Homework #11 (100 points) - Show all work on the following problems:
(Grading rubric: Solid attempt = 50% credit, Correct approach but errors = 75% credit, Correct original solution = 100% credit, Copy of online solutions = 0% credit)

Problem 1 (30 points): Find the magnetic dipole moment (magnitude and direction) of a spherical shell with radius *R*, carrying a uniform surface charge σ, and spinning around the z-axis with angular velocity ω.

Problem 2 (20 points): Use the formula $\vec{F} = \nabla(\vec{m} \cdot \vec{B})$ to find the force between two perfect magnetic dipoles with magnitude m_1 and m_2, both lying on the z-axis, aligned in the $+z$ direction, and separated by a distance r.

Problem 3 (20 points): Find the magnetic field of an infinitely long cylinder with a uniform magnetization M parallel to its axis, for the region inside the cylinder (s < R) and the region outside the cylinder (s > R).

Problem 4 (30 points): Consider an infinitely long cylinder of radius R, with a permanent magnetization $\vec{M}(s) = ks\,\hat{z}$ that increases linearly with distance from the axis to the surface. Find the magnetic field inside and outside the cylinder using two methods:

5a (20 points): Locate all the bound surface and volume currents, and use Ampere's law for *B* (Eq. 5.57) to calculate the field inside and outside the cylinder.

5b (10 points): Use Ampere's law for *H* (Eq. 6.20), and then compute *B* from *H* and *M*.