Short Answer
(12 Points Each)

1. A glass rod receives a positive charge by rubbing it with a silk cloth. In the rubbing process, have protons been added to the object? Why is it positively charged?

2. An electron (charge is $q = -1.60 \times 10^{-19}$ C) moves directly down the negative x-axis (towards the left side of this page) with a speed of 10.0 m/s. Imagine that it does so in a uniform magnetic field pointing straight out of this page towards you. The strength of the magnetic field is $B = 3.50$ T. What are the magnitude and direction of the magnetic force on the electron?

3. Draw the electric field around a pair of oppositely charged particles. Be sure to include arrows indicating the direction of the field lines.
4. Three electrons and one proton are contained inside a closed spherical surface. What is the electric flux through this surface?

5. A particle with charge $q = 3.0 \times 10^{-19}$ C is fired into a uniform magnetic field with a speed of 16 m/s. If the particle begins spiraling in a circular loop with radius $R = 5.0$ cm and the strength of the magnetic field is $B = 4.5$ T, what is the mass of the particle?
Problems
(20 Points Each)

1. The following questions refer to the circuit diagram below. 1) Find the total effective resistance of the circuit. 2) Determine the current flowing through resistors $a$, $b$, $c$, and $d$. Express your answers to three significant figures.
2. A constant magnetic field with strength $B = 1.30 \, \text{T}$ points straight down the positive $x$-axis. A single loop of wire with area $A = 0.200 \, \text{m}^2$ begins aligned with the $y$-axis so that the magnetic field points directly through it. The loop is quickly rotated counterclockwise by $45.0^\circ$ during a time period of $0.200 \, \text{s}$. If the total resistance of the wire loop is $0.120 \, \Omega$, what is the average current induced in the loop during this time?
3. Three charges given by $q_1 = 4.0 \times 10^{-6}$ C, $q_2 = 2.0 \times 10^{-6}$ C, and $q_3 = 6.0 \times 10^{-6}$ C are held in place as shown in the figure below. Determine the magnitude of the net force on charge $q_3$. 

![Diagram of charges](image)