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^{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^{+}? ($h = 6.6\times10^{-27}$ erg-sec, $m_e = 9.1\times10^{-28}$ g, 1 erg = 6.24×10^{11} 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 :
$\Delta x \cdot \Delta P_x \geq h/4\pi$. 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 :

$Co^{2+}(aq)(0.1M) + 2e = Co(s) \quad E°_{Co^{2+}/Co} = -0.288\,V$

$Al(s) = Al^{3+}(aq)(0.1M) + 3e \quad E°_{Al/Al^{3+}} = +1.66\,V$

Given Faraday constant (F) = 96500 C mol^{-1} and R = 8.314 J mol^{-1} 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 pKa 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 :

$$MO_2^{2+} \xrightarrow{0.97\,volt} MO_2^+ \xrightarrow{?} M^{4+} \xrightarrow{1.08\,volts} M^{3+}$$
$$\text{1.01 volts}$$

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 from 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