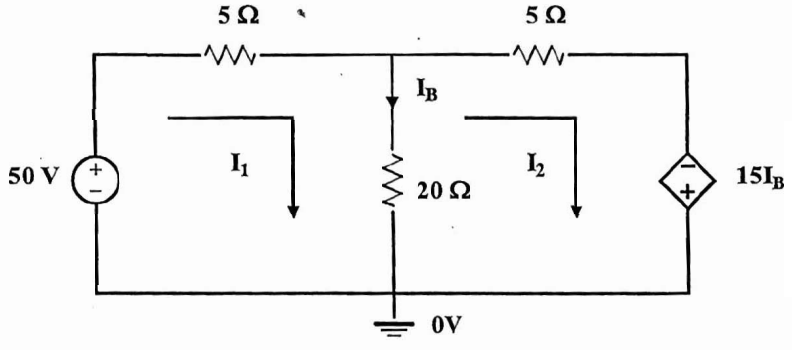
ECE 300
Spring Semester, 2008
Test #1

wlg: Test B : Section I: 11:10 AM **Name** _____
Print (last, first)

Work the exam on your own engineering paper. Work on one side of your paper only. Attach your work to the back of this exam sheet and staple in the top left hand corner. Each problem 20%. Be sure to give units for all your answers.

(1) You are given the circuit of Figure 1. Use mesh analysis in working this problem.

(a) Find the currents I_1 and I_2.
(b) Determine the power delivered to the dependent source.



(a) AROUND Mesh 1

$$-50 + 5I_1 + 20(I_1 - I_2) = 0$$

$$25I_1 - 20I_2 = 50$$

AROUND Mesh 2

$$20(I_2 - I_1) + 5I_2 - 15I_B = 0$$

$$I_B = I_1 - I_2$$

$$20(I_2 - I_1) + 5I_2 - 15(I_1 - I_2) = 0$$

$$-35I_1 + 40I_2 = 0$$

$$\begin{bmatrix} 25 & -20 \\ -35 & 40 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 50 \\ 0 \end{bmatrix}$$

$I_1 = 6.67\ A$

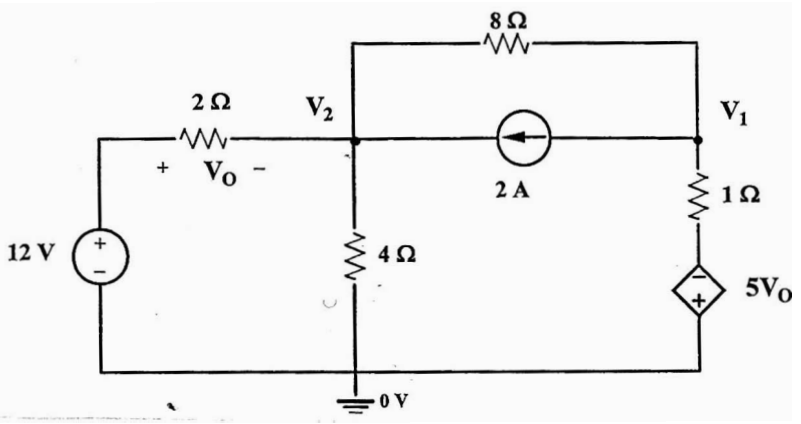
$I_2 = 5.83\ A$

(b)

$$P = -15I_B \times I_2 = -15(I_1 - I_2)I_2 = -73.46\ W$$

Test B

(2) Determine V_1 and V_2 for the circuit of Figure 2. Use <u>any method</u> you desire.



Use nodal analysis, easiest.

At V_2

$$\frac{V_2 - 12}{2} + \frac{V_2}{4} + \frac{V_2 - V_1}{8} - 2 = 0$$

$$4V_2 - 48 + 2V_2 + V_2 - V_1 - 16 = 0$$

$$-V_1 + 7V_2 = 64$$

At V_1

$$\frac{V_1 - V_2}{8} + 2 + \frac{V_1 + 5V_o}{1} = 0$$

but $V_o = 12 - V_2$

$$\frac{V_1 - V_2}{8} + 2 + V_1 + 5(12 - V_2) = 0$$

$$V_1 - V_2 + 16 + 8V_1 + 480 - 40V_2 = 0$$

$$9V_1 - 41V_2 = -496$$

(2) cont

$$\begin{bmatrix} -1 & 7 \\ 9 & -41 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} 64 \\ -496 \end{bmatrix}$$

$V_1 = -38.55\ V$ $V_2 = 3.64\ V$

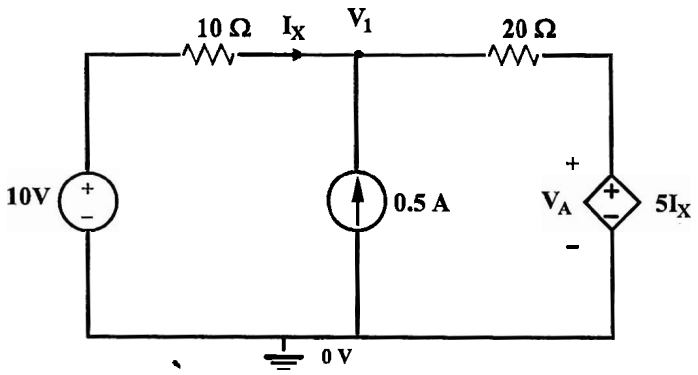
Test B

(3) This problem is the same as problem 3 on Test A. V_A and V_B have been reversed. This does not change the answers. See Test A for answers

Test B

(4) You are given the circuit of Figure 4. Use nodal analysis for this problem.

(a) Determine V_1.
(b) Determine V_A.



At V_1

$$20\left(\frac{V_1-10}{10}+\frac{V_1-V_A}{20}-0.5=0\right)$$

$$2V_1-20+V_1-V_A-10=0$$

$$\boxed{3V_1-V_A=30}$$

Constraint

$$V_A-5I_x=0$$

but $I_x=\frac{10-V_1}{10}$

$$V_A-5\left(\frac{10-V_1}{10}\right)=0$$

$$10V_A-50+5V_1=0$$

$$\boxed{5V_1+10V_A=50}$$

(4) cont.

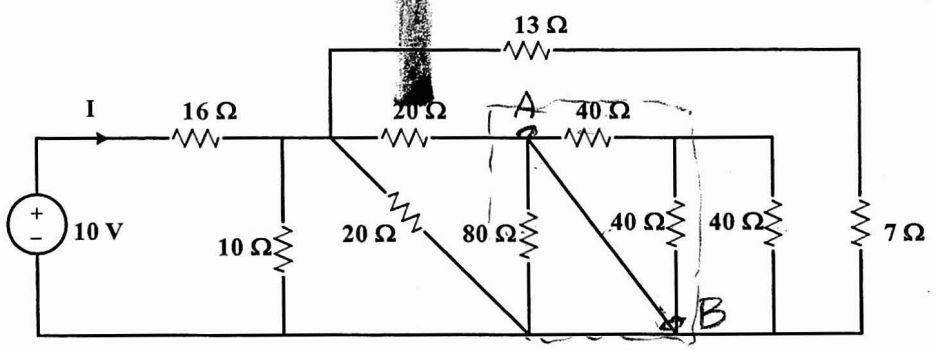
$$\begin{bmatrix} 3 & -1 \\ 5 & 10 \end{bmatrix} \begin{bmatrix} V_1 \\ V_A \end{bmatrix} = \begin{bmatrix} 30 \\ 50 \end{bmatrix}$$

$V_1 = 10V$; $V_A = 0V$

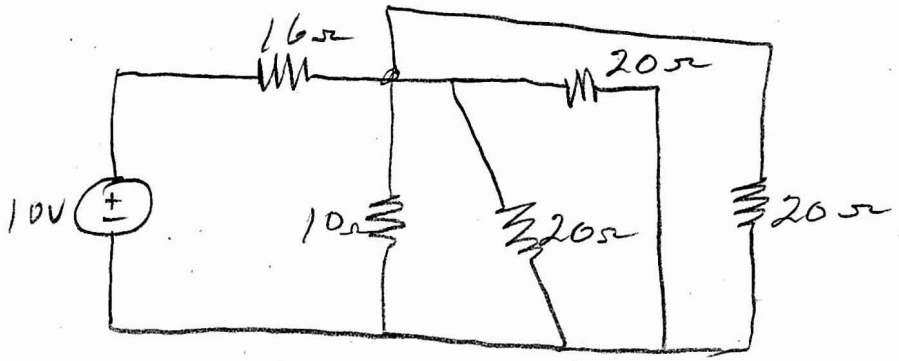
(a) $V_1 = 10\ V$

(b) $V_A = 0\ V$

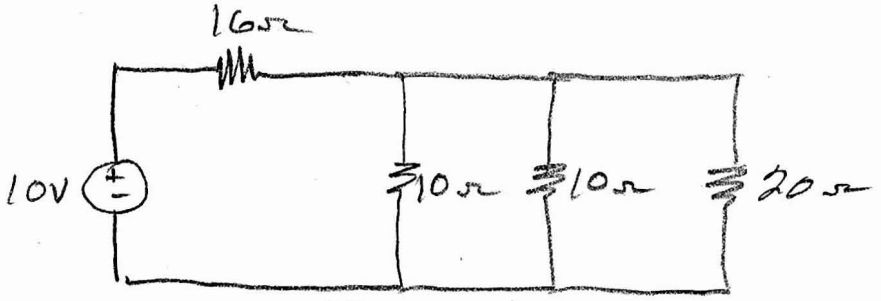
(5) You are given the circuit shown in Figure 5. Determine the current I. Do not use mesh analysis in your solution.

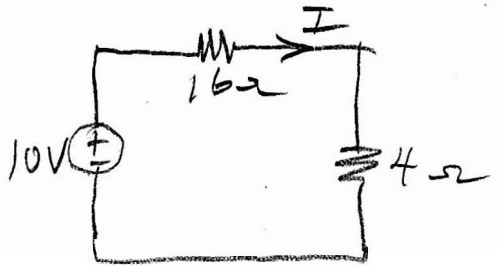


The short from A to B causes the circuit to change and becomes as given below



which becomes





$\therefore \quad I = \frac{10}{20} = 0.5\,A$