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ECE 301
Fall Semester, 2005
Test #1

wlg **Version B**

Name wlg
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. You may omit one problem: either problem 1, or 2. Indicate at the top of the exam cover sheet which problem you omit. Each problem counts 25%.

(1) You are given the circuit of Figure 1. Find the current I_o. Use any method.

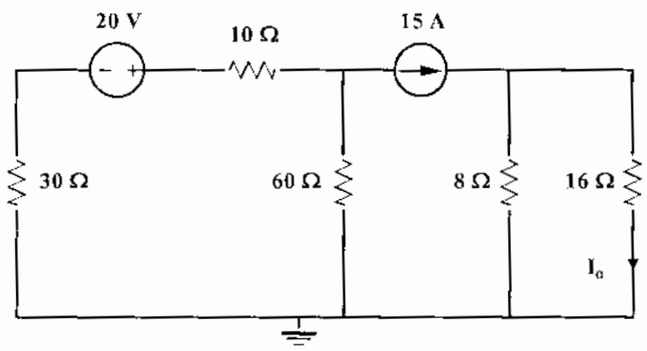

Figure 1: Circuit for problem 1.

(2) You are given the circuit of Figure 2.
(a) Find the voltage V_{ab}. Use any method.
(b) Find the power dissipated in the 5 Ω resistor.

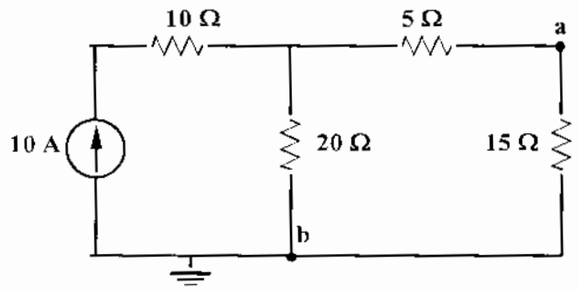

Figure 2: Circuit for problem 2.

(3) You are given the circuit of Figure 3. Use mesh analysis to find the mesh currents I_1 and I_2 as indicated in the diagram.

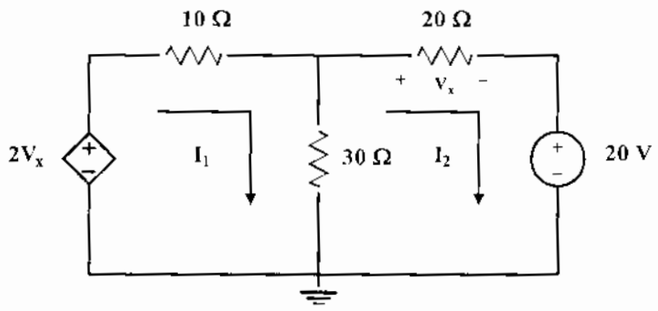

Figure 3: Circuit for problem 3.

(4) You are given the circuit of Figure 4.
(a) Find V_{TH} and R_{TH} for the circuit looking into terminals a-b.
(b) Draw the Thevenin circuit. Show the terminals a-b on your diagram.
(c) Using the information from the Thevenin circuit, draw the Norton equivalent circuit to the left of a-b. Show terminals a-b on your drawing.

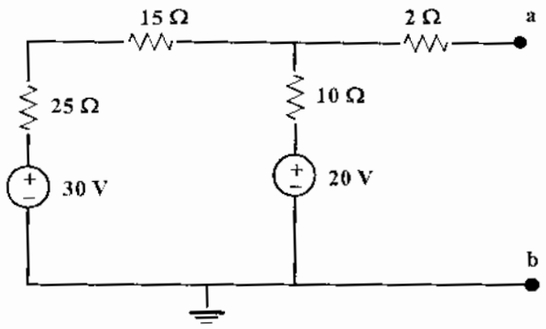

Figure 4: Circuit for problem 4

(5) You are given the circuit of Figure 5.
(a) Use nodal analysis to find V_1 and V_2.
(b) Find the current I_o in the 30 Ω resistor.

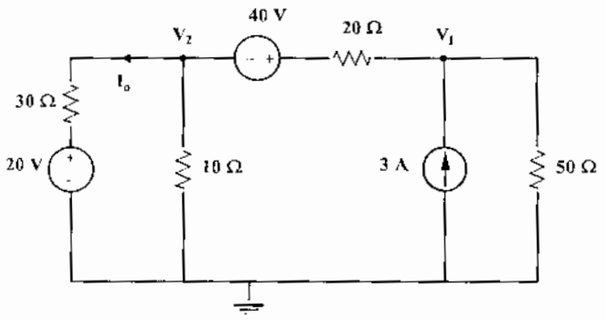

Figure 5: Circuit for problem 5.

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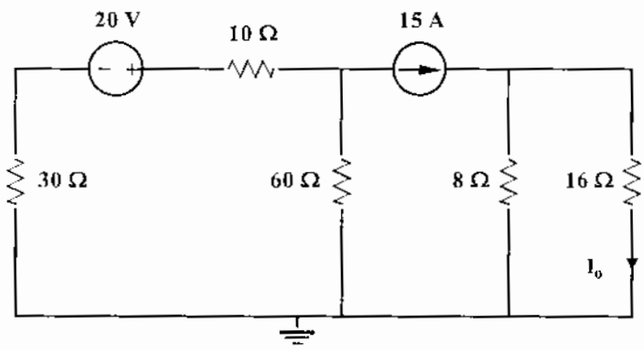
(1) Find I_o in the following circuit.

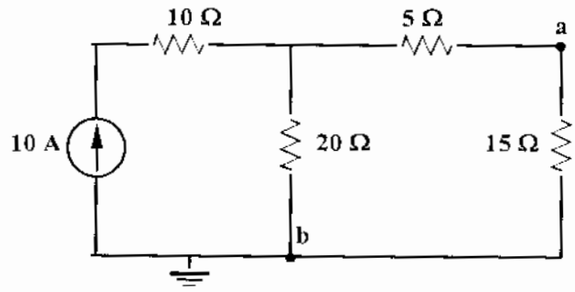


Since the 15 A source feeds the 2 parallel resistors, we may use current division.

$$I_o = \frac{15 \times 8}{16 + 8} = 5\,A$$

$$\boxed{I_o = 5\,A}$$

(2) (a) FIND V_{ab} ; (b) FIND Power dissipated in the 5Ω resistor.



FIND the THEVENIN to the left of a-b

R_{TH}: Disable the 10A source

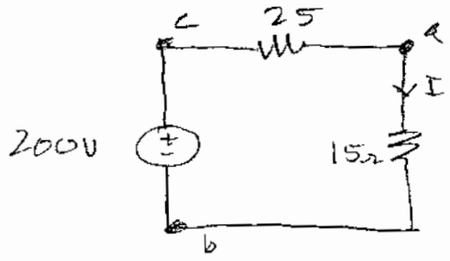
$$R_{IN} = 5 + 20 = 25\Omega$$

$$\boxed{R_{TH} = 25\Omega}$$

V_{TH}

$$V_{TH} = 10 \times 20 = 200V$$

Nodal analysis is easier on this problem.



$$V_{ab} = \frac{200 \times 15}{15 + 25} = 75V$$

$$\boxed{V_{ab} = 75V}$$

$$I = \frac{200}{40} = 5A$$

$$P_{5\Omega} = I^2 R = 5^2 \times 5 = 125W$$

$$\boxed{P_{5\Omega} = 125W}$$

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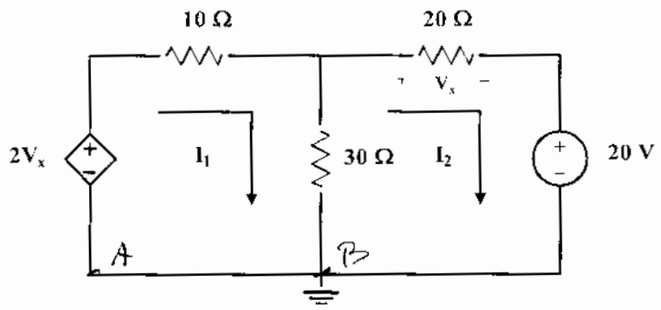
(3) Use mesh analysis to find I_1 and I_2.



start at A, cw, drops = 0

$$-2V_x + 10I_1 + 30(I_1 - I_2) = 0$$

but $V_x = 20I_2$

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

$$40I_1 - 70I_2 = 0$$

start at B, go cw, use drops = 0

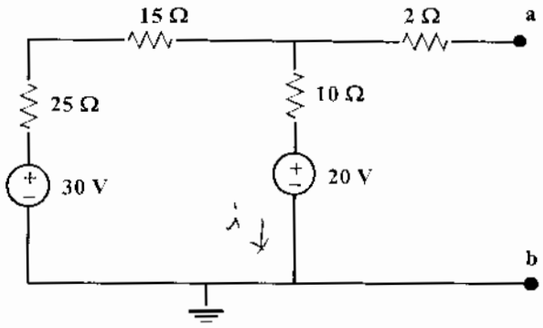
$$-30(I_1 - I_2) + 20I_2 + 20 = 0$$

$$-30I_1 + 50I_2 = -20$$

$$\begin{bmatrix} 40 & -70 \\ -30 & 50 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 0 \\ -20 \end{bmatrix}$$

$I_1 = 14\text{ A}$, $I_2 = 8\text{ A}$

(4) (a) Find V_{TH}, R_{TH}, circuit
(b) Develop Norton, circuit
} show a-b



R_{TH}: Disable voltage sources. Find R_{IN}

$R_{IN} = 2 + 10 \| 40 = 10\ \Omega$

$R_{TH} = 10\ \Omega$

V_{TH}

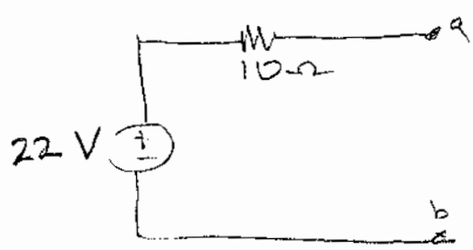
$-30 + 25i + 15i + 10i + 20 = 0$

$50i = 10$

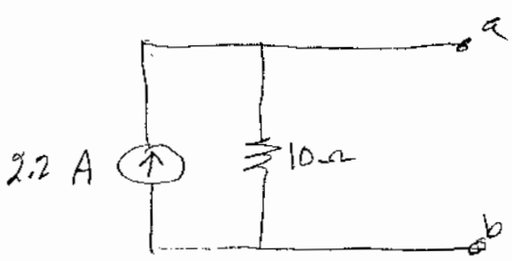
$i = 0.2\ A$

$V_{ab} = 20 + 10 \times 0.2 = 22\ V$

$V_{TH} = 22\ V$



Thevenin circuit



Norton circuit

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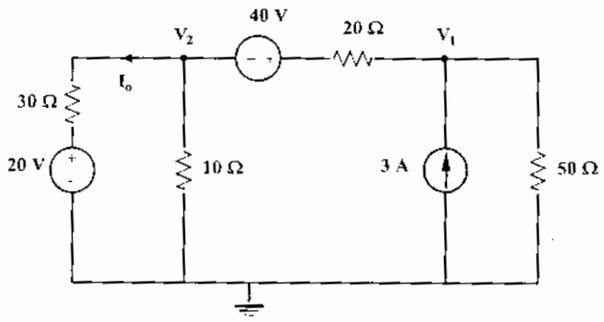
⑤ (a) Use nodal, find V_1 & V_2

(b) Find I_o.



At V_1

100) $\frac{V_1}{50} + \frac{V_1 - 40 - V_2}{20} = 3$

$2V_1 + 5V_1 - 200 - 5V_2 = 300$

$$7V_1 - 5V_2 = 500$$

At V_2

60) $\frac{V_2}{10} + \frac{V_2 - 20}{30} + \frac{V_2 + 40 - V_1}{20} = 0$

$6V_2 + 2V_2 - 40 + 3V_2 + 120 - 3V_1 = 0$

$$-3V_1 + 11V_2 = -80$$

$$\begin{bmatrix} 7 & -5 \\ -3 & 11 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} 500 \\ -80 \end{bmatrix}$$

$V_1 = 82.3\ V$ $\quad$ $V_2 = 15.16\ V$

$I_o = \frac{V_2 - 20}{30} = -0.16\ A$

$$I_o = -0.16\ A$$