

3 (Sem-3) CHM M 1

2014

CHEMISTRY

(Major)

Paper : 3.1

Full Marks : 60

Time : 2½ hours

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

1. Answer the following questions : 1×7=7

(a) Which quantum number is not obtained from the Schrödinger wave equation?

(b) Why are the line spectra of two elements not identical?

(c) What is the difference between a quantum and a photon?

(d) What is the bond order?

(e) What are l and m values of $2p_x$ electron?

(2)

(f) What physical meaning is attributed to the square of the absolute value of wave function, $|\psi|^2$?

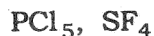
(g) Write the electronic configuration of F^- .

2. Answer the following questions : $2 \times 4 = 8$

(a) An electron is in a $4f$ orbital. What possible values for the quantum numbers n , l , m and s can it have?

(b) Draw two simple but clear diagrams for spin angular momentum (\vec{s}) and the associate spin magnetic moment ($\vec{\mu}_s$) of clockwise and anticlockwise spinning electrons.

(c) Draw the Lewis structures of the following :



(d) Explain why BF_3 has not dipole moment, but NH_3 has.

3. Answer any *three* questions : $5 \times 3 = 15$

(a) What is the energy of a photon of wavelength 6000 \AA ?

(3)

(b) What is the main difference between electromagnetic wave theory and Planck's quantum theory?

(c) "Electronegativity is not a property of the isolated atom, but rather a property of an atom in a molecule." Explain with suitable example.

(d) Calculate the frequency and energy of photon associated with wavelength 580 nm .

(e) What is effective nuclear charge? How is it related with screening effect?

(f) State and explain Pauli's exclusion principle.

4. Answer any *three* questions : $10 \times 3 = 30$

(a) Draw the energy-distribution curve (emissive power vs wavelength) of black-body radiation for at least four different temperatures in Kelvin scale and explain the chief characteristics of the curve.

(b) Explain the following :

(i) HCl in gaseous state is covalent, which in the aqueous solution it is ionic.

(ii) The dipole moment of $\text{H}-\text{C}\equiv\text{C}-\text{Cl}$ is in the direction \leftarrow . Explain carefully.

(c) (i) Describe briefly an experiment which demonstrates the wave nature of electron.

(ii) What is the total energy of an electron whose de Broglie wavelength is 1.2×10^{-8} cm?

(d) Explain the valence-bond theory of bonding in H_2 molecule. Point out the main limitation of valence-bond theory.

(e) (i) Calculate percent ionic character in HCl molecule when the bond distance in this molecule is 1.275 \AA and observed dipole moment value is 1.03 D .

(ii) Show that the wavelength λ associated with an electron of mass m and kinetic energy E is

$$\lambda = \frac{h}{\sqrt{2mE}}$$

- (f) (i) On the basis of wave mechanics, explain why s -orbital is spherical and p -orbital is dumbbell shaped.
- (ii) Compare and contrast between the Bohr's theory and the Schrödinger theory of the ground state of the hydrogen atom.
