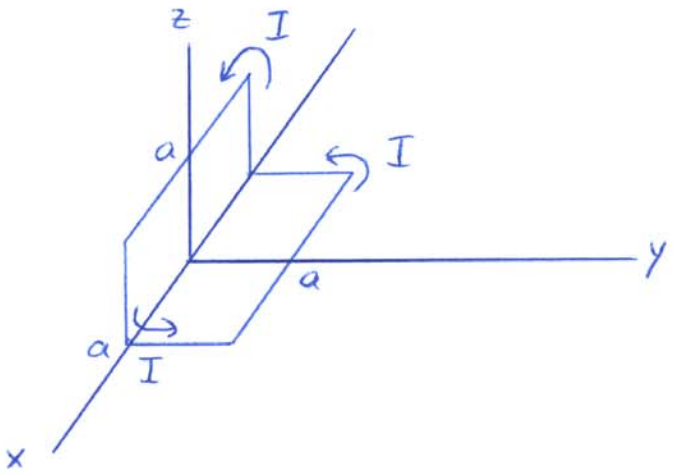
Assignment 8

1. Find the magnetic dipole moment of the loop shown below.



2a) Find the magnetic field of a magnetic dipole from its vector potential.

b) Sketch the magnetic field for a dipole aligned along the $\hat{z}$ direction.

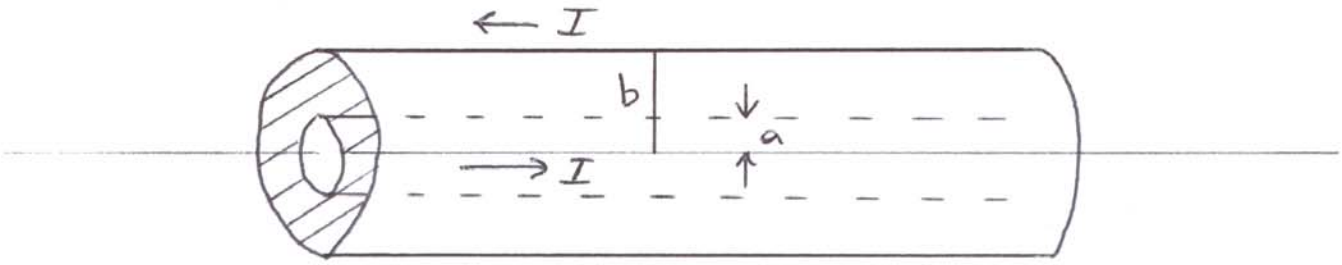
3a) A particle having charge e, mass m moves around a circle of radius r with speed v. Show that the magnetic dipole moment $\mu = \frac{e}{2mc}L$ where L is the angular momentum. In general $\vec{\mu} = \gamma\vec{L}$ where γ is called the gyromagnetic ratio.

b) A magnetic dipole $\vec{\mu}$ points in the $\hat{x}$ direction at $t = 0$. A uniform magnetic field in the $\hat{z}$ direction exerts a torque

$$\vec{N} = \vec{\mu} \times \vec{B}$$

Using $\vec{\mu} = \gamma\vec{L}$ solve for $\vec{\mu}(t)$ and sketch its motion. The dipole is said to precess about the field.

4. A coaxial cable consists of two very long cylindrical tubes separated by linear insulating material having magnetic susceptibility χ_m. A current I flows down the inner conductor and returns along the outer one.



a) Find $\vec{H}$, $\vec{B}$ and $\vec{M}$ everywhere.

b) Find the bound currents.

5. Explain how a permanent magnet is made.