

RC Circuit: Discharging the Capacitor



- Loop rule: $IR + \frac{Q}{C} = 0$
- Differential equation: $R \frac{dQ}{dt} + \frac{Q}{C} = 0 \Rightarrow \frac{dQ}{dt} = -\frac{Q}{RC}$
 $\Rightarrow \int_{\mathcal{E}C}^Q \frac{dQ}{Q} = - \int_0^t \frac{dt}{RC} \Rightarrow \ln \left(\frac{Q}{\mathcal{E}C} \right) = -\frac{t}{RC} \Rightarrow \frac{Q}{\mathcal{E}C} = e^{-t/RC}$
- Charge on capacitor: $Q(t) = \mathcal{E}C e^{-t/RC}$
- Current through resistor: $I(t) \equiv \frac{dQ}{dt} = -\frac{\mathcal{E}}{R} e^{-t/RC}$

