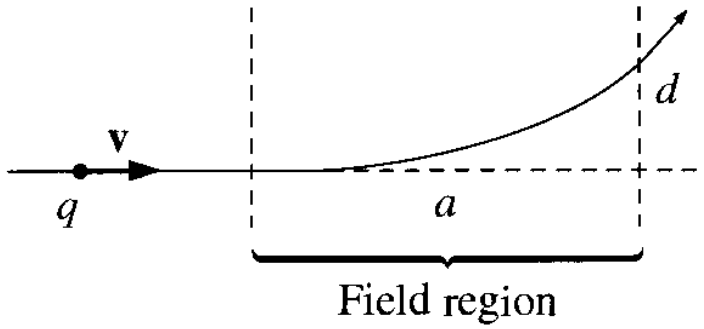
PHYS305 Homework# 6

Due on 12Dec2021

Q#1:

A particle of charge q enters a region of uniform magnetic field B (pointing into the page). The field deflects the particle a distance d above the original line of flight, as shown in the figure below. Is the charge positive or negative? In terms of a, d, B and q, find the momentum of the particle.

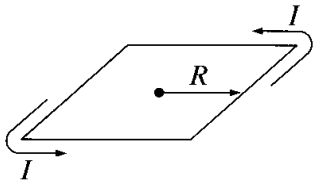


Q#2:

Suppose that the magnetic field in some region has the form $\vec{B} = kz\hat{\imath}$ (where k is a constant). Find the force on a rectangular loop of length *a* and width *b*, lying in the yz-plane and centered at the origin, if it carries a current I, flowing counterclockwise, when looking down the x-axis.

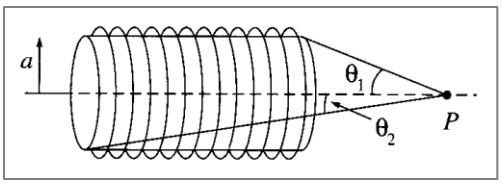
Q#3:

(a) Find the magnetic field at the center of a square loop, which carries a current I. Let R be the distance from center to side as shown in the figure below.
(b) Find the field at the center of a regular n-sided polygon, carrying a current I. Again, let R be the distance from the center to any side.
(c) Check that your formula reduces to the field at the center of a circular loop, in the limit $n \to \infty$.



Q#4:

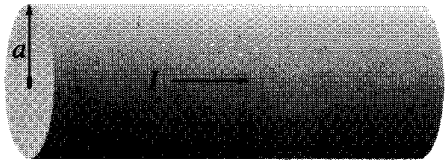
Find the magnetic field at point P on the axis of a tightly wound solenoid consisting of n turns per unit length wrapped around a cylindrical tube of radius *a* and carrying current *I*. Express your answer in terms of θ_1 and θ_2. Consider the turns to be essentially circular. What is the field at the center of an infinite solenoid?



Q#5:

A steady current I flows down a long cylindrical wire of radius a. Find the magnetic field both inside and outside of the wire, if

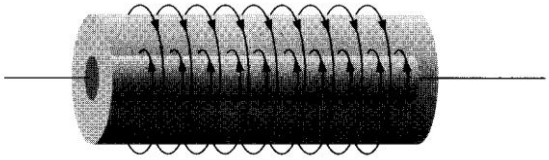
(a) The current is uniformly distributed over the outside surface of the wire.
(b) The current is distributed in such a way that J is proportional to s, the distance from the axis.



Q#6:

Two long co-axial solenoids each carry current I but in opposite directions, as shown in the figure below. The inner solenoid with radius a has n_1 turns per unit length and the outer one with radius b has n_2 turns per unit length. Find the magnetic field in the following three regions:

(a) Inside the inner solenoid.
(b) Between the two solenoids.
(c) Outside both solenoids.



Q#7:

Use equation 5.66 in the book to find the magnetic vector potential of a finite segment of straight wire, carrying a current I. After finding the vector potential determine the magnetic field produced by this current and see if it is consistent with what you will get using Biot-Savart's law.

Q#8:

Find the magnetic dipole moment of a spinning spherical shell of radius R, carrying a uniform surface charge σ which is spinning at angular velocity ω. Show that outside the shell the potential is that of a perfect dipole.