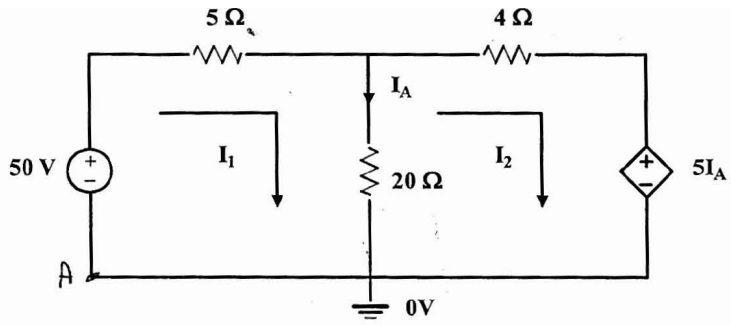
ECE 300
Spring Semester, 2008
Test #1

wlg: Test A : 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 how much power is being supplied by the dependent source.



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

$$25I_1 - 20I_2 = 50$$

$20(I_2 - I_1) + 4I_2 + 5(\overbrace{I_1 - I_2}^{I_A}) = 0 \rightarrow (I_A = I_1 - I_2)$

$$-15I_1 + 19I_2 = 0$$

$$\begin{bmatrix} 25 & -20 \\ -15 & 19 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 50 \\ 0 \end{bmatrix}$$

$I_1 = 5.43\ A$; $I_2 = 4.29\ A$

Test A

(1) continued

16) $P_{\substack{sup \\ 5I_A}} = (5I_A)(-I_2)$

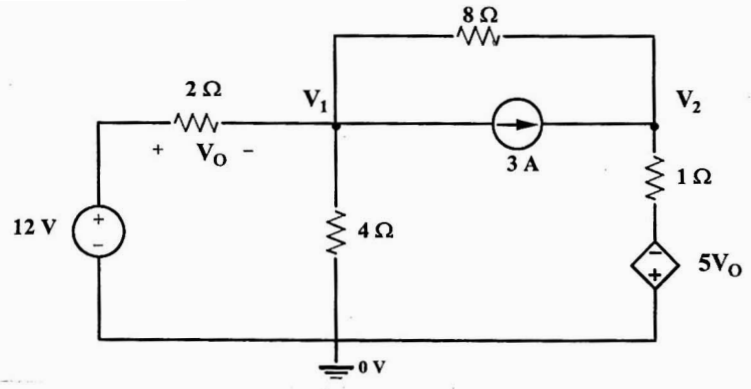
$= 5(I_1 - I_2)(-I_2)$

$= 5(5.43 - 4.29)(-4.29)$

$P_{\substack{sup \\ 5I_A}} = -24.45 \text{ W}$

Test A

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



Homework Problem
Easiest by nodal analysis

At V_1

$$8\left(\frac{V_1-12}{2}+\frac{V_1}{4}+\frac{V_1-V_2}{8}+3=0\right)$$

$$4V_1-48+2V_1+V_1-V_2+24=0$$

$$7V_1-V_2=24$$

At V_2

$$\frac{V_2-V_1}{8}-3+\frac{V_2+5V_o}{1}=0$$

but

$$12-V_o-V_1=0$$

$$V_o=12-V_1$$

$$\frac{V_2-V_1}{8}-3+V_2+5(12-V_1)=0$$

$$V_2-V_1-24+8V_2+480-40V_1=0$$

$$-41V_1+9V_2=-456$$

$V_1 = -10.9\text{V}$

$V_2 = -100.36\text{V}$

(2) cont.

$$\begin{bmatrix} 7 & -1 \\ -41 & 9 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} 24 \\ -456 \end{bmatrix}$$

$V_1 = -10.91\,V$; $V_2 = -100.36\,V$

Test A

(3) You are given the circuit of Figure 3. The following is know:

$V_A = 7$ V; $V_B = 0.5$ V

Use these values in answering the following questions.

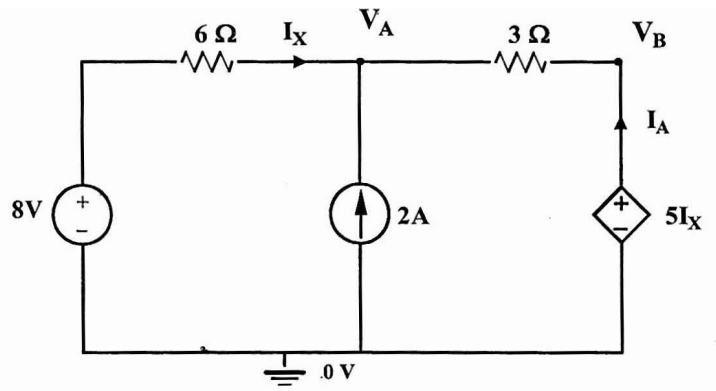


Figure 3: Circuit for problem 3.

(a) Determine the current I_X.
(b) Determine the power supplied by the dependent voltage source.
(c) Determine the power supplied by the independent current source.
(d) Determine the power supplied by the independent voltage source.
(e) Determine the power absorbed by the 6 Ω resistor.
(f) Determine the power absorbed by the 3 Ω resistor.

Case 1: Using the above circuit, $V_A \neq 7V$, $V_B \neq 0.5V$ (wrong label on dependent source) so we solve for V_A & V_B.

At V_A

$$\frac{V_A - 8}{6} + \frac{V_A - V_B}{3} - 2 = 0$$

Constraint:

$$V_B - 5I_x = 0$$

OR $$V_B - 5\left(\frac{8 - V_A}{6}\right) =$$

Solving gives; $V_A = 7.14V$; $V_B = 0.714V$

13) cont.

We now start the problem:

(a) $I_x = \frac{8 - V_A}{6} = \frac{8 - 7.14}{6} = 0.143\ A$

(b) $P_{\substack{sup \\ 5I_x}} = (5I_x)(I_A)$

$I_A = -(I_x + 2) = -2.143\ A$

Check:

$I_A = \frac{V_B - V_A}{3} = \frac{0.714 - 7.14}{3} = -2.14\ A$ check

$P_{\substack{sup \\ 5I_x}} = (5 \times 0.143)(-2.143) = -1.53\ W$

(c) $P_{\substack{sup \\ 2A}} = V_A \times 2 = 7.14 \times 2 = 14.28\ W$

(d) $P_{\substack{sup \\ 8V}} = 8 \times I_x = 1.14\ W$

$\Sigma\ supplied = (1.14 - 1.53 + 14.28)W = 13.89\ W$

(e) $P_{\substack{ABS \\ 6\Omega}} = I_x^2 \times 6 = (.143)^2 \times 6 = 0.123\ W$

(f) $P_{\substack{ABS \\ 3\Omega}} = I_A^2 \times 3 = (2.143)^2 \times 3 = 13.77\ W$

$\Sigma\ Absorbed = 13.89\ W$ checks

Test A

(3) cont

using the dependent source as $3I_x$ rather than $5I_x$, leads to

$V_A = 7\ V, \quad V_B = 0.5V$ (for sure)

(a)

$$I_x = \frac{8 - V_A}{6} = \frac{1}{6}\ A = 0.167\ A$$

(b) $P_{sup}_{3I_x} = (3I_x) I_A$

where $I_A = -(I_x + 2) = -\frac{13}{6} = -2.167A$

check

$$I_A = \frac{V_B - V_A}{3} = \frac{-6.5}{3} = -2.167\ A$$

$$P_{sup}_{3x} = 3 \times \left(\frac{1}{6}\right)(-2.167) = -1.084\ W$$

(c) $P_{sup}_{2A} = V_A \times 2 = 14\ W$

(d) $P_{sup}_{8V} = 8 \times I_x = 8 \times \frac{1}{6} = 1.333 W$

Σ supplied $= (1.333 + 14 - 1.084) = \underline{14.25\ W}$

(e) $P_{ABS}_{6\Omega} = I_x^2 \times 6 = \left(\frac{1}{6}\right)^2 \times 6 = 0.1667\ W$

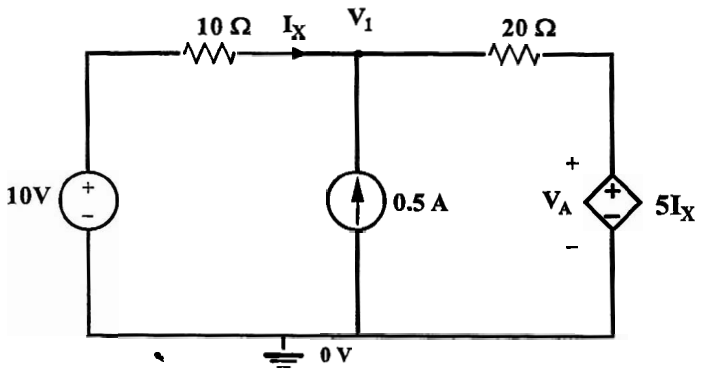
(f) $P_{ABS}_{3\Omega} = I_A^2 \times 3 = (2.167)^2 \times 3 = 14.088\ W$

Σ Absorbed $= (14.088 + 0.1667) = 14.25\ W$ checks

Test A

(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

$$V_A-5I_x=0$$

where

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

so

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

$$10V_A-50+5V_1$$

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

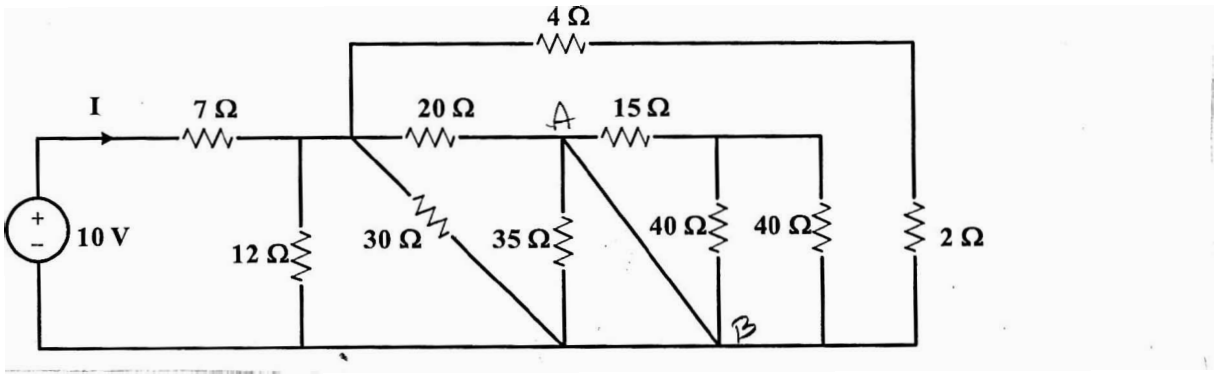
$$\begin{bmatrix} 3 & -1 \\ 5 & 10 \end{bmatrix} \begin{bmatrix} V_1 \\ V_A \end{bmatrix} = \begin{bmatrix} 30 \\ 50 \end{bmatrix}$$

$V_1 = 10\ V \qquad V_A = 0\ V$

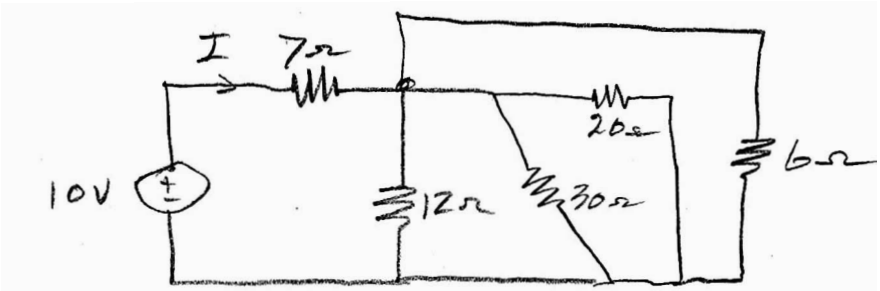
(a) $V_1 = 10\ V$

(b) $V_A = 0\ V$

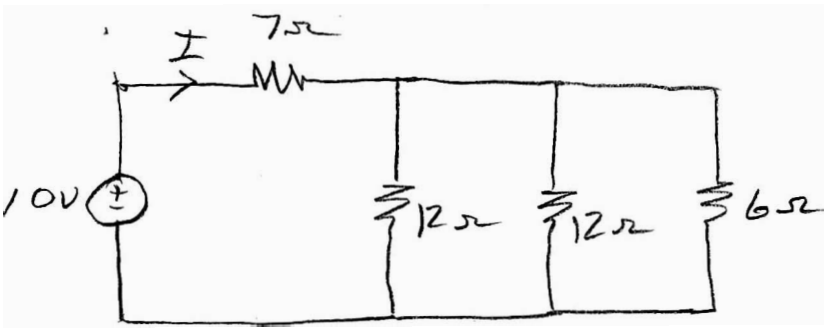
(5) You are given the circuit shown in Figure 5. Determine the current I. Do not use mesh analysis in your solution.



The short from A to B causes the circuit to become as follows



which becomes;



Giving $I = \frac{10}{10} = 1A$