Molecular Physics (Prof. Käs) **WS 2007/08**
Universität Leipzig
Fakultät für Physik und Geowissenschaften

Problem Set 10
Due date: January 7, 2007

Problem 36)
Atomic hydrogen shows a series of spectroscopic lines at λ = {656.46, 486.27, 434.17, 410.29} nm. A) What is the wavelength of the next line in the series? B) What is the ionization energy of the atom when it is in the lower state of the transitions?
(4 points)

Problem 37)
State the orbital degeneracy of the levels of various hydrogenic atoms (Z in parantheses) that have the energy
a) $-9hcR_{atom}$ (3)
b) $-(hcR_{atom})/2$ (2)
c) $-hcR_{atom}$ (4).
(4 points)

Problem 38)
A point mass rotates in a circle with l =3. Calculate the magnitude of its angular momentum and the possible projections of the angular momentum on an arbitrary axis.

Problem 39)
The D_2 line of the sodium spectrum ($3\ ^2P_{3/2} \rightarrow 3\ ^2S_{1/2}$ transition) is observed at a wavelength λ_D = 588,9963 nm. How many lines result from splitting of the D_2-Linie due to a magnetic field of B = 1 T and how large is the difference between these lines (in Hz)?
Use the equation for the energy shift for a corresponding energy level with m_l while the atoms are exposed to an external magnetic field B: $\Delta E = m_l\, g\, \mu_B\, B$. ($\mu_B = 9{,}274 \cdot 10^{-24}\ \mathrm{Jm^2(Vs)^{-1}}$, the Bohr magneton, g is the Landé factor)
(5 points)