

PHY505 - Classical Electrodynamics
Homework No. 10
Due: Wednesday, Dec. 4, 2002

1. Calculate the energy in eV and the wave length in cm of the ground state hyperfine line of atomic hydrogen.¹ You may start from the results derived in lecture.
2. By direct calculation from the Biot-Savart Law find $\vec{B}(\vec{x})$ inside and outside an ideal infinitely long solenoid with radius a , n turns of wire per unit length and current I carried by the wires.²
3. A spherical shell of radius a carries a total charge Q uniformly distributed over its surface. The shell is rotated about a diameter with constant angular velocity $\vec{\omega}$. Find the magnetic induction \vec{B} along the axis of rotation both inside and outside the sphere. Compare the result for points far away from the sphere to the magnetic dipole approximation.

¹The relevant physical constants can be found on the web site of the Particle Data Group, <http://pdg.lbl.gov>.

²You may find it useful to use the identity

$$(r_1^2 + r_2^2 - 2r_1r_2 \cos \phi) = (r_> - r_<e^{i\phi})(r_> - r_<e^{-i\phi})$$