1 SEM TDC CHMH (CBCS) C 1

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(December)

CHEMISTRY

(Core)

Paper : C–1

(Inorganic Chemistry)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

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

1. Choose the correct answer from the following : 1×6=6

   (a) Heisenberg's uncertainty principle is

   (i) $\Delta x \cdot \Delta P = \dfrac{h}{4\pi m}$

   (ii) $\Delta x \cdot \Delta P = \dfrac{h}{mV}$

   (iii) $\Delta x \cdot \Delta P \geq \dfrac{h}{4\pi}$

   (iv) $\Delta x \cdot \Delta P \leq \dfrac{h}{4\pi}$

(*Turn Over*)

(b) The standard electrode potentials of four electrodes are

Electrode : $Zn^{2+}|Zn$ $Cd^{2+}|Cd$ $Ag^+|Ag$ $Fe^{3+}|Fe$

E° (V) : -0.76 -0.40 0.80 -0.44

Which of the following cells is not feasible?

(i) $Zn|Zn^{2+}||Cd^{2+}|Cd$

(ii) $Fe|Fe^{3+}||Zn^{2+}|Zn$

(iii) $Cd|Cd^{2+}||Ag^+|Ag$

(iv) $Fe|Fe^{3+}||Ag^+|Ag$

(c) The electronegativity of C, N, P and Si increases in the order

(i) $C < N < Si < P$

(ii) $N < Si < C < P$

(iii) $Si < P < C < N$

(iv) $P < Si < N < C$

(d) Which of the following has the highest lattice energy?

(i) BeO

(ii) MgO

(iii) CaO

(iv) SrO

(Continued)

(e) The geometrical shape of ClF_3 molecule is

    (i) pyramidal

    (ii) trigonal planar

    (iii) T-shape

    (iv) tetrahedral

(f) Which of the following is paramagnetic?

    (i) O_2^-

    (ii) CO

    (iii) NO^+

    (iv) CN^-

2. Answer the following questions :   2×9=18

(a) What are normalized and orthogonal wave functions?   1+1=2

(b) Write Schrödinger's wave equation and give the meanings of the symbols used there.   1+1=2

(c) Arrange H_2O, H_2S, H_2Se and H_2Te in the increasing order of bond angle, giving the proper explanation for this trend.   2

(4)

(d) What do you mean by ionization potential? Why is the value of second ionization potential higher than the first ionization potential? $1+1=2$

(e) Define electron affinity. Electron affinity value increases from nitrogen to fluorine in the periodic table. Explain giving reason. 2

(f) Which of the following orbitals are not possible and why? 2

$1p$, $2s$, $2p$ and $3f$

(g) Using VSEPR theory, predict the structures of the following : $1 \times 2 = 2$

(i) SF_4

(ii) XeF_2

(h) Using Fazans' rule, explain that "AlF_3 is high-melting solid while $AlCl_3$ is low-melting volatile solid". 2

(i) Arrange the following in the increasing order of bond length : 2

O_2, O_2^-, O_2^+, O_2^{2+}

3. Answer any *two* of the following questions : 4×2=8

    (a)   *(i)* State and explain the principles applied to build up the electronic configuration of nitrogen atom.   2

        (ii) Determine the values of n, l, m and s for the valence shell electron of potassium.   2

    (b) Derive de Broglie equation. Calculate the wavelength associated with a moving electron having kinetic energy 1.375×10^{-25} J. $(h = 6.626 \times 10^{-34}$ J-s$)$ 2+2=4

    (c)   *(i)* Write the radial and angular wave functions for hydrogen atom.   2

        (ii) Write a note on contour boundary.   2

4. Answer any *two* of the following questions :

                                        3×2=6

    (a) What is effective nuclear charge? Explain on the basis of Slater's rule, why 4s orbital is filled earlier than 3d orbital taking potassium atom as an example.   1+2=3

(b) What do you mean by electronegativity of an element? Calculate the electronegativity of fluorine using Allred-Rochow equation. (Covalent radius of fluorine = 0·72 Å)   1+2=3

(c) Nitrogen has positive electron gain enthalpy whereas oxygen has negative. However, oxygen has lower ionization enthalpy than nitrogen. Explain.   3

5. Answer any *two* of the following questions :

$$3\times2=6$$

(a) What do you mean by percentage of ionic character? HBr molecule has H—Br bond length $1\cdot41\times10^{-10}$ m and its dipole moment is $0\cdot79\times10^{-29}$ cm. Calculate the percentage of ionic character of HBr molecule. (Given, electronic charge = $1\cdot602\times10^{-19}$ C)   1+2=3

(b) What do you mean by hydrogen bond? What are the different types of hydrogen bond? Explain why *o*-hydroxybenzaldehyde is a liquid whereas *p*-hydroxybenzaldehyde is a solid.   ½+1+1½=3

(Continued)

(c) What do you mean by bond order of a molecule? The bond dissociation energy of C_2 (599 kJ mol^{-1}) decreases slightly on forming C_2^+ (513 kJ mol^{-1}) and increases greatly on forming C_2^- (818 kJ mol^{-1}). Why?   1+2=3

6. Write short notes on any *two* of the following :   2½×2=5

   (a) Solvation energy

   (b) Defects in solids

   (c) Mulliken-Jaffe electronegativity scales

7. What is standard electrode potential? Explain two important applications of its inorganic reaction.   1+1½+1½=4

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