1. A manufacturing plant discovers that its electrical load due to the large numbers of motors is largely an inductive reactance equivalent to an inductance of 0.23 H. What capacitance would then need to be placed in series so that the power factor is a maximum? Assume 60 Hz and 220 V. (10)

2. Express the following units in terms of the fundamental set of Mass, Length, Time, and Charge (MLTC):
   a. Ampere (5)
   b. Henry (5)
   c. Tesla (5)
   d. Weber (5)
   e. Hertz (5)

3. An electron is moving toward the right in the plane of the paper in the indicated region below where the magnetic field has a magnitude of 1.5x10^-2 T. Its speed is 2.4x10^7 m/s.

   a. What is the force on the electron? (10)
   b. What would be the shape of its path in the magnetic field? (5)

4. The electrical power supplied to a device is 120 V at 60 Hz. The device requires 20.0 V and draws 2.5 A. An ideal transformer is used.
   a. What would be the ratio of turns in the secondary to the primary? (5)
   b. What would be the current in the primary? (5)

5. What are Maxwell’s equations—you need not write them out, but state how many and what they are, and their significance. Note: if you supply more than the minimum correct answers, then you may receive more than the 5 points—up to 10! (5-10)

6. An AC generator produces a sinusoidal voltage at 60 Hz with a maximum of 120 V.
   a. What is the average voltage? (5)
   b. What is the rms voltage? (5)
   c. If it were a DC generator with the same maximum of 120 V, what would be the “rms” voltage? (5)

7. An inductor (L = 400 mH), a capacitor (C = 5.30 µF), a resistor (R = 500 Ω) are connected in series. A 50.0 Hz AC generator connected in series to these elements produces a maximum current of 300 mA in the circuit.
   a. What is the impedance of the circuit? (15)
b. What is the phase angle by which the current leads or lags the applied voltage? (5)
c. What is the maximum voltage produced by the generator? (5)

\[ \varepsilon_0 = 8.854 \times 10^{-12} \text{ C}^2/N\text{m}^2 \]
\[ \mu_0 = 4\pi \times 10^{-7} \text{ N} \text{m}^2/\text{C}^2 \]
\[ e = -1.60 \times 10^{-19} \text{ C} \]
\[ m_e = 9.11 \times 10^{-31} \text{ kg} \]
\[ m_p = 1.673 \times 10^{-27} \text{ kg} \]
\[ c = 2.99792 \times 10^8 \text{ m/s} \]