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M.Sc. (Third Semester)
EXAMINATION, Dec. - Jan., 2021-22
PHYSICS
Paper Second
(Atomic and Molecular Physics)

Time : Three Hours] *[Maximum Marks:80*

Section - A

(Objective/Multiple Choice Questions)

(1 Mark each)

Note : Attempt all questions.

Choose the correct answer:

1. Spectrum of hydrogen atom is -

   (A) Line spectrum

   (B) Band spectrum

   (C) Continuous spectrum

   (D) None of these

2. Fine structure of alkali atoms is because of -

   (A) L - S coupling

   (B) J - J coupling

   (C) Spin - Orbit interaction

   (D) Interaction with nuclear magnetic moment.

3. For a single electron system -

   (A) All energy levels are singlets

   (B) All energy levels are doublets

   (C) Ground level is singlet and all other are doublets

   (D) Ground level is singlet and all others are triplets

4. According to Pauli's principle.....electrons can have same total quantum number '*n*' in a system -

   (A) Only one

   (B) Only two

   (C) Certain limited number of

   (D) All

5. Usually j - j coupling occurs in electrons with -

   (A) Large principal quantum number

   (B) Small principal quantum number

   (C) In lighter elements

   (D) None of these

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6. The hyperfine splitting of a spectral line of atom is due to

(A) Coupling between spins of two electron

(B) Coupling between spin and angular moment of electron

(C) Coupling between spins of electron and nucleus

(D) Coupling with external electro magnetic field.

7. Zeeman effect is an example of -

(A) Electromagnetic phenomenon

(B) Electromechanical phenomenon

(C) Theromo - Electric phenomenon

(D) Magnetic - Optical phenomenon

8. The energy shift due to Zeeman effect is given as -

(A) $\Delta E = m_i \left(\frac{eh}{4\pi m} \right) B$

(B) $\Delta E = m_i \left(\frac{eh}{4\pi m} \right)^2 B$

(C) $\Delta E = -m_i \left(\frac{e\alpha}{4\pi m} \right) B$

(D) None of these

9. Molecule of methane (CH_4) is -

(A) Linear molecule

(B) Symmetric top molecule

(C) Asymmetric top molecule

(D) Spherical top molecule

10. Which of the following molecules would not give rotational specturm?

(A) CO

(B) HCl

(C) HBr

(D) H_2

11. Raman spectrum is obtained because of -

(A) Scattering

(B) Emission

(C) Absorption

(D) Diffraction

12. The number of possible modes of vibration in CH_3I molecule is -

(A) 6

(B) 7

(C) 8

(D) 9

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13. The vibrating frequency of a diatomic molecule of reduced mass μ and force constant K is-

(A) $2\pi\sqrt{\frac{k}{\mu}}$

(B) $\sqrt{\frac{k}{\mu}}$

(C) $\frac{\pi}{2}\sqrt{\frac{\mu}{k}}$

(D) $2\pi\sqrt{\frac{\mu}{k}}$

14. Vibration energy levels of molecules are -

(A) Continuous

(B) Discrete and equispaced

(C) Discrete and unequally spaced

(D) Nothing can be said

15. Which of the following absorption spectra are observed in near visible region with transition energy of the order of 0.1 eV -

(A) Electronic Spectra

(B) Rotational Spectra

(C) Vibrational Rotational Spectra

(D) None of these

16. For P branch in the spectrum -

(A) $\Delta J = 0$

(B) $\Delta J = 1$

(C) $\Delta J = 2$

(D) $\Delta J = -1$

17. Lowest vibration energy is -

(A) hv

(B) $\frac{1}{2}hv$

(C) $2hv$

(D) Zero

18. Stark effect is effect of -

(A) Nuclear field

(B) Electric field

(C) Gravitational field

(D) Magnetic field

19. Spin angular momentum of electron is -

(A) 0

(B) $\hbar$

(C) $\frac{1}{2}\hbar$

(D) $2\hbar$

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20. In Hydrogen Spectrum, the emission lines obtained in visible region are due to transition from higher energy levels to-

(A) Ground level

(B) 1st excited level

(C) 2nd excited level

(D) 4th excited level

Section - B

(Very short answer type questions)

(2 Marks each)

Note : Attempt all questions.

1. What are Atomic Orbitals?
2. What do you mean by Spin-Orbit interaction?
3. What are penetrating and non - penetrating orbits?
4. Give Pauli's principle.
5. Give examples of two electron systems.
6. What is Principal Series Effect?
7. What do you mean by spherical top molecule?
8. What is meant by Vibrating Rotators?

Section - C

(Short Answer Type Questions)

(3 Marks each)

Note: Attempt all questions.

1. Explain relativistic correction in fine structure of hydrogen.
2. Describe equivent and non-equivent electrons.

3. Explain Stark Effect in Hydrogen.
4. Explain orbital model.
5. Describe various types of molecules.
6. Describe Microwave Spectrometer.
7. Explain pure rotational Raman Spectra.
8. Discuss vector atom model for one electron system.

Section - D

(Long Answer Type Questions)

(5 Marks each)

Note : Attempt all questions.

1. Discuss spectra of alkali elements and explain the fine structure.

OR

Describe interaction energy in L-S and J - J coupling.

2. Obtain expression for magnetic moment of a bound electron and the magnetic interaction energy.

OR

Describe Zeeman and Paschen - Back effect in hydrogen.

3. Explain rotational spectrum of a rigid rotator giving the energy levels and selection rules.

OR

Give the theory of Raman effect.

4. Describe vibrational spectra of molecules for an hormonic vibrations.

OR

Explain vibrational - rotational Raman Spectrum.

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