PROBLEM 4A

(a) How many independent junction equations can be written for the circuit shown? (b) How many independent loop equations? (c) Using the current labels and direction given, write a set of junction and loop equations that can be used to analyze the circuit. (To simplify grading, go clockwise around your loops.)

a) **three**  b) **three**

**Junction equations**

\[
\begin{align*}
I_3 &= I_1 + I_2 \\
I_5 &= I_2 + I_6 \\
I_5 &= I_3 + I_7 \\
I_6 &= I_1 + I_7
\end{align*}
\]

**Loop equations**

\[
\begin{align*}
\mathcal{E}' &= (R_3 + R_4) I_3 + R_5 I_5 \\
\mathcal{E}' &= (R_1 + R_2) I_1 + R_6 I_6 \\
\mathcal{O} &= R_6 I_6 + R_5 I_5 + R_7 I_7
\end{align*}
\]

There is only 6 unknowns so you only need 6 of the above equations. Some other possible loop equations are:

\[
\begin{align*}
\mathcal{E}' &= (R_3 + R_4) I_3 + R_5 I_5 \\
\mathcal{E}' &= (R_1 + R_2) I_1 + R_6 I_6 \\
\mathcal{O} &= R_6 I_6 + R_5 I_5 + R_7 I_7
\end{align*}
\]

\[
\begin{align*}
\mathcal{E}' &= (R_3 + R_4) I_3 - R_7 I_7 - R_6 I_6 \\
\mathcal{E}' &= (R_1 + R_2) I_1 + R_6 I_6 \\
\mathcal{O} &= R_6 I_6 + R_5 I_5 + R_7 I_7
\end{align*}
\]

and so on...