Homework 1

ECE2004 CRN:12898

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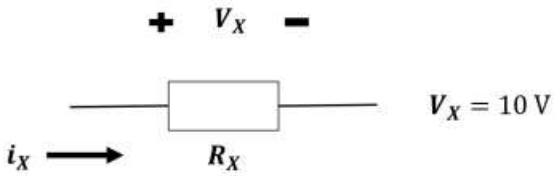
Question 1:



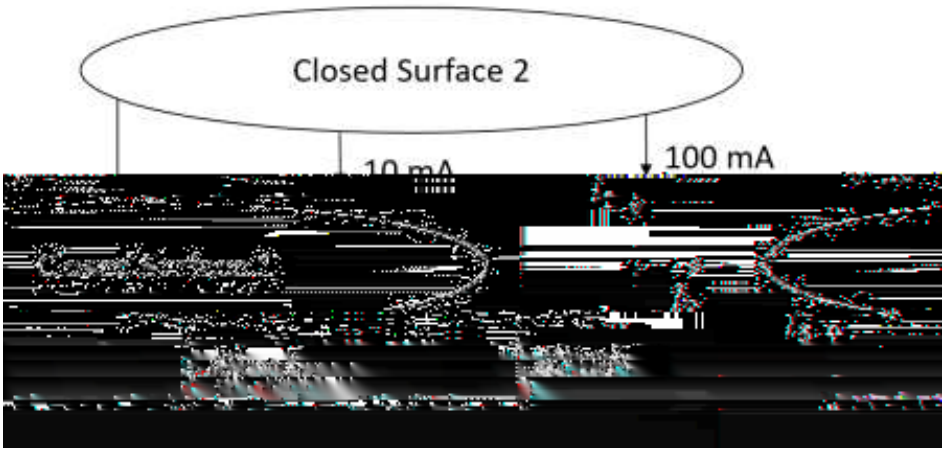
A. The power absorbed by this element is -100 mW. Find R_x and i_x.

$$i_x = \frac{P}{V} = \frac{-100mW}{10V} = -0.01A$$
$$R_x = \frac{V^2}{P} = \frac{(10V)^2}{-100mW} = -1000\Omega$$

B. Which direction is the current i_x flowing? From negative to positive.

C. Is this element producing or consuming power? It is producing power.

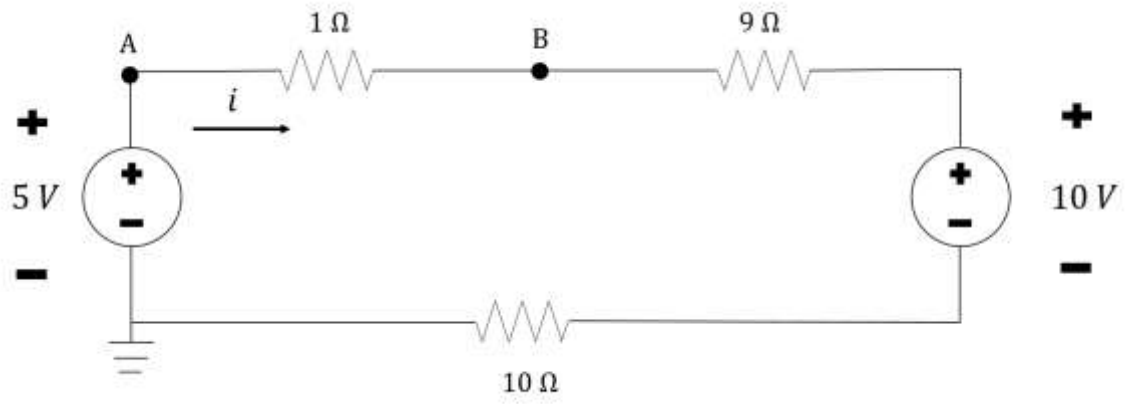
Question 2: KCL states current entering a node is equal to current leaving a node. There is, however, no reason to restrict ourselves to simply nodes. It may be restated as currents entering a closed surface have to equal currents leaving a closed surface. That being said, solve for the currents (I_1,I_2,I_3).



$$\begin{aligned}
\text{Closed Surface 1} &= -40mA + 30mA + 100mA + 10mA - I_2 \\
&= 0.1A - I_2 \\
I_2 &= 0.1A \\
\text{Closed Surface 2} &= -10mA - 100mA - I_1 \\
I_1 &= -0.11A \\
I_1 I_2 I_3 \text{Node} &= I_1 + I_2 + I_3 \\
I_3 &= -I_1 - I_2 \\
I_3 &= 0.11A - 0.1A \\
I_3 &= 0.01A
\end{aligned}$$

$$(I_1, I_2, I_3) = (-0.11A, 0.1A, 0.01A)$$

Question 3:



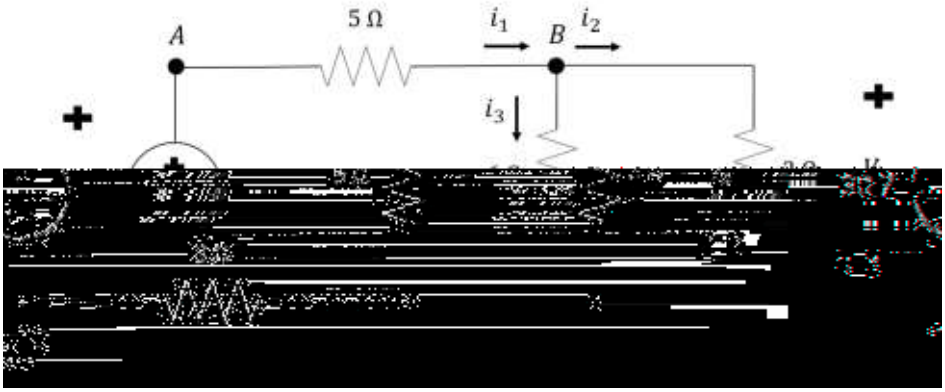
A. Find the current i.

$$\begin{aligned} -5V + v_{1\Omega} + v_{9\Omega} + 10V + v_{10\Omega} &= 0 \\ v_{1\Omega} + v_{9\Omega} + v_{10\Omega} &= -5V \\ 1\Omega \times i + 9\Omega \times i + 10\Omega \times i &= -5V \\ 20\Omega \times i &= -5V \\ i &= \frac{-5V}{20\Omega} \\ i &= -0.25A \end{aligned}$$

B. Find V_{AB}, the voltage across the 1Ω resistor. $V_{AB} = 1\Omega \times -0.25A = -0.25V$

C. Is the voltage at node B higher or lower than the voltage at node A? The voltage is higher at node A than at node B as the potential difference V_{AB} is negative indicating that the voltage is decreasing as you approach B from A.

Question 4:



A. Solve for the current (i_1, i_2, i_3) as well as V_x.

$$
\begin{aligned}
-30V + i_1 \times (5\Omega + 3\Omega + \frac{1}{\frac{1}{6\Omega} + \frac{1}{3\Omega}}) &= 0 \\
i_1 \times (5\Omega + 3\Omega + 2\Omega) &= 30V \\
i_1 &= \frac{30V}{10\Omega} \\
i_1 &= 3A \\
i_2 &= 3A\frac{2\Omega}{6\Omega} \\
i_2 &= 1A \\
i_3 &= 3A\frac{2\Omega}{3\Omega} \\
i_3 &= 2A \\
i_1 - i_2 - i_3 &= 0A \\
(i_1, i_2, i_3) &= (3A, 1A, 2A)
\end{aligned}
$$

B. What is the voltage across the 5Ω resistor (V_{AB})? $V_{AB} = 5\Omega \times 3A = 15V$