

Practice Problems - Week 7

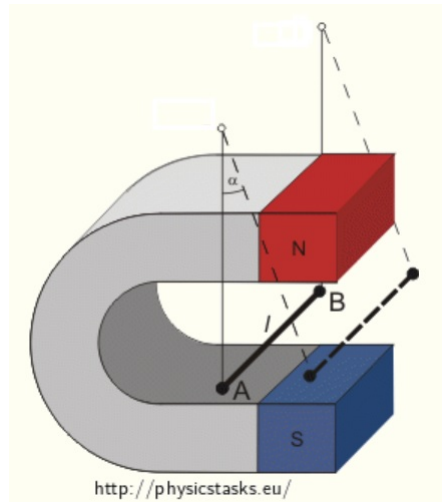
1 Dipole Beside A Wire

An infinitely long wire with current $I\hat{y}$ runs along the y -axis. A magnetic dipole of moment μ lies a distance x on the x -axis in the xy -plane. Which direction (in xyz) should the dipole be oriented to maximize the force it experiences from the wire? What is the magnitude and direction of this force?

2 Cyclotron Frequency

An electron is moving vertically and westward, 20° west of vertical, at a speed of 10^4 m/s (ignore the effects of gravity and relativity). Upon entering a region with a constant eastward magnetic field of magnitude 600 mT, the electron begins to follow a corkscrew trajectory. The electron performs three full rotations before exiting the region of magnetic field. How wide is this region?

3 Biot-Savart Law

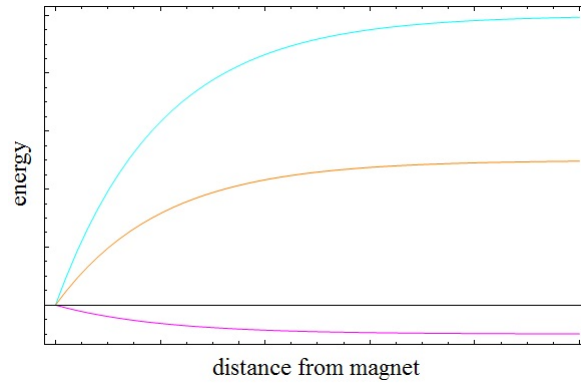


A wire having a length of 10 cm and a weight of 20 g is part of a circuit, hanging on two thin conductors of negligible mass. If the wire carries a current of 0.4 A it deflects from the vertical in homogeneous magnetic field by an angle of 35° . Derive the expression for the magnetic field.

4 Hall Effect

A rectangular aluminium strip measures 1.0 mm in the direction of a uniform 4.2 T magnetic field. When the strip carries a 8.5 A current perpendicular to the field, a $1.2 \mu\text{V}$ Hall potential develops across the strip. Find the number density of free electrons in the aluminium.

5 Types of Magnetism



You bring three objects near a strong magnet. The figure above shows a potential energy plot of the three objects as a function of distance from the magnet. Which of the three plots corresponds to an object that is ferromagnetic? Paramagnetic? Diamagnetic?