For the circuit shown the switch is closed after being open for a long time.

i. Calculate the potential across $R_1$ at $t = 0$.
ii. Calculate the potential across $R_1$ at $t = \infty$.
iii. Calculate the charge on the capacitor after 1.70 time constants have elapsed from $t = 0$.

For this part the switch opened at $t = 0$ after being closed for a long time. Calculate the current in $R_2$ after $1.27 \times 10^{-3}$ s have elapsed.

From the beginning, using loops and junctions as discussed in class, and no shortcuts, calculate the time constant for charging the capacitor.

\[ V = 135 \text{ V} \quad R_1 = 275 \text{ ohms} \]
\[ R_2 = 125 \text{ ohms} \quad R_3 = 95 \text{ ohms} \]
\[ C = 4.5 \times 10^{-6} \text{ F} \]

\[ a) \quad I = \frac{V}{R_2} = 0.410 \quad V = IR_1 = 113 \frac{V}{t=0} \]

\[ \frac{V}{t=\infty} = \frac{22}{125} \frac{V}{t=0} \]

\[ V(t) = V_0 \left( 1 - e^{-t/\tau} \right) = \left( V - V_0 \right) \left( 1 - e^{-t/\tau} \right) = 345 \text{ V} \Rightarrow \tau = 1.55 \times 10^{-4} \text{ s} \]

\[ t = \left( R_2 + R_3 \right) = 990 \mu s \]

\[ I(t) = \frac{422}{R_2 + R_3} \frac{C}{t=\tau} = 53.2 \mu A \]

\[ b) \quad I_1 - I_2 - I_3 = 0 \quad i - R_1 \left( I_2 + I_3 \right) - I_2 R_2 = 0 \]

\[ \frac{\varepsilon - I_2 R_2 - I_3 R_2 - V_C = 0}{\left( \varepsilon - I_2 R_2 \right) R_2} - I_2 R_3 - V_C = 0 \]

\[ \left( \frac{\varepsilon - I_2 R_2}{R_1 + R_2} \right) - I_3 R_3 - V_C = 0 \]

\[ \frac{\varepsilon R_2}{R_1 + R_2} - I_3 R_3 - V_C = 0 \]

\[ \frac{\varepsilon R_2}{R_1 + R_2} = \frac{I_3 \left( \frac{R_1 R_2}{R_1 + R_2} + R_3 \right) + \phi}{C} \]

\[ I_3 = \frac{\phi}{C} \Rightarrow \tau = \left( \frac{R_1 R_2}{R_1 + R_2} \right) C \text{ sec} \]