

9.13.10 Charge in a Magnetic Field

A coil of radius R with its symmetric axis along the $+x$ -direction carries a steady current I . A positive charge q moves with a velocity $\vec{v} = v\hat{j}$ when it crosses the axis at a distance x from the center of the coil, as shown in Figure 9.13.8.

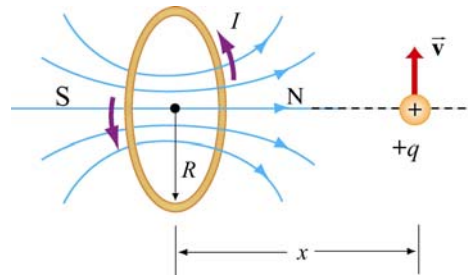


Figure 9.13.8

Describe the subsequent motion of the charge. What is the instantaneous radius of curvature?

9.13.11 Permanent Magnets

A magnet in the shape of a cylindrical rod has a length of 4.8 cm and a diameter of 1.1 cm. It has a uniform magnetization M of 5300 A/m, directed parallel to its axis.

- (a) Calculate the magnetic dipole moment of this magnet.
- (b) What is the axial field a distance of 1 meter from the center of this magnet, along its axis? [Ans: (a) $2.42 \times 10^{-2} \text{ A} \cdot \text{m}^2$, (b) $4.8 \times 10^{-9} \text{ T}$, or $4.8 \times 10^{-5} \text{ gauss}$.]

9.13.12 Magnetic Field of a Solenoid

- (a) A 3000-turn solenoid has a length of 60 cm and a diameter of 8 cm. If this solenoid carries a current of 5.0 A, find the magnitude of the magnetic field inside the solenoid by constructing an Amperian loop and applying Ampere's Law. How does this compare to the magnetic field of the earth (0.5 gauss). [Ans: 0.0314 T, or 314 gauss, or about 600 times the magnetic field of the earth].

We make a magnetic field in the following way: We have a long cylindrical shell of non-conducting material which carries a surface charge fixed in place (glued down) of $\sigma \text{ C/m}^2$, as shown in Figure 9.13.9 The cylinder is suspended in a manner such that it is free to revolve about its axis, without friction. Initially it is at rest. We come along and spin it up until the speed of the surface of the cylinder is v_0 .