7. A current loop is arranged along three faces of a cube with edge length L as shown to the right. The current in the current loop is given as well as the value of the constant magnetic field that exists in the given space. \( L = 50.0 \text{ cm} \quad I = 9.00 \text{ A} \)
\( \vec{B} = 75.0 \text{ mT} \)

a. Determine the force exerted on each of the three wire segments due to the current interaction with the magnetic field.

b. Determine the torque exerted on the current loop by the magnetic field.

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8. An "infinite" conducting sheet of thickness \( t = 10.00 \text{ cm} \) has the indicated current density \( \vec{J} = ax^2 \hat{z} \quad a = 240. \text{ A/m}^2 \). A proton is moving with a velocity of \( \vec{v} = 3.00 \times 10^5 \text{ m/s} \) at point A \( (z_A = 20.00 \text{ cm}) \). Determine where the proton hits the conducting sheet (change in x coordinate) and with what velocity.

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9. A very long straight wire carries a current \( \{ I(t) = I_0 \text{e}^{ct} \} \) \( (I_0 \text{ given below}) \) along the x-axis as shown to the right. Nearby there is a rectangular conducting loop that has a total resistance of \( R \). When \( t = 20.0 \text{ s} \) the force exerted on section AB of the rectangular loop due to the current-induced current interaction is given.
\( (a = 80.0 \text{ cm} \quad b = 1.0 \text{ cm} \quad L = 2.50 \text{ m}) \)
\( I_0 = 40.0 \text{ Amps} \quad R = 4.00 \text{ mO} \quad F_{AB} = 450. \text{nN} \)

a. Determine the value of the constant \( c \).

b. Determine the current in the long straight wire and the induced current in the rectangular loop at this time of 20.0 s.
10. A RCL circuit is set up as shown to the right. It consists of a battery, a resistor, an inductor, and a capacitor connected in series with a switch. At t=0.00 s when the switch is closed the capacitor is charged (Q₀).

\[ \varepsilon = 40.0 \text{ Volts} \quad C = 50.0 \ \mu\text{F} \quad R = 10.0 \ \Omega \quad L = 30.0 \ \text{mH} \quad Q₀ = 450. \ \mu\text{C} \]

a. Write down the loop theorem for the circuit going clockwise from point A. Why must the initial current in the circuit be zero?

b. After a very long time (how long?) determine the energy stored in the capacitor.

c. When t = 12.0 ms determine;

(i) the charge on the capacitor and the current in the resistor.

(ii) the time rate of change of the energy stored in the inductor.

11. A RCL circuit is set up as shown to the right. It consists of an ac source, a resistor, an inductor, and a capacitor connected in series. \( \varepsilon_{\text{max}} = 50.0 \ \text{Volts} \)

\[ C = 30.0 \ \mu\text{F} \quad R = 150. \ \Omega \quad L = 70.0 \ \text{mH} \quad f = 140. \ \text{Hz} \]

a. Determine the impedance and the phase angle for this circuit and draw a phasor diagram.

b. Determine the average power output for this circuit and explain what circuit element delivers the power and to what circuit element is the power delivered.

c. Determine another frequency of the ac source for which the average power is the same as found in part b and draw a phasor diagram.

12. Write a one to two page paper describing the development of Maxwell’s Equations found in our textbook, starting in chapter 21 and ending in chapter 32.