EE1-Fall2022 HW2 Solution

Principle of EE1 Laboratory (International University - VNU-HCM)

Name:

ID :

PRINCIPLES OF EE1

Homework #2 - Solution

Submission deadline:

IMPORTANT: You should hand in a copy of your report that contains a full and detailed description of all the work done on the homework. Marks will be deducted if there are sign of violation of regulation and late submission (20% for each day). *You should print out this document and write down your solution directly on it.*

Tip: You should draw a bounding box for your final answer. Ex: $Y = ABC + AC = \boxed{ABC}$

Problem 1: (30 marks)

Using the node voltage method to find:

a/ The power of the 8A source in Figure 1.1

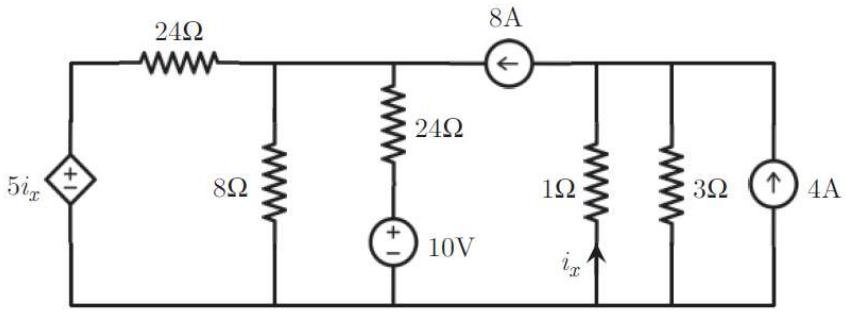


Figure 1.1

b/ The current i_z in Figure 1.2

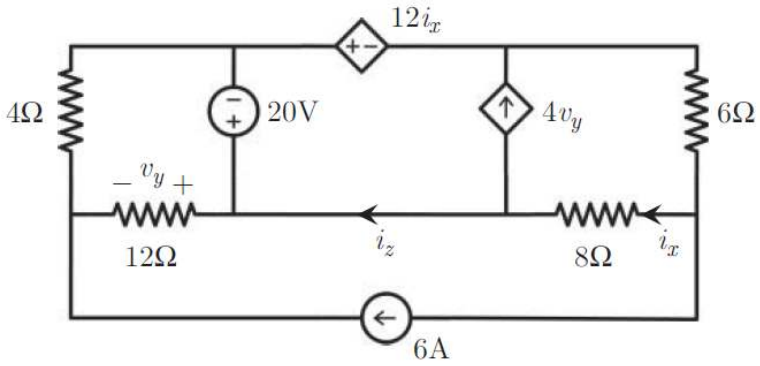
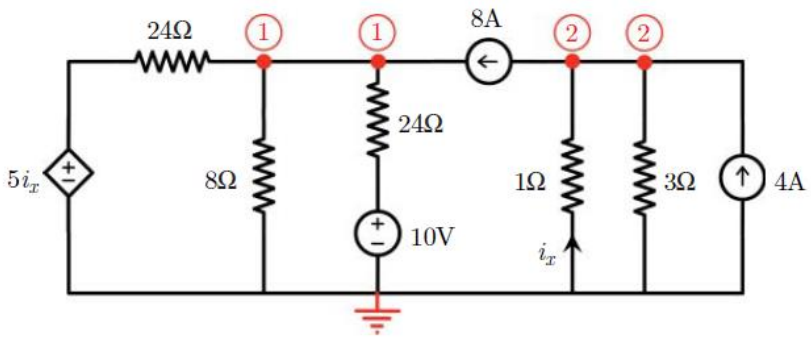


Figure 1.2

Solution

a/



$$\boldsymbol{i_x = -v_2}$$

Apply KCL:

At node 1

$\frac{v_1-5i_x}{24} + \frac{v_1}{8} + \frac{v_1-10}{24} - 8 = 0$ => $5v_1 + 5v_2 = 202$

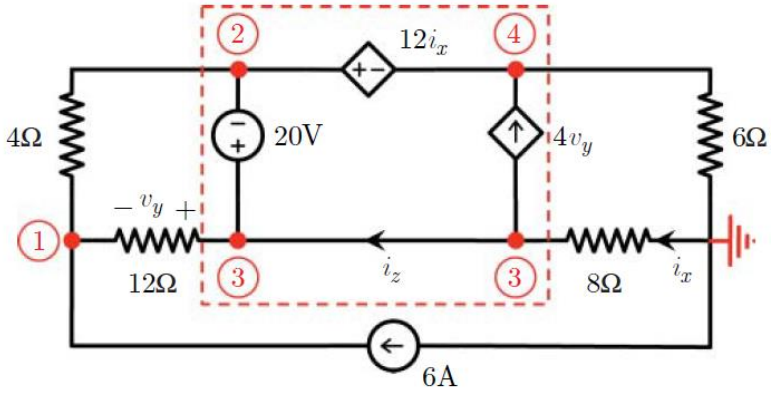
At node 2

$8 + \frac{v_2}{1} + \frac{v_2}{3} - 4 = 0$ => $v_2 = -3$

⇨ $v_1 = 217/5(V)$

So, the power of the 8A source: $p_{8A} = 8 \times (-3 - 217/5) = \boldsymbol{-1856/5(W)}$

b/



We have: $v_3 = v_2 + 20$ (1)

Apply KCL at node 1

$\frac{v_1 - v_2}{4} + \frac{v_1 - v_3}{12} - 6 = 0$ => $v_1 = v_2 + 23$ (2)

Apply KCl at node 2, 3 and 4

$\frac{v_2 - v_1}{4} + \frac{v_3 - v_1}{12} + \frac{v_4}{6} + \frac{v_3}{8} = 0$ => $5v_3 - 2v_4 = 40$ (3)

Apply supernode, we have:

$v_3 = v_4 + 20 + 12i_x$ => $5v_3 - 2v_4 = 40$ (4)

From (1) (2) (3) (4)

$$v_1 = 263/13(V)$$

$$v_2 = -36/12(V)$$

$$v_3 = 224/13(V)$$

$$v_4 = 300/13(V)$$

So, $\boldsymbol{i_z = i_x - 4v_y = -28/13 + 12 = 128/13(A)}$

Problem 2: (30 marks)

Using mesh current method to determine:

a. The power of the 100V voltage source in Figure 2.1

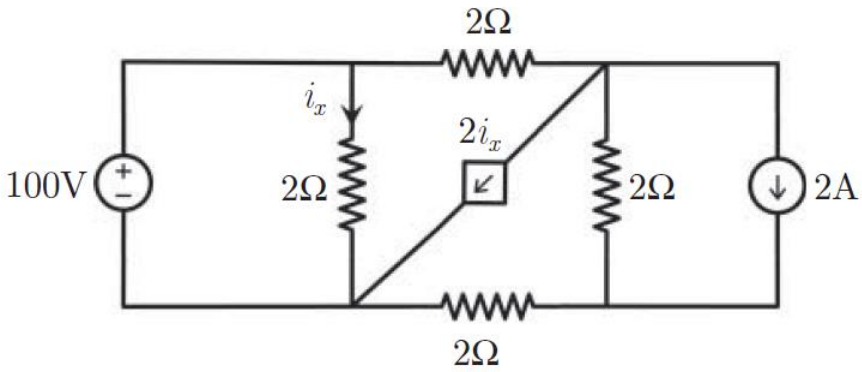


Figure 2.1

b. The value of i_x in Figure 2.2

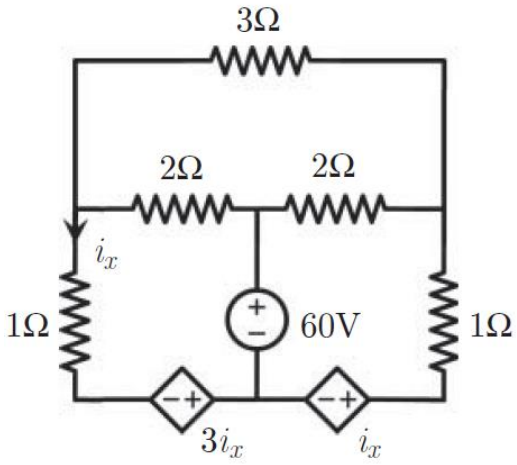
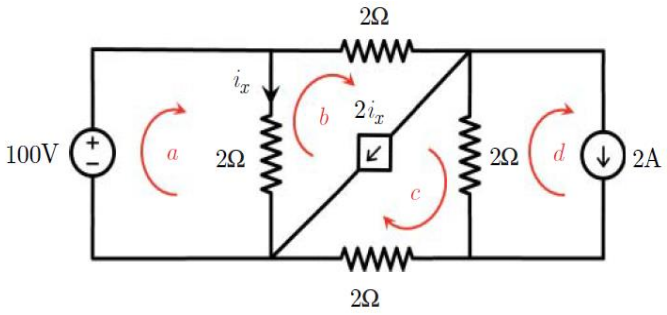


Figure 2.2

Solution

a/



We have: $i_d = 2(A)$

In Mesh a:

$-100 + 2(i_a - i_b) = 0$ => $i_a - i_b = 50$ (1)

Apply Supermesh, we have

$i_b - i_c = 2i_x = 2(i_a - i_b)$ => $2i_a - 3i_b + i_c = 0$ (2)

In Mesh (b&c):

$2(i_b - i_a) + 2i_b + 2(i_c - i_d) + 2i_c = 0$ =>$i_a - 2i_b - 2i_c = -2$ (3)

From (1) (2) (3)

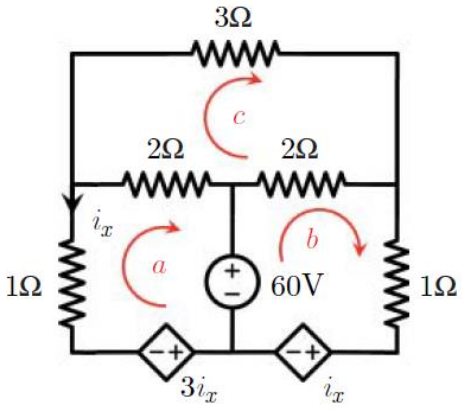
$$i_a = 134(A)$$

$$i_b = 84\ (A)$$

$$i_c = -16(A)$$

The power of 100V source: $p_{100V} = -100 \times 134 = \mathbf{-13.4(kW)}$

b/



We have: $i_x = -i_a$

In Mesh a:

$i_a + 2(i_a - i_b) + 60 + 3i_x = 0$ => $i_c = 30\ (A)$ (1)

In Mesh b:

$-60 + 2(i_b - i_c) + i_b + i_x = 0$ => $3i_b - i_a = 120$ (2)

In Mesh c:

$2(i_c - i_a) + 3i_c + 2(i_c - i_b) = 0$ => $i_a + i_b = 105$ (3)

From (2) (3), we have:

$$i_a = 195/4(A)$$

$$i_b = 225/4(A)$$

So, $i_x = \mathbf{-195/4(A)}$

Problem 3: **(20 marks)**

Make a series of source transformations to find the voltage V_x in the circuit in Figure 3.

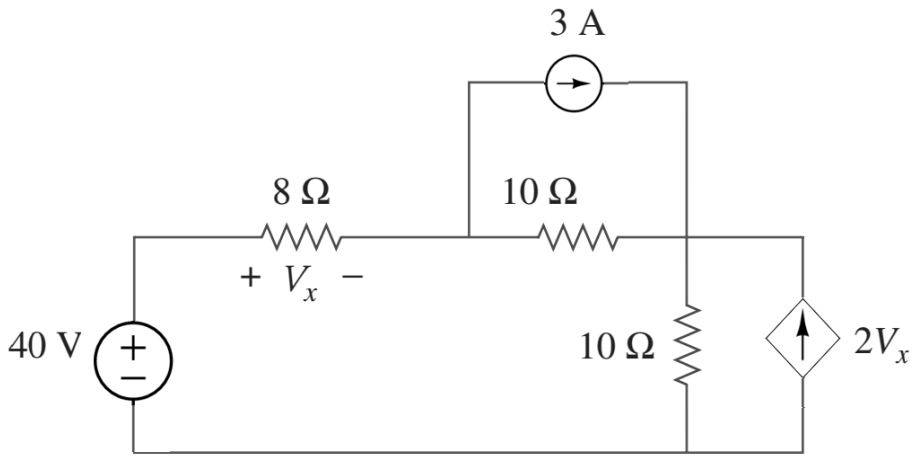


Figure 3

Solution

Apply source trans.

1/ Current source 3A in parallel with 10 ohm

2/ Current source 2Vx in parallel with 10 ohm

Then, redraw the circuit and apply KVL:

$$-40 + 8i - 30 + 10i + 10i + 20V_x = 0$$

$\Leftrightarrow\ 28i + 20V_x = 70$

We also have: $V_x = 8i$

$\Rightarrow\ \boldsymbol{V_x = \frac{70}{\frac{28}{8}+20} = 2.98\ (V)}$

Problem 4: **(20 marks)**

Find the values of v_1, v_2 and v_3 for the circuit in Figure 4.

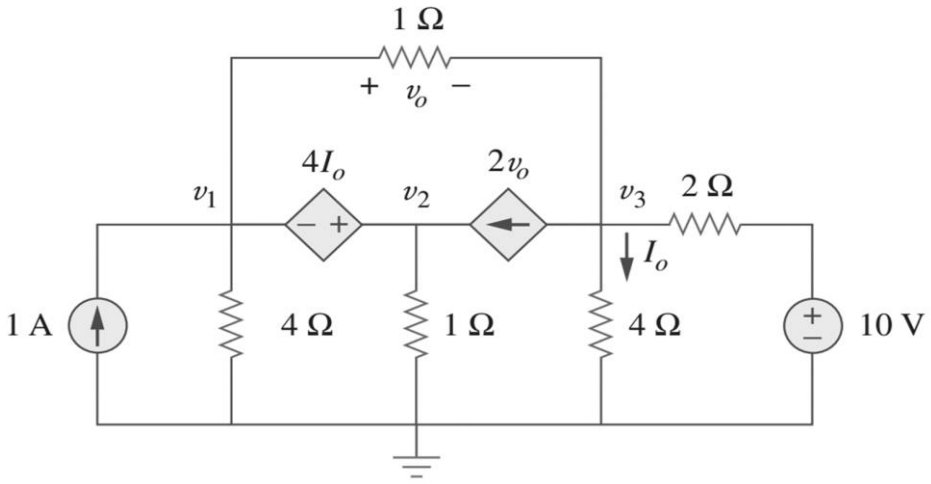
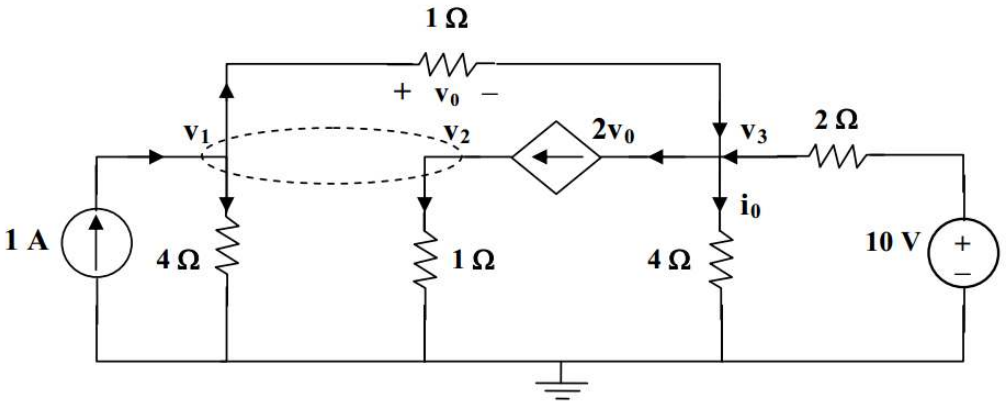


Figure 4

Solution



At the supernode,

$$1 + 2v_0 = \frac{v_1}{4} + \frac{v_2}{1} + \frac{v_1 - v_3}{1} \quad (1)$$

But $v_0 = v_1 - v_3$

So, (1) becomes $4 = -3v_1 + 4v_2 + 4v_3$

$$2v_0 + \frac{v_3}{4} = v_1 - v_3 + \frac{10 - v_3}{2}$$

Or $20 = 4v_1 - v_3$ (2)

At the supernode, $v_2 = v_1 + 4i_0$ (3) and $i_0 = \frac{v_3}{4}$

So, $v_2 = v_1 + v_3$ (4)

From (2) and (4), we can solve the equations:

$$\boldsymbol{v_1 = 4.97\,V, \quad v_2 = 4.85\,V, \quad v_3 = -0.12\,V}$$