

## Homework 2 – PHYS626

- 1) Find the moment of inertia for ethylene with the long axis rotating about the center of the double bond (center of the molecule) and determine  $\nu$  for the  $n=3$  to  $n=4$  transition.
- 2) Show  $\nu=\alpha c$  for the first Bohr orbit in hydrogen where  $\alpha$  is the fine structure constant.
- 3) Assume you want to measure the Zeeman splitting of the Balmer  $\alpha$  line on the transition  $2^2S_{1/2} - > 3^2P_{1/2}$  in a magnetic field of 1 Tesla. What is the spectral resolution  $\delta\lambda/\lambda$  needed to clearly resolve the splitting?
- 4) Consider a one electron atom (or ion) with a nucleus of  $Z$  protons and  $N$  neutrons. Obtain the relative correction  $dE/E$  to the Bohr energy levels due to the finite nuclear mass for the case of hydrogen ( $Z=1$ ), deuterium ( $Z=1, N=1$ ), helium, ( $Z=2, N=2$ ) and lithium ( $Z=3, N=4$ ).
- 5) Use Moseley's law with the shielding  $\sigma=1$  for K lines and  $\sigma=7.4$  for L lines to calculate
  - a. the two longest wavelengths in the K series for Cu.
  - b. three longest wavelengths in the L series of gold.
  - c. find the element whose  $K\alpha$  line has a wavelength of 0.723 Angstroms.