3. An uncharged particle of mass M and magnetic moment m sits in a vacuum above a superconductor. The surface of the superconductor is the infinite plane $z = 0$. It is an ideal superconductor, so the magnetic field vanishes ($\vec{B} = 0$) inside the superconductor ($z < 0$). The particle's position and the orientation of its magnetic moment are those that minimize its energy in the presence of gravity $\vec{g} = -g\hat{z}$.

   (a) How far above the superconductor does the particle sit?

   (b) What is the orientation of its magnetic moment relative to the z-axis?