

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, $|\psi|^2$?

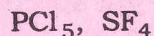
(g) Write the electronic configuration of F^- .

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 Å?

(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.
