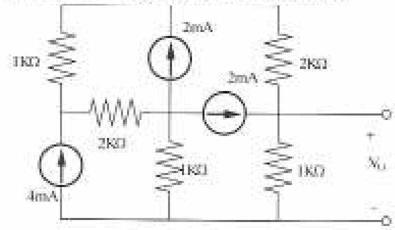
ECE202 Electrical Networks

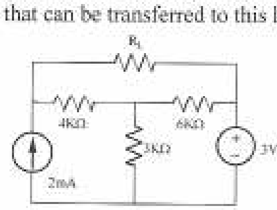
Homework #4

Assigned: Thursday, February 8th 2007
Due: Thursday, February 15st 2007

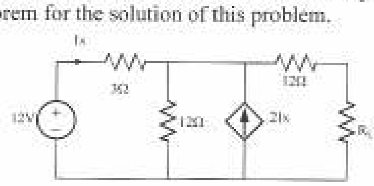
1. Find Vo in the circuit shown using Thevenin's Theorem.



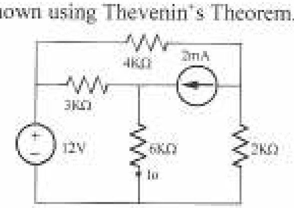
2. In the network shown using Thevenin's theorem find R_L for maximum power transfer and the maximum power that can be transferred to this load.



3. Find the value of R_L in the network shown for maximum power transfer to this load. Use Northon's theorem for the solution of this problem.

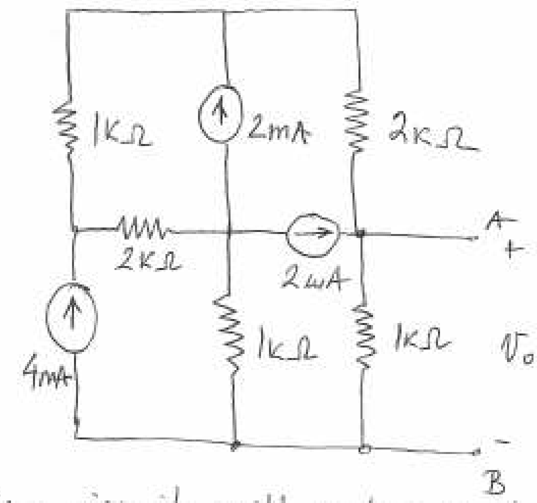


4. Find Io in the network shown using Thevenin's Theorem.



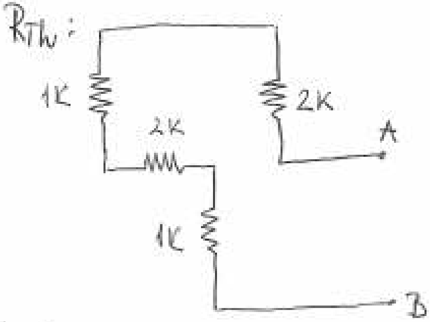
Solutions to HW #4

1.



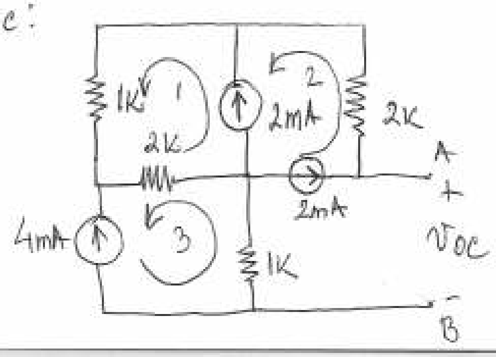
This is a circuit with independent sources only and we need only to calculate R_{Th} and V_{oc}. We disconnect the 1KΩ resistor between nodes A and B.

R_{Th}:



$R_{Th} = 2K + 2K + 1K + 1K = 6K$

V_{oc}:



$I_1 - I_2 = 2mA$

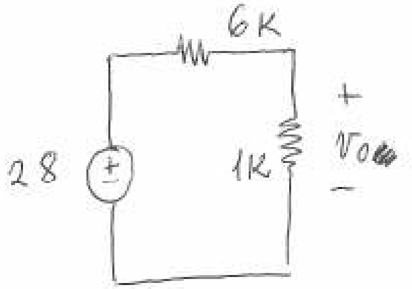
$I_2 = 2mA \qquad I_1 = 4mA$

$I_3 = -4mA$

$V_{oc} = 2K I_2 + 1K I_1 + 2K(I_1 - I_3) - 1K I_3$

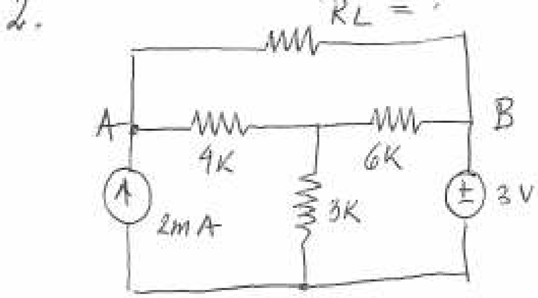
$V_{oc} = 2k \times 2m + 1k \times 4m + 2k\,(4m + 4m) + 1k \cdot 4m =$

$= 4 + 4 + 16 + 4 = 28\,V$



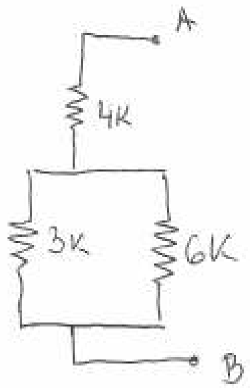
$$V_0 = 28 \cdot \frac{1}{6+1} = \frac{28}{7} = 4\,V$$

2.

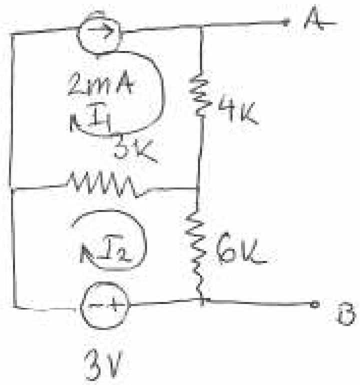


$R_L = ?$ for maximum power transfer + we have to calculate maximum power transvered.

This is also a Type 1 circuit since it only has independent voltage sources so we need to calculate the open circuit voltage V_{oc} and thevenin's Resistance



$$R_{Th} = 4k + \frac{6k \cdot 3k}{9k} = 6k$$



$I_1 = 2mA$

$3K(I_2 - I_1) + 6K I_2 + 3 = 0$

$9K I_2 + 3 - 6 = 0$

$9K I_2 = 3$

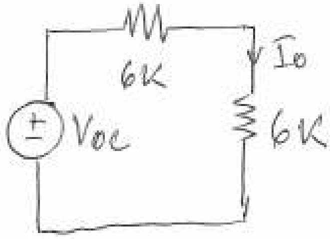
$I_2 = \frac{1}{3} mA$

$V_{oc} = 4K I_1 + 6K I_2 = 4K \times 2m + 6K \times \frac{1}{3} m$

$= 10 V$

The condition for maximum power transfer is

$R_L = R_{Th} = 6K$

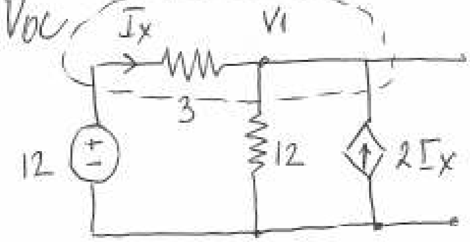


$I_o = \frac{10}{12K} = \frac{5}{6} mA$

$P_{max} = V_o I_o = R_L I_o^2 =$

$= 6K \left(\frac{5}{6} m\right)^2 = \frac{25}{6} mW$

3. We have a circuit with both independent and dependent sources so $R_{Th} = V_{oc}/I_{sc}$



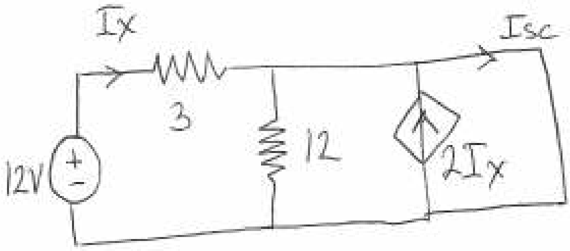
$$\frac{V_1}{12} - 2I_x - I_x = 0$$

$$\frac{V_1}{12} - 3I_x = 0$$

$$I_x = \frac{12 - V_1}{3} \Rightarrow \frac{V_1}{12} - \not{3}\,\frac{12 - V_1}{\not{3}} = 0$$

$$\frac{V_1}{12} - 12 + V_1 = 0$$

$$\frac{13}{12} V_1 = 12 \qquad V_1 = \frac{144}{13} = V_{oc}$$



$I_{sc} = 3I_x$

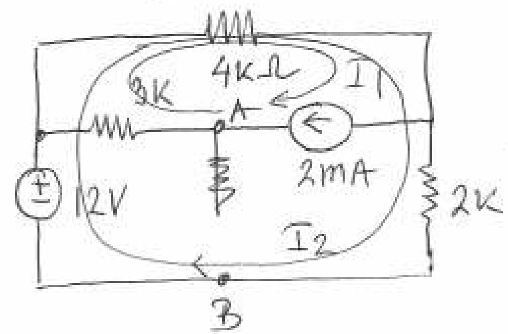
$12V = 3I_x \qquad I_x = 12/3 = 4A \quad I_{sc} = 12A$

$$R_{Th} = \frac{V_{oc}}{I_{sc}} = \frac{144}{13 \times 12} = \frac{12}{13}$$

$$R_L = R_{Th} + 12\Omega = \frac{12}{13} + 12 = \frac{168}{13} = 12.923\Omega$$

4. This is Type I circuit for independent voltage sources so we need to calculate Voc and Rth. Disconnect the 6K resistor.

← $R_{Th} = 3K$



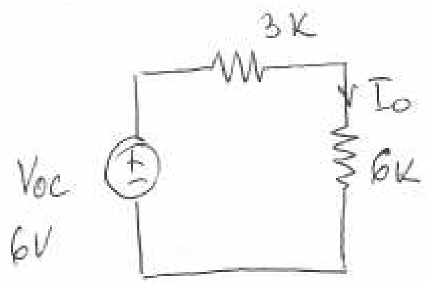
$I_1 = 2mA$

$-12 + 4K(I_1 + I_2) + 2K I_2 = 0$

$-12 + 6K I_2 + 8 = 0$

$6K I_2 = 4 \Rightarrow I_2 = \frac{2}{3} mA$

$V_{oc} = V_{AB} = -3K(I_1 +$ [illegible] $) + 12V = 12 - 3K \times 2m = 6V$



$I_o = \frac{6}{9K} = \frac{2}{3} mA$