EE 109 Homework 1

Name: _________________________________________
Due: See website
Score: ________

Neatly show your work to get full credit and clearly show your final answer.

1.) [5 pts.] Use KCL to solve for $I_0$.

2.) [8 pts.] Use KVL to solve for $V_1$ and $V_2$.

3.) [9 pts.] Solve for the currents $i_1$, $i_2$, $i_3$.

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1 Many of these exercises were derived or inspired from Fundamentals of Electric Circuits, 3rd ed. By Alexander, Sadiku. McGraw-Hill Publishers.
4.) [9 pts.] Solve for the voltages $V_1$, $V_2$, $V_3$

\[
\begin{align*}
&+4V_+ \\
&-10V \\
&+V_1 \\
&+3V \\
&-V_2 \\
&+V_3 \\
&-5V \\
\end{align*}
\]

5.) [9 pts.] Solve for the voltages $V_1$, $V_2$, $V_3$ across the respective resistors.

\[
\begin{align*}
&+12V \\
&R_1 \\
&-V_2+ \\
&R_2 \\
&+V_1 \\
&R_3 \\
&-V_3+ \\
&R_4 \\
&+V_4+ \\
&-V_5+ \\
&+9V \\
\end{align*}
\]

6.) [10 pts.] Reduce the resistor network shown below to a single equivalent resistance. Assume the values of the resistors are given as $R_1=3\Omega$, $R_2=4\Omega$, $R_3=2\Omega$, $R_4=2\Omega$, $R_5=1\Omega$.

\[
\begin{align*}
&a \\
&R_1 \\
&-V_1+ \\
&R_2 \\
&-V_2+ \\
&R_3 \\
&-V_3- \\
&R_4 \\
&-V_4+ \\
&+V_5+ \\
\end{align*}
\]

7.) [10 pts.] Reduce the resistor network shown below to a single equivalent resistance assuming the following resistor values: $R_1=5\Omega$, $R_2=4\Omega$, $R_3=3\Omega$, $R_4=1\Omega$, $R_5=1\Omega$, $R_6=2\Omega$, $R_7=7\Omega$.

Hint: Start by combining $R_4$ and $R_5$ then combine those with $R_6$ and keep going…
8.) **[8 pts.]** Find an expression for the current $i_1$ if $R_1 = 4\Omega$, $R_2 = 3\Omega$, $R_3 = 6\Omega$, $R_4 = 2\Omega$.

Hint: Combine $R_2$, $R_3$, $R_4$ into an equivalent resistance which will be in series with $R_1$. From here you can use a KVL loop or Ohm's law to solve for $i_1$.

9.) **[16 pts.]** Use the generalized concept of a voltage divider (review your notes/lecture slides) to find expressions for the voltage $V_1$ and also $V_4$ in the circuit below. Your expression should be in terms of $V_s$ and $R_1$-$R_4$.

10.) **[6 pts.]** Look at the circuit from problem 9. If $R_4$ is very large (approaches infinity) what would $V_4$ be (approximately)? Your expression should be in terms of $V_s$ and (possibly) some of $R_1$-$R_4$.

Hint: Use your equation from the previous problem and let $R_4$ go to infinity…

11.) **[5 pts.]** Look at the circuit from problem 9. If $R_3$ is very large (approaches infinity) again solve (approximately) for the voltage $V_4$? Your expression should be in terms of $V_s$ and (possibly) some of $R_1$-$R_4$.

Hint: Use your equation from problem 9 and let $R_3$ go to infinity.

12.) **[5 pts.]** Look at the circuit from problem 9. If $R_3$ is effectively $0\Omega$ (i.e. replaced by a wire), solve (approximately) for the voltage $V_4$? Your expression should be in terms of $V_s$ and (possibly) some of $R_1$-$R_4$. 

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**Diagram:**

- Circuit diagram with labels $R_1$, $R_2$, $R_3$, $R_4$, $i_1$, $i_2$, $i_3$, $i_4$, $V_1$, $V_2$, $V_3$, $V_4$, and $GND = 0V$.