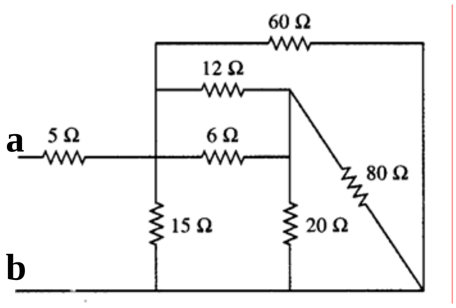
AMERICAN UNIVERSITY OF BEIRUT
ELECTRICAL AND COMPUTER ENGINEERING DEPARTMENT

EECE 210 | Electric Circuits | Fall 2006-2007

QUIZ I- Solution

Problem 1 (4 points)

Find the equivalent resistance between terminals a and b for the circuit shown below

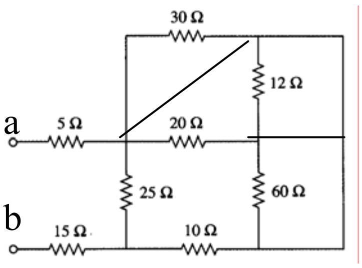


Answer:

$$R_{Th} = [\{[(6//12)+(80//20)]//60\}//15]+5$$
$$= ([\{4+16\}//60]//15)+5 = (20//60//15)+5 = (15//15)+5 = 7.5+5 = 12.5\Omega$$

Problem 2 (4 pts)

Find the equivalent resistance between terminals a and b for the circuit shown below



a. 30//0 = 0 Ω,

b. 12//0 = 0 Ω

c. 60 // 0 = 0 Ω

d. 20 // 0 = 0 Ω

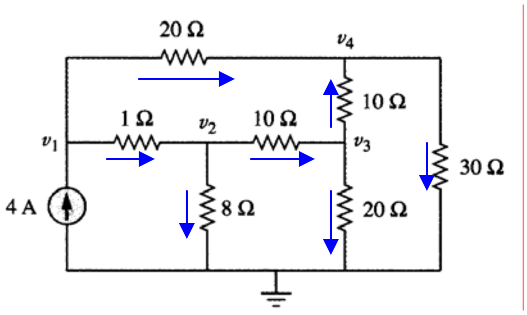
e. 0+0+10 = 10 Ω

f. 10//25 = 50/7 Ω

g. $R_{Th} = 5+15+50/7 = \dfrac{35+105+50}{7} = \dfrac{190}{7}\Omega$

Problem 3 (6 pts)

Write the node voltage-equations for the circuit shown below. Do not solve.



at Node v_1, $$4=\frac{v_1-v_2}{1}+\frac{v_1-v_4}{20}$$

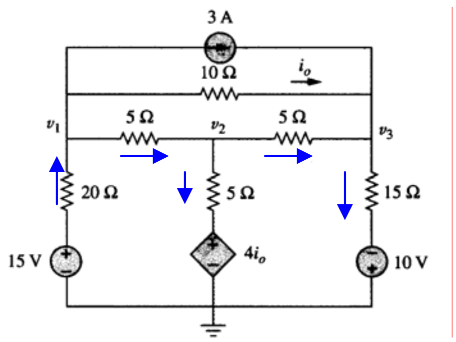
at Node v_2, $$\frac{v_1-v_2}{1}=\frac{v_2-v_3}{10}+\frac{v_2}{8}$$

at Node v_3, $$\frac{v_2-v_3}{10}=\frac{v_3}{20}+\frac{v_3-v_4}{10}$$

at Node v_4, $$\frac{v_1-v_4}{20}+\frac{v_3-v_4}{10}=\frac{v_4}{30}$$

Problem 4 (6 pts)

Write the node voltage-equations for the circuit shown below. Do not solve.



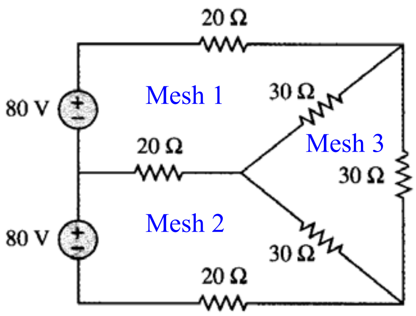
at Node v_1, $$\frac{15-v_1}{20}=3+\frac{v_1-v_2}{5}+\frac{v_1-v_3}{10}$$

at Node v_2, $$\frac{v_1-v_2}{5}=\frac{v_2-v_3}{5}+\frac{v_2-4i_0}{5}$$, Extra Equation : $$i_0=\frac{v_1-v_3}{10}$$

at Node v_3, $$\frac{v_2-v_3}{5}+\frac{v_1-v_3}{5}+3=\frac{v_3+10}{15}$$

Problem 5 (3 pts)

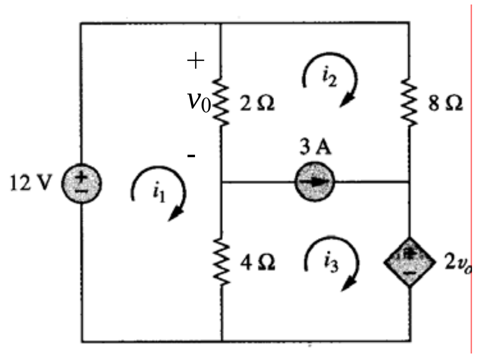
In the circuit shown below, write the mesh equations. Do not solve.



$$\text{Mesh 1: } -80 + 20i_1 + 30(i_1 - i_3) + 20(i_1 - i_2) = 0$$
$$\text{Mesh 2: } -80 + 20(i_2 - i_1) + 30(i_2 - i_3) + 20i_2 = 0$$
$$\text{Mesh 3: } 30i_3 + 30(i_3 - i_2) + 30(i_3 - i_1) = 0$$

Problem 6 (6 pts)

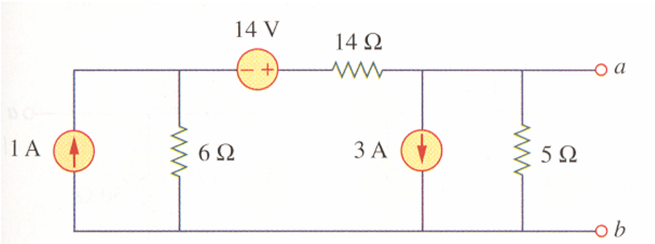
In the circuit shown below, write the mesh equations. Do not solve



$$\text{Mesh 1: } -12 + 2(i_1 - i_2) + 4(i_1 - i_3) = 0$$
$$\text{Mesh } (2+3): 2(i_2 - i_1) + 8i_2 + 2v_0 + 4(i_3 - i_1) = 0$$
$$\text{Extra Equation 1: } \quad i_3 - i_2 = 3A$$
$$\text{Extra Equation 2: } \quad v_0 = 2(i_1 - i_2)$$

Problem 7 (5 Pts)

Find the Thevenin equivalent with respect to the terminals a, b for the circuit shown below

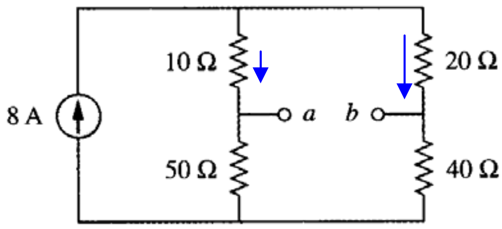


$R_{Th} = (6+14)//5 = (20//5) = 4\Omega$

- To determine V_{Th}, convert the 1A current source and the 3A current source to voltage sources. Add voltage sources (6 and 14), add the resistances (6+14), and determine the total current in the 5Ω resistor. It is found to be: (20+15)/(25)=1.4A.
- The voltage across the 5Ω resistor is: 7 Volts. Therefore, $V_{Th} = 7 - 15 = -8V$

Problem 8 (6 pts)

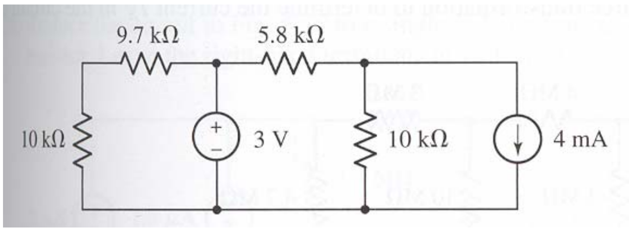
Find the Thevenin equivalent with respect to the terminals a, b for the circuit shown below



- $R_{Th} = (20+10)//(40+50) = (30//90) = 22.5\Omega$
- Using Current divider rule, the currents in the $10\,\Omega$ and 20 Ω resistors are 4A. Using KVL, $V_{Th} = -(10\times 4)+(20\times 4) = 40$volts

Problem 9 (6 pts)

Using source transformation, determine the power dissipated by the 5.8KΩ resistor in the figure shown below.



- Convert the current source to a voltage source and use KVL, the current in the 5.8KΩ resistor is found to be:

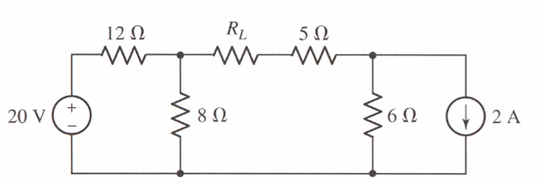
$$I_{5.8K\Omega} = \frac{43}{15.8 \times 10^3} = 2.72mA$$

- The power dissipated in the 5.8 KΩ is found to be:

$$P = RI^2 = (5.8 \times 10^3)(2.72 \times 10^{-3})^2 = 42.9mW$$

Problem 10 (4 pts)

If any value whatsoever may be selected for R_L in the circuit shown below, what is the value of R_L for maximum power transfer?



- For Maximum Power transfer, R_L must be the same as R_{Th} . R_{Th} is found by setting all sources to zero. It is found to be:
  $R_L = R_{Th} = (12 // 8) + 6 + 5 = 15.8\Omega$