



বিদ্যাসাগর বিশ্ববিদ্যালয়  
VIDYASAGAR UNIVERSITY

Question Paper

**B.Sc. Honours Examinations 2022**

(Under CBCS Pattern)

Semester - II

**Subject: CHEMISTRY**

Paper: C 3 - T

**Inorganic Chemistry - I**

**Full Marks : 40**

**Time : 2 Hours**

*Candidates are required to give their answers in their own words as far as practicable.*

*The figures in the margin indicate full marks.*

**Group - A**

Answer any **four** from the following.

5×4=20

1. (a) From Bohr's theory compare the frequencies of the radiation emitted from  $n^{\text{th}}$  orbit of H-atom with those emitted by the  $He^+$  and  $Be^{3+}$  ions. 2

- (b) Calculate Pauling's electronegativity of hydrogen atom from the following data :

Bond energies (kJ/mole)

$H_2$  (458),  $F_2$  (155),  $HF$  (565)

and Pauling's electronegativity of  $F = 4.0$ .

3

2. (a) What would be the wavelength of emission spectrum when the electron jumps from the level with  $n = 2$  to ground state of  $He^+$ ? ( $h = 6.6 \times 10^{-27}$  erg-sec,  $m_e = 9.1 \times 10^{-28}$  g,  $1 \text{ erg} = 6.24 \times 10^{11} \text{ eV}$ ) 3
- (b) Find the smallest and largest sized ions from the following :  
 $H^-$ ,  $F^-$ ,  $Cl^-$ ,  $Br^-$   
 Give reason in support of your answer. 2
3. (a) Calculate Allred-Rochow electronegativity of  $Zn$  taking its covalent radius as 125 pm. 2
- (b) What is de Broglie relationship? How de Broglie's equation can be used to explain Bohr's atomic model? 3
4. (a) Draw the different shapes of Sommerfield's orbits of hydrogen atom for  $n = 4$ . 2½
- (b) Qualitatively compare the first ionization energy of  $Ca$  and  $Zn$ , both having  $4s^2$  configuration in their valence shell. 2½
5. (a) Determine the ground state term symbol of 'Cr' atom. 2
- (b) Explain Heisenberg's uncertainty principle with reference to the following expression :  

$$\Delta x \cdot \Delta P_x \geq \frac{h}{4\pi}$$
 2
- (c) What is Pauli's exclusion principle? 1
6. (a) The electronegativity of  $Ga$  is greater than of  $Al$  — Explain. 2
- (b) Explain Pauling's approach for the determination of ionic radii. Determine the ionic radii of  $Na^+$  and  $F^-$  ions by this method. (Given internuclear distance  $r_{Na^+ - F^-}$  is 231 pm) 3

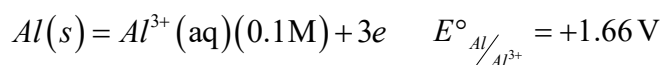
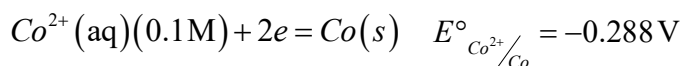
### Group - B

Answer any *two* questions.

10×2=20

7. (a) Arrange the following in the increasing order of Lewis activity. Justify your answer.  
 $SiF_4$ ,  $SiCl_4$ ,  $SiBr_4$ ,  $SiI_4$  2
- (b) What are superacids? How the acidity of such solutions can be measured? 1+2
- (c) Explain why electron affinity of  $Mn^{3+}$  is greater than that of  $Fe^{3+}$ . 2
- (d) What is formal potential? Explain why it is considered more important than standard electrode potential. 1+2

8. (a) Calculate the cell potential at 30°C from the following half-cell reactions :



Given Faraday constant ( $F$ ) = 96500 C mol<sup>-1</sup> and  $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$ . 3

- (b)  $HgO$  is added to an aqueous solution of  $KI$ . Comment on the change in acidity of the resulting solution. 2
- (c) Calculate the buffer capacity of a buffer medium when 0.05 mole of  $NaOH$  is added to 1.0 litre of the buffer solution and the change of  $pH$  is from 5.70 - 5.85. 3
- (d) Arrange the following compounds in the order of increasing  $C-F$  bond length with necessary explanation  $CF_4$ ,  $CH_3F$ ,  $CH_2F_2$ ,  $CHF_3$ . 2
9. (a) Explain why methyl mercury ion is taken as the standard for comparison of hard and soft characters of acids and bases? 2
- (b) Using Pauling's rule, identify the structural formula that are nearly consistent with the actual  $pK_a$  values — (i) 1.8 for  $H_3PO_3$  and (ii) 9.0 for  $H_3AsO_3$ . 3
- (c) Write down the composition of Zimmermann Reinhardt solution. Explain why this solution is used during redox titration of  $Fe(II)$  ion by  $KMnO_4$  solution in  $HCl$  medium. 3
- (d) Calculate the  $E_0$  value of  $MO_2^+/M^{4+}$  couple in 1 M acid medium from the following diagram :
- $$\begin{array}{ccccccc}
 MO_2^{2+} & \xrightarrow{0.97 \text{ volt}} & MO_2^+ & \xrightarrow{?} & M^{4+} & \xrightarrow{1.08 \text{ volts}} & M^{3+} \\
 & & & & & & \uparrow \\
 & & & & & & 1.01 \text{ volts}
 \end{array}$$
- 2
10. (a) Construct a Frost diagram of oxygen in acidic solution from the following Latimer diagram :
- $$O_2 \xrightarrow{+0.695 V} H_2O_2 \xrightarrow{+1.75 V} 2H_2O$$
- Hence, explain the disproportionation or / and comproportionation reaction. 3
- (b) In qualitative group analysis, what is the role of  $NH_4Cl + NH_4OH$  mixture in the precipitation of group III A cations? 3
- (c) Explain why  $BH_3F^-$  and  $BF_3H^-$  react to form  $BF_4^-$  and  $BH_4^-$ ? 2
- (d) Identify the Lewis acid and base in the reaction  $I^- + I_2 \rightarrow I_3^-$ . Justify your answer. 2