1 SEM TDC CHMH (CBCS) C 1

2 0 2 1

(Held in January/February, 2022)

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 :   1×6=6

   (a) A golf ball has a mass of 40 g and a speed of 50 m/s. If the speed can be measured within accuracy of 2%, the uncertainty in the position is

      (i) $1·4 \times 10^{-31}$ m

      (ii) $1·4 \times 10^{-30}$ m

      (iii) $1·3 \times 10^{-30}$ m

      (iv) $1·3 \times 10^{-31}$ m

(*Turn Over*)

(b) Among the following, the third ionization energy is highest for

(i) Mg

(ii) Be

(iii) B

(iv) Al

(c) The pair of species with the same bond order is

(i) O_2^{2-} and B_2

(ii) O_2^+ and NO^+

(iii) NO and CO

(iv) N_2 and O_2

(d) The type of hybridization in NH_4^+ ion is

(i) sp^3

(ii) sp^2

(iii) sp

(iv) dsp^3

(e) The shape of SF_4 molecule is

(i) square planar

(ii) tetrahedral

(iii) T-shape

(iv) see-saw

22P/159C

(f) The oxidation number of chromium in potassium dichromate molecule is

  (i) +6

  (ii) +4

  (iii) +3

  (iv) +5

2. Answer the following questions : $2 \times 9 = 18$

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

 (b) What are normalised and orthogonal wave functions? $1+1=2$

  (c) Explain in the light of effective nuclear charge that Cl^- ion is larger in size than Cl atom.   2

  (d) Zn and Cd have negative values of electron affinity. Explain why.   2

  (e) Explain two factors on which the elctronegativity of an element depends.   2

  (f) What will be the bond order and bond energy when you remove an electron from O_2 molecule?   2

(g) Using VSEPR theory, predict the structure of the following : 1+1=2

   (i) ClF_3

   (ii) XeF_2
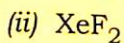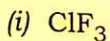
(h) There is a decrease in bond angle from NH_3 (107°) to H_2O (104·5°) and an increase in bond angle from OF_2 (105°) to OCl_2 (111°). Explain why. 2

(i) Explain covalent character in ionic compounds with the help of Fajans' rules. 2

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

   (a) (i) Draw the shapes of different d-orbitals.

      (ii) Explain the contour boundary diagram. 2+2=4

   (b) (i) An atom of an element contains 29 electrons and 35 neutrons. Deduce the number of protons and write the electronic configuration of the element. 1+1=2

      (ii) Using $(n + l)$ rule, predict which of the following orbitals has highest energy :

         $5p, 5d, 5f, 6s, 6p$ 2

22P/**159C**

(c) *(i)* The velocity associated with a proton moving in a potential difference of 1000 V is $4 \cdot 37 \times 10^5$ ms^{-1}. If a hockey ball of mass $0 \cdot 1$ kg is moving with this velocity, calculate the wavelength associated with this velocity. 2

(ii) How many electrons in an atom may have the following quantum numbers? 1+1=2

1. $n = 4$, $m_s = -1/2$

2. $n = 3$, $l = 0$

4. Answer any *two* of the following questions : 3×2=6

(a) Mention two factors on which the electron affinity of an element depends. Explain why the electron affinity of F is lower than that of Cl. 1+2=3

(b) Mention two factors on which the ionization potential of an element depends. The 1st ionization potential of Be is higher than that of B, while the 2nd ionization potential of Be is lower than that of B. Explain. 1+2=3

(c) Calculate the effective nuclear charge for the last electron of sodium ion. How do effective nuclear charges vary while moving down a group? 1+2=3

(Turn Over)

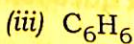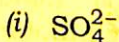5. Answer any *four* of the following questions :

$3 \times 4 = 12$

(a) What is Born-Haber cycle? Show with example, how the lattice energy can be obtained. $1+2=3$

(b) Draw the resonating structures of the following molecules and ions : $1+1+1=3$

(i) SO_4^{2-}

(ii) $RCOO^-$

(iii) C_6H_6

(c) Discuss inter- and intra-molecular hydrogen bonding with suitable examples. 3

(d) Draw the molecular orbital energy-level diagram for N_2 molecule and calculate the bond order. $2+1=3$

(e) Explain the following in the light of hydrogen bonding : $1+1+1=3$

(i) Density of ice is lower than water

(ii) Glycerol is more viscous than glycol

(iii) Salicylic acid is insoluble in water

6. What is standard electrode potential? Explain two applications of standard electrode potential in inorganic reactions.

1+2=3

★ ★ ★