ECE 301
Spring Semester, 2007
Test #1

wlg Test B **Name** _____
Print (last, first)

Work the exam on the paper provided. Each problem counts 25%.

(1) You are given the circuit of Figure 1.

Use nodal analysis to find voltages v_1 and v_2.

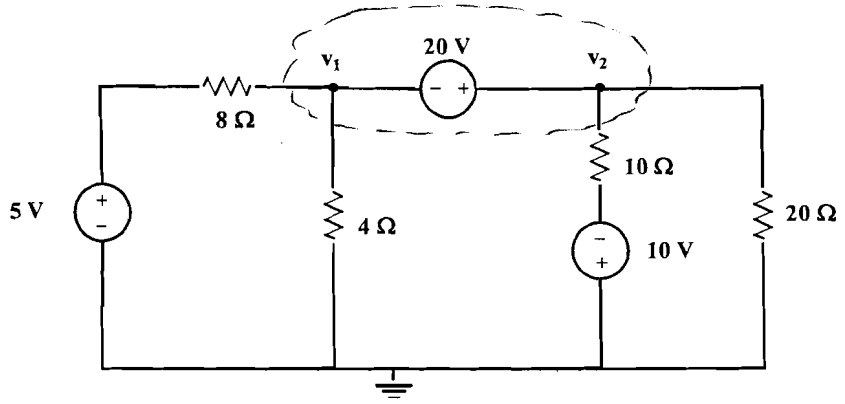


Figure 1: Circuit diagram for problem 1.

We have a super node as indicated

$$40\left(\frac{V_1-5}{8}+\frac{V_1}{4}+\frac{V_2+10}{10}+\frac{V_2}{20}=0\right)$$

$$5V_1-25+10V_1+4V_2+40+2V_2=0$$

$$15V_1+6V_2=-15$$

constraint

$$V_1+20-V_2=0$$

$$V_1-V_2=-20$$

$$\begin{bmatrix}15 & 6\\ 1 & -1\end{bmatrix}\begin{bmatrix}V_1\\ V_2\end{bmatrix}=\begin{bmatrix}-15\\ -20\end{bmatrix}$$

$V_1 = -6.43\,V$ $V_2 = 13.57\,V$

(2) You are given the circuit of Figure 2.

Determine the value of R_L so that maximum power will be delivered to R_L.

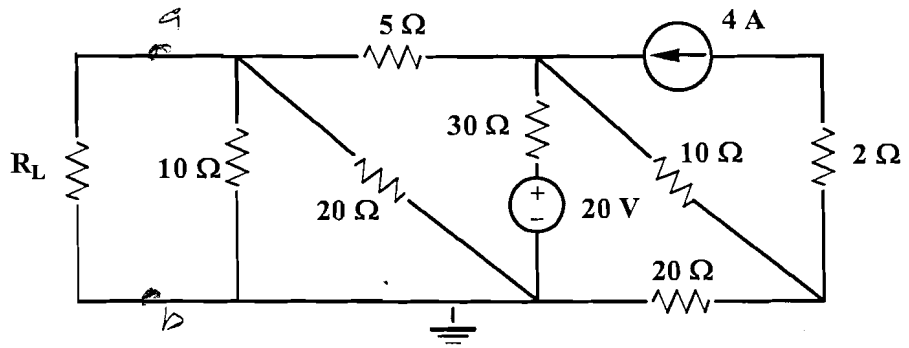
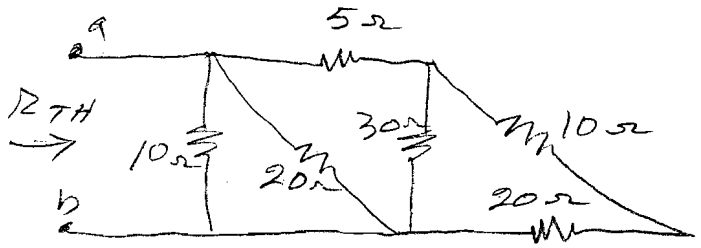


Figure 2: Circuit diagram for problem 2

To get maximum power transfer, R_L equals the resistance seen looking into terminals a-b.



$$R_{TH} = (((10+20)\,||\,30 + 5)\,||\,20)\,||\,10$$

$$(10+20)\,||\,30 = \frac{30\times 30}{60} = 15\,\Omega$$

$$(15+5)\,||\,20 = \frac{20\times 20}{20+20} = 10\,\Omega$$

$$10\,||\,10 = \frac{10\times 10}{10+10} = 5\,\Omega$$

So $R_L = 5\,\Omega$

(3) You are given the circuit of Figure 3.

(a) Find the Thevenin equivalent circuit looking into terminals a-b.

(b) Draw the Thevenin equivalent circuit and determine the current flowing through a 20 Ω resistor connected between terminals a-b.

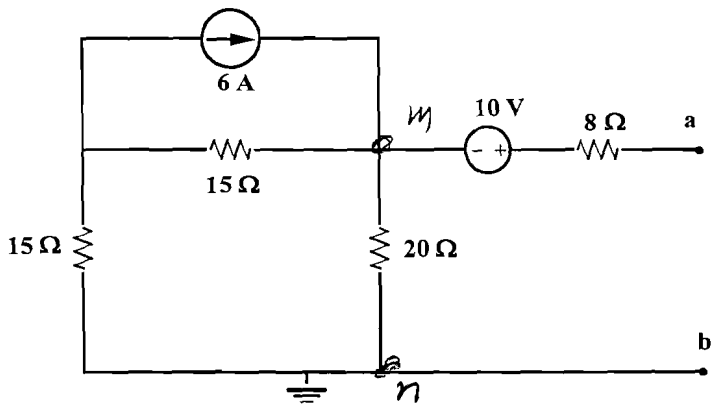
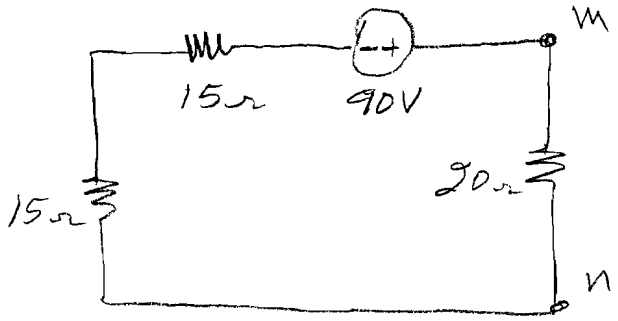


Figure 3: Circuit diagram for problem 2.

Use source transformation



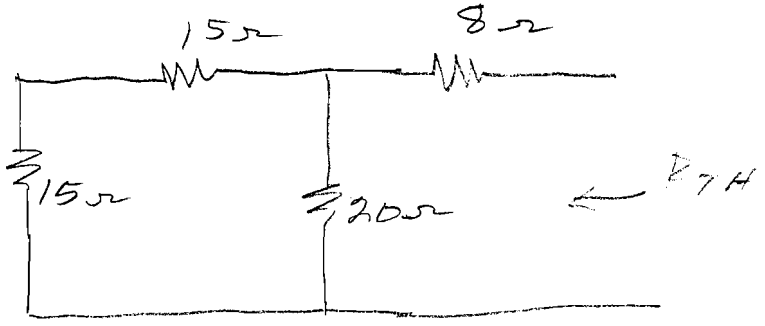
By voltage division

$$V_{mn} = \frac{90 \times 20}{20 + 15 + 15} = 36V$$

$$V_{oc} = V_{TH} = V_{mn} + 10 = 46V$$

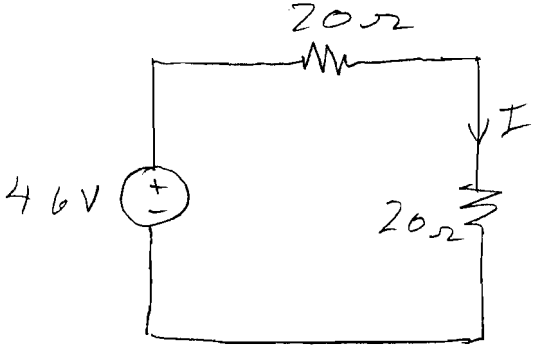
3B

FOR R_{TH}



$$R_{TH} = (15+15)\,//\,20 + 8$$

$$R_{TH} = 12 + 8 = 20\Omega$$



$$I = \frac{46}{40} = 1.15\ A$$

(4) You are given the circuit of Figure 4.

(a) Use mesh analysis to find currents I_1 and I_2 as indicated in the diagram.

(b) How much power is supplied by the 50 V source?

(c) How much power is absorbed by the 10 Ω resistor?

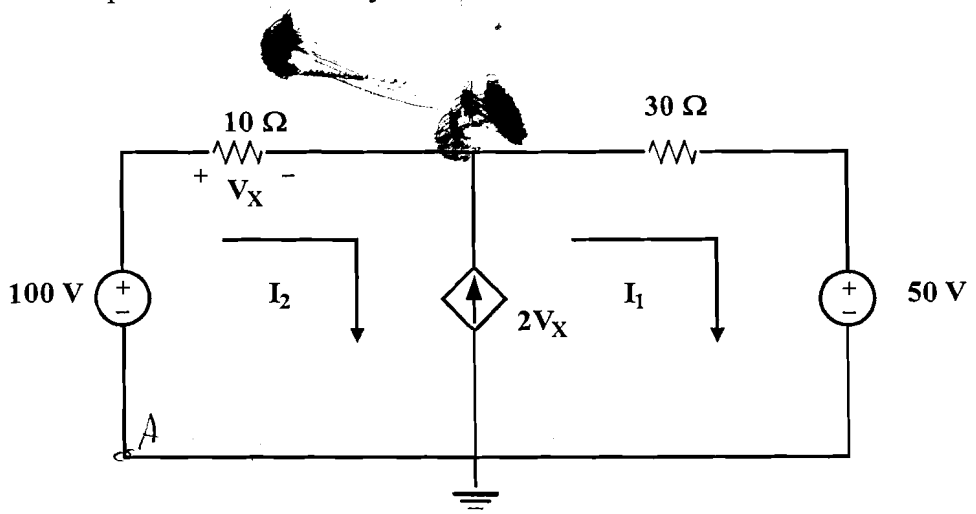


Figure 4: Circuit diagram for problem 1.

1(a) We have a super mesh.

Start at A, go c.w, $\sum drops = 0$

$-100 + 10I_2 + 30I_1 + 50 = 0$

$30I_1 + 10I_2 = 50$

Constraint

$I_1 - I_2 = 2V_x = 2 \times 10 I_2$

$I_1 - 21I_2 = 0$

$$\begin{bmatrix} 30 & 10 \\ 1 & -21 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 50 \\ 0 \end{bmatrix}$$

$I_1 = 1.64$ A, $I_2 = 0.078$ A

(b)

$$P = -50 I_1$$

$$P_{\underset{30}{sup}} = -50 \times 1.64 = -82\,W$$

$$\boxed{P_{\underset{30}{sup}} = -82\,W}$$

(c) $$P_{\underset{10}{ABS}} = I_2^2 \times 10 = 0.078)^2 \times 10$$

$$\boxed{P_{\underset{10}{ABS}} = 0.0608\,W}$$