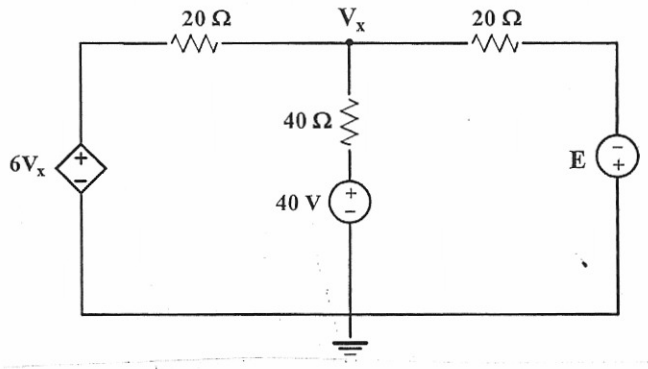
ECE 301
Test #1
FALL 2006

wlg **Version B**

(1) You are given the circuit of Figure 1. Find the value of E that will make $V_x = 0$ volts.



Using Nodal Analysis

At V_x

$$\frac{V_x - 6V_x}{20} + \frac{V_x - 40}{40} + \frac{V_x + E}{20} = 0$$

$$2V_x - 12V_x + V_x - 40 + 2V_x + 2E = 0$$

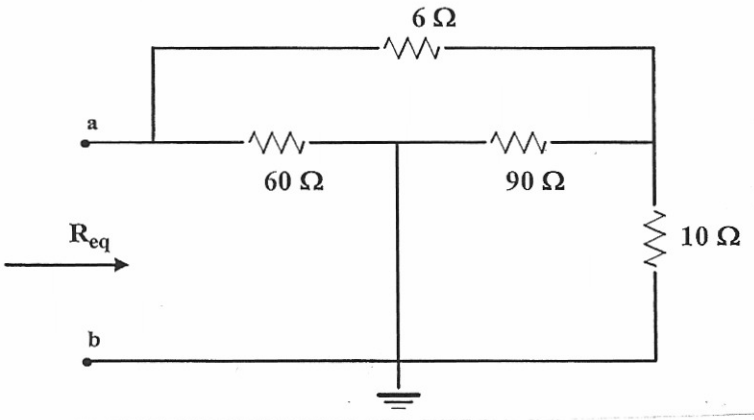
$$-7V_x - 40 + 2E = 0$$

If $V_x = 0$,

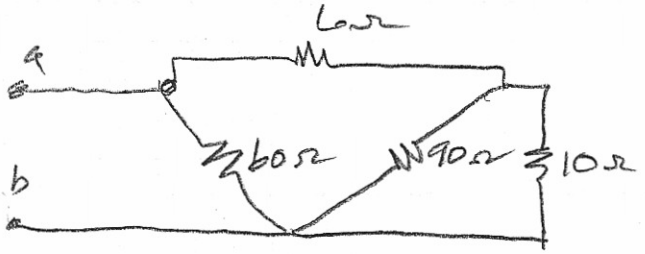
$$2E = 40$$

$$\boxed{E = 20\ V}$$

(2) You are given the circuit of Figure 2. Solve for R_{eq}, resistance looking into terminals a-b.

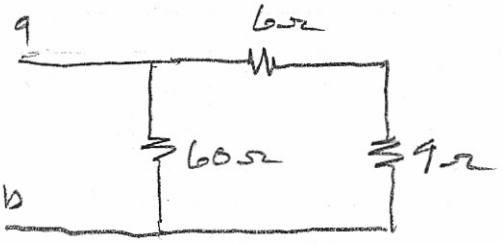


Re-draw the circuit:



$(10 \| 90 + 6) \| 60 = 12\,\Omega$

$90 \| 10 = \frac{900}{100} = 9\,\Omega$



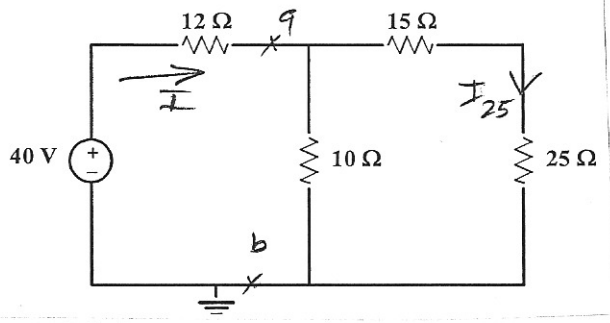
$R_{eq} = R_{ab} = 60 \| 15 = \frac{60 \times 15}{60 + 15} = 12\,\Omega$

$R_{eq} = 12\,\Omega$

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

(a) Find the power supplied by the 40 V source.

(b) Find the power absorbed by the 25 Ω resistor.



Resistance to the right of a-b

$$R_{ab} = 10 \| 40 = \frac{400}{10+40} = \frac{400}{50}$$

$$R_{ab} = 8\ \Omega$$

Resistance seen by the source $= 12 + 8 = 20\ \Omega$

$$I = \frac{40}{20} = 2\ A$$

Using current division

$$I_{25} = \frac{I \times 10}{10+40} = \frac{2 \times 10}{50} = 0.4\ A$$

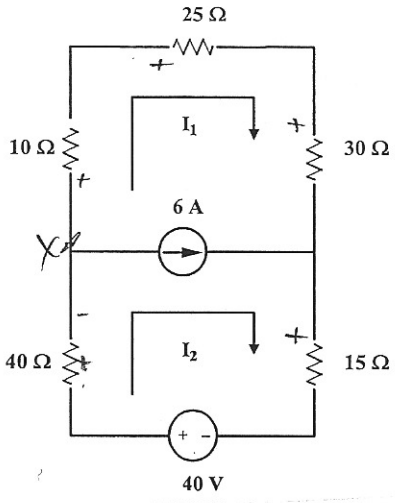
$$P_{Abs_{25}} = I_{25}^2 \times 25 = (0.4)^2 \times 25 = 4\ W$$

$$\boxed{P_{Abs_{25}} = 4\ W}$$

$$P_{sup_{40}} = 40 \times I = 40 \times 2 = 80\ W$$

$$\boxed{P_{sup_{40}} = 80\ W}$$

(4) You are given the circuit of Figure 4. Use mesh analysis to solve for I_1 and I_2.



$$10I_1 + 25I_1 + 30I_1 + 15I_2 - 40 + 40I_2 = 0$$

$$65I_1 + 55I_2 = 40$$

Constraint

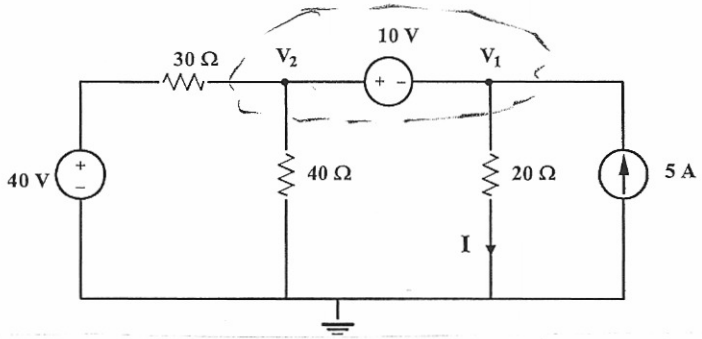
$$I_1 - I_2 = -6$$

$$\begin{bmatrix} 65 & 55 \\ 1 & -1 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 40 \\ -6 \end{bmatrix}$$

$I_1 = -2.417$ A

$I_2 = 3.583$ A

(5) You are given the circuit of Figure 5. Use nodal analysis to find the current I as indicated.



Super Mesh

120 $\frac{V_2 - 40}{30} + \frac{V_2}{40} + \frac{V_1}{20} = 5$

$4V_2 - 160 + 3V_2 + 6V_1 = 600$

$6V_1 + 7V_2 = 760$

Constraint

$V_2 - 10 - V_1 = 0$

$-V_1 + V_2 = 10$

$$\begin{bmatrix} 6 & 7 \\ -1 & 1 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} 760 \\ 10 \end{bmatrix}$$

$V_1 = 53.08V$

$V_2 = 63.08V$

$I = \frac{V_1}{20} = \frac{53.08}{20}$

$I = 2.65A$