ECE 301
Spring Semester, 2007
Test #1

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

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

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

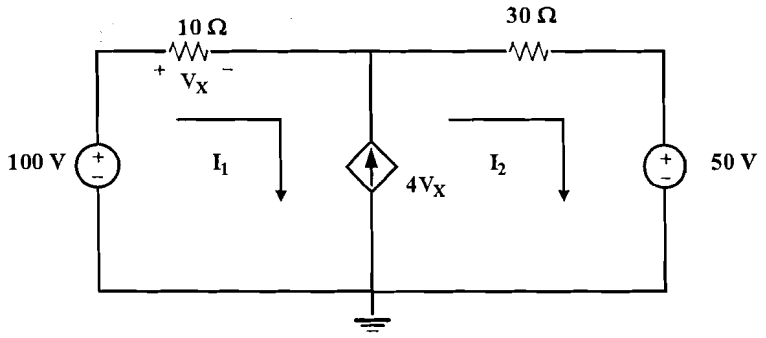


Figure 1: Circuit diagram for problem 1.

1(a)

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

$$10I_1 + 30I_2 = 50$$

$$I_2 - I_1 = 4V_x = 4 \times 10I_1$$

$$-41I_1 + I_2 = 0$$

$$\begin{bmatrix} 10 & 30 \\ -41 & 1 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 50 \\ 0 \end{bmatrix}$$

$I_1 = 0.04A$ $I_2 = 1.65A$

1b)

$$P_{\underset{50}{sup}} = -50 I_2 = -50(1.65)$$

$$\boxed{P_{\underset{50}{sup}} = -82.5\ W}$$

1c) $P_{10} = I_1^2 \times 10 = (0.04)^2 \times 10$

$$\boxed{P_{10} = 0.016\ W}$$

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

(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.

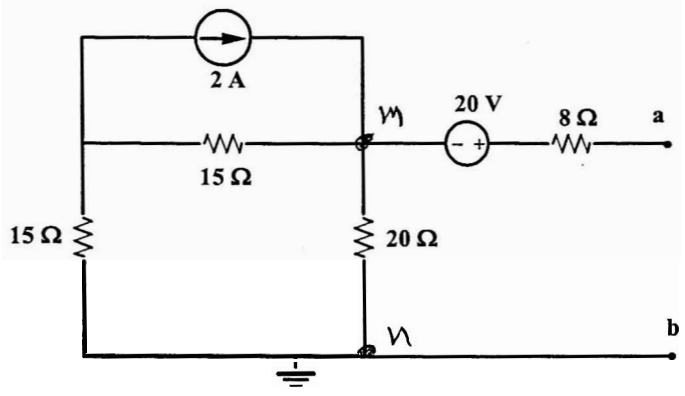
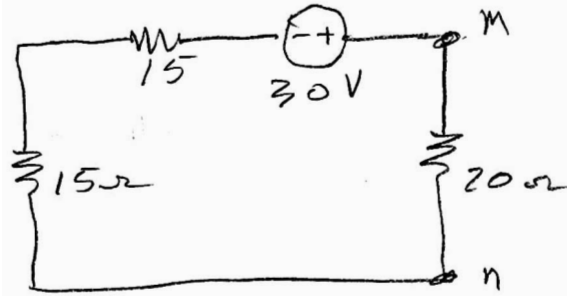


Figure 2: Circuit diagram for problem 2.

Use source transformation:



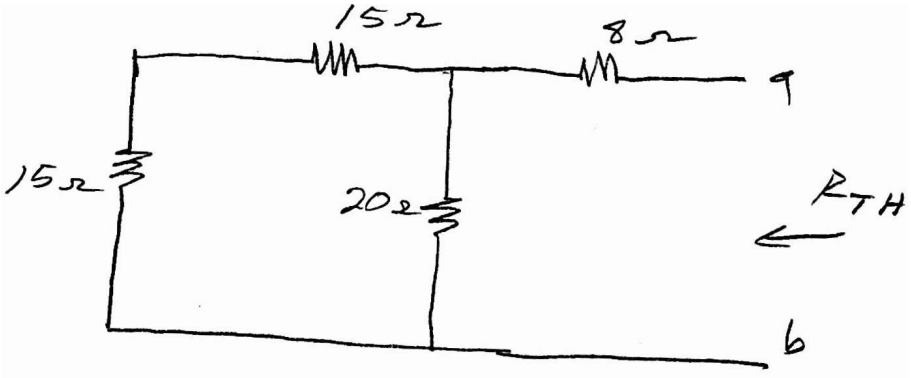
Using voltage division;

$$V_{mn} = \frac{30 \times 20}{20 + 15 + 15} = 12V$$

$$V_{TH} = V_{mn} + 20 = 32V$$

(2) A

FOR R_{TH}

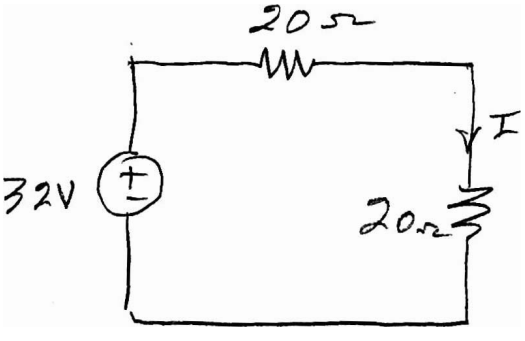


$$R_{TH} = (15+15) \parallel 20 + 8$$

$$= \frac{30 \times 20}{30+20} + 8$$

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

(b)



$$I = \frac{32}{40} = 0.8\ A$$

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

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

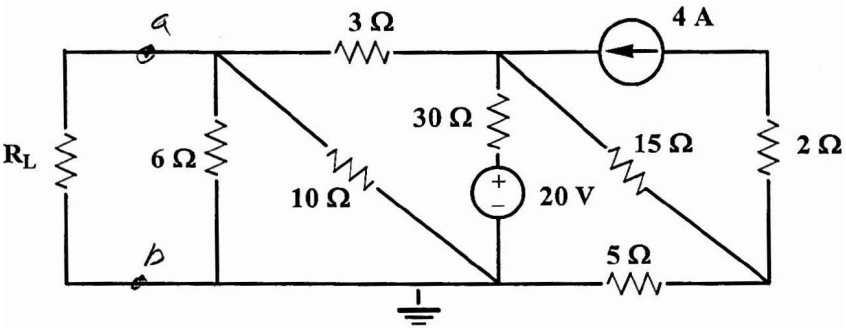
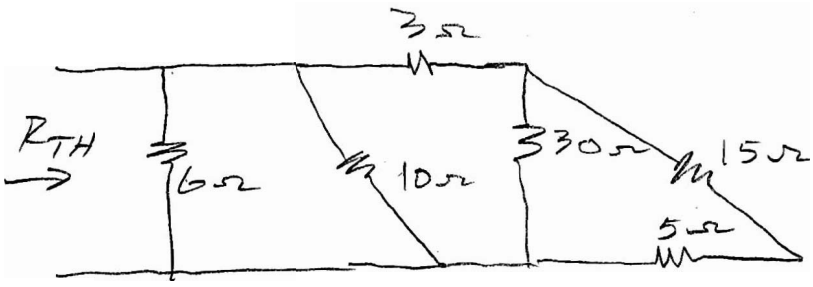


Figure 3: Circuit diagram for problem 3.

The R_L will be the resistance seen looking into terminals a-b.



$$R_{TH} = (((15+5) \parallel 30 + 3) \parallel 10) \parallel 6$$

$$(15+5) \parallel 30 = \frac{20 \times 30}{50} = 12\,\Omega$$

$$(12+3) \parallel 10 = \frac{15 \times 10}{25} = 6\,\Omega$$

$$6 \parallel 6 = 3\,\Omega$$

40

$$R_L = 3\,\Omega$$

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

Use nodal analysis to find voltages v_1 and v_2.

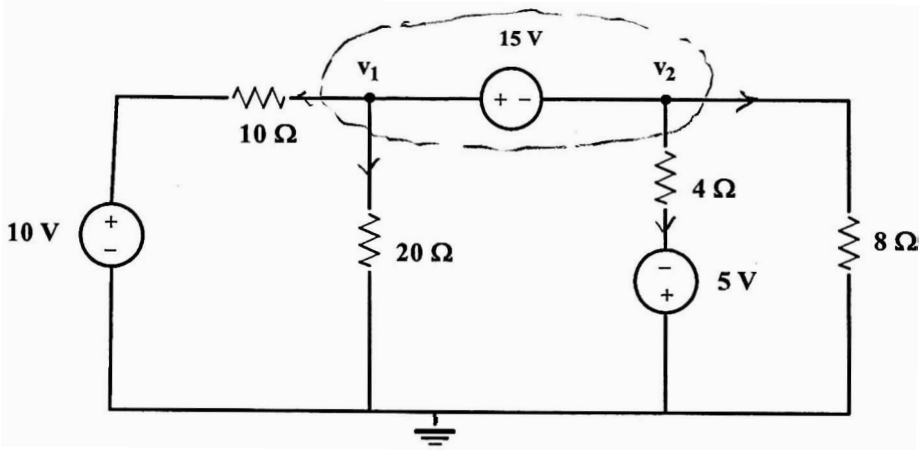


Figure 4: Circuit diagram for problem 4.

We have a supernode.

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

$$4V_1-40+2V_1+10V_2+50+5V_2=0$$

$$\boxed{6V_1+15V_2=-10}$$

Constraint

$$V_1-15-V_2=0$$

$$\boxed{V_1-V_2=15}$$

$$\begin{bmatrix}6 & 15\\ 1 & -1\end{bmatrix}\begin{bmatrix}V_1\\ V_2\end{bmatrix}=\begin{bmatrix}-10\\ 15\end{bmatrix}$$

$$\boxed{V_1=10.24\,V} \qquad \boxed{V_2=-4.76\,V}$$