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3 (Sem-1/CBCS) CHE HC 1

2022

CHEMISTRY

(Honours)

Paper : CHE-HC-1016

(Inorganic Chemistry-I)

Full Marks : 60

Time : Three hours

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

1. Answer **any seven** questions from the following : 1×7=7
- (a) Which series of spectral lines of hydrogen atom falls in visible range of sunlight?
 - (b) What is an eigenfunction?
 - (c) What is the value of shielding constant for the valence electron of Li atom?

Contd.

- (d) Arrange the halogens in decreasing order of their electronegativities.
- (e) Calculate the formal charge of P in PH_4^+ ion.
- (f) How does bond multiplicity affect bond length?
- (g) Can the molecule Be_2 exist?
- (h) An element can show +1, +3 and +5 oxidation states. In which state does the element can act both as an oxidising agent as well as a reducing agent?
- (i) What is reduction potential?
- (j) In which group of the periodic table will the element having atomic number 119 lie?
- (k) What is an operator?
- (l) Which group of elements of the periodic table are collectively known as chalcogen?

2. Answer **any four** questions from the following : 2×4=8

- (a) If the value of Rydberg constant for H atom is $1.1 \times 10^7 m^{-1}$, what would be its value for He^+ ion?
- (b) Define micro and macro particles in terms of 'action'.
- (c) Show that the probability of finding the electron in a hydrogen-like atom is independent of the angle ϕ .
- (d) Discuss the trend in basic strength of the hydrides of group 15 elements.
- (e) Second electron affinity of the elements is positive. Why?
- (f) Ionic radii of O^{2-} ion is greater than O^- ion. Why?
- (g) With the help of a proper example explain that a non-polar molecule can have polar bonds.
- (h) With the help of a proper example explain disproportionation reaction.

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

(a) What do you mean by orbital quantum numbers? How are their values interrelated? $3 + 2 = 5$

(b) What are symmetric and antisymmetric wave functions? Explain Pauli's antisymmetry principle. $2 + 3 = 5$

(c) How can the ionisation energy values of the elements be applied in determining reducing power and reactivity order of the elements. $2\frac{1}{2} \times 2 = 5$

(d) How does electronegativity vary with bond order and hybridisation? With the help of electronegativity concept explain that HClO_3 is a stronger acid than HClO . $2 + 3 = 5$

(e) Give Kapustinskii expression for lattice energy and identify the terms involved. What are its utilities? $3 + 2 = 5$

(f) With the help of VSEPR theory explain the shapes of XeF_2 and IF_5 molecules. $2\frac{1}{2} \times 2 = 5$

(g) Discuss electrostatic theory of H -bonding. Give reason why ice floats over water. $3 + 2 = 5$

(h) Derive Nernst equation for measuring EMF of cell.

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

(a) (i) With the help of Bohr's theory, explain the line spectra of H -atom.

(ii) Explain Hund's rule of maximum multiplicity.

(iii) Show that an s orbital has spherical shape.

(b) What is effective nuclear charge? Explain the variation in effective nuclear charge of the elements along a period. Give Slater's rules for calculating screening constant. $3 + 2 + 5 = 10$

(c) (i) Explain Allred and Rochow's approach of electronegativity. What are its limitations? $3 + 2 = 5$

- (ii) What are radial nodes? Draw the radial probability distribution curve for $4p$, $4d$, $3s$ and $5f$ orbitals. 1+4=5
- (d) Give Heitler and London approach of bonding in H_2 molecule.
- (e) What is polarisation in ionic compounds? Give Fajan's rules on polarisation. With the help of polarisation explain the solubility of silver halide in water. 3+4+3=10
- (f) (i) Discuss electron sea model of metallic bonding and explain the metallic properties arising out of it. 4
- (ii) Explain various types of hybridisation involving s and p orbitals with suitable examples. 6
- (g) (i) What is ionisation energy? Explain the factors on which it depends. 1+4=5
- (ii) Discuss the crystal structure of zinc blende. 5

- (h) (i) Draw the resonance structure of CO_3^{2-} and SO_4^{2-} . 2
- (ii) What do you mean by well-behaved function? 2
- (iii) Identify whether the following functions are eigenfunctions of d^2/dx^2 :
- (a) $\cos kx$
- (b) e^{ikx}
- Find the eigenvalue (if any). 3
- (iv) Draw the shapes of the orbitals for $l=2$. 3