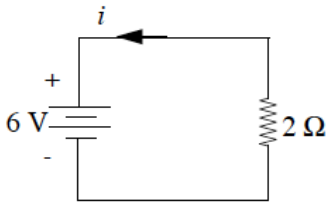
EE2210 Electric Circuits **Spring 2017**

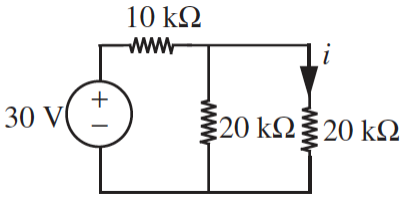
Quiz 1 (Total 120 points) Solutions

It is a closed-book, closed-note quiz. Calculator is allowed. Please show the process of thinking/calculation. Indicate your final answers clearly. Unit is needed if applicable.

1. (i) Find the current i indicated in the network in the following figures. (14%)
   (ii) What is the power dissipated by the 2-Ω resistor in figure (a)? (5%)



(a)



(b)

Solution:

(1)

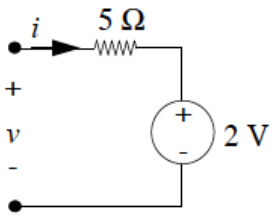
(a) i=$-\frac{6}{2}$=-3A (7%)

(b) i=$\frac{30V}{10K+(20K\|20K)} * \frac{1}{2} = 0.75\text{mA}$ (7%)

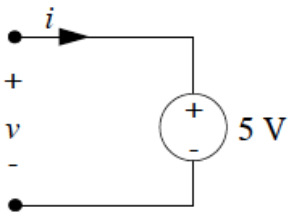
(2)

(a) P=$v_R * i_R = 6 * 3 = 18W$ (5%)

2. Sketch the $i - v$ characteristics for the networks in the following figures. (16%)



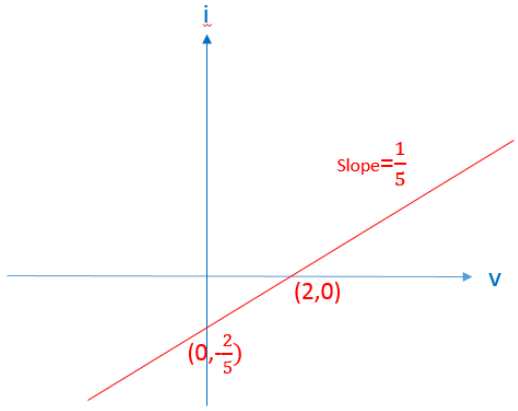
(a)



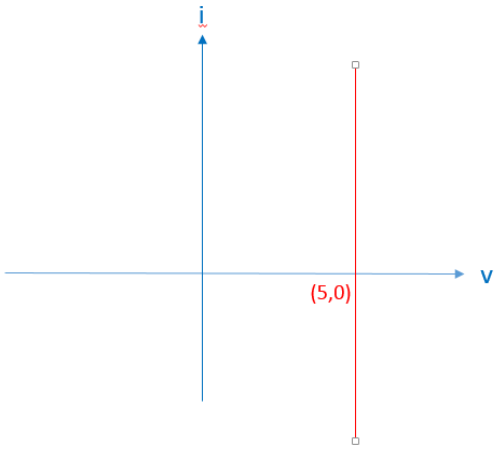
(b)

Solution:

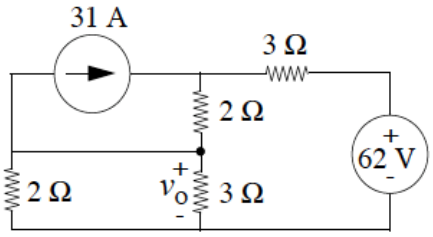
(a).**(8%)**



(b)(8%)

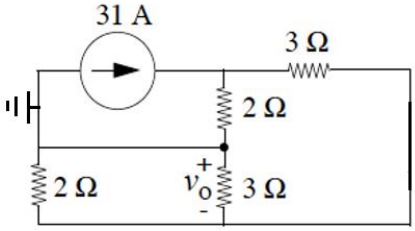


3. Find the voltage v_0 in the network in the following figure using superposition. (15%)



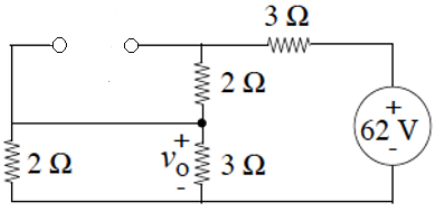
Solution:

Turn off the voltage source(short)



$$v_{o,cs} = -31A * \frac{2\Omega}{2\Omega + (3\Omega + 3\Omega \| 2\Omega)} * \frac{2\Omega}{3\Omega + 2\Omega} * 3\Omega = -12V$$

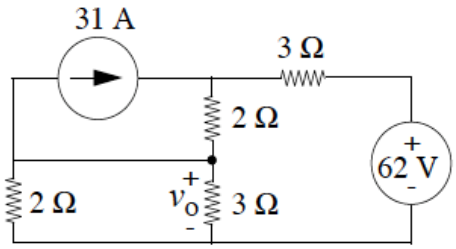
Turn off the current source(open)



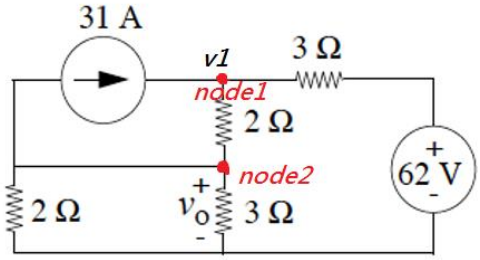
$$v_{o,vs} = 62V * \frac{3\Omega \| 2\Omega}{3\Omega + 2\Omega + 3\Omega \| 2\Omega} = 12\text{V}$$

$$v_o = v_{o1} + v_{o2} = -12V + 12V = 0V$$

4. Find the voltage v_0 in the network in the following figure using node method. (15%)



Solution:



node1: $31A+\frac{62V-v1}{3\Omega}=\frac{v1-v_o}{2\Omega}$ ---------- (1)

node2: $\frac{v1-v_o}{2\Omega}=\frac{v_o}{3}+\frac{v_o}{2}+31A$ ---------- (2)

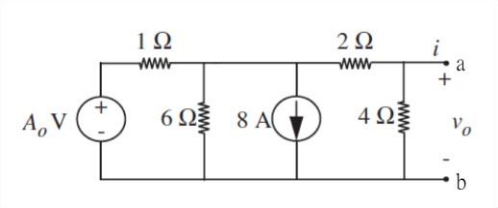
From (2) we know

v1=$\frac{8v_o+186}{3}$ ---------- (3)

and from (1) and (3), we get

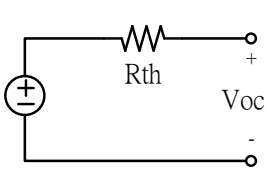
$v_o = 0\text{V}$

5. Find the Thevenin equivalent of the circuit at terminal ab in the following figure. Assume $A_0 = 4$. (20%)

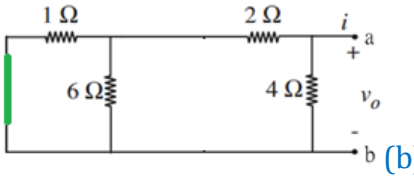


Solution:

To find Thevenin equivalent, we have to find out the open circuit voltage (Voc) and equivalent impedance (Rth), which is indicated on the following figure (a). To find R_{Th}, we need to turn off all the independent source and the circuit becomes figure (b).



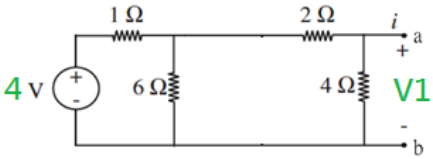
(4%) (a)



(b)

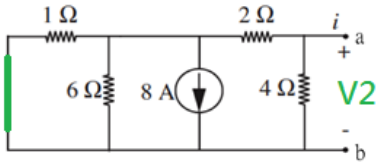
$$R_{Th} = \frac{5}{3}\ \Omega$$

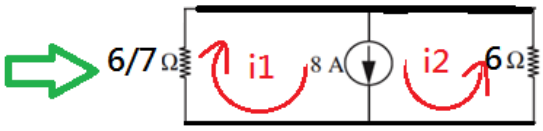
For finding Voc, we use superposition method. Turn off the current source.



$V_1 = 0.5A * 4\ \Omega = 2\text{V}$

Turn off the Voltage source.



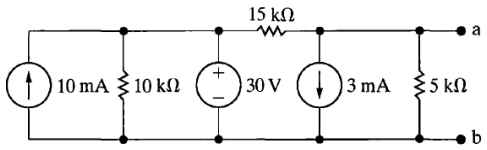


$$i_2 = -8A * \frac{\frac{6}{7}\ \Omega}{\frac{6}{7}\ \Omega + 6\Omega} = -1A$$

$$V_2 = i_2 * 4\ \Omega = -4\text{V}$$

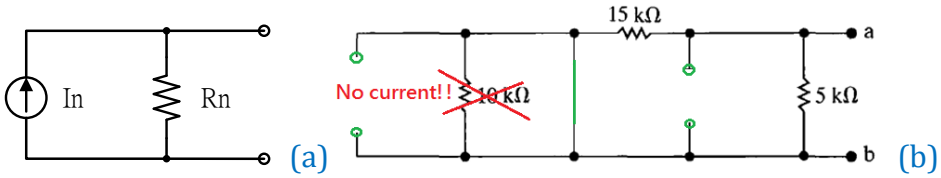
$$\rightarrow V_{oc} = V_1 + V_2 = -2V \quad (16\%)$$

6. Find the Norton equivalent of the circuit at terminal ab in the following figure. (20%)



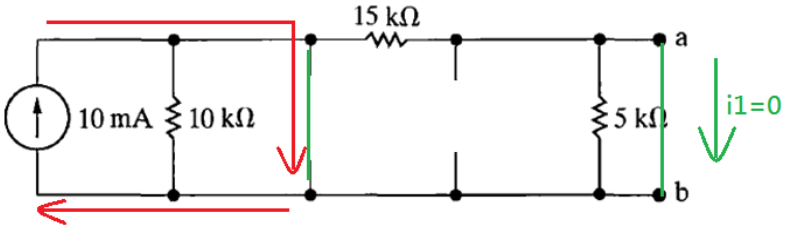
Solution:

To find Norton equivalent, we have to find out the short circuit current (Is) and equivalent impedance (R_N), which is indicated on the following figure (a). To find R_N, we need to turn off all the independent source and the circuit becomes figure (b).



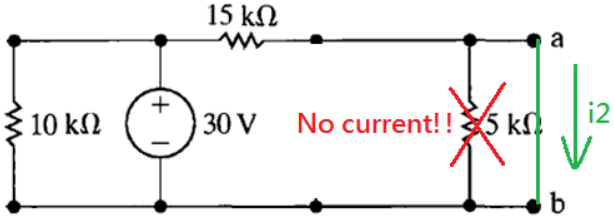
$$R_N = \frac{15}{4}\ k\Omega$$

For finding In, we use superposition method. Turn off the 30V voltage source and 3mA current source.



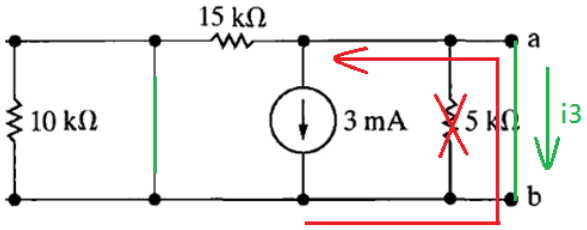
$$i_1 = 0\ A$$

Turn off the 10mA current source and 3mA current source.



$$i_2 = \frac{30V}{15k\Omega} = 2\ mA$$

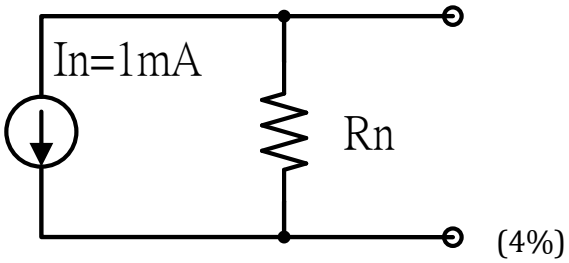
Turn off the 10mA current source and 30V voltage source.



$$i_3 = -3\ mA$$

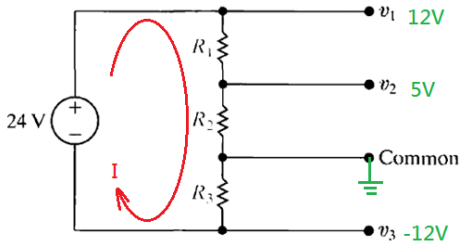
$$I_N = i_1 + i_2 + i_3 = -1\ mA \quad (16\%)$$

The answer is acceptable with $I_N = 1mA$, but the current direction is converse, please refer to the following figure.



(4%)

7. Determine the values of the resistors R_1, R_2, and R_3 such that $v_1 = 12$ V, $v_2 = 5$ V, $v_3 = -12$ V, and the total power dissipated by the circuit by the 24 V source is 80W in the following figure. (15%)



Solution:

$$80\text{W} = 24\ \text{V} * \text{I} \rightarrow \text{I} = \frac{10}{3}\text{A}$$

R1=(12V-5V)/I=2.1 Ω(5%)

R2=(5V-0V)/I=1.5Ω(5%)

R3=12V/I=3.6Ω(5%)