Chapter F - Problems

Blinn College - Physics 2426 - Terry Honan

Problem F.1

An electron moves in a region where the magnetic field points to the north. What is the direction of the force on an electron that moves
(a) to the east,
(b) to the south,
(c) upward and
(d) to the northwest.

Problem F.2

An electron with a speed of $5\times10^{6}\,m/s$ experiences an acceleration of magnitude $2\times10^{18}\,\mathrm{m/s^2}$ in a magnetic field of strength 2.6 T. What is the angle between the velocity and magnetic field?

Problem F.3

An electron moves in the negative x direction at $5\times10^{6}\,m/s$ in a magnetic field of $\langle -4,\,-5,\,3\rangle$ mT. What is the force on the electron? What is magnitude of this force?

Problem F.4

The earth's magnetic field at some postition has a component to the north of B. A horizonntal wire with a mass per length given by μ runs in the east-west direction.
(a) In which direction (east or west) should the current be in so that the magnetic force is upward?
(b) What must the current through the wire be so that the magnetic force cancels the weight of the wire?
(c) If the strength of the earth's field at some position is 5×10^{-5} T then find the value of the current in part (b) for a copper wire with a 2 mm diameter. The density of copper is $\rho = 8900\,\mathrm{kg/m^3}$.

Problem F.5

A bar magnet is rotated in a magnetic field of strength 0.030 T until the maximum torque is found. If the value of the maximum torque is $8\times10^{-4}\,N\cdot m$ then what is the magnetic moment of the dipole?

Problem F.6

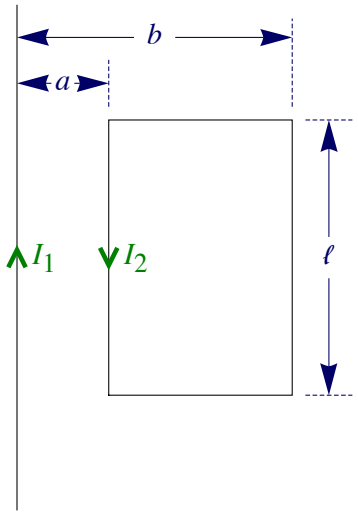
An electron is shot with a horizontal initial velocity in an upward uniform magnetic field of 1.5 mT. It moves in a circle in the field.
(a) Does it move clockwise or counterclockwise?
(b) How long does each orbit take?
(c) If the radius of the circle is 1.3 cm then what is the speed of the electron?

Problem F.7

Consider a long wire with a current I_1 and a loop with a current I_2 as shown. What is the force on the loop due to the long wire? If the values of the currents and distances are

$$I_1 = 20\text{ A}, I_2 = 8\text{ A}, a = 2\text{ cm}, b = 5\text{ cm and } \ell = 2\text{ m}$$

then what is the value of the net force?

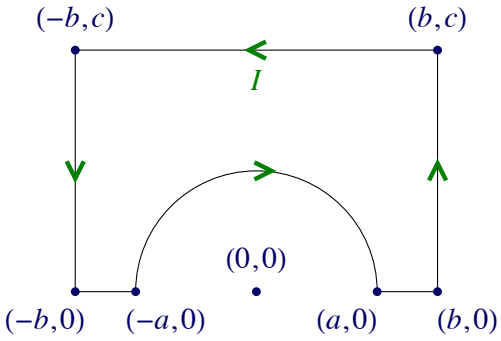


Problem F.8

A Helmholtz coil is an apparatus connsisting of two identical flat circular coils of radius R, each with N turns. Take the coils to both be parallel to the xy plane and centered at the z axis at $z = -z_0$ and $z = +z_0$. If both coils have counterclockwise currents of I, then what is the field as a function of position along the z axis?

Problem F.9

What is the magnetic field at the origin, (0,0)? GIve both its magnitude and direction.



Problem F.10

Consider flat $\ell \times \ell$ square coil with N turns that sits in the xy plane and with a clockwise (when viewed from above) current I? (Take the positive z direction to be up.)
(a) What is the magnetic field at the center?
(b) If this sits in an external magnetic field of magnitude B in the y direction the what is the torque on it?

Problem F.11

Consideer a long hollow wire with an inside radius a and outside radius b.
(a) If the wire has a uniform current density J then what is the magnetic field strength as a function of r, the distance from the central axis?
(b) Suppose instead of being given the current density J you were given the current I. Write the field as a function of position in terms of I.

Problem F.12

A solenoid has a circular cross-section with a 3 cm radius, a length of 80 cm and 300 turns. It carries a curent of 5 A.
(a) What is the magnetic field strength inside the solenoid?
(b) What is the magnitude of the solenoid's magnetic moment?