Section B. Electricity and Magnetism

1. **Magnetic Levitation**

   It is possible to make an object made from a diamagnetic material (such as bismuth or pyrolitic graphite) sit in equilibrium above a permanent magnet.

   (a) Consider a small sphere of radius R made from a linear diamagnetic material with magnetic susceptibility $\chi_m < 0$, placed in a uniform magnetic field $\vec{B}_0$. What is the total magnetic moment $\vec{m}$ induced in the sphere? Note the direction of the magnetic moment.

   (b) The sphere is placed at a height d $(d \gg R)$ above the center of a horizontal circular wire loop of radius a $(a \gg R)$ with current I flowing in the loop. Find the force on the sphere from the current loop and note its direction, for general a and d in this small R limit.