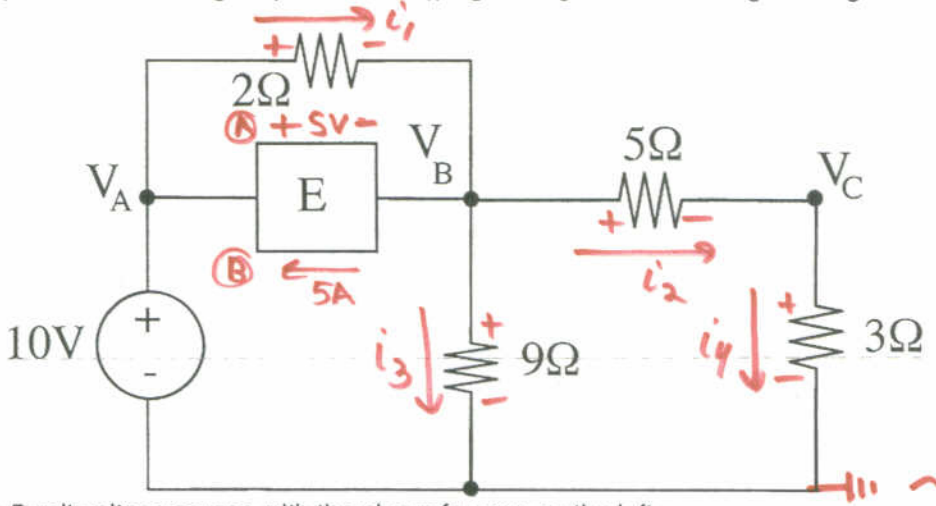
Name : Solution Section:_____ CWRU e-mail:_____

Quiz No. 4 2/11/05

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

NODE VOLTAGE ANALYSIS

1. (10 points) Write node voltage equations for V_A, V_B and V_C for the following circuit given that



(a) E is a 5 volt voltage source with the plus reference on the left.

NODE	Node Voltage Equations	
A	$1\ V_A + 0\ V_B + 0\ V_C = 10V$	(2) −1 for answer, −1 for V_A or V_C term
B	$0\ V_A + 1\ V_B + 0\ V_C = 5V$	(1) −1 for answer
C	$0\ V_A + -1/5\,\Omega\ V_B + 8/15\,\Omega\ V_C = 0$	(2) −1 for answer, −1 for V_B or V_C term

* $V_A - V_B = 5V$ also accepted

node A * $V_A - 0 = 10V$ $V_A = 10V$

node B * $V_A - V_B = 5V \rightarrow 10V - V_B = 5V$ $V_B = 5V$

node C * $-i_2 + i_4 = 0$ $-\frac{V_B - V_C}{5\Omega} + \frac{V_C - 0}{3\Omega} = 0$ $-\frac{V_B}{5} + \frac{V_C}{5} + \frac{V_C}{3} = 0$

$-\frac{1}{5}V_B + \frac{8}{15}V_C = 0$

(b) E is a 5 ampere current source with the reference arrow pointing left.

NODE	Node Voltage Equations	
A	$1\ V_A + 0\ V_B + 0\ V_C = 10V$	(1) −1 for answer
B	$-1/2\,\Omega\ V_A + 73/90\,\Omega\ V_B + -1/5\,\Omega\ V_C = -5A$	(2) −1 for answer, −1 for any right term
C	$0\ V_A + -1/5\,\Omega\ V_B + 8/15\,\Omega\ V_C = 0$	(2) −1 for answer, −1 for V_B or V_C term

node A * $V_A - 0 = 10V$ $V_A = 10V$

node B * $-i_1 + 5A + i_3 + i_2 = 0$ $-\frac{V_A - V_B}{2\Omega} + 5A + \frac{V_B - 0}{9\Omega} + \frac{V_B - V_C}{5\Omega} = 0$

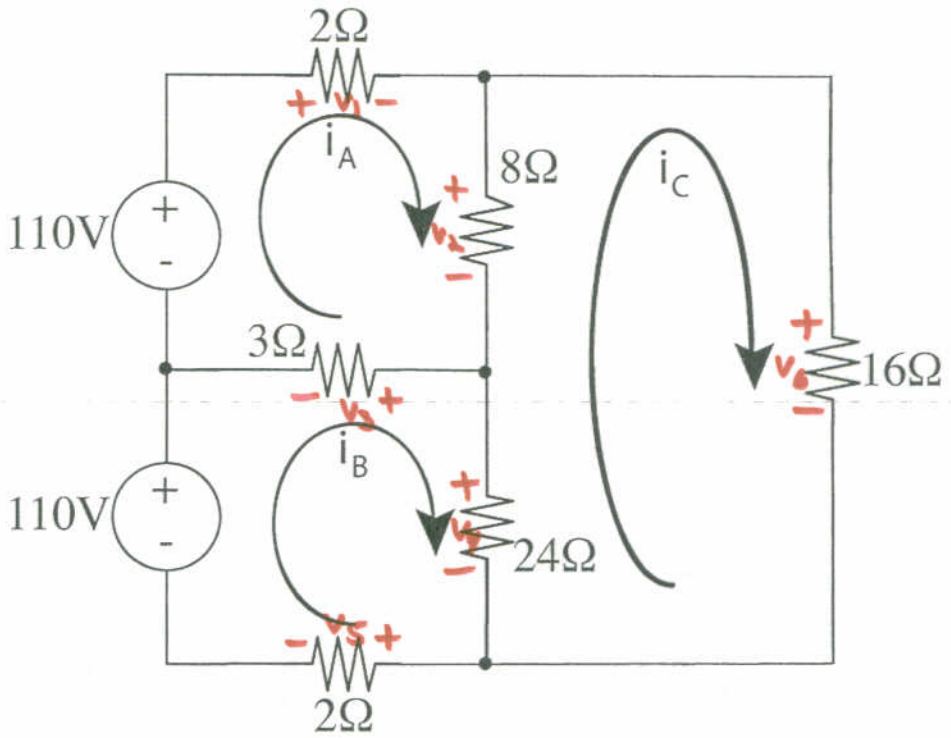
$-\frac{1}{2}V_A + \frac{73}{90}V_B - \frac{1}{5}V_C = -5A$

node C * $-i_2 + i_4 = 0$ $-\frac{V_B - V_C}{5\Omega} + \frac{V_C - 0}{3\Omega} = 0$ $-\frac{1}{5}V_B + \frac{8}{15}V_C = 0$

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

MESH CURRENT ANALYSIS

2. (10 points) The circuit shown below is a DC model of a residential power distribution circuit. Use the mesh current method to write equations for the indicated currents.



MESH	Mesh Current Equations
A	$13\Omega\, i_A + -3\Omega\, i_B + -8\Omega\, i_C = 110V$
B	$-3\Omega\, i_A + 29\Omega\, i_B + -24\Omega\, i_C = 110V$
C	$-8\Omega\, i_A + -24\Omega\, i_B + 48\Omega\, i_C = 0$

(3) – 1 for answer, 1 for any right term, 1 for right equation
(3) – same as above
(3) – same as above
(1) – general neatness; strategy

$-110V + v_1 + v_2 + v_3 = 0$
$-110V - v_3 + v_4 + v_5 = 0$
$-v_4 - v_2 + v_6 = 0$

$v_1 = (2\Omega) i_A$
$v_2 = (8\Omega)(i_A - i_C)$
$v_3 = (3\Omega)(i_A - i_B)$
$v_4 = (24\Omega)(i_B - i_C)$
$v_5 = (2\Omega) i_B$
$v_6 = (16\Omega) i_C$

$-110V + 2i_A + 8(i_A - i_C) + 3(i_A - i_B) = 0$
$-110V - 3(i_A - i_B) + 24(i_B - i_C) + 2i_B = 0$
$-24(i_B - i_C) - 8(i_A - i_C) + 16 i_C = 0$

$$13 i_A - 3 i_B - 8 i_C = 110V$$
$$-3 i_A + 29 i_B - 24 i_C = 110V$$
$$-8 i_A - 24 i_C + 48 i_C = 0$$