Quiz 4

Constants

mass of an electron	$m_e = 9.11 \times 10^{-31}$ kg
mass of a proton	$m_p = 1.67 \times 10^{-27}$ kg
nano, n	1×10^{-9}
micro, μ	1×10^{-6}
magnitude of the charge of an electron or proton	$e = 1.6 \times 10^{-19}$ C

Resistance of a wire

Resistance of a wire: $R = \frac{\rho L}{A}$

Power

$$\begin{aligned} P &= \frac{\text{energy}}{\Delta t} \\ P &= I\Delta V \\ P &= I^2 R = \frac{|\Delta V|^2}{R} \qquad \text{for a resistor} \end{aligned}$$

Resistance

Resistors in parallel:

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$$

Resistors in series:

$$R = R_1 + R_2 + \cdots$$

Capacitance

$$\begin{aligned} Q &= C\Delta V \\ C &= \frac{K\varepsilon_0 A}{d} \end{aligned}$$

Charging Capacitor

$$\begin{aligned} Q &= Q_{max}(1 - e^{-\frac{t}{RC}}) \\ \Delta V_C &= \Delta V_{C,max}(1 - e^{-\frac{t}{RC}}) \\ \Delta V_R &= \Delta V_{R,max} e^{-\frac{t}{RC}} \\ I &= I_{max} e^{-\frac{t}{RC}} \end{aligned}$$

Discharging Capacitor

$$\begin{aligned} Q &= Q_{max}e^{-\frac{t}{RC}} \\ \Delta V_C &= \Delta V_{C,max}e^{-\frac{t}{RC}} \\ \Delta V_R &= \Delta V_{R,max}e^{-\frac{t}{RC}} \\ I &= I_{max}e^{-\frac{t}{RC}} \end{aligned}$$

Time Constant

$$\tau = RC$$

Magnetic Field

$$\begin{aligned} \frac{\mu_0}{4\pi} &= 1 \times 10^{-7}\ \frac{\mathrm{T \cdot m}}{\mathrm{A}} \\ \mu_0 &= 4\pi \times 10^{-7}\ \frac{\mathrm{T \cdot m}}{\mathrm{A}} \\ \mu_0 &= 1.257 \times 10^{-6}\ \frac{\mathrm{T \cdot m}}{\mathrm{A}} \end{aligned}$$

$$B_{\text{long straight wire}} = \frac{\mu_0 I}{2\pi r}$$

$$B_{\text{center of loop}} = \frac{\mu_0 I}{2R}$$

Force by a magnetic field on a moving charged particle

$$F_{mag} = |q|vB\sin(\theta)$$

Uniform circular motion of a charged particle in a magnetic field.

$$R = \frac{mv}{|q|B}$$

$$\omega = \frac{|q|B}{m}$$

$$T = \frac{2\pi m}{|q|B}$$

$$f = \frac{1}{T}$$