

e/m

1) Write answers to these questions in your lab notebook:

Suppose an electron is accelerated from rest through a potential difference, ΔV . What would be the change in kinetic energy after the electron has been accelerated through the potential difference ΔV ? Derive an equation relating the change in electric potential to the change in kinetic energy.

Write an equation relating the final kinetic energy in terms of the mass and velocity (use the non-relativistic Newtonian expression for kinetic energy, not relativistic) after acceleration to the charge and final potential, V . Use e and m for the charge and mass of an electron and v for its velocity.

If, after the electron has been accelerated to a velocity, v , it passes through a region of constant magnetic field, B , perpendicular to its motion, what would happen? Would there be a magnetic force on the electron? In which direction? What would be the magnitude of the magnetic force? Draw a picture illustrating this situation. Label the force and the velocity of the electron.

Remember or look up the acceleration of a particle moving at constant velocity in a circle. Write an equation for the net force on an object moving in a circle in terms of the mass and velocity of the object and the radius of the circle.

If the object is an electron moving at constant velocity in a circle and the net force on it is the magnetic force due to a magnetic field, B , how are the field, charge, mass, velocity and radius of the circle related?

If an electron is accelerated through a potential difference, V , and then enters a magnetic field, B , perpendicular to its velocity, it will move in a circle.

2) Next do the following:

A) Observe the experimental set-up. Ask the TA to explain to you how the electron is accelerated and how an approximately uniform magnetic field is created by two large coils. Observe the path of the electrons in the magnetic field.

B) Use the equations above to solve for the ratio e/m in terms of the magnetic field, B , the potential difference, V , and the radius of the circle.

C) Use the information in the lab to determine the value of e/m . Take data with different currents through the coils and determine the ratio e/m from a graph.