EE 202 (122)- HW2

Due Monday 25/2/2013

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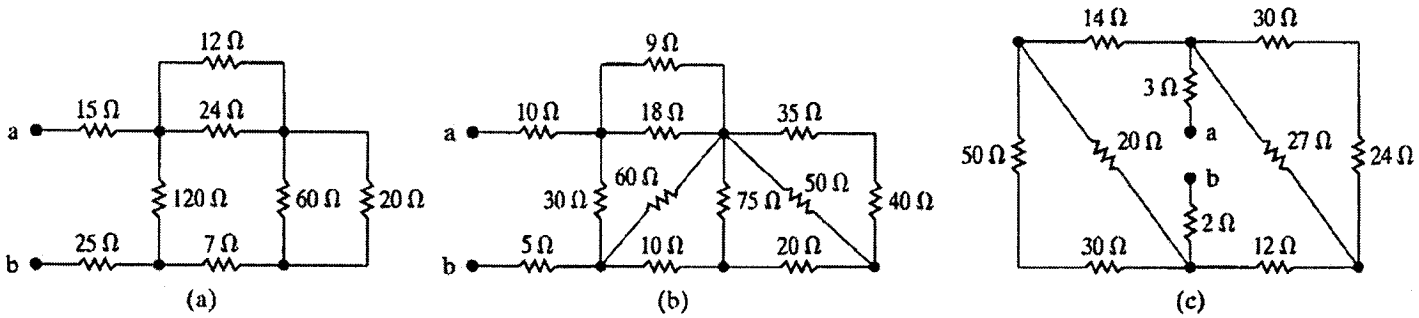


Q1 For the circuits shown above , find the equivalent resistant between nodes **a** and **b**

[a] $60\|20 = 1200/80 = 15\,\Omega$ $\qquad$ $12\|24 = 288/36 = 8\,\Omega$

$15 + 8 + 7 = 30\,\Omega$ $\qquad$ $30\|120 = 3600/150 = 24\,\Omega$

$R_{ab} = 15 + 24 + 25 = 64\,\Omega$

[b] $35 + 40 = 75\,\Omega$ $\qquad$ $75\|50 = 3750/125 = 30\,\Omega$

$30 + 20 = 50\,\Omega$ $\qquad$ $50\|75 = 3750/125 = 30\,\Omega$

$30 + 10 = 40\,\Omega$ $\qquad$ $40\|60 + 9\|18 = 24 + 6 = 30\,\Omega$

$30\|30 = 15\,\Omega$ $\qquad$ $R_{ab} = 10 + 15 + 5 = 30\,\Omega$

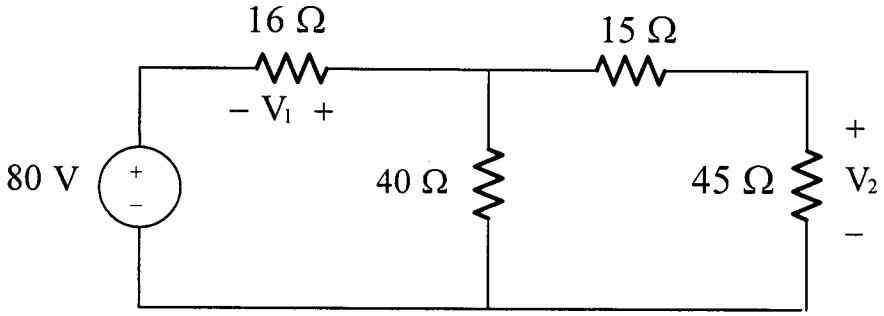
[c] $50 + 30 = 80\,\Omega$ $\qquad$ $80\|20 = 16\,\Omega$

$16 + 14 = 30\,\Omega$ $\qquad$ $30 + 24 = 54\,\Omega$

$54\|27 = 18\,\Omega$ $\qquad$ $18 + 12 = 30\,\Omega$

$30\|30 = 15\,\Omega$ $\qquad$ $R_{ab} = 3 + 15 + 2 = 20\,\Omega$

Q2

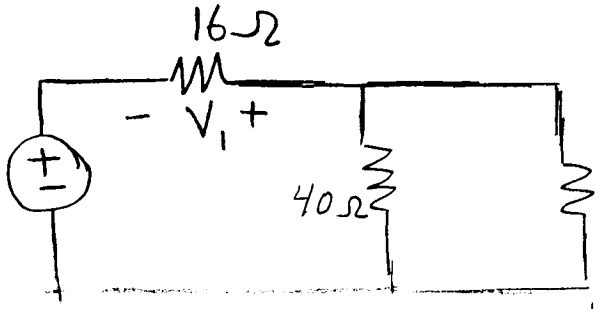


For the circuit shown above , find the followings:

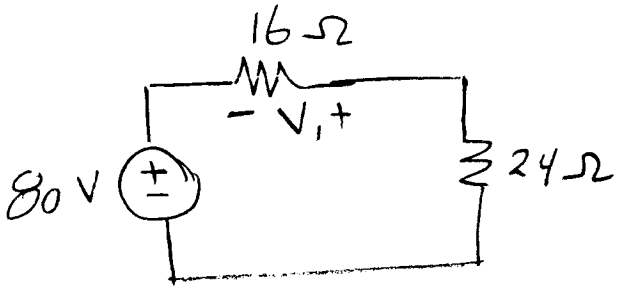
(a) V_1 **using voltage division method only** ?

(b) V_2 **using current division method only** ?

(a)



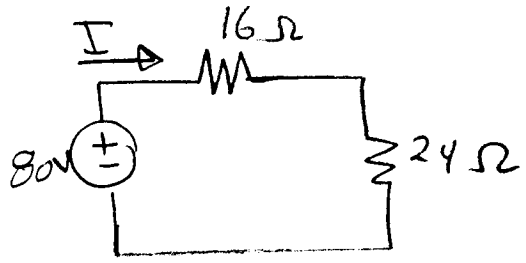
$40 // 60 = 24\,\Omega$



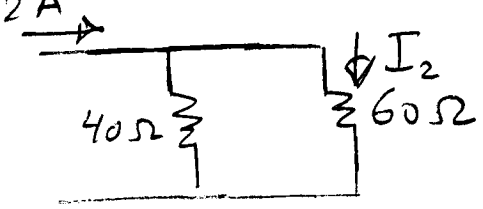
$$V_1 = -\frac{16}{16+24}\,80$$

$$= -32\ \text{V}$$

(b)



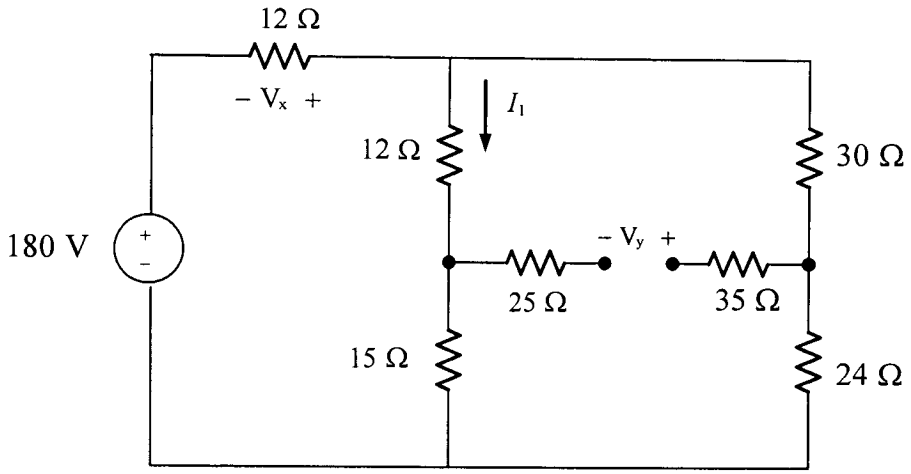
$$I = \frac{80}{16+24} = 2\ \text{A}$$



$$I_2 = \frac{40}{40+60}\,2 = 0.8\ \text{A}$$

$$V_2 = 45\,(I_2) = 45(0.8) = 36\ \text{V}$$

Q3



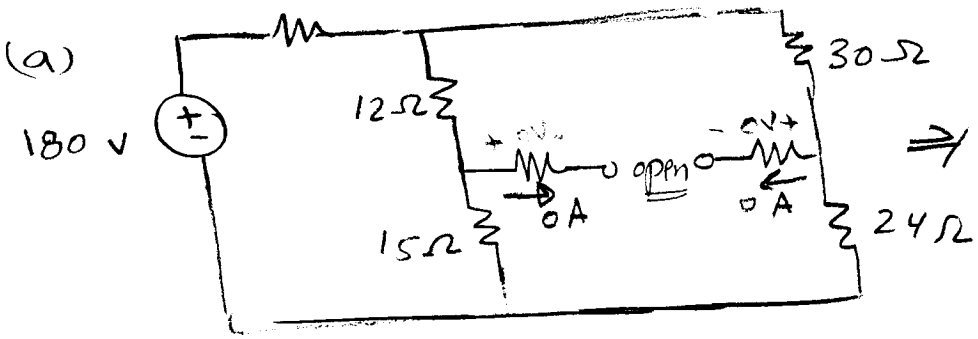
For the circuit shown above , find the followings:

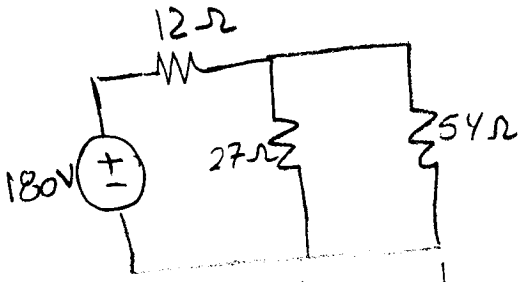
(a) V_x **using voltage division method only** ?

(b) I_1 **using current division method only** ?

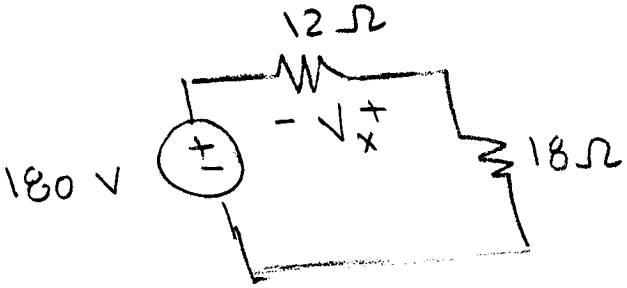
(c) V_y

(a)



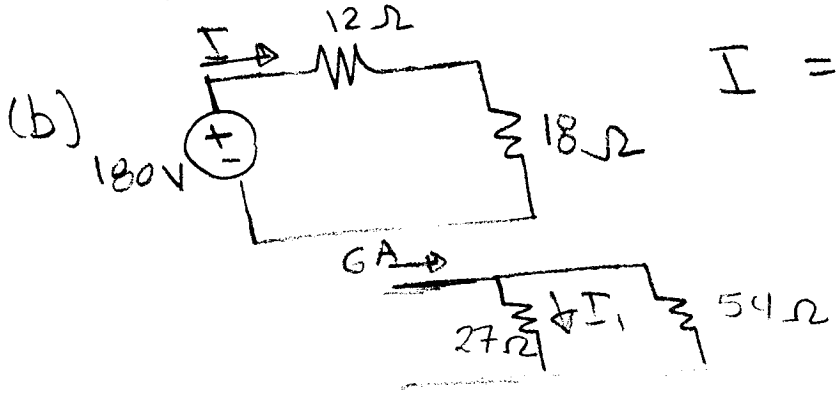


Note:
35Ω, 25Ω has no effect



$$V_x = -\frac{12}{12+18}180 = -72\ V$$

(b)

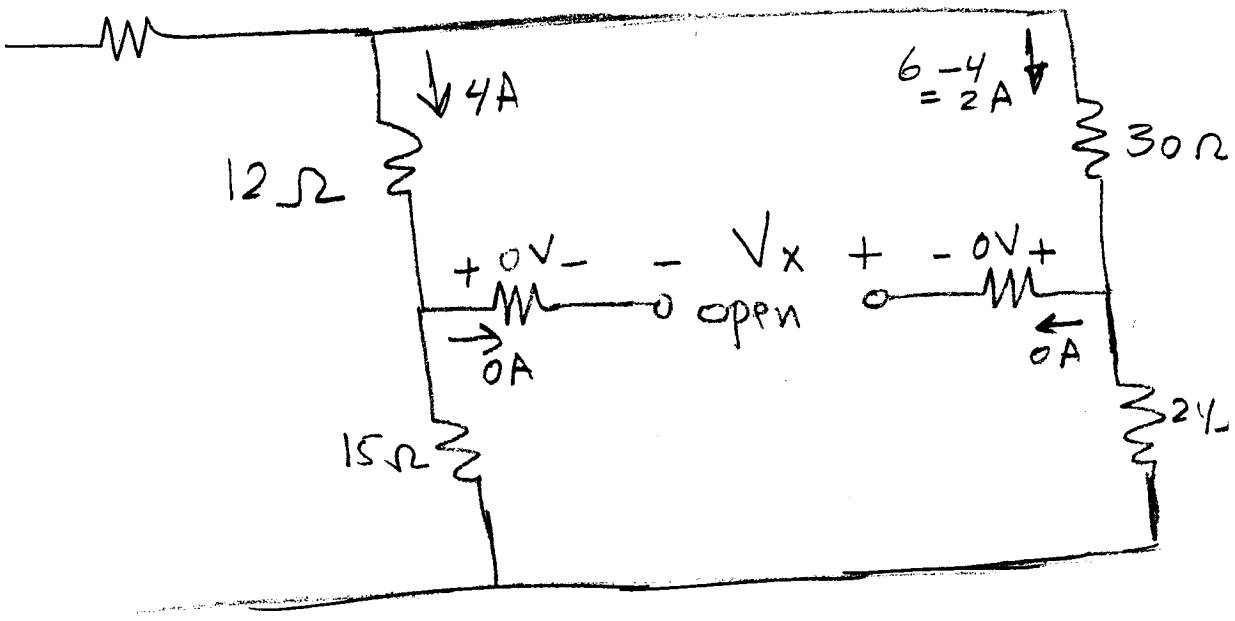


$$I = \frac{180}{12+18} = 6\ A$$

$$I_1 = \frac{54}{27+54}(6) = 4A$$

Continue →

(c)



Applying KVL on the upper loop (or the lower loop).

$$30(2) + 0 + V_x - 0 - 12(4) = 0$$

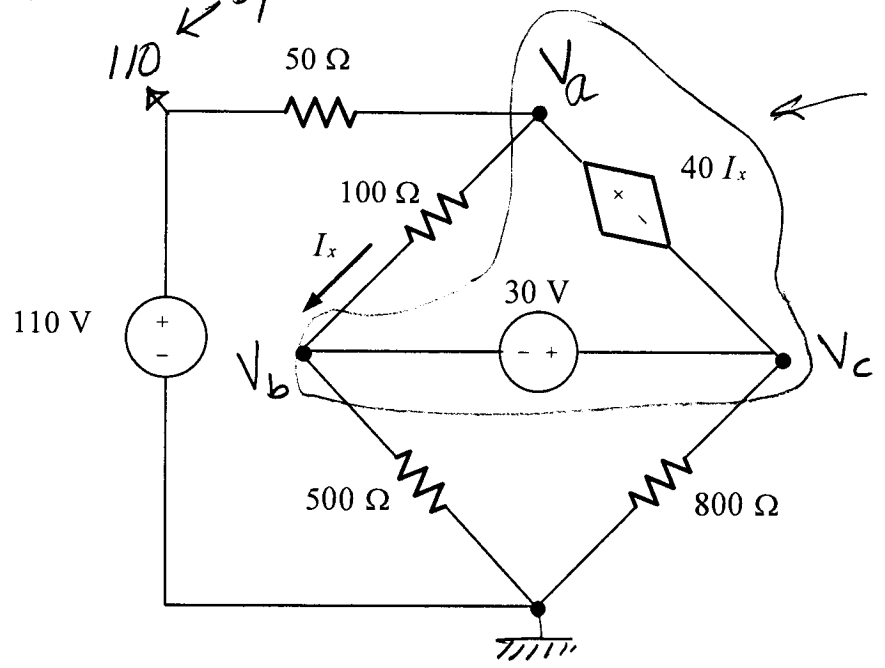
$$\Rightarrow V_x = -12\ V$$

Lower Loop

$$24(2) - 15(4) + 0 - V_x - 0 = 0$$

$$\Rightarrow V_x = -12\ V$$

Q4



by inspection

supper supper node (SSN)

For the circuit shown above , **using the node voltage method** find the followings :

(a) The power deliver by the 30 V independent voltage source ?

(b) The power absorb by the dependent voltage source ?

(a) KCL at SSN

$$\frac{V_a - 110}{50} + I_x + \frac{V_c}{800} + \frac{V_b}{500} - I_x = 0$$

$$\Rightarrow 80V_a + 8V_b + 5V_c = 8800 \quad -(1)$$

Voltage sources restriction relations

$$V_c - V_b = 30 \quad -(2)$$

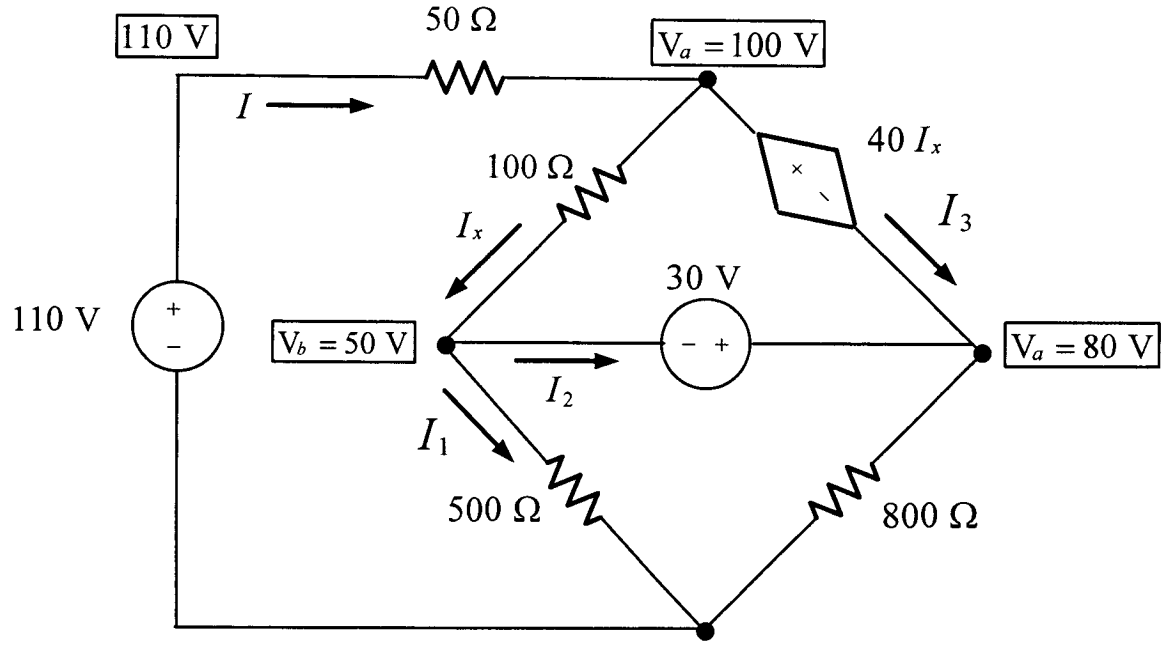
$$V_a - V_c = 40 I_x = 40\left(\frac{V_a - V_b}{100}\right)$$

$$\Rightarrow 3V_a + 2V_b - 5V_c = 0 \quad -(3)$$

$$\begin{bmatrix} 80 & 8 & 5 \\ 0 & -1 & 1 \\ 3 & 2 & -5 \end{bmatrix} \begin{bmatrix} V_a \\ V_b \\ V_c \end{bmatrix} = \begin{bmatrix} 8800 \\ 30 \\ 0 \end{bmatrix} \Rightarrow \begin{matrix} V_a = 100\ V \\ V_b = 50\ V \\ V_c = 80\ V \end{matrix}$$

⇒ continue

Q4 (Continue)



$P_{30V}^{absorb} = -30(I_2)$, we need I_2

$I_2 = I_x - I_1$ we need I_x, I_1

$I_x = \frac{V_a - V_b}{100} = \frac{100-50}{100} = 0.5\ A$

$I_1 = \frac{V_b}{500} = \frac{50}{500} = 0.1\ A$

$\Rightarrow I_2 = I_x - I_1 = 0.5 - 0.1 = 0.4\ A$

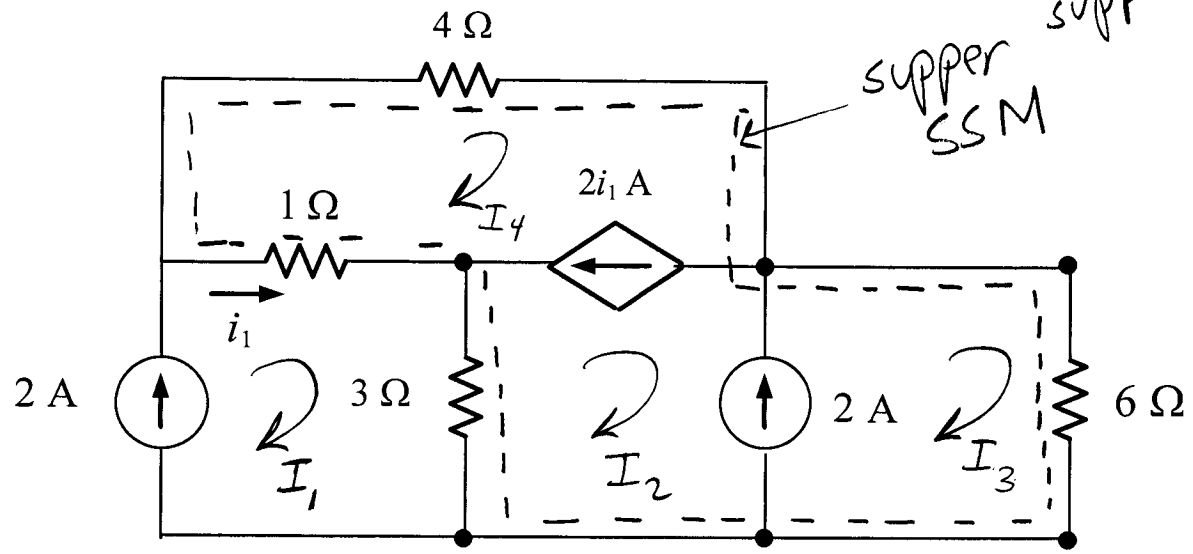
$\Rightarrow P_{30V}^{absorb} = -30(0.4) = -12\ W \Rightarrow P_{30V}^{deliver} = 12\ W$

(b) $P_{40I_x}^{absorb} = (40I_x)I_3$ we need I_3

$I_3 = I - I_x = \left(\frac{110 - V_a}{50}\right) - 0.5 = -0.3\ A$

$\Rightarrow P_{40I_x}^{absorb} = (40(0.5))(-0.3) = -6\ W$

Q5



For the circuit shown above , **using the Mesh current method** find the followings :

(a) The power deliver by the dependent current source?

(b) The power absorb by the 3 Ω resistor ?

(a) by inspection $I_1 = 2\ A$

KVL on (SSM)

$$4i_4 + 6i_3 + 3(I_2 - I_1) + 1(I_4 - I_1) = 0$$

$$\Rightarrow 3I_2 + 6I_3 + 5I_4 = 8 \quad -①$$

- From the 2A independent current source,

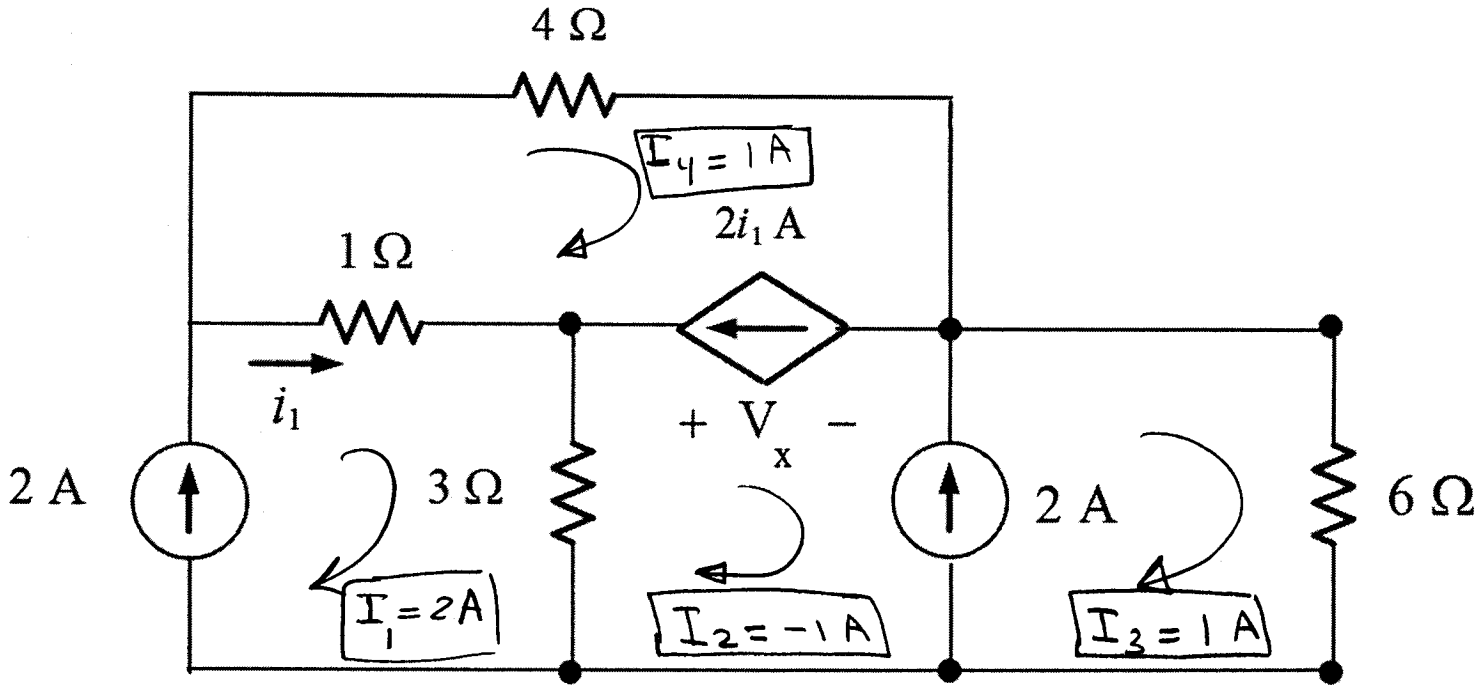
$$I_3 - I_2 = 2 \quad -②$$

- From the dependent current source,

$$I_4 - I_2 = 2i_1 = 2(I_1 - I_4) \Rightarrow -I_2 + 3I_4 = 4 \quad -③$$

$$\begin{bmatrix} 3 & 6 & 5 \\ -1 & 1 & 0 \\ -1 & 0 & 3 \end{bmatrix} \begin{bmatrix} I_2 \\ I_3 \\ I_4 \end{bmatrix} = \begin{bmatrix} 8 \\ 2 \\ 4 \end{bmatrix} \Rightarrow \begin{aligned} I_2 &= -1\ A \\ I_3 &= 1\ A \\ I_4 &= 1\ A \end{aligned}$$

Q5 (continue)



KVL on the upper loop (mesh)

$$4I_4 - V_x + 1(I_4 - I_1) = 0 \Rightarrow V_x = 3\,V$$

$$\Rightarrow P_{2i_1}^{absorb} = -V_x(2i_1)$$

$$= -(3)(2(I_1 - I_4))$$

$$= -(3)(2(2-1)) = \underline{-6W}$$

$$\Rightarrow P_{2i_1}^{deliver} = \underline{6W}$$

(b) $$P_{3\Omega}^{absorb} = 3(I_1 - I_2)^2 = 3(2+1)^2 = \underline{27\,W}$$