Homework 3

ECE2004 CRN:12898

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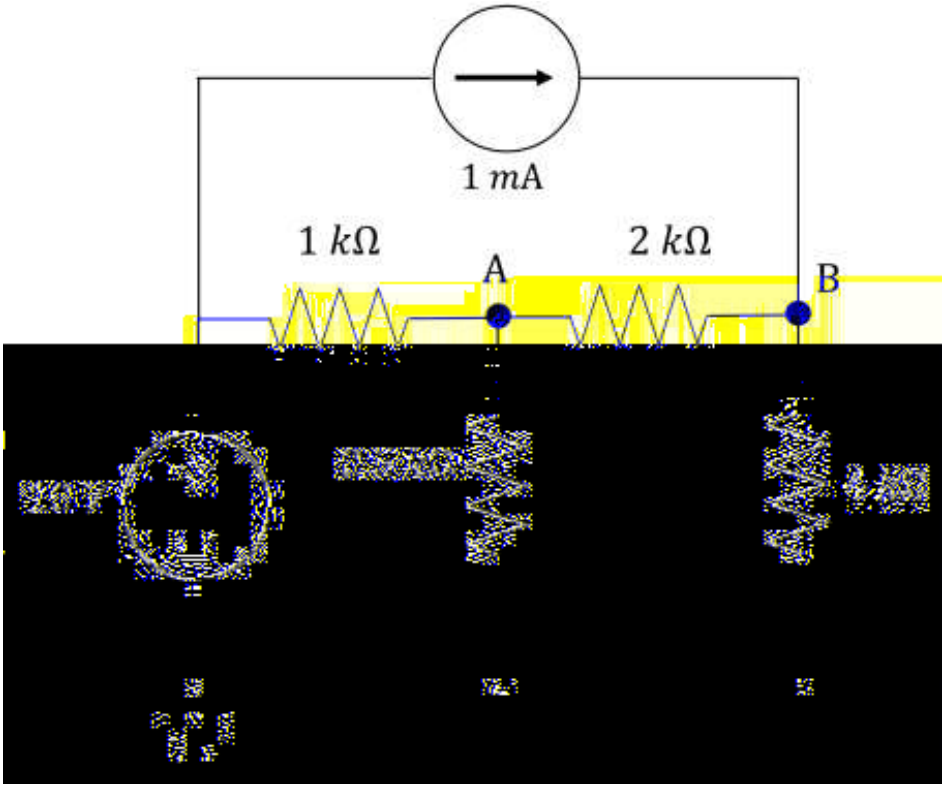
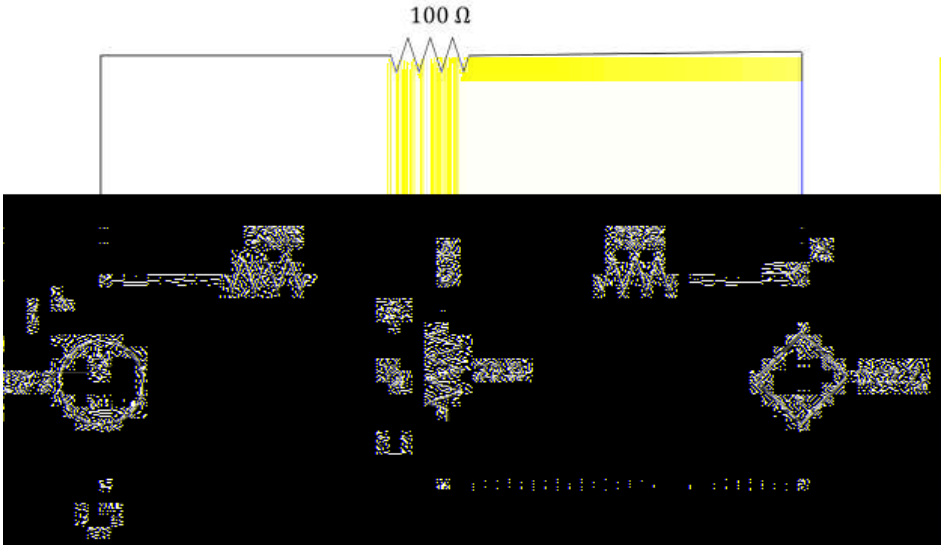
Question 1: Solve for the voltages at node A and node B.



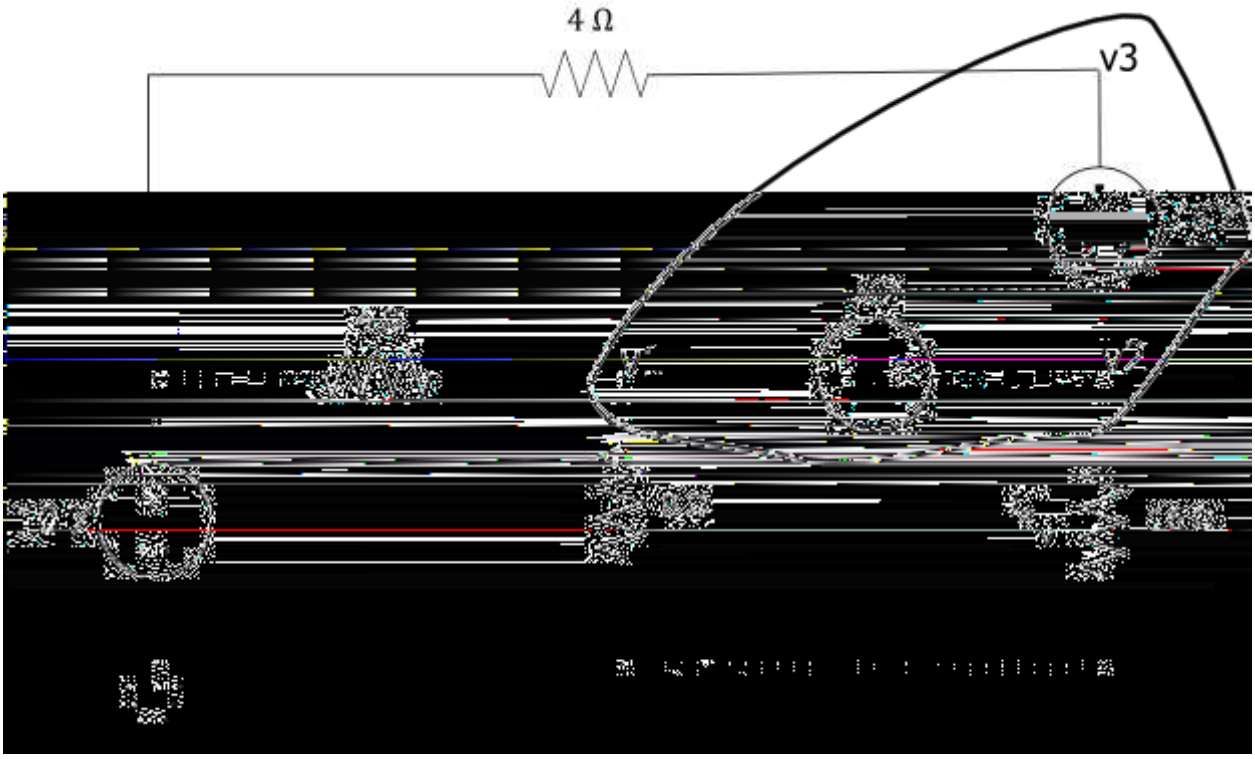
$$\begin{aligned}
\frac{A-10V}{1k\Omega}+\frac{A-B}{2k\Omega}+\frac{A}{0.5k\Omega} &= 0 \\
\frac{B-A}{2k\Omega}+\frac{B}{4k\Omega}-1mA &= 0 \\
7A-B &= 20V \\
3B-2A &= 4V \\
7A-20V &= B \\
A &= \frac{64}{19}V \approx 3.37V \\
B &= \frac{68}{19}V \approx 3.58V
\end{aligned}$$

Question 2: Solve for i.



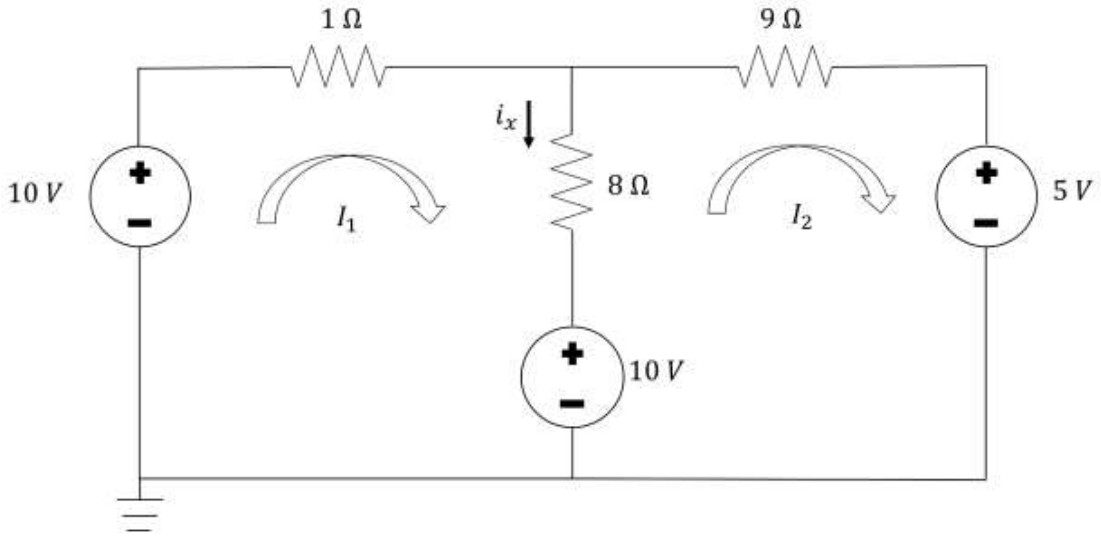
$$\begin{aligned}
\frac{10V - B}{100\Omega} + \frac{10V - A}{10\Omega} - i &= 0 \\
\frac{A - 10V}{10\Omega} + \frac{A}{20\Omega} + \frac{A - B}{30\Omega} &= 0 \\
\frac{B - 10V}{100\Omega} + \frac{B - A}{30\Omega} + 0.02A &= 0 \\
\frac{B + 10A}{100\Omega} &= 1.1A - i \\
11A - 2B &= 60V \\
13B - 4A &= 30V \\
\frac{11}{2}A - 30V &= B \\
\frac{56}{9}V &= A \\
\frac{38}{9}V &= B \\
\frac{299}{450}A &= 1.1A - i \\
i &= \frac{98}{255}A \approx 0.435A
\end{aligned}$$

Question 3: Solve for i_x. (Hint: Super nodes may contain more than two nodes.)



$$
\begin{aligned}
v_1 + 5V &= v_2 \\
v_1 + 20V &= v_3 \\
\frac{v_1 - 10V}{4\Omega} + \frac{v_1}{8\Omega} + i_x + \frac{v_3 - 10V}{4\Omega} &= 0 \\
i_x &= -\frac{5v_1}{8\Omega} \\
\frac{v_1 + 5V}{16\Omega} + \frac{5v_1}{8\Omega} &= 0 \\
\frac{5V + 11v_1}{16\Omega} &= 0 \\
v_1 &= \frac{-5}{11}V \\
i_x &= -\frac{5\frac{-5}{11}V}{8\Omega} \\
i_x &= \frac{25}{88}A \approx 0.284A
\end{aligned}
$$

Question 4:



A) Use Mesh Current Analysis to solve for I_1 and I_2.

$$
\begin{aligned}
1\Omega(I_1) + 8\Omega(I_1 - I_2) + 10V - 10V &= 0 \\
8\Omega(I_2 - I_1) + 9\Omega(I_2) - 5V + 10V &= 0 \\
I_1(9\Omega) - 8\Omega(I_2) &= 0 \\
I_2(17\Omega) - 8\Omega(I_1) + 5V &= 0 \\
I_1 &= \frac{8}{9} I_2 \\
\frac{89\Omega}{9} I_2 + 5V &= 0 \\
I_2 &= -\frac{45}{89} A \approx -0.506A \\
I_1 &= -\frac{40}{89} A \approx -0.449A
\end{aligned}
$$

B) What is the value of the current through the 8Ω resistor, i_x, and in what direction is it flowing?

$$
\begin{aligned}
i_x + I_2 - I_1 &= 0 \\
i_x &= I_1 - I_2 \\
i_x &= -\frac{40}{89} A + \frac{45}{89} A \\
i_x &= \frac{5}{89} A \approx 0.056A
\end{aligned}
$$

i_x is flowing towards ground (aka in the same direction as the arrow on the diagram for i_x is pointing.)