

Total No. of printed pages = 5

3 (Sem 3) CHM M1

2015

CHEMISTRY

(Major)

Paper : 3.1

Full Marks – 60

Time – Three hours

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

1. Answer the following questions : $1 \times 7 = 7$

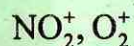
- (a) What is the difference between atomic mass and mass number ?
- (b) What is the angular momentum of an electron in 2S orbital ?
- (c) At what distance is the radial probability maximum for 1S orbital ? What is this distance called ?
- (d) What is $n+l$ rule in electronic configuration of elements ?

[Turn over

- (e) How many orbitals do you expect to be present in the 5th shell ?
- (f) How many electrons having same spin in 4f subshell of an atom contain 10 electrons ?
- (g) How many nodes are present in a 3P orbital ?

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

- (a) If the uncertainties in position and momentum are equal, then what will be the uncertainty in the velocity ?
- (b) In what ways Heisenberg's uncertainty principle contradicts the concept of stationary orbit for electron as suggested by Bohr ?
- (c) Draw probability distribution curves for 1S and 2S electrons.
- (d) Which of the following has higher bond dissociation energy and why ?



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

- (a) Write about success and failure of Bohr's theory. (Five points about success and five points about failure)

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- (b) Distinguish between radial wave function and radial probability function and sketch the both for $n = 1, 2, 3$ for hydrogen atom.

- (c) From the Heisenberg's uncertainty principle can you prove that electron cannot exist in the nucleus. (Given diameter of atomic nucleus = 10^{-15} m, mass of electron = 9.1×10^{-31} kg).

- (d) How is electronegativity related with the type of bond formed between atoms.

- (e) Draw Lewis structures for H_2SO_4 , H_2CO_3 , SO_3 , HClO_2 and HClO_4 .

- (f) How formal charge of an atom can be calculated ? What is the formal charge of the following ?

(i) Phosphonium ion (in P and H atom).

(ii) Nitrous oxide (in central N-atom).

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

- (a) Find out an expression of Planck's radiation law in terms of frequency. Do you think that this law led to the formulation of quantum mechanics ? 10

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(b) (i) Justify the statements "the number of molecular orbitals obtained in the LCAO is equal to the number of atomic orbitals involved in the summation". 5

(ii) Discuss the directional characteristics of the function (θ_1, ϕ_0) 5

(c) Explain with suitable examples.

(i) Maximum number of electrons, that can be accommodated by a shell with principal quantum number n is equal to $2n^2$.

What principle is involved in this statement? 5

(ii) Calculate σ and Z eff. for 3d electron in Cu ($Z=29$). 5

(d) (i) Briefly discuss the electronegativity difference method for calculating the percentage ionic character of a polar covalent bond with suitable example. 5

(ii) Explain why SO_2 has dipole moment while CO_2 does not. 5

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(e) (i) "The resonance energy and entire phenomenon of resonance are merely a result of the overly restrictive approach in valence bond theory". Explain the statement with suitable examples. 5

(ii) The mass of an electron is 9.1×10^{-31} kg. If its K.E. is 3.0×10^{-25} g, calculate the wave length. 5

(f) (i) Using spectral data on black body radiation suggest a method of finding the value of Planck's constants. Give the value of the constant in S.I. units.

4+1=5

(ii) State and explain Pauli's exclusion principle. 5

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