

Practice Problem Set – Magnetic Fields

Practice only – not to be turned in for grades!

Question 1 (1 point)

Draw the magnetic field lines emanating from a magnetic dipole. How does the shape of the field compare to that from an electric dipole?

Question 2 (3 points)

- (a) A proton is moving at 12% of the speed of light in the direction which is 20 degrees up from west. It passes through the earth's magnetic field which points due north with a strength of 0.5×10^{-4} T. What is the resultant force on the proton? What will the radius of curvature of its path be?
- (b) A cyclotron is used to accelerate protons to a velocity of 35,000 m/s. If the magnetic field for the cyclotron is 0.75 Tesla, how large does the cyclotron have to be? If the protons are directed from the cyclotron to a velocity selector with the same magnetic field, what electric field is needed for the protons to pass through the selector?

Question 3 (3 points)

A wire loop is bent into the shape of a square with each side of length 4.5 cm. The loop is placed horizontally on a tabletop with two of the sides oriented north/south and two of the sides oriented east/west. A battery is connected so that a current of 24 mA is produced around the loop; the current flows in the clockwise direction looking from the top. What is the force produced by the earth's magnetic field on each section of current-carrying wire? What is the overall torque on the loop? What would the torque be if the same length of wire were bent into a circle instead of a square (assuming the same current)?

Question 4 (3 points)

- a) A wire of length 24 cm is bent into a square and placed flat on a table. A current of 45 mA is passed through the wire in a counter-clockwise direction (looking from above). What is the magnitude and direction of the resulting magnetic field at the center of the square?
- b) Two squares of wire like that in part (a) are placed side by side on a table with a distance of 8 cm between the closest sides of the two squares. A 45 mA current passes counter-clockwise through both squares. What is the resulting force between the two squares? Is it attractive or repulsive?