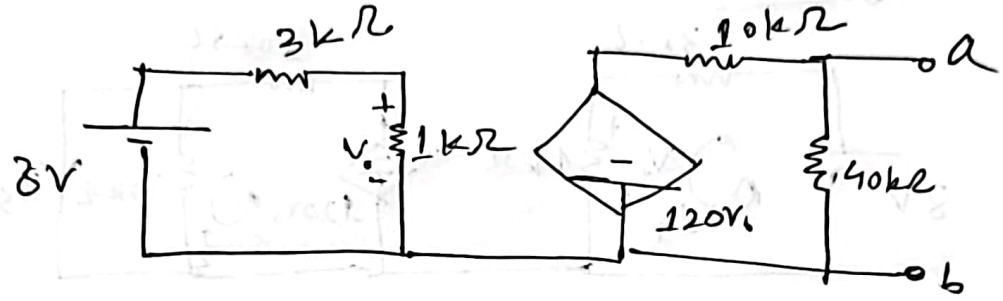
$$P_{max} = \frac{V_{th}^2}{4 \times R_{th}}$$

$$= 0.0067\ W$$

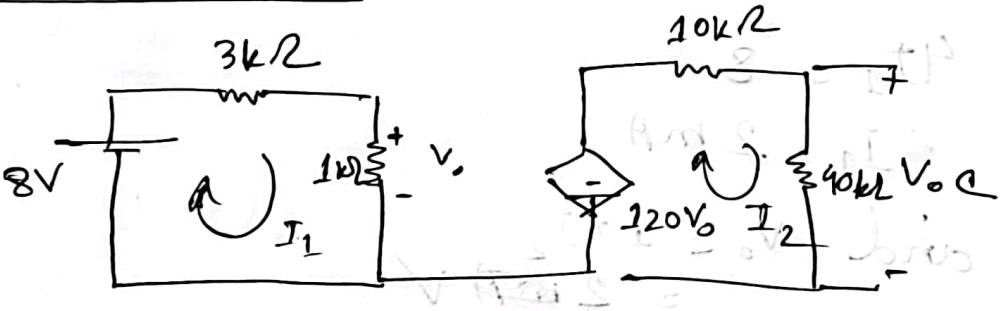
$$= 96.70\ mW$$

Ans

Q#9



finding V_{oc}



at loop 1

$$3I_1 + 1I_1 = 8$$

$$I_1 = 2 \text{ mA}$$

$$V_o = 1 \times I_1$$

$$= 1 \times 2 = 2V$$

at loop 2

$$40I_2 + 10I_2 + 120V_o = 0$$

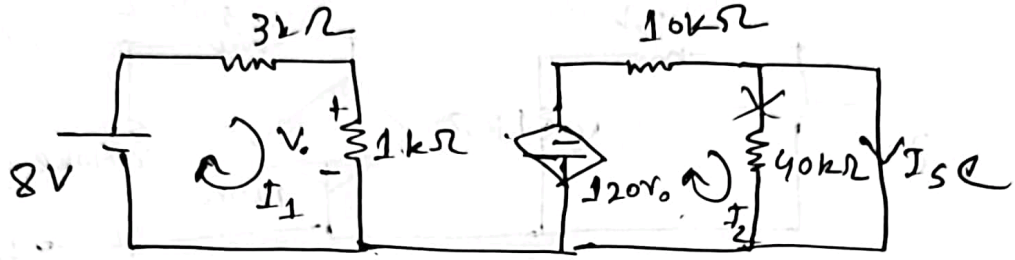
$$40I_2 + 10I_2 = -120 \times 2$$

$$\therefore I_2 = -4.8 \text{ mA}$$

$$\therefore V_{oc} = 40 \times I_2$$

$$= 40 \times (-4.8) = -192V = V_{th}$$

finding I_{sc}



at loop 1

$$4I_1 = 8$$

$$\therefore I_1 = 2\,mA$$

and $V_o = 1 \times I_2$

$= 2$ V

at loop 2

$$10I_2 + 120V_o = 0$$

$$10I_2 = -120 \times 2$$

$$\therefore I_2 = -24\,mA$$

$$\therefore I_{sc} = I_2 = -24\,mA$$

$$\therefore R_{th} = \frac{V_{th}}{I_{sc}}$$

$$= \frac{-192}{-24}$$

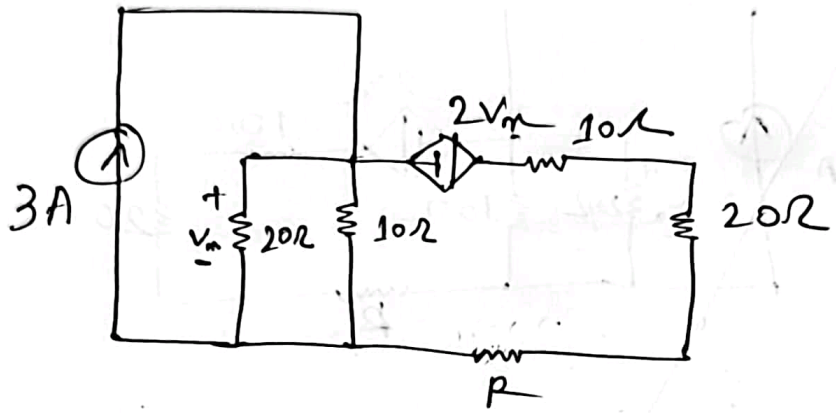
$$= 8k\Omega$$

$$P_{max} = \frac{V_{th}^2}{4R_{th}}$$

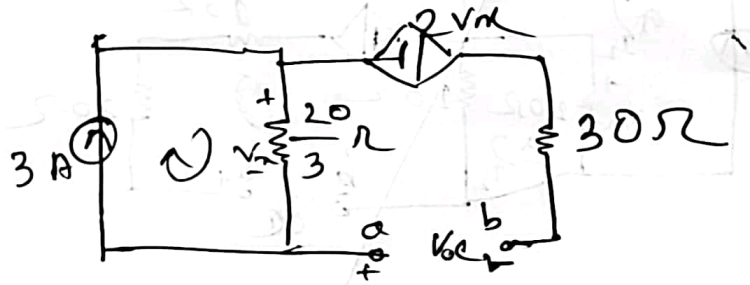
$$= \frac{(192)^2}{4 \times (8 \times 10^3)}$$

$= 1.152$ W (Ans)

Q#10



Finding V_{oc}



$I_1 = 3A$

$V_x = \frac{20}{3} \times 3 = 20V$

~~$V_{oc} = 2V_x + 30I_1 + \frac{20}{3} I_1$~~

~~$= 40 + 90 + 20$~~

$V_{oc} = -(V_x + 2V_x)$ ~~$+ 30I_1$~~

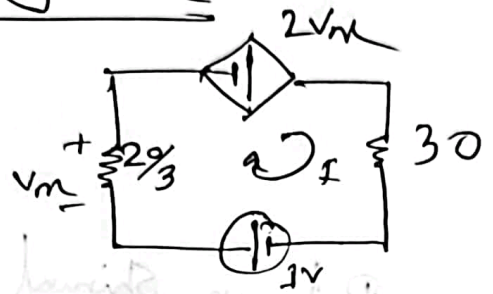
$= -(3V_x)$

$= -3 \times 20$

$= -60V$

$\therefore V_{th} = V_{oc} = -60V$

finding R_{th}:



$$\left(\frac{20}{3}+30\right)I - 2V_x = 1$$

$$\therefore I = \frac{1}{50}$$

$$\therefore R_{th} = \frac{V}{I} = \frac{1}{1/50} = 50\,\Omega$$

So, $$P_{max} = \frac{V_{th}^2}{4R_{th}} = \frac{(-60)^2}{4\times 50}$$

$$= 18\,W \quad \text{(Ans)}$$