Name : _____ Section:_____ CWRU e-mail:_____

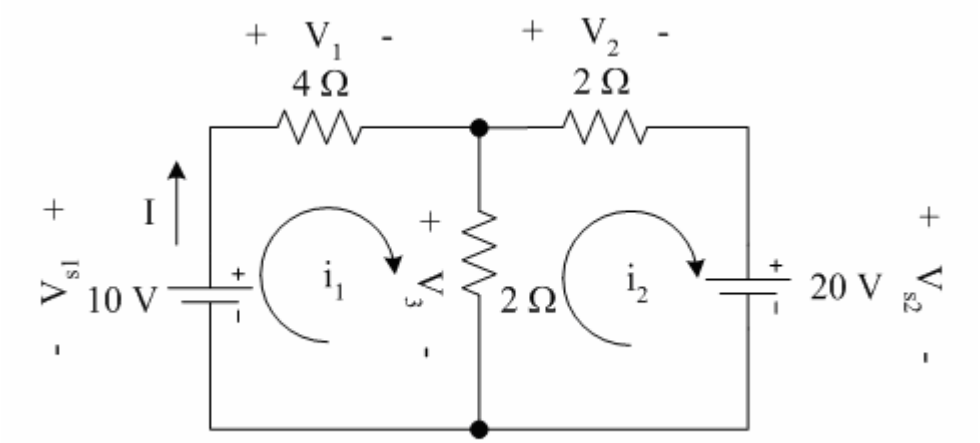
CASE WESTERN RESERVE UNIVERSITY
Case School of Engineering
Department of Electrical Engineering and Computer Science
ENGR 210. Introduction to Circuits and Instruments (4)

Quiz No. 4 2/13/04

PUT ANSWERS IN THE SPACE PROVIDED AND SHOW YOUR WORK IF APPROPRIATE
STATE ALL ASSUMPTIONS

Problem 1 (10 points) What is the current I supplied by the 10 volt source in the figure below? Be sure to used the polarity indicated in the drawing.

I= 0 Amps



ANSWER:
Using mesh currents to formulate the circuit equations, quite similar to the analysis listed in p.85 in the textbook.
Mesh 1: $-V_{s1} + V_1 + V_3 = 0$
Mesh 2: $+V_{s2} - V_3 + V_2 = 0$

We can also write the element voltage in terms of mesh currents and input voltages:
$V_1 = i_1 * 4\Omega$,
$V_2 = i_2 * 2\Omega$,
$V_3 = (i_1 - i_2) * 2\Omega$,
$V_{s1} = 10V$,
$V_{s2} = 20V$

So $-10+4i_1+2(i_1-i_2)=0 \Rightarrow -10+6i_1-2i_2=0 \Rightarrow -5+3i_1-i_2=0$
$\Rightarrow i_2=-5+3i_1$ (1)
$20-2(i_1-i_2)+2i_2=0 \Rightarrow 20-2i_1+4i_2=0$
$\Rightarrow 10-i_1+2i_2=0$ (2)

Using (1) in (2), we can get
$10-i_1+2(-5+3i_1)=0 \Rightarrow 5i_1=0 \Rightarrow i_1=0$

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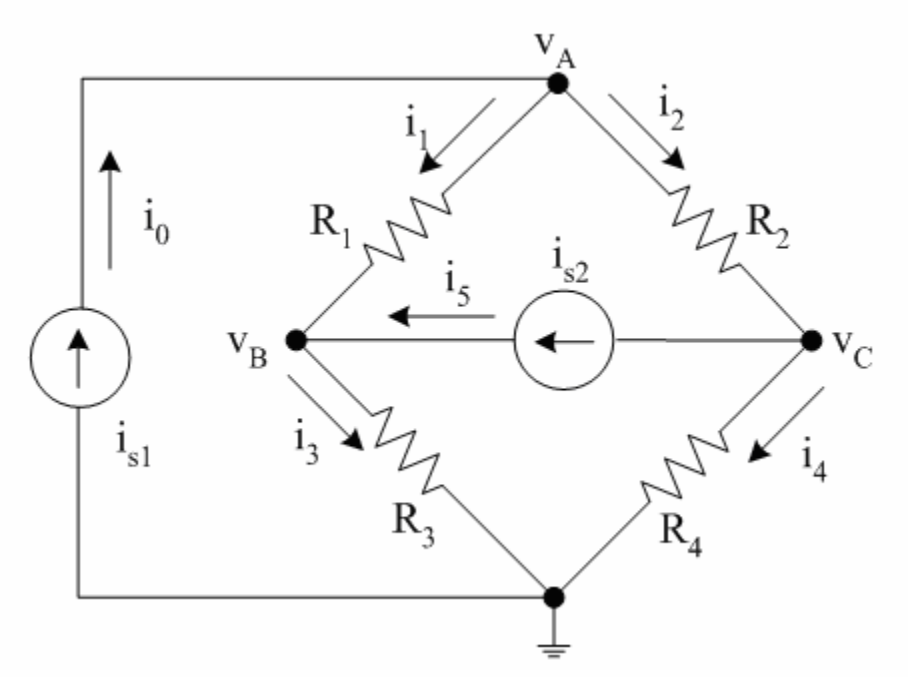
Problem 2 (10 points)

Find the node-voltage equations for this circuit. Complete the table.



Answer:

Using KCL to write the equations: Σ in = Σ out

At node A: $i_0 = i_1 + i_2$

At node B: $i_1 + i_5 = i_3$

At node C: $i_2 = i_4 + i_5$

Also we can write the element current based on the voltage drop across it and input current source:

$i_0 = i_{s1}$

$i_1 = (V_A - V_B)/R_1$

$i_2 = (V_A - V_C)/R_2$

$i_3 = V_B/R_3$

$i_4 = V_C/R_4$

$i_5 = i_{s2}$

And using these equations in the KCL equations listed above, we can get

$i_{s1} = (V_A - V_B)/R_1 + (V_A - V_C)/R_2$

$(V_A - V_B)/R_1 + is2 = V_B/R_3$

$(V_A - V_C)/R_2 = V_C/R_4 + i_{s2}$

Simplifying these equations:

$(1/R_1 + 1/R_2)V_A + (-1/R_1)V_B + (-1/R_2)V_C = i_{s1}$

$(-1/R_1)V_A + (1/R_1 + 1/R_2)V_B + 0V_C = i_{s2}$

$(-1/R_2)V_A + 0V_B + (1/R_2 + 1/R_4)V_C = -i_{s2}$