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SARDAR PATEL UNIVERSITY
6th Semester B. Sc. (Under CBCS) Examination 2021
Friday, 16th July 2021
Time: 10:00 am to 12:00 pm
Subject: PHYSICS [US06CPHY22]
[Title: Atomic and Molecular Spectroscopy]

Total Marks: 70

N.B: (i) All the symbols have their usual meanings.
    (ii) Figures at the right side of questions indicate full marks.

Q.1 Answer the following Multiple Choice Questions. (10)
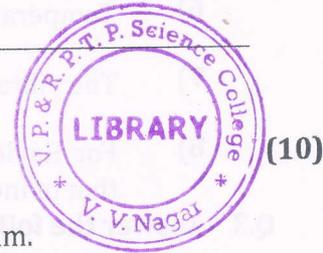
1. Paschen series is observed in ____ region of EM spectrum.
   (a) X-Rays   (b) UV   (c) visible   (d) IR

2. Lyman series has the convergence limit at wavenumber ($\bar{\gamma}$)= ____ .
   (a) $R^3/3$ (b) $R^2/2$ (c) $R/2$ (d) R

3. In alkali metals, the outermost shell contains ____ electron/s.
   (a) one   (b) two   (c) three   (d) four

4. Molecular spectra are emitted when the emitting substance is in ____ state.
   (a) atomic   (b) molecular   (c) bulk   (d) all of these

5. The diatomic molecule such as ____ does not exhibit pure rotational spectra.
   (a) H_2 (b) HCl   (c) HBr   (d) HF

6. Vibrational – Rotational molecular spectra observed in ____ region.
   (a) infrared   (b) Far - infrared   (c) Microwave   (d) X - ray

7. A line which is found missing in the center of the band is called ____ line.
   (a) null   (b) first   (c) sixth   (d) front

8. The rotational quantum number is denoted by ____ .
   (a) K   (b) J   (c) R   (d) L

9. Raman used horn shaped tube in his apparatus to avoid ____ .
   (a) multiple interference   (b) multiple reflection
   (c) multiple refraction   (d) multiple emission

10. Lines on high frequency side of exciting lines called ____ lines.
    (a) Stokes   (b) Rayleigh   (c) anti-stokes   (d) Euler

* * * * *

(P.T.O.)

Q.2 Fill in the blanks (1-4) / State whether the sentence is true or false (5-8). **(08)**

1) The alkali spectra can be grouped into total (number) ____ chief series.

2) Among different series in alkali spectra, ____ and ____ series have a common limit.

3) The electronic transition in a molecule is associated with ____ region/s of EM spectrum.

4) Raman effect offers as a ____ method of studying crystals.

5) The para-positroniums have anti-parallel spin.

6) Temperature radiation method may produce spectrum.

7) The vibrational quantum number is represented by V.

8) For Rayleigh lines, the frequency of scattered Raman lines is same as that of incident light.

Q.3 Answer the following questions in short: (Attempt Any Ten) **(20)**

1) State Ritz combination principle.

2) State the shortcomings of Bohr's theory.

3) Name alkali elements with its electronic configuration.

4) Classify various types of spectra.

5) What is a non-rigid rotator?

6) State the salient features of pure rotational spectra.

7) What is a harmonic oscillator?

8) Define: Atomic spectra and Molecular spectra.

9) Write in brief about detector used in absorption spectra for single beam arrangement.

10) Explain in brief about polarization of Raman lines.

11) List basic requirement for Raman spectra in laboratory.

12) Give the difference between Raman spectra and Infrared spectra.

Q.4 Answer any four questions from the following. (8 Marks each) **(32)**

1 Explain Stern-Gerlach experiment with neat diagram.

2 Explain Franck-Hertz experiment with neat diagram.

3 Discuss the Born-Oppenheimer approximation.

4 Derive the equation for rotational energy (E_r) of a rigid diatomic rotator (molecule) in terms of rotational quantum number (j).

5 In case of vibrating diatomic molecule obtain energy levels

$$E_v = hc\omega \left[v + \frac{1}{2}\right]$$

6 With help of proper arrangement of absorption spectra – single beam, explain general experimental arrangement for studying infrared spectra.

7 Explain how the Raman effect is used in different areas of physics.

8 What is Raman effect? State the salient features of Raman spectra. With necessary diagram, explain the laboratory experimental set-up to observe it.

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