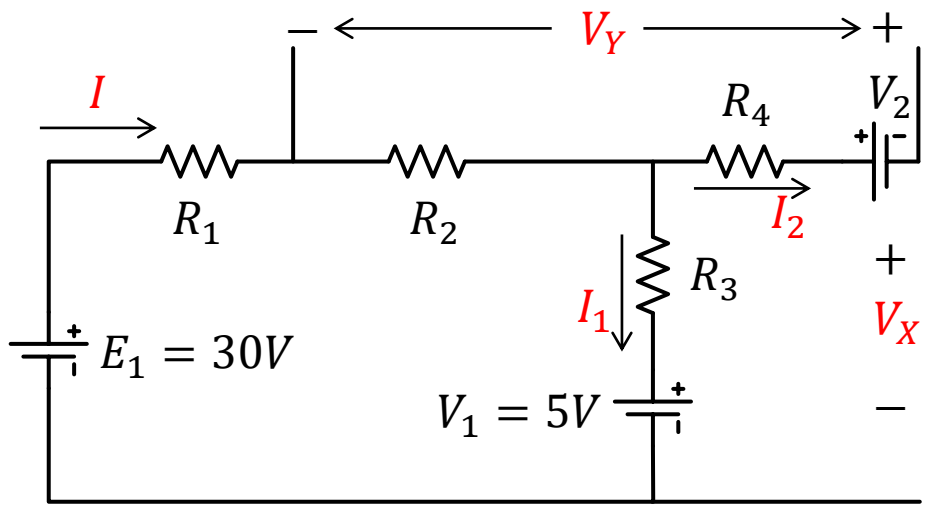
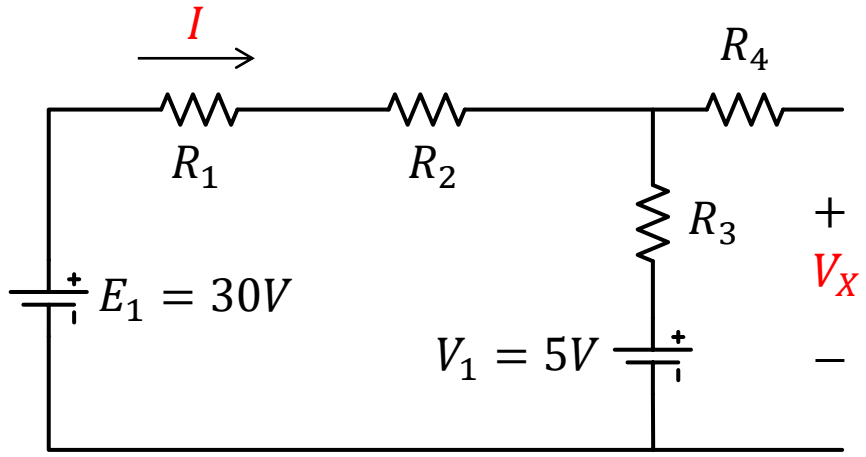
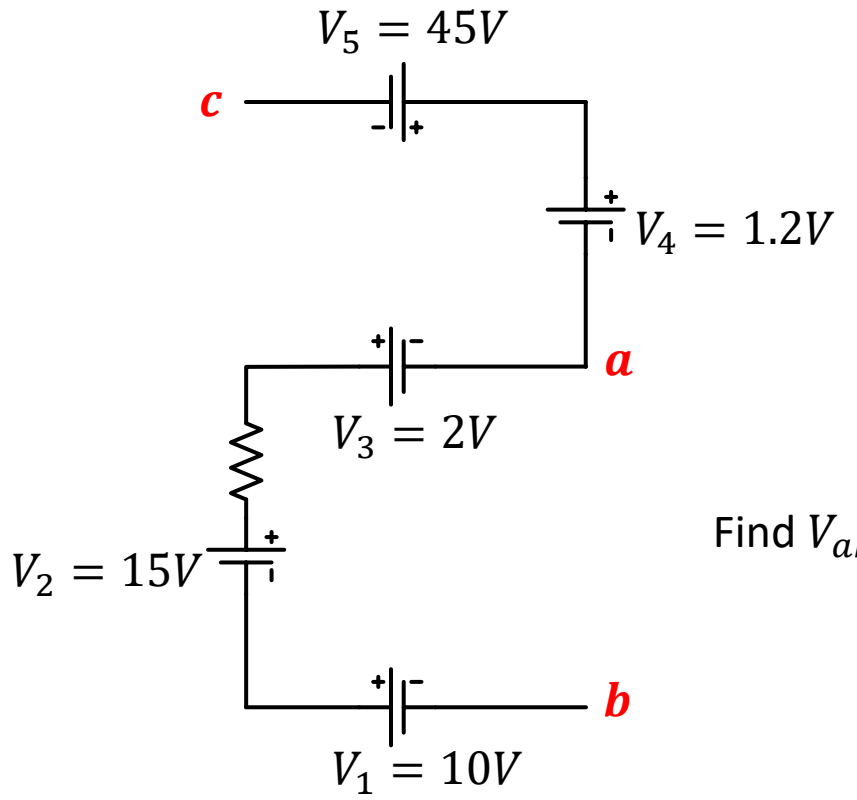
Review: Concepts of DC Circuit Analysis.



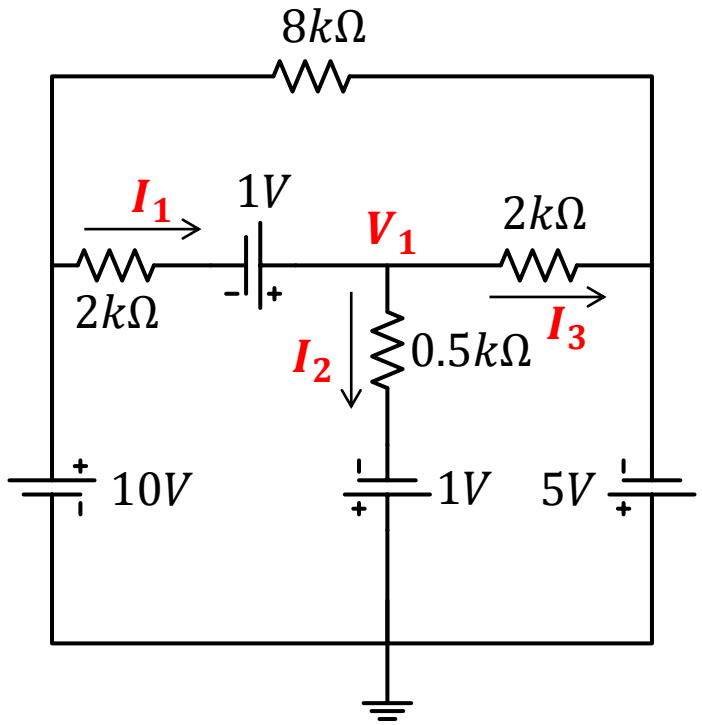


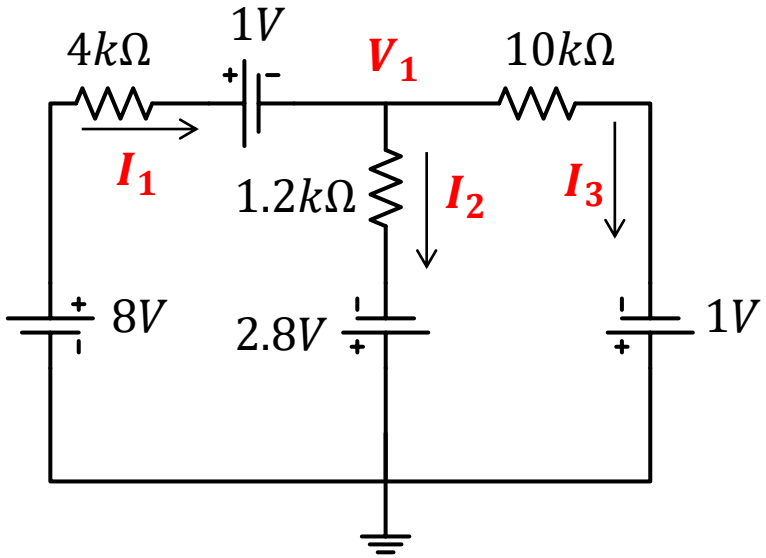
Using KVL, KCL, ohm's law, determine the labelled currents and the voltages in the following circuits. $R_1 = 10\Omega, R_2 = 20\Omega, R_3 = R_4 = 15\Omega, V_2 = 10V$.

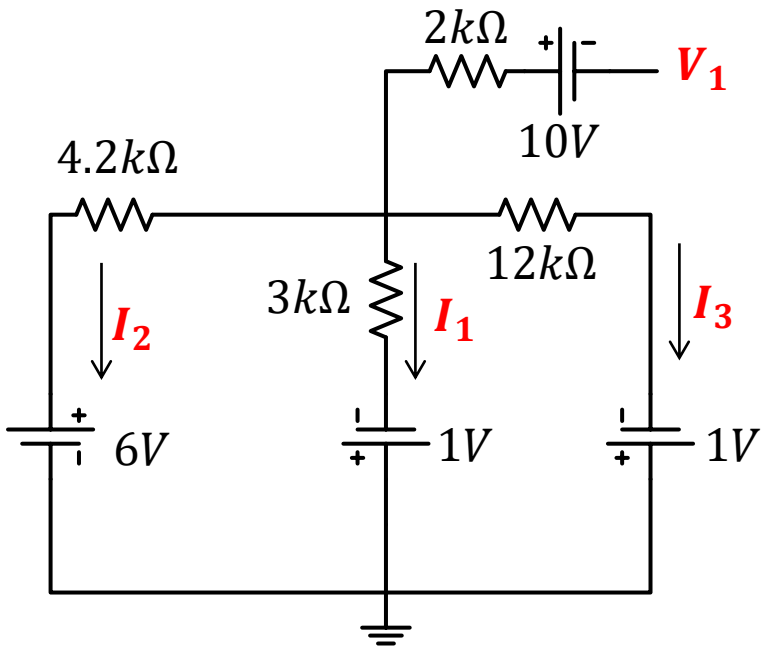


Find V_{ab} *and* V_{cb}

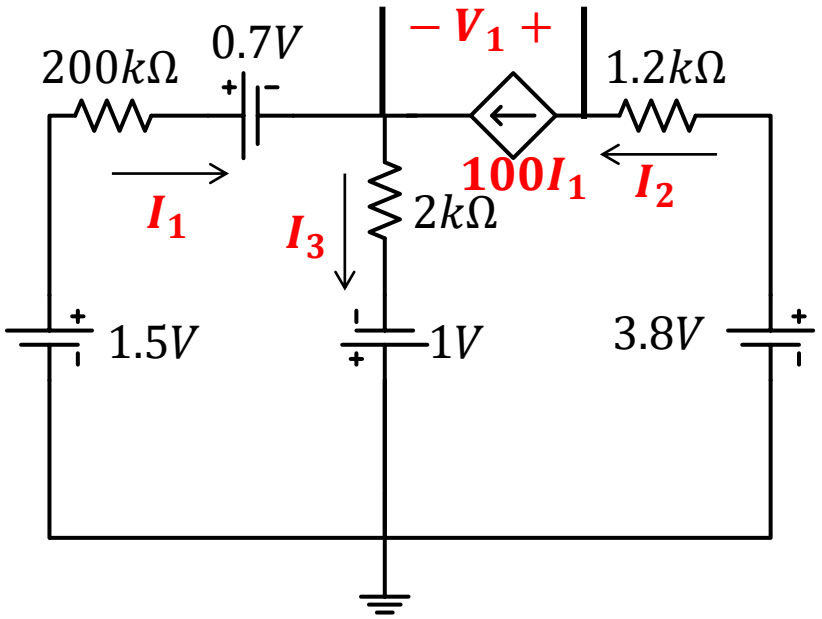
Employing **Mesh Analysis** & **Node Analysis**, determine the labelled currents and the node voltage of the circuits shown in figure below.

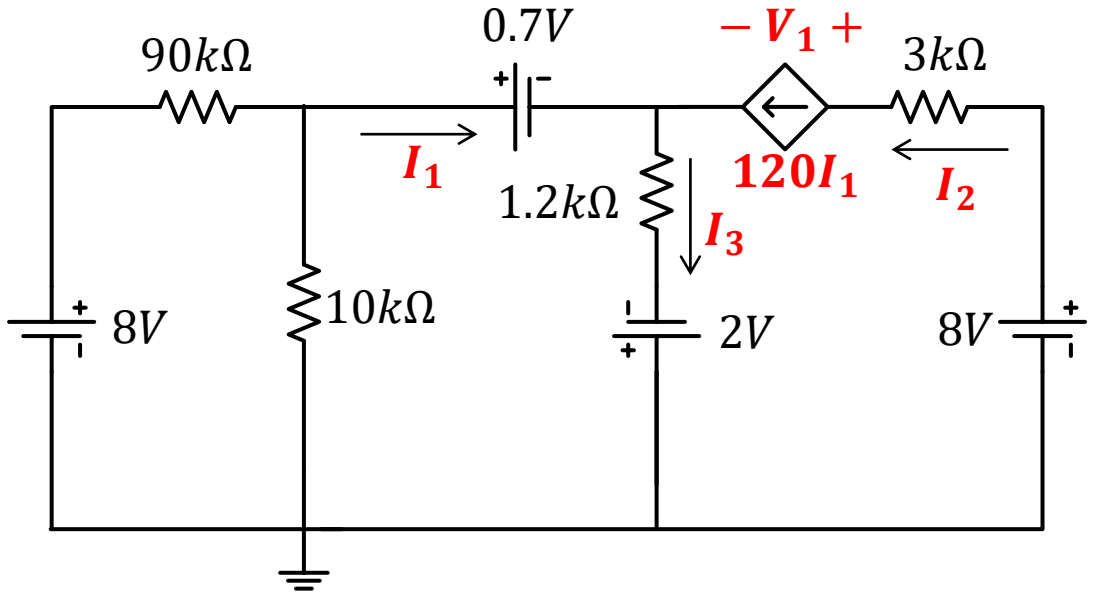




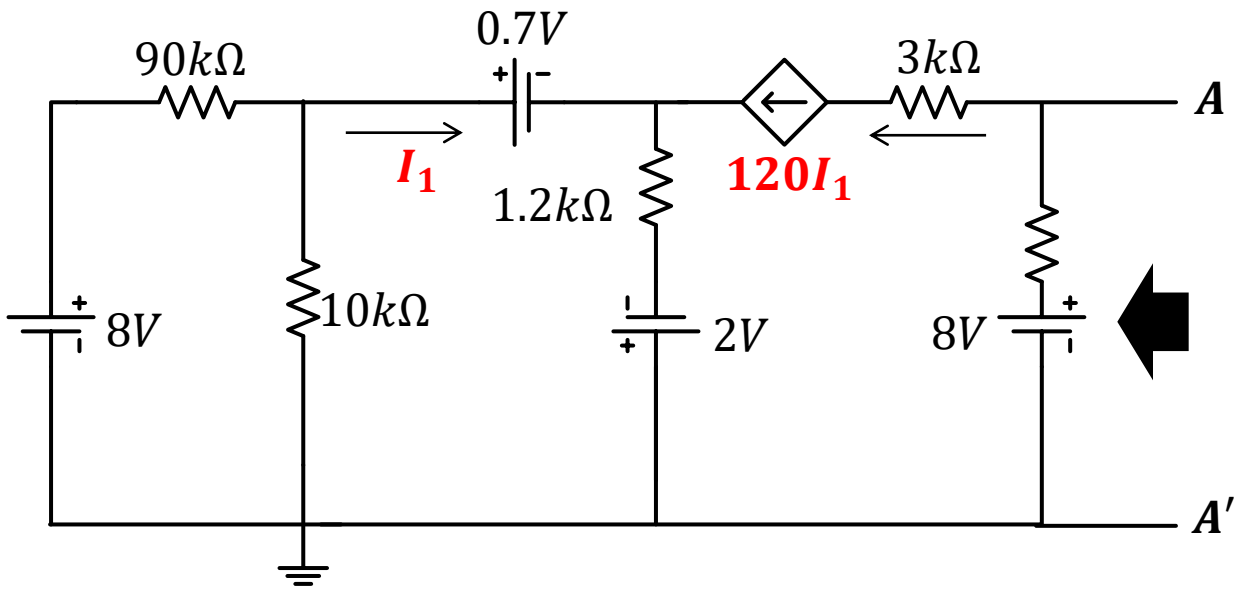


Determine the labelled currents and the node voltage of the circuits shown in figure below.





Determine V_{Th} & R_{TH} between $\boldsymbol{A} - \boldsymbol{A}'$



EEE205

HW-1

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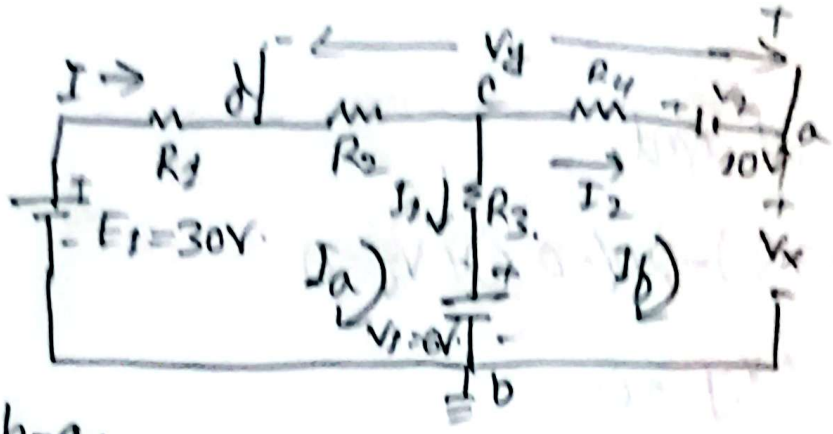
Section: 04

5] a)



For mesh-a,

$30-10I_a-20I_a-15I_a+15I_b-5=0$

$\Rightarrow -45I_a+15I_b+25=0$

$\Rightarrow 45I_a-15I_b-25=0 \cdots (i)$

For mesh-b,

$\Rightarrow 5-R_3(I_b-I_a)-R_4I_b-10=0$

$\Rightarrow 5-15I_b+15I_a-15I_b-10=0$

$\Rightarrow 30I_b-15I_a+5=0 \cdots (ii)$

From (i), (ii),

$I_a=-2A,\ I_b=-4.33A.$

$I_1=I_a-I_b=2.33A.$
$I_2=I_b=-4.33A.$ } Ans.

again,

Applying KVL at abc,

$\Rightarrow 5-15(-0.467)-15(0.133)-10=V_x.$

$\therefore V_x=0.01V.$ Ans

again,

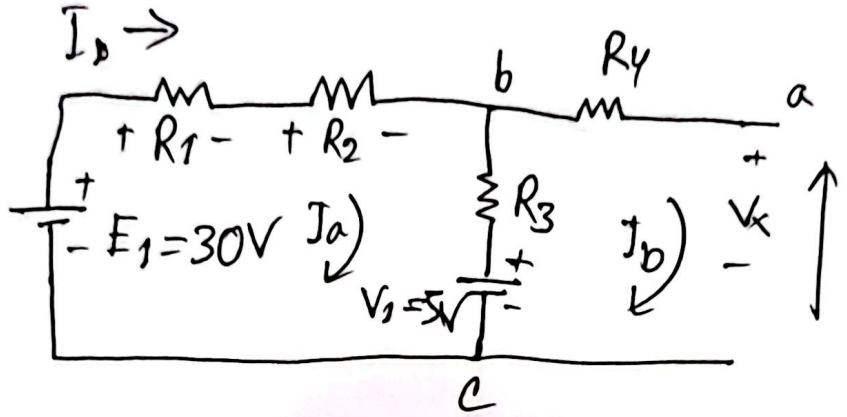
Applying KVL at acd,

$$10 - 15(-0.133) - 20(-0.6) + V_y = 0$$

$$\Rightarrow 23.995 + V_y = 0$$

$$\therefore V_y = -23.995\ V \quad \underline{\text{Ans}}$$

1] b]



Applying KVL at loop-a,

$$E_1 - V_{R_1} - V_{R_2} - R_3(I_a - I_b) - V_1 = 0$$

$$\Rightarrow E_1 - I_a R_1 - I_a R_2 - I_a R_3 + I_b R_3 - V_1 = 0$$

$$\Rightarrow 30 - 10I_a - 20I_a - 15I_a + 15I_b - 5 = 0$$

$$\Rightarrow -45I_a + 15I_b + 25 = 0$$

$$\Rightarrow 45I_a - 15I_b = 25 \quad \text{..(i)}$$

Applying KVL at loop-b,

$$+V_1 - V_{R_3} - V_{R_4} = 0$$

$$\Rightarrow 5 - I_b R_3 + I_a R_3 - I_b R_4 = 0$$

$$\Rightarrow 5 - 15I_b + 15I_a - 15I_b = 0$$

$$\Rightarrow 15I_a - 30I_b = -5 \quad \text{..(ii)}$$

from (i), (ii),

$I_a = 0.733A$

$I_b = 0.533A.$

$I_a - I_b = 0.2A$

Applying KVL in abc,

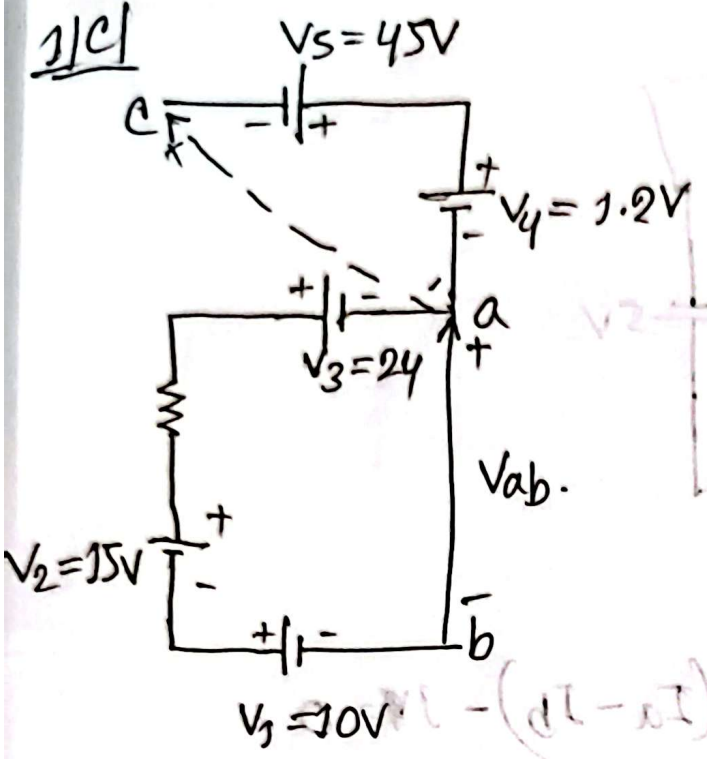
$$V_x + V_{R_4} + V_{R_3} - V_1 = 0$$

$$\Rightarrow V_x + 15(-0.533) + 15(0.2) - 5 = 0$$

$$\Rightarrow V_x - 9.995 = 0$$

$$V_x = 9.995\ V$$ Ans

1|c|



Here,
$R_1 = 10\Omega$
$R_2 = 20\Omega$
$R_3 = R_4 = 15\Omega$
$V_2 = 10V$.

Applying KVL

$$V_1 + V_2 - V_3 - V_{ab} = 0$$

$$V_{ab} = V_1 + V_2 - V_3$$
$$= 10 + 15 - 2$$
$$= 23\ V.$$ Ans.

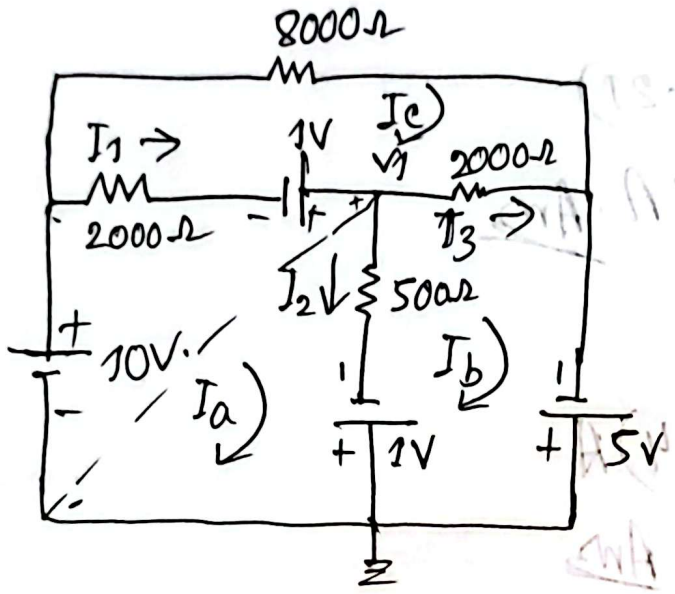
now,

$$V_{ab} + V_{ac} = V_{cb}$$
$$\Rightarrow V_{cb} = (23 - 43.8)$$
$$\Rightarrow -20.8\ V$$ Ans

Applying KVL

$$V_{ac} + V_5 - V_4 = 0$$
$$\Rightarrow V_{ac} = V_4 - V_5.$$
$$\Rightarrow V_{ac} = 1.2 - 45.$$
$$\Rightarrow V_{ac} = -43.8.$$

2] a]



For mesh a,

$$-10 + 2000I_a - 2000I_c - 1 + 500I_a - 500I_b - 1 = 0$$

$$\Rightarrow 2500I_a - 500I_b - 2000I_c = 12 \quad \text{(i)}$$

For meshb,

$$1 + 500I_b - 500I_a + 2000I_b - 2000I_c - 5 = 0$$

$$\Rightarrow -500I_a + 2500I_b - 2000I_c = 4$$

$$\Rightarrow 500I_a - 2500I_b + 2000I_c = -4 \quad \text{(ii)}$$

For meshc,

$$8000I_c + 2000I_c - 2000I_b + 1 + 2000I_c - 2000I_a = 0$$

$$\Rightarrow -2000I_a - 2000I_b + 12000I_c = -1 \ldots$$

$$\Rightarrow 2000I_a + 2000I_b - 12000I_c = 1 \quad \text{(iii)}$$

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

$$I_a = 7.21\,A \quad I_b = 4.54\,A \quad I_c = 1.88\,A$$

Here

$I_1 = I_c - I_a$

$= (1.88 - 7.21)$

$= -5.33\,A$ Ans

$I_2 = I_a - I_b$

$= (7.21 - 4.54)\,A$

$= 2.67\,A$ Ans

$I_3 = I_b - I_c$

$= (4.54 - 1.88)$

$= 2.66\,A$ Ans

for V_1:

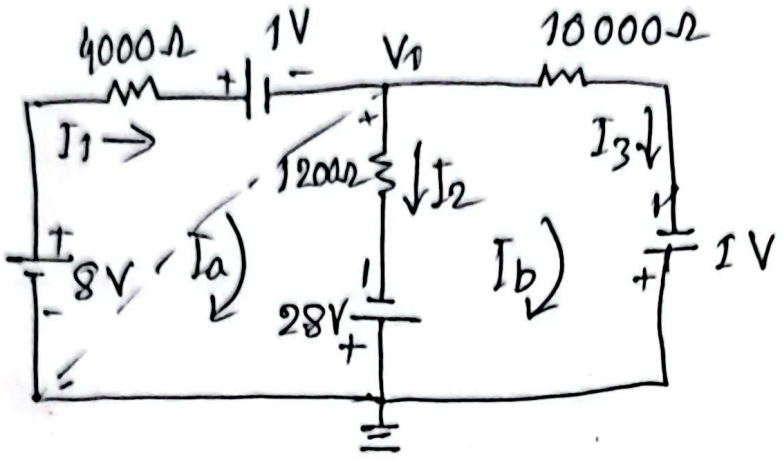
$-1 - 500 I_2 - V_1 = 0$

$-1 - 500 I_2 - V_1 = 0$

$-1 - 500(2.67) = 0 V_1$

$V_1 = -1336\,V$ Ans

Ans 2|b|



For mesh-a,

$-8+4000I_a+1+1200I_a-1200I_b-28=0$

$\Rightarrow 5200I_a-1200I_b=35 \quad \ldots (i)$

For mesh-b,

$28+1200I_b-1200I_a+10000I_b-1=0$

$\Rightarrow -1200I_a+11200I_b=-27$

$\Rightarrow 1200I_a-11200I_b=27 \quad \ldots (ii)$

from (i), (ii),

$I_a=6.33A, \quad I_b=-1.73A$

$I_1=I_a=6.33\ A$

$I_2=I_b-I_a=-1.73-6.33=-8.06A$

$I_3=I_b=-1.73A$

} Ans

For V_1,

$-28-1200V-V_1=0$

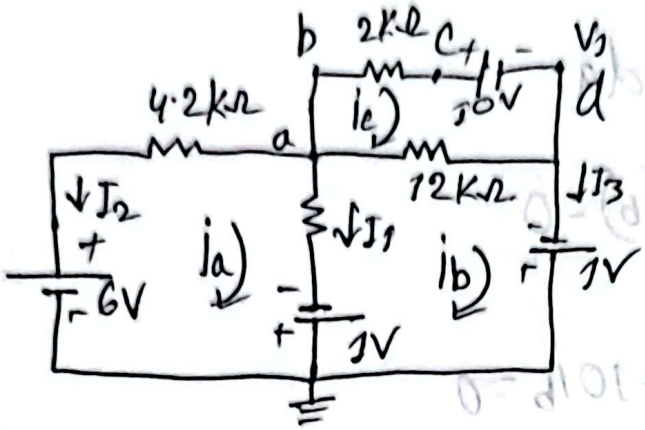
$\Rightarrow -28-1200I_2=V_1$

$V_1=-28-1200(-8.06)$

$=-28+9672$

$=9644\ V$ Ans

2) c)



For mesh-a,

$-6 + 4.2i_a + 3i_a - 3i_b - 1 = 0$

$\Rightarrow 7.2i_a - 3i_b = 7 \ldots$ (i)

For mesh-b,

$1 + 3i_b - 3i_a + 12i_b - 12i_c - 1 = 0$

$\Rightarrow i_a - 15i_b + 12i_c = 0 \ldots$ (ii)

For mesh c,

$12(i_c - i_b) + 2i_c + 10 = 0$

$\Rightarrow 12i_c - 12i_b + 2i_c + 10 = 0$

$\Rightarrow -12i_b + 14i_c = -10$

$\Rightarrow 12i_b - 14i_c = 10 \ldots$ (iii)

From, (i), (ii), (iii),

$i_a = 0.24\,mA,\ i_b = -1.77\,mA,\ i_c = -2.23\,mA.$

$\therefore I_2 = -i_a = 0.24\,mA.$

$I_1 = (i_b - i_a) = (-1.77 - 0.24) = -2.01\,mA$

$I_3 = i_b = -1.77\,mA.$

Ans

Applying KVL at abcda;

$2i_c + 10 - V_1 + 10(i_c - i_b) = 0$

$\Rightarrow 2i_c + 10 - V_1 + 10i_c - 10i_b = 0$

$\Rightarrow -10i_b + 12i_c - V_1 = -10.$

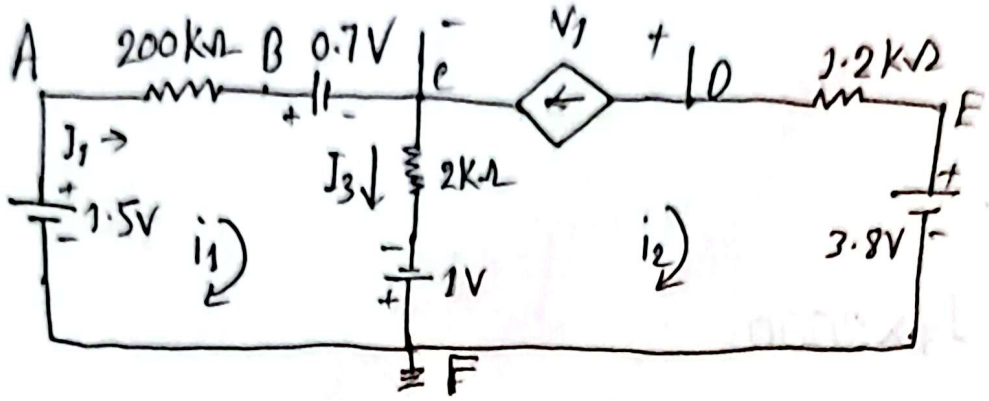
$\Rightarrow -V_1 = -10 + 10i_b - 12i_c.$

$\Rightarrow V_1 = 10 - 10(-1.77) - 12(-2.23)$

$= 10 + 17.7 + 26.73$

$= 54.43\ V$ Ans.

3[a]



For mesh-1,

$-1.5+200000i_1+0.7+2000(i_1-i_2)-1=0$

$\Rightarrow 202000\,i_1-2000\,i_2=1.8$ ---(i)

again,

$i_2=-100I_1=-100i_1$ $[I_1=i_1]$

(i) $\Rightarrow$

$202000\,i_1-2000\times(-100)\,i_1=1.8$

$\Rightarrow 402000\,i_1=1.8$

$i_1=4.478\times10^{-6}\,A$

$\therefore i_2=-100\times i_1=-4.478\times10^{-4}\,A.$

$\therefore I_1=i_1=4.78\times10^{-6}\,A,\ I_2=-i_2=4.478\times10^{-4}\,A.$

$\therefore I_3=i_1-i_2=(4.78\times10^{-6}+4.478\times10^{-4})=4.5258\times10^{-3}.$

For 1.2kΩ, $V_E-V_D=I_2\times1.2\times1000$

$\Rightarrow V_E-V_D=I_2\times1.2\times1000$

$\Rightarrow V_D=-0.53736*3.8=3.26\,V$

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For 2KΩ,

$V_C - V_G = I_3 \times 2000$

$\Rightarrow V_C - V_G = (4.5258 \times 10^{-3}) \times 2000$

$V_C = 1.90456\,V.$

$\therefore V_1 = V_D - V_C$

$= (3.26 - 1.90456)\,V$

$= 1.356\,V$ Ans

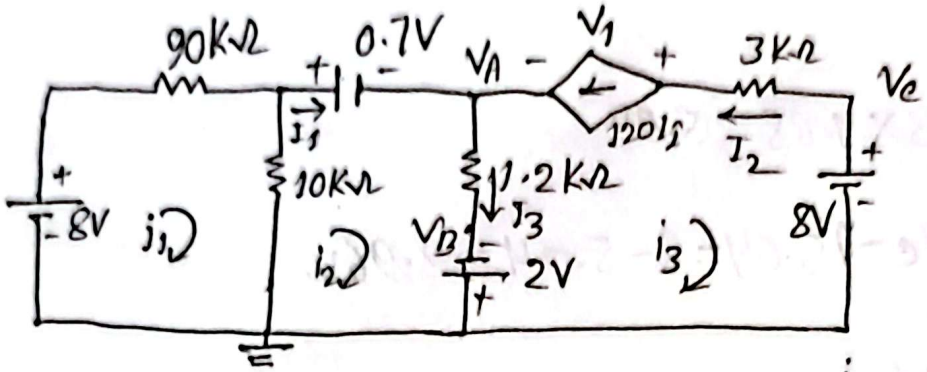
$I_1 = 4.78 \times 10^{-6}\,A$

$I_2 = 4.478 \times 10^{-4}\,A$

$I_3 = 4.5258 \times 10^{-3}\,A$

} Ans

3] b]



$i_3 = -120 I_1$

$= -120 i_2$

For mesh 1,

$-8 + 90 i_1 + 10(i_1 - i_2) = 0$

$\Rightarrow 100 i_1 - 10 i_2 = 8 \quad \ldots (i)$

For mesh-2,

$10(i_2 - i_1) + 0.7 + 1.2(i_2 - i_3) - 2 = 0$

$\Rightarrow -10 i_1 + 11.2 i_2 - 1.2 i_3 = 1.3$

$\Rightarrow -10 i_1 + 11.2 i_2 - 1.2(-120 i_2) = 1.3$

$\Rightarrow -10 i_1 + 155.2 i_2 = 1.3 \quad \ldots (ii)$

From, (i) and (ii),

$i_1 = 0.08$ mA, $i_2 = 0.014$ mA.

$I_1 = i_2 = 0.014$ mA, $I_2 = -i_3 = 120 i_2 = 1.68$ mA

$I_3 = I_1 + I_2 = 1.694$ mA

For 1.2KΩ, $V_A - V_B = 1.2 \times 1.694 = 2.0328$ V.

$\Rightarrow V_A = 2.0328 + V_B$

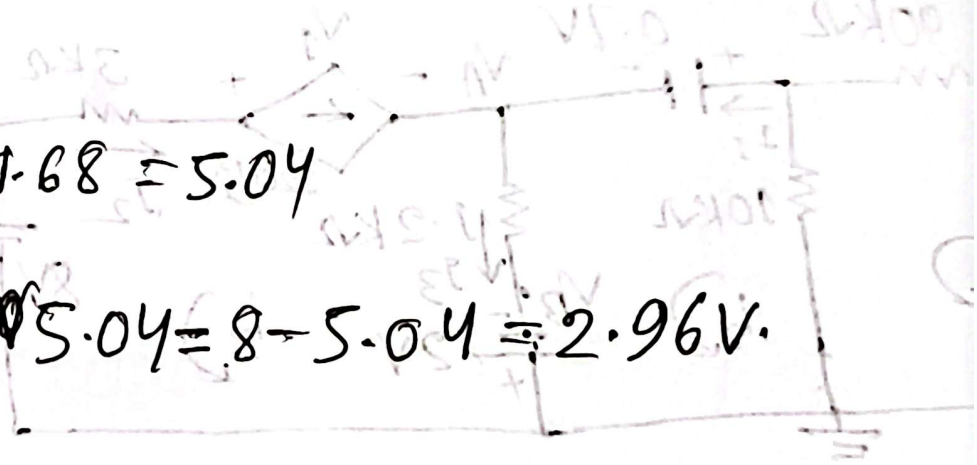
$= 2.0328 + 2$

$= 4.0328$ V

For 1, 3 KΩ

$V_C - V_D = 3 \times 1.68 = 5.04$

$\Rightarrow V_D = V_C - 5.04 = 8 - 5.04 = 2.96\,V.$



$\therefore V_1 = V_D - V_A$

$= 2.96 - 4.0328$

$= -1.07\ V$

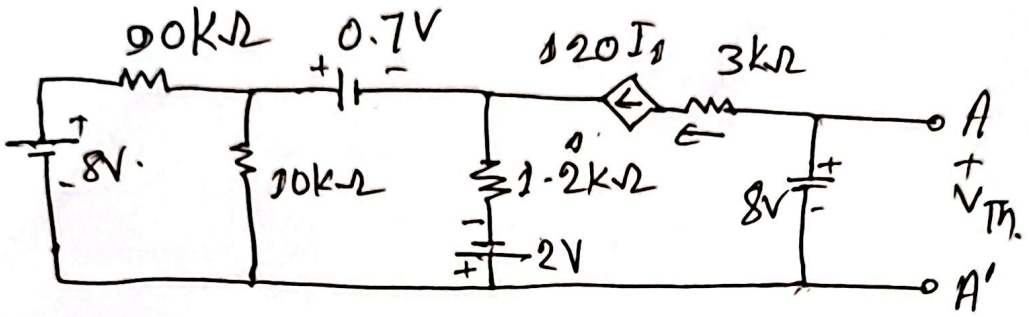
$I_1 = 0.014\,mA.$

$I_2 = 1.68\,mA$

$I_3 = 1.694\,mA$

Ans

4]

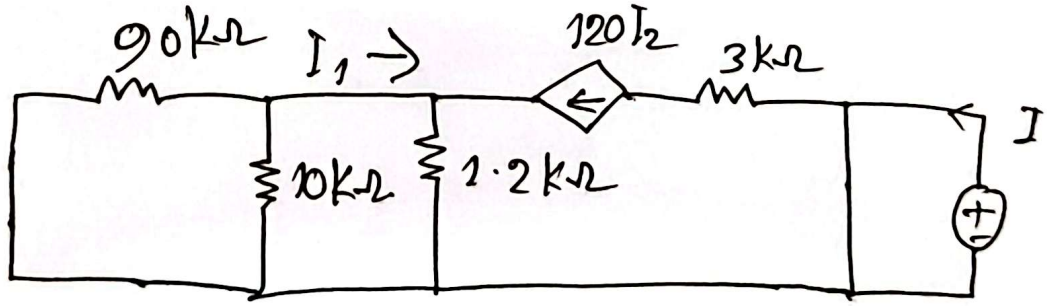


V_{Th}

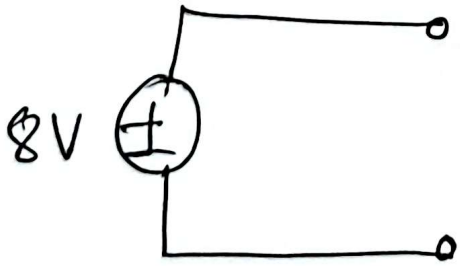
Here 8V DC source parallely connected. in reference node. to ground. Bon this reason,

$$V_{Th} = V_{OC} = 8V$$

R_{Th}



$$R_{Th} = 0\,\Omega$$



Thevenin equivalent circuit.