St. Josephs College (Autonomous), Bangalore-27

MSc. Physics, I Semester-Mid Semester Examination, August 2016

PH 7315: Atomic and Molecular Physics

Time: 1½hrs Max Marks: 35

This Paper contains two parts and one page

Part A

Answer any **two** of the following [2 x 10=20]

1) Explain the spectrum of a rigid diatomic vibrating rotator.

2) Derive the expression for translational frequencies of an atom kept in a strong magnetic field and explain the spectrum of sodium of D1, D2 lines in such a magnetic field.

3) Rearrange the equation of translational frequency of a rotating molecule into the form of y=mx+c so that m involves only D. Plot y against x using the data given to obtain B and D in cm^{-1}.

J''	J'	ν/GHz
0	1	115.271 195
1	2	230.537 974
2	3	345.795 900
3	4	461.040 68
4	5	576.267 75
5	6	691.472 60

Part B

Answer any **three** of the following [3 x 5=15]

4) Work out the lowest energy terms for the following atoms a) $Ca(4s^2)$ b)La $(5d6s^2)$ c) $Pt(5d^96s)$.

5) The absorption spectrum of O_2 shows vibrational structure which becomes a continuum at 56876 cm^{-1}; the upper electronic state dissociates into one ground state and one excited atom (the excitataion energy of ground state energy of which,measured from the atomic spectrum,is 15875 cm^{-1}). Estimate the dissociation energy of ground state O_2 in kJ mol^{-1}.

6) The spectral line corresponding to an atomic transition J=1 to J=0 states splits in a magnetic field of 1kG into three components seperated by 1.6 x 10^{-3} A^0. If the zero field spectral line corresponds to 1849 A^0, what is the g factor corresponding to the J=1 state?

7) Assuming the following data for the molecule $^1H^{35}Cl$: Bond length=127.5pm, bond force constant=516.3 Nm^{-1}. Calculate a) the zero point energy and fundamental vibration ν_0 , rotational constant B, the wavenumbers of the lines $P_{(1)}$,$P_{(2)}$,$P_{(3)}$,$R_{(0)}$,$R_{(1)}$ and $R_{(2)}$.