

2014

(5th Semester)

PHYSICS

EIGHTH (A) PAPER

(Spectroscopy)

Full Marks : 55

Time : 2 hours

(PART : B—DESCRIPTIVE)

(Marks : 35)

*The figures in the margin indicate full marks
for the questions*

1. Derive Rutherford's scattering cross-section formula. Discuss Rutherford's atom model and mention its limitations. 4+3=7

Or

- (a) Explain the different spectroscopic terms. Also explain multiplicity of the terms. 4
- (b) Calculate the two possible orientations of spin vector \vec{s} with respect to magnetic field direction. 3

(2)

2. Distinguish between normal and anomalous Zeeman effects. Use classical ideas to explain normal Zeeman effect. 2+5=7

Or

What are X-rays? Explain Bragg's law. X-rays of wavelength 1.392 \AA are reflected from the face of an NaCl crystal. The first-order reflection is observed at an angle of 14° . Calculate the lattice spacing. 2+3+2=7

3. Define spontaneous emission and induced emission, and hence derive Einstein's A and B coefficients. 3+4=7

Or

Explain the construction and working of He-Ne laser. 7

4. Obtain an expression for the allowed energies for a vibrating diatomic molecule treated as a harmonic oscillator. Show that the vibrational spectrum consists of a single band. 4+3=7

Or

- (a) Obtain an expression for the rotational energy of a diatomic molecule when considered as a rigid rotator. Explain the isotope effect. 3+2=5

(b) The transition $J = 1 \leftarrow 0$ in HCl occurs at 20.68 cm^{-1} . Regarding the molecule to be a rigid rotator, calculate the wavelength of the transition $J = 15 \leftarrow 14$. 2

5. What is Raman effect? Explain it using quantum mechanics. Also compare Raman spectra with infrared spectra. 1+4+2=7

Or

(a) Discuss rotational fine structure of electronic vibrational transitions. 5

(b) State and explain Franck-Condon principle. 2

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PHYSICS

EIGHTH (A) PAPER

(**Spectroscopy**)

(PART : A—OBJECTIVE)

(Marks : 20)

The figures in the margin indicate full marks for the questions

SECTION—I

(Marks : 5)

Put a Tick (✓) mark against the correct answer in the brackets provided : 1×5=5

1. The possible quantum numbers n , l , j and m_j of the outer electron of sodium given by $3^2S_{1/2}$ are

(a) $n = 2, l = 1, j = +\frac{1}{2}, m_j = \pm\frac{1}{2}$ ()

(b) $n = 3, l = 0, j = \frac{1}{2}, m_j = \pm\frac{1}{2}$ ()

(c) $n = 1, l = 2, j = \frac{3}{2}, m_j = \pm\frac{3}{2}$ ()

(d) $n = 0, l = 3, j = \frac{3}{2}, m_j = \pm\frac{3}{2}$ ()

2. According to Pauli's exclusion principle, the total number of states with a given principal quantum number n is

(a) $2n^2$ ()

(b) $2n$ ()

(c) $2n^2 + 1$ ()

(d) $2n + 1$ ()

3. An atom initially in the upper energy state E_2 drops to a lower state E_1 by emitting a photon of energy $h\nu$. The process is known as

(a) photon emission ()

(b) spontaneous emission ()

(c) stimulated emission ()

(d) induced emission ()

4. According to Born-Oppenheimer approximation, the molecular energy levels can be divided into electronic (E_e), vibrational (E_v) and rotational (E_r) energy levels. The order of magnitudes is

(a) $E_e > E_v > E_r$ ()

(b) $E_v > E_e > E_r$ ()

(c) $E_r > E_v > E_e$ ()

(d) $E_r > E_e > E_v$ ()

5. If one electron is removed from oxygen molecule, it will be in the highest energy orbital ($\pi_g^* 2p$). This electron is called

(a) anti-bonding electron ()

(b) bonding electron ()

(c) π -bonding electron ()

(d) σ -bonding electron ()

(4)

SECTION—II

(Marks : 15)

Give short answers of the following questions :

3×5=15

1. State and explain Larmor's theorem.

(5)

2. Write a short note on Auger effect.

3. With suitable diagram, explain the method of pumping in laser.

(7)

4. Obtain the bond length of HCl molecule. (Given, $B = 10.35 \text{ cm}^{-1}$, $h = 6.62 \times 10^{-34} \text{ J-s}$, $c = 3 \times 10^{10} \text{ cm/s}$, $m_1 = 1.008 \text{ a.m.u.}$, $m_2 = 35.46 \text{ a.m.u.}$, $N_A = 6.024 \times 10^{23}$)

5. Write a short note on Fortrat diagram.

Subject Code :

V/BOT (viii)

Booklet No. **A**

322

V/BOT (viii)

2014

(5th Semester)

BOTANY

EIGHTH PAPER

(**Environmental Biology and Ethnobotany**)

Full Marks : 55

Time : 2 hours

(**PART : B—DESCRIPTIVE**)

(Marks : 35)

*The figures in the margin indicate full marks
for the questions*

1. Define environment. Describe in brief
different types of climatic factor. 1+6=7

Or

What is biogeochemical cycle? Describe
nitrogen cycle with a neat diagram. 1+6=7

2. What are non-biodegradable pollutants?
Mention their role in biomagnification. 2+5=7

Or

Write short notes on the following : $3\frac{1}{2}+3\frac{1}{2}=7$

(a) Radioactive waste disposal

(b) The causes of ozone-layer depletion

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semester

/ Commerce /

) Exam., 2014

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G15—350/157a

(Turn Over)

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