Fields and Waves
Tutorial-9 (29th Match, 2016)

Q1. Consider two infinitely large sheets lying in the xy-plane separated by a distance *d* carrying surface current densities $\mathbf{K_1}$ = K **i** and $\mathbf{K_2}$ = -K **i** in the opposite direction as shown in Figure 1 (the extent of the sheets in the y direction is infinite.) Note that K is the current per unit width perpendicular to the flow.

a) Find the magnetic field everywhere due to $\mathbf{K_1}$.
b) Find the magnetic field everywhere due to $\mathbf{K_2}$.
c) Find the magnetic field everywhere due to both current sheets.
d) How would your answer in (c) change if both currents were running in the same direction, with $\mathbf{K_1} = \mathbf{K_2}$ = K **i**?

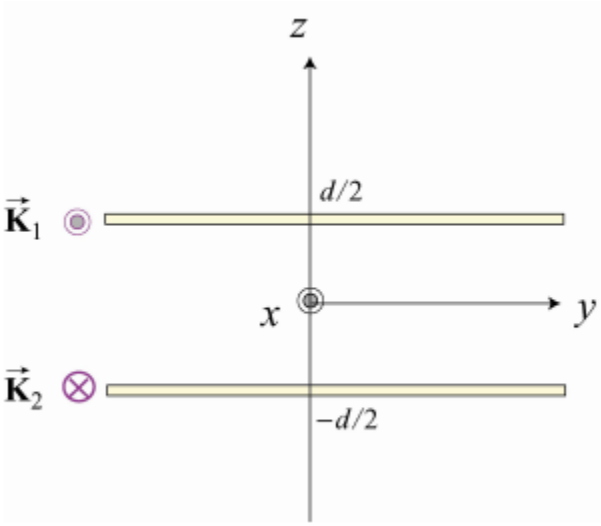

Figure 1

Q2. Earth has a magnetic dipole moment associated with currents flowing in the planet's liquid outer core. Suppose that current flowed in a single loop at the outer edge of the liquid core (radius 3000 km). What current would be needed to give the observed dipole moment of 8×10^{22} A.m^2?

Q3. A single-turn square wire loop 5.0 cm on a side carries a 450-mA current.
(a) What is the magnetic moment of the loop?
(b) If the loop is in a uniform 1.4-T magnetic field with its dipole moment vector at 40° to the field direction, what is the magnitude of the torque it experiences?

Home Assignment to be submitted and discussed during tutorial session.

Q1. Find the magnetic field at point P due to current loop as shown in Figure 2:

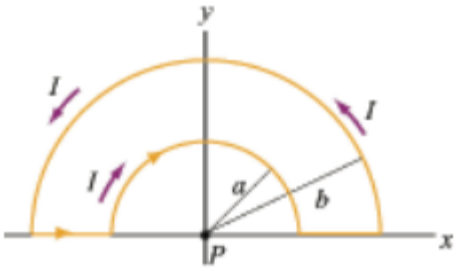

Figure 2

Q2. Consider the magnetic field:

$$\mathbf{H(r)} = z\cos\phi\,\mathbf{a}_\rho + \rho z^2\,\mathbf{a}_\phi + \rho^2\sin\phi\,\mathbf{a}_z \quad (A/m)$$

Determine the current density **J(r)** that created this magnetic flux density.