RC Circuits

Circuits that have resistors and capacitors.

\[ V_{\text{emf}} = 9\text{V}, \]

\[ R = 1.0 \text{ kilo ohm}, \quad C = 4.0 \text{ micro farad} \]

\[ V_R = R \, I_R, \quad Q_C = C \, V_C \quad I_R = \frac{dQ_C}{dt} \]

Voltage of battery = Sum of $V_R$ and $V_C$

\[ V_{\text{emf}} = R \, I_R + \frac{1}{C} Q_C \]

\[ \frac{V_{\text{emf}}}{R} = \frac{dQ_C}{dt} + \frac{1}{RC} Q_C \quad \text{Oh! It's a differential equation!} \]

\[ Q_C (t) = CV_{\text{emf}} \left( 1 - e^{-\frac{t}{RC}} \right) \quad \text{Charging takes time!} \]