

**2023**

*Time : 3 hours*

*Full Marks : 60*

*Candidates are required to give their answers*

*in their own words as far as practicable.*

*The figures in the margin indicate full marks.*

*Answer any five questions in*

*which question no 1 is compulsory.*

1. Choose the correct answer :  $1 \times 12 = 12$

- (i) Expression for energy for a particle in one dimensional box is :

(a)  $E = \frac{n^2 h^2}{8ma^2}$

(b)  $E = \frac{n^2 h^2}{4ma^2}$

(c)  $E = \frac{n^2 h}{8ma^2}$

(d)  $E = \frac{nh^2}{8ma^2}$

- (ii) If the wave function of an electron is  $\psi$ , then the probability density is :

(a)  $\psi$

(b)  $2\psi$

(c)  $\psi^2$

(d)  $\frac{\psi}{2}$

- (iii) For a single electron in an atom the wave function is known as :

(a) Atomic orbital

(b) Molecular orbital

(c) Electron charge density

(d) Electron cloud

(iv) The following will not give pure rotational spectra :

(a)  $H_2O$

(b)  $N_2O$

(c)  $HCl$

(d)  $CO_2$

(v) The selection rule for rotational spectra is :

(a)  $\Delta J = +1$

(b)  $\Delta J = -1$

(c)  $\Delta J = \pm 1$

(d)  $\Delta J = 0$

(vi) The statement that each molecule or atom activated by light absorbs only one

quantum of light which causes activation is known as :

(a) Grotthuss-Draper Law

(b) Lambert's Law

(c) Beer's Law

(d) Stark-Einstein Law

(vii) Beer's law is applicable only to :

(a) Solids

(b) Liquid solution

(c) Gases

(d) Semi solid substance

(viii) The wave length of ultraviolet and visible regions of electromagnetic spectrum is :

(a) Less than 2000 Å

(b) More than 8000 Å

(c) 2000 to 8000 Å

(d) None of these

(ix) The rotational spectra involve :

- (a) A very high energy changes
- ✓(b) Small energy changes
- (c) No energy change
- (d) None of these

(x) The wave numbers are expressed in :

- (a)  $sec^{-1}$
- ✓(b)  $cm\ sec^{-1}$
- (c)  $cm^{-1}$
- (d)  $cm^2\ sec^{-1}$

(xi) Which one is not the law of photo-chemistry ?

- (a) Grotthuss-Draper law
- (b) Lambert's law
- (c) Beer's law
- ✓(d) Raoult's law

(xii) Raman spectra contains :

- (a) Stokes lines
- (b) Anti-stokes lines
- (c) Rayleigh lines
- ✓(d) All

✓2. Derive Schrodinger wave equation. What is the physical significance of  $(\psi)$   $\psi$  in it. 12

✓3. State and explain postulates of quantum mechanics. <https://www.jharkhandstudy.com> 12

4. What are radial probability distribution curves ? Draw and explain it for 1s, 2s, 2p and 3s orbitals. 12

5. What do you mean by molecular spectroscopy ? Explain its different types. 12

6. Write down short notes on any two of the following : 6×2=12

- (a) Linear operator

- (b) Hamiltonian operator
- (c) Hermitian operator
- (d) Zero point energy
- (e) Laplacian operator

7. Discuss vibrational rotational spectra observed in diatomic molecule. 12

8. State and explain Lambert's law and derive an equation to relate intensity of absorbed radiation and intensity of incident radiation.

12

9. What are photochemical reactions? Explain giving examples. Discuss the photochemical combination of Hydrogen and Chlorine. 12

10. Answer any two of the following questions :

6×2=12

(a) What are normal mode of vibrations?

- (b) What are Rayleigh stokes and antistoke lines
- (c) What are application of IR spectroscopy?
- (d) What is Born Oppenheimer approximation?

\_\_\_\_\_x\_\_\_\_\_