Name: ____ **(Print)**

Signature ____

Date: _____________

ECE 2300 -- Quiz #1

S.R. Brankovic Section – MW 11:30 AM

September 14, 2005

KEEP THIS QUIZ CLOSED AND FACE UP UNTIL YOU ARE TOLD TO BEGIN.

1. This quiz is closed book, closed notes. You may use one 8.5” x 11” crib sheet, or its equivalent.
2. Show all work on these pages. Show all work necessary to complete the problem including appropriate referent current and voltage sign convention. A solution without the appropriate work shown will receive no credit. A solution which is not given in a reasonable order will lose credit.
3. It is assumed that your work will begin on the same page as the problem statement. If you choose to begin your work on another page, you must indicate this on the page with the problem statement, with a clear indication of where the work can be found. **If your work continues on to another page, indicate clearly where your work can be found. Failure to indicate this clearly will result in a loss of credit.**
4. Show all units in solutions, intermediate results, and figures. Units in the quiz will be included between square brackets.
5. Do not use red ink. Do not use red pencil.
6. You will have 35 minutes to work on this quiz.

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Problem #1. The electrical circuit is defined below in Figure 1. Find the values of the currents i_1, i_2, and i_3 and the power delivered to the system by a 6V independent voltage source. For the time interval of 60 seconds, what is the energy delivered to the system by 12 V independent voltage source.

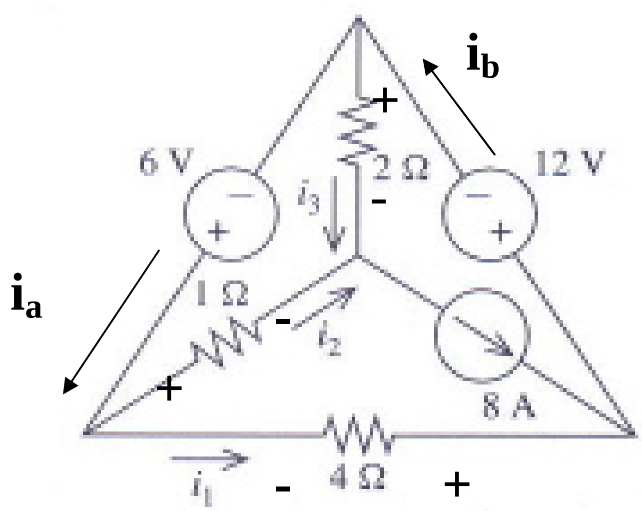

Figure 1 : An electrical circuit

<u>Solution:</u>

We have to look carefully this circuit. If we have done that, and we put referent signs for our voltages and currents, than we would notice that solution for i_1 is straightforward from the KVL equation of the big loop defined by the contours of the circuit.

KVL (big loop)

$-i_1*4\Omega + 6V-12V=0, \Rightarrow i_1 = -1.5\ [A]$

$\boxed{i_1 = -1.5\ [A]}$

Now let us have look the node that has other two currents, i_2 and i_3 involved in its KCL? How about the central node, let us call it N#1.

KCL N#1

$-i_3 - i_2 + 8A = 0; 8A = i_3 + i_2$

Obviously, we have two unknown currents and one equation. How are we going to find the other equation in order to solve our currents? Have a look to the circuit, which part of the circuit (loop) has the branches that carry i_2 and i_3?, How about the small left side loop?, Let's write KVL for the small left side loop.

KVL (small left side loop)

$i_3 * 2\Omega - i_2 * 1\Omega + 6V = 0; \Rightarrow i_2 = 2 * i_3 + 6A;$

Now we can substitute result for i_2 into the KCL N#1, and solve for i_3;

$8A = i_3 + 2 * i_3 + 6A; \Rightarrow \boxed{i_3 = 0.67\ [A]}$

Also, we can use result for i_3 to solve the i_2, using KCL N#1. If we substitute the value for i_3 in KCL N#1 we get :

$8A - i_3 = i_2 \Rightarrow \boxed{i_2 = 7.33\ [A]}$

We solved the i_1, i_2 *and* i_3, and now we can use them to find the current i_a necessary to calculate the power (p_{6V}) delivered to the circuit by 6V independent voltage source. Have a look to the left bottom node, let us call it N#2. The KCL for N#2 is:

KCL N#2:

$-i_a + i_2 + i_1 = 0,$

And it is straightforward that:

$\Rightarrow i_a = i_2 + i_1; \boxed{i_a = 5.83[A]}$

The power delivered to the circuit by 6V independent voltage source is:

$p_{6V} = i_a * 6V$ *(active sign convention)*

$\boxed{p_{6V} = 35.04\ [W]}$

Using the same logic, we find the energy delivered to the circuit by the 12 V independent voltage source. From the node in the bottom right corner, let us call it N#3, we get:

KCL N#3:

$- i_1 - 8A + i_b = 0 ; \Rightarrow i_b = i_1 + 8A = 6.5A; \quad \boxed{i_b = 6.5\ [A]}$

The energy delivered to the circuit is

$W = \int_0^t p dt;$

$W = p*\Delta t = -i_b*v*\Delta t$; *(passive sign convention)*

$W_{12V} = -6.5A*12V*60s = -4680\ [J]$. $\boxed{W = -4680\ [J]}$

Notice that the energy delivered to the circuit has the negative sign, which as we know means that the energy was actually absorbed by this voltage source.