Sirindhorn International Institute of Technology

Thammasat University at Rangsit

School of Information, Computer and Communication Technology

ECS 203: Problem Set 2

Semester/Year: **2/2015**
Course Title: Basic Electrical Engineering
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Course Web Site: http://www2.siit.tu.ac.th/prapun/ecs203/

Due date: Feb 1, 5 PM

Instructions

1. Solve all problems. (5 pt)
   a. Write your name and ID on the top of **every** submitted page.
   b. For each part, write your explanation/derivation and answer in the space provided.
2. ONE sub-question will be graded (5 pt). Of course, you do not know which part will be selected; so you should work carefully on all of them.
3. There is no need to submit (or even print out) page 1 (this cover sheet).
4. Late submission will be rejected.
5. ***Write down all the steps*** that you have done to obtain your answers. You may not get full credit even when your answer is correct without showing how you get your answer.

Questions

1) [Alexander and Sadiku, 2009, PP2.2] For the circuit shown in Figure 1, calculate the voltage *v* and the power *p* (dissipated by the 10kΩ resistor).

The 2 mA current source forces clockwise 2 mA current through the circuit (which is simply one loop and hence, by KCL, we have the same 2 mA current flowing through the loop).

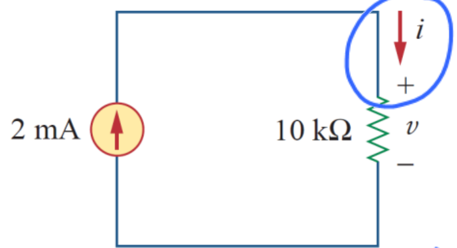


Figure 1

"enter +" $p = iv$ and (not $p = -iv$) $v = iR$. (not $v = -iR$)

The arrow of i agrees with the clockwise direction of the forced 2mA current.

Hence, $i = 2mA$. (not $-2mA$)

Here, $i = 2mA$ and $R = 10\ k\Omega$.

Therefore,

$v = iR = 2mA \times 10\ k\Omega = 20\ V$

and

$p = iv = 2mA \times 20\ V = 40\ mW$

2) [Alexander and Sadiku, 2009, Q2.4]
   a) Calculate current *i* in Figure 2 when the switch is in position 1.

Because the switch is in position 1, all the current i flows in the CCW direction through the left half of the circuit.

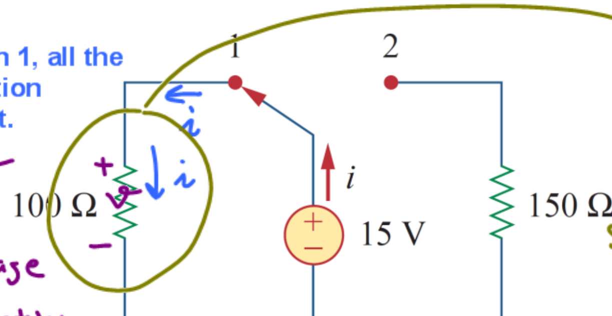


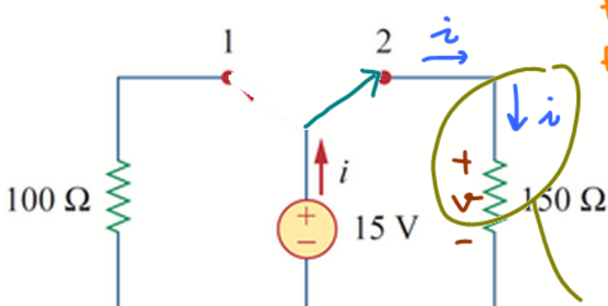
Figure 2

We define a voltage v across the resistor. Because the 15 V voltage source is connected directly across v and their polarities (+,−) match. We have $v = 15\ V$.

"Enter +" $v = iR$

So, $i = \frac{v}{R} = \frac{15V}{100\ \Omega} = 0.15\ A$ or $150\ mA$.

   b) Find the current when the switch is in position 2.



The same reasoning in part (a) also applies to this part except that now the current i is flowing through a new loop on the right half in the clockwise direction

$i = \frac{v}{R} = \frac{15V}{150\ \Omega} = 0.1\ A$ or $100\ mA$.

"Enter +"

same as node 5

3) [Alexander and Sadiku, 2009, Q2.7] Find the number of branches and nodes in each of the circuits of Figure 3.

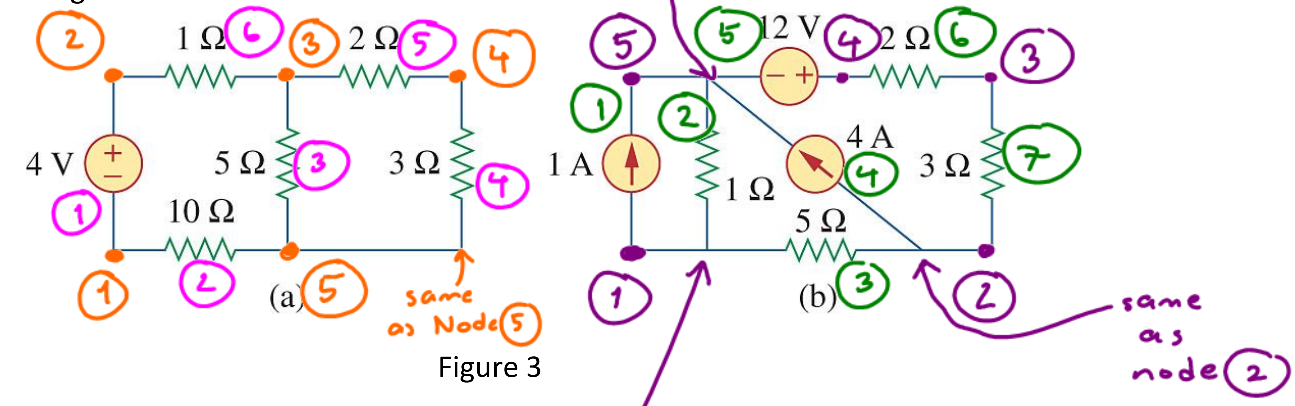


Figure 3

(a) # branches = 6

nodes = 5

(b) # branches = 7

nodes = 5

4) [Alexander and Sadiku, 2009, Q2.10] Determine i_1 and i_2 in the circuit of Figure 4.

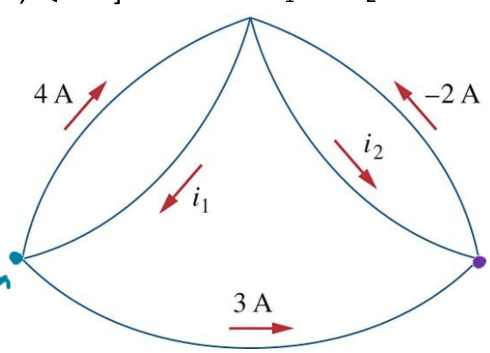


Figure 4

Applying KCL at this node, we have ($\Sigma i = 0$)

$4 + (-i_1) + 3 = 0$

$i_1 = 7$ A

Applying KCL at this node, we have ($\Sigma i = 0$)

$-2 - i_2 - 3 = 0$

$i_2 = -5$ A

We may check the answers by applying KCL ($\Sigma i = 0$) at the top node:

$-4 + i_1 + i_2 - (-2) = 0$

$-4 + 7 - 5 + 2 = 0$ ✓

use i_1, i_2 that we know.

5) [Alexander and Sadiku, 2009, Q2.14] Given the circuit in Figure 5, use KVL to find the branch voltages V_1 to V_4.

As hinted, we need to apply KLV. $(\Sigma v = 0)$
Because there are four unknowns, we need at least 4 loops.

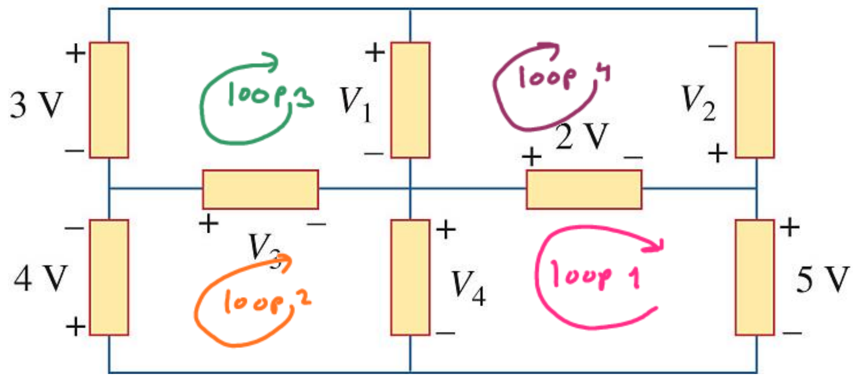


Figure 5

We will try to start with a loop that involves minimum # of unknown variables

So, we start with "loop 1":

(only one unknown variable)

$$+V_4 - 2 - 5 = 0$$

With respect to the loop direction, we move from the "-" to "+" terminals of V_4. So, we "gain" V_4 by moving in such direction

With respect to the loop direction, we move from the "+" to the "-" terminals of the 2V. So, we "lose" 2V by moving in such direction.

$$V_4 = 7V$$

Because we already know V_4, "loop 2" now has only one unknown variable (V_3):

$$-4 - V_3 - V_4 = 0 \quad (V_4 = 7V)$$

$$V_3 = -4 - V_4 = -11\ V$$

Similarly, when we know V_3, "loop 3" has only one unknown variable (V_1):

$$+3 - V_1 + V_3 = 0 \quad (V_3 = -11\ V)$$

$$V_1 = 3 - 11 = -8\ V$$

Finally, from "loop 4":

$$+V_1 + V_2 + 2 = 0 \quad (V_1 = -8V)$$

$$V_2 = 8 - 2 = 6V$$

$V_1 = -8V$
$V_2 = 6V$
$V_3 = -11V$
$V_4 = 7V$