

Total No. of printed pages = 5

3 (Sem 3) CHEM MI

2015

CHEMISTRY

(Major)

Paper : 3.1

Full Marks - 60

Time - Three hours

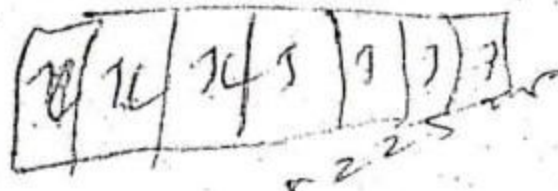
The figures in the margin indicate full marks for the questions.

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 ? $(2\hbar)$
- (c) At what distance is the radial probability maximum for 1S orbital ? What is this distance called ? 0.53 \AA
- (d) What is $n+l$ rule in electronic configuration of elements ? ~~Handwritten rule~~ Aufbau rule

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(e) How many orbitals do you expect to be present in the 5th shell? m^2

(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?

$$\begin{aligned} n-l &= 3-1=2 \\ 3-1-1 &= 1 \\ 2 \times 4 &= 8 \end{aligned}$$

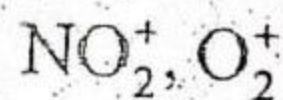
2. Answer the following questions :

(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).

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(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? YES

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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 $(\theta_1, \theta_2, \phi_0)$. 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

(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} J, calculate the wave length. 5

(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