

2021

CHEMISTRY — HONOURS

Second Paper

(Group - A)

Full Marks : 50

*The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.*

CHT-11a

Unit - I

Answer *any three* questions.

1. (a) Calculate the decay constant, mean lifetime and half-life of a radio nuclide whose activity diminishes by 10% during 100 days.
- (b) What is meant by K-electron capture? Give example. 3+2
2. (a) What is artificial radioactivity? Cite one application of artificial radioactivity.
- (b) How many α -particles and β -particles are emitted in the transformation from ${}_{92}\text{U}^{238}$ to ${}_{82}\text{Pb}^{206}$? 3+2
3. (a) Differentiate between nuclear fission and spallation.
- (b) State and explain Pauli's exclusion principle. 3+2
4. (a) Sketch the radial distribution function for the 2s orbital and show how many nodal planes are there in 2s orbital.
- (b) Calculate the radius of the Li^{2+} ion in the first excited state. 3+2
5. (a) Discuss briefly the limitations of Aufbau principle.
- (b) Determine the ground state term symbol for V^{3+} ion. 3+2

Unit - II

Answer *any two* questions.

6. (a) Using Slater's rules calculate the effective nuclear charge for a 3d-electron of an element having atomic number 26.
- (b) The atomic radii of Zr and Hf are almost identical. Explain why. 3+2

Please Turn Over

7. (a) What is electron affinity of an element? Why is the electron affinity of chlorine greater than that of fluorine?
 (b) Justify : $r_{K^+} < r_{Ar} < r_{Cl^-}$ 3+2
8. (a) Using Pauling scale calculate the electronegativity values of As in AsF_3 and AsF_5 .
 Given : $E_{As-As} = 146 \text{ kJmol}^{-1}$, $E_{F-F} = 155 \text{ kJmol}^{-1}$, $E_{As-F}(AsF_5) = 484 \text{ kJmol}^{-1}$,
 $E_{As-F}(AsF_3) = 406 \text{ kJmol}^{-1}$, $\chi_F = 4.0$.
 (b) The first ionization energies (kJmol^{-1}) of Ca(590), Sr(550) and Ba(503). Justify. 3+2

CHT-11b

Unit - I

Answer *any three* questions.

9. (a) State Bent's rule. With the help of this rule explain the structure of PCl_3F_2 .
 (b) Explain the solubility trends in water : $MgSO_4 > CaSO_4 > BaSO_4$. 3+2
10. (a) Apply VSEPR theory to predict the shape of the following species :
 (i) $XeOF_4$ (ii) ClO_2F_3 (iii) H_3O^+
 (b) Why is the melting point of $CuCl$ ($422^\circ C$) much lower than that of KCl ($776^\circ C$)? 3+2
11. (a) What are the differences between Schottky and Frenkel defects in ionic solids?
 (b) Explain : He_2 is not formed but He_2^+ is. 3+2
12. (a) Calculate the limiting radius ratio for $NaCl$ structure.
 (b) BrF_5 is square pyramidal. Justify. 3+2
13. (a) Calculate the heat of formation of KF crystal using Born-Haber cycle from the given data :
 Heat of sublimation of $K(s) = 21 \text{ kcal/mol}$, Dissociation energy of $F_2(g) = 38 \text{ kcal/mol}$, Ionization energy of $K(g) = 99 \text{ kcal/mol}$, Electron affinity of $F(g) = -80 \text{ kcal/mol}$, Lattice energy of $KF(s) = -193 \text{ kcal/mol}$.
 (b) Discuss the relative bond lengths in N_2 and N_2^+ species. 3+2

Unit - II

Answer *any two* questions.

14. (a) HCl , H_2SO_4 and HNO_3 all are strong acids in H_2O but they differ in strength in acetic acid medium. Explain.
 (b) Calculate approximate pK_a values of H_2SO_3 and H_2SO_4 using Pauling's rules. 3+2

(3)

T(I)-Chemistry – H-2A

- 15.** (a) What are superacids? Give an example. What parameter is used to express their acidity?
(b) Write the conjugate acids and bases for the following ions or molecules.
HS⁻, H₂PO₄⁻, CH₃COOH, HF 3+2
- 16.** (a) Discuss the trend in acidity of the oxyacids of chlorine.
(b) Calculate the pH of a mixture containing 100 ml 0.1(M) CH₃COOH and 200 ml 0.01(M) CH₃COONa. [Given : pK_a = 4.74] 3+2
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