P404 Name:……..……

Reg. No……..……..

MSc DEGREE END SEMESTER EXAMINATION MARCH 2016

SEMESTER – **4, PHYSICS**

COURSE: P4PHYT13, ATOMIC AND MOLECULAR PHYSICS

Time: 3 Hours Max. Marks: 75

Part A

(Answer **all** questions. Each question carries 1 mark)

1. In alkali spectra, when the electron jumps from any ***p***- level to the lowest ***s*** level, it emits a line of ……..
   a) principal series b) sharp series c) diffuse series d) fundamental series
2. The $H\alpha$ line arise due to transition of the electron from the
   a) n=2 to n= 1 state b) n=4 to n= 2 state c) n=3 to n= 2 state d) n=3 to n= 1 state
3. Rotational spectrum occurs in the ……region.
   a) far infra red b) radiofrequency c) visible d) X ray
4. The wave number corresponding to green line of Hg (λ =546 nm) is ---------per metre
   a) 5000 b) 1.83×10^6 c) 54945 d) 18310
5. In a prolate symmetric top molecule,
   a) Ia = 0, Ib = Ic b)Ia < Ib < Ic c) Ia = Ib < Ic d) Ia < Ib = Ic

(1 x 5 = 5)

Part B

(Answer **any five** questions. Each question carries 2 marks)

6. Explain LS and jj coupling schemes in atomic spectra.
7. What are the factors affecting width of spectral lines?
8. What is the effect of isotopic substitution in rotational spectrum?
9. Explain the break down of Born – Oppenheimer approximation.
10. Distinguish between dissociation energies Do and De.
11. What is hyper Raman effect?
12. What is the role of spin – spin coupling in NMR spectroscopy?
13. Explain the factors affecting hyperfine structure in ESR spectra.

(2 x 5 = 10)

Part C

(Answer **any three** questions. Each question carries 4 marks)

14. The term symbol of a state is $^2P_{3/2}$. What are the values of L, S and J? Also calculate g.
15. The IR spectrum of $H^1 Br^{79}$ consists of a series of lines spaced 17 cm^{-1} apart. Find the inter nuclear distance of $H^1 Br^{79}$ (h= 6.62×10^{-27} erg-sec, N= 6.023×10^{23})

(PTO)

16. The fundamental band for CO is centered at 2143cm^{-1} and first overtone at 4259cm^{-1}. Calculate the equilibrium oscillation frequency and the corresponding an harmonicity constant.

17. If the bond length of H_2 is .075nm, what would be the positions of the first three rotational Raman lines in the spectrum? (H^1 = 1.673x10^{-27}Kg)

18. A free electron (g = 2) is placed in a magnetic field of strength 1.5 Tesla. Calculate the resonance frequency? (4 x 3 = 12)

Part D

(Answer **all** questions. Each question carries 12 marks)

19. Describe spin – orbit interaction. Derive an expression for spin orbit interaction energy.

OR

Discuss the theory of Stark effect. Explain in detail the hyperfine structure of spectral lines.

20. Explain the theory of rotational spectra of a rigid diatomic molecule.

OR

Explain the theory of a diatomic vibrating rotator. Obtain the equation for energy levels.

21. Discuss the rotational fine structure of electronic vibration spectra.

OR

Describe pure rotational Raman spectra of (a) linear and (b) symmetric top molecules.

22. Explain Bloch equation and their steady state solutions in NMR.

OR

Explain recoilless emission and absorption of γ rays. What is chemical isomer shift in Mossbauer spectroscopy.

(12 x 4 = 48)

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