Q-1(Node)

Set B

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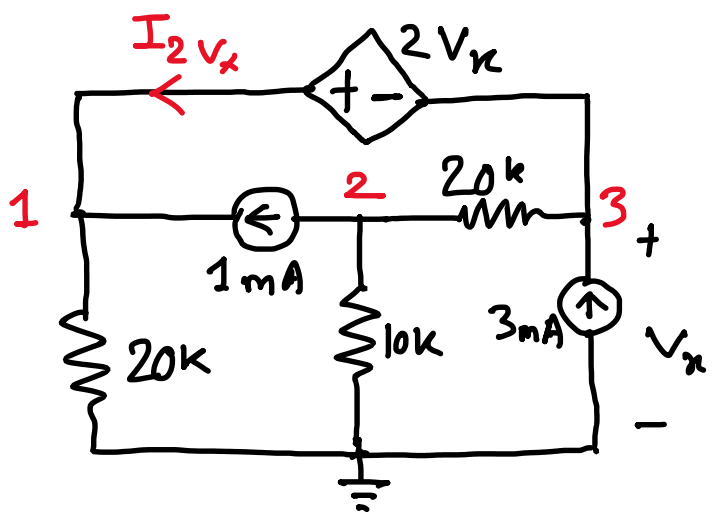
(a)



Supernode KCL (1 & 3) :

$$\frac{v_1}{20} + \frac{v_3 - v_2}{20} = 1 + 3$$

Supernode KVL :

$$v_1 - v_3 = 2v_x = 2v_3$$

$$\Rightarrow v_1 - 3v_3 = 0$$

Solving,

$v_1 = 60$ V

$v_2 = 0$ V

$v_3 = 20$ V

KCL at '2' :

$$\frac{v_2}{10} + \frac{v_2 - v_3}{20} + 1 = 0$$

(b) $P_{2v_x} = -2v_x \times I_{2v_x}$

$$= -(v_1 - v_3) \times \left[\frac{v_1}{20} - 1\right]$$

$= -40 \times 2 = -80$ mW

(Supplying)

Q-2(Mesh)

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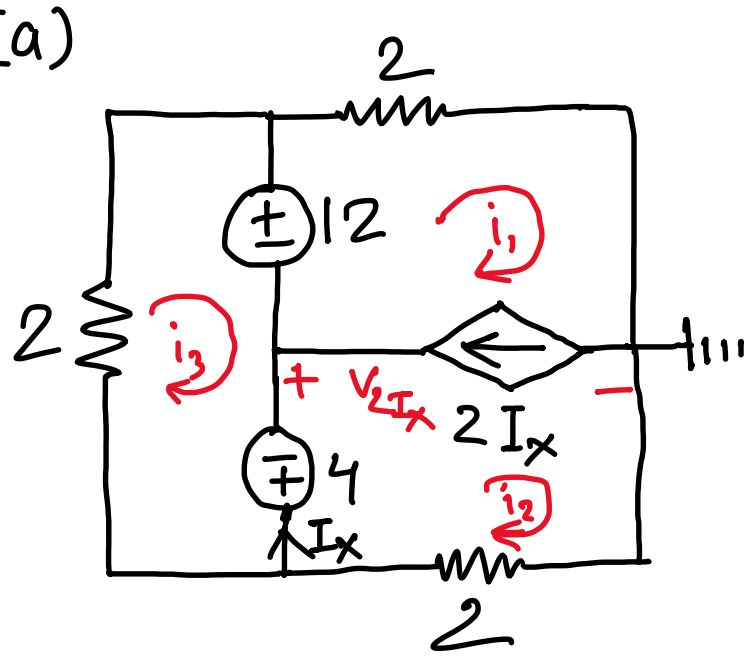
(a)



Supermesh KVL:

$$2i_1 + 4 + 2i_2 - 12 = 0$$

$$\Rightarrow i_1 + i_2 = 4$$

Supermesh KCL:

$$i_1 = 2I_x + i_2$$

$$\Rightarrow i_1 = 2(i_2 - i_3) + i_2$$

$$\Rightarrow i_1 - 3i_2 + 2i_3 = 0$$

Solving,

$$i_1 = 5 \text{ A}$$

$$i_2 = -1 \text{ A}$$

3rd mesh KVL:

$$2i_3 + 8 = 0$$

$$\Rightarrow i_3 = -4 \text{ A}$$

(b) KVL in mesh 2 $\rightarrow$ $4 + 2i_2 + V_{2I_x} = 0$

$$\Rightarrow V_{2I_x} = -4 - 2 \times (-1) = -2 \text{ V}$$

Q-2(Nodal)

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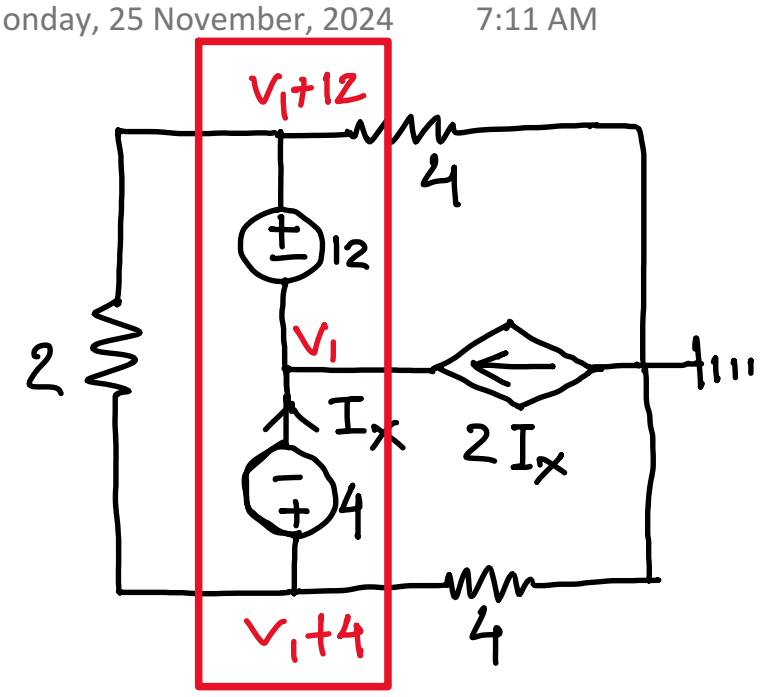
(a)



Supernode

KCL at V_1+8,

$$\Rightarrow \frac{V_1+12-(V_1+4)}{2} - \frac{V_1+4}{2} - I_x = 0$$

$$\Rightarrow I_x = 2 - \frac{V_1}{2}$$

KCL at supernode:

$$\frac{V_1+12}{2} + \frac{V_1+4}{2} - 2\times\left(2-\frac{V_1}{2}\right) = 0$$

$$\therefore V_1 = -2V$$

$\therefore$ Node voltages $-2V$, $2V$ & $10V$.

(b) Voltage of $2I_x$ current source

$$= V_1 = -2V$$

Q-3

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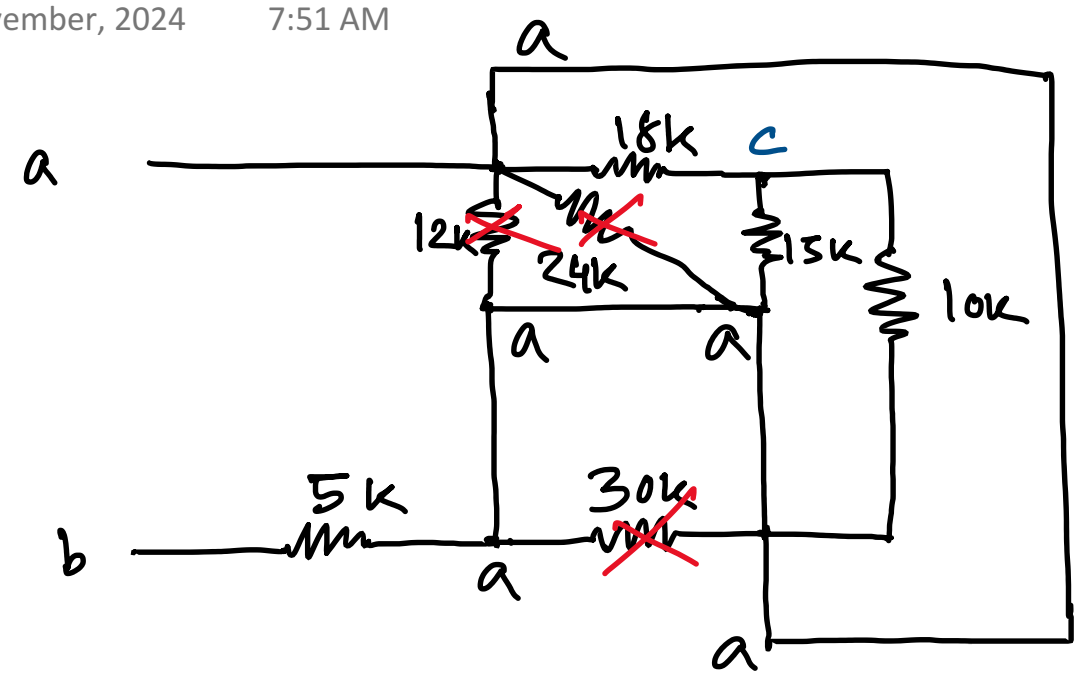
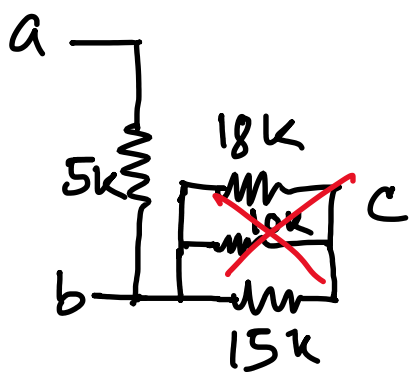
(a)





$\therefore R_{ab} = 5k\Omega$

(b)(i) $kVL \rightarrow -V_y + (-6) + 12 - 24 - (-4) + 8 + 12 = 0$

$\Rightarrow V_y = 6\,V$

(ii) $kVL \rightarrow -V_{ab} - 24 - (-4) + 8 = 0$

$\Rightarrow V_{ab} = -12\,V$