

## Atomic Physics Assignment 1

5 x 2 = 10 marks

1. A muon which is simply an overweight electron (muon mass = 207 electron mass) can be captured by a proton to form a “muonic” atom.
  - a) Find the Bohr radius of this atom.
  - b) Find the Rydberg energy of this atom.
2. Find the recoil energy of a hydrogen atom after it emits a photon in going from the  $n=4$  to the  $n=1$  state.
3. Account for the presence of certain lines in the spectrum of  $\text{He}^+$  which are almost at identical wavelengths as certain lines of the H spectrum.
4. Interaction of Atom with Earth's Magnetic Field
  - a) Calculate the interaction in eV of a Bohr magneton with the Earth's magnetic field.
  - b) Repeat for a nuclear magneton.
5. Stern Gerlach Experiment

Consider a neutral beam of atoms whose magnetic dipole moment is given by the outer one electron. The beam passes through a 5 cm long region having a magnetic field gradient of  $10^4$  Gauss/cm. The atoms are detected on a screen located one meter further on.

  - a) Sketch the beam trajectory.
  - b) Calculate the deflection observed on the screen.