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# SARDAR PATEL UNIVERSITY

B. Sc. SEMESTER VI

Subject: PHYSICS

Course Code: US06CPHY22

[Atomic and Molecular spectroscopy]

Date: 24-6-2022, Friday

Time: 10:00 am. to 12:00 pm.

Total marks: 70

Instructions: - i. Attempt all the questions.

ii. Figure on right hand side indicates full marks of that question.

## Q-1 Multiple choice questions:

[10]

- In Frank- Hertz experiment, the voltage corresponding to the peaks are called
  - excitation potential
  - Peak to peak voltage
  - maximum voltage
  - Maximum current
- The relation expressing the frequency of Larmor precession is called
  - Larmor's precession motion
  - Larmor's theorem
  - Larmor's frequency
  - Larmor's relation
- The diffuse series arises from the transitions between the various D-levels and
  - lowest S-level
  - S-level
  - lowest P-level
  - lowest F-level
- In molecular spectra, a transition between \_\_\_\_\_ levels results in a radiation that falls in the visible or ultra violet region.
  - two vibrational
  - Two rotational
  - (a) & (b) both
  - two electronic
- In practice, \_\_\_\_\_ spectra is observed in absorption.
  - Rotational
  - vibrational
  - electronic
  - translational
- Condition of moment of inertia for spherical top molecules is
  - $I_a \neq I_b \neq I_c$
  - $I_a = I_b = I_c = I$
  - $I_a = I_b < I_c$
  - $I_a < I_b = I_c$
- Vibrational-rotational spectra are observed only for molecules that have
  - permanent dipole moment
  - dipole moment
  - Symmetrical structure
  - Non symmetrical structure
- \_\_\_\_\_ are used for collimating and focusing of radiations in infra-red region.
  - Slits
  - collimators
  - Mirrors
  - Condensers
- Anti Stokes' lines are frequently less intense than the \_\_\_\_\_ lines.
  - Rayleigh
  - Stokes'
  - Balmer
  - Fraunhofer
- Under high resolution Stokes' lines and anti-stokes' lines are found to be composed of \_\_\_\_\_ fine structure.
  - rotational
  - vibrational
  - translational
  - electronic

[PTO]

Q-2 Do as directed:

[08]

(A) Fill in the blank:

1. Para-Positronium in which the spin of two particles are
2. The \_\_\_\_\_ diatomic molecules do exhibits pure rotational spectra.
3. A vibrating diatomic molecule can be approximated to a linear \_\_\_\_\_.
4. Difference of the frequency of incident radiation and scattered frequency is called \_\_\_\_\_.

(B) State true and false:

5. Thermopile and bolometer are used to investigate spectra in the far infra red region.
6. Angular momentum is not conserved in molecules.
7. The moment of inertia can be deduced from the rotational structure of the vibrational band.
8. The Raman effect was initially considered as the optical analogue of the Compton effect.

Q-3 Answer the following short questions (any ten).

[20]

- [1] Enlist the characteristics of band spectra.
- [2] Discuss Bohr's first assumptions in short.
- [3] Write Ritz combination principle.
- [4] Write definition of rigid rotator and draw figure of it.
- [5] Enlist regions of the electromagnetic spectrum.
- [6] Explain in short oblate type molecules.
- [7] Discuss salient features of vibrational -- rotational spectra for HCl molecule.
- [8] Briefly explain R-branch for spectrum of diatomic molecule.
- [9] Explain how to identify the unknown compound by matching its infra-red spectrum.
- [10] What is Raman effect?
- [11] Write the difference between Raman spectrum and fluorescence spectrum.
- [12] Explain in brief Raman effect in liquids.

Q-4 Answer the following long questions (any four).

[32]

- [1] Describe Stern Gerlach experiment.
- [2] Describe the general features of the spectra of alkali metals and explain fine structure of alkali spectra.
- [3] Discuss rotational spectra of a diatomic molecule, treated as a non rigid rotator.
- [4] Explain the rotational spectra of poly atomic molecules.
- [5] Describe the general experimental arrangement for studying Infra-red Spectra.
- [6] Narrate the experimental set up to observe the Raman spectra.
- [7] Discuss the quantum theory of Raman effect.
- [8] Describe how to study the structure of molecules with the help of Raman effect.

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