



WEST BENGAL STATE UNIVERSITY
B.Sc. Honours 3rd Semester Examination, 2022-23

CEMACOR06T-CHEMISTRY (CC6)

Full Marks: 40

Time Allotted: 2 Hours

The figures in the margin indicate full marks.

Answer any *three* questions taking *one* from each unit

UNIT-I

2×3 = 6

1. (a) Justify or criticise the following statements:
- From the radius ratio ($r_+/r_- = 0.76$), RbBr can adopt the CsCl structure but in practice it crystallises in the NaCl structure. A similar situation arises for KCl.
 - From the radius ratio, NH_4F is expected to crystallise in the NaCl structures like other NH_4X ($\text{X} = \text{Cl}, \text{Br}, \text{I}$). But it crystallizes in the ZnS structure.
 - The lattice energies of silver halides are almost the same as that of alkali halides, yet they are insoluble in water.
- (b) The dipole moment of KCl is 3.336×10^{-29} cm. The distance between K^+ and Cl^- ion is 2.6×10^{-10} m. Calculate the % of ionic character of KCl [$e = 1.60 \times 10^{-19}$ coulomb]. 2
- (c) The dipole moment of NH_3 is 1.49 D but that of BF_3 is zero — Why? 2
- (d) Calculate the heat of formation (ΔH_f) of MgF_2 from its elements using Born-Haber cycle. 2
- Sublimation energy of Magnesium, (S) = $146.4 \text{ kJ mol}^{-1}$.
Dissociation of F_2 (D) = $158.9 \text{ kJ mol}^{-1}$.
Ionisation energy of Mg (g), $I(\text{Mg}^{2+}) = 2184.0 \text{ kJ mol}^{-1}$.
Electron affinity for F (g) = $-334.7 \text{ kJ mol}^{-1}$.
Lattice energy of MgF_2 (U_0) = $-2922.5 \text{ kJ mol}^{-1}$.
- (e) Write down the resonating structure of SCN^- ion indicating the formal charges on each atom. Indicate which structure is most contributing and why? 2
- (f) Using VSEPR theory, predict the shape of SOF_4 . Indicate the state of hybridisation of the central atom. 2
2. (a) Predict the shapes and indicate the state of hybridisation of the central atom for the following: 3
- XeOF_4
 - I_5^-
 - PCl_3Br_2 .

Turn Over

- (b) Calculate the lattice energy of $\text{Mg}(\text{ClO}_4)_2$ using Kapustinskii equation. Radii of Mg^{2+} and ClO_4^- ions are 86 pm and 226 pm respectively. 3

$$K = 1.214 \times 10^5 \text{ pm} \cdot \text{mol}^{-1}$$

- (c) $(\text{SiH}_3)_3\text{N}$ and $(\text{CH}_3)_3\text{N}$ react with HCl to give different products — Explain. 3

- (d) Solubility trend of fluorides of alkali metals in water are 3



But this trends is reverse for iodides. Explain.

- (e) K^+ and F^- have comparable sizes. Which one has the greater hydration energy and why? 2

- (f) Give reasons why: 2

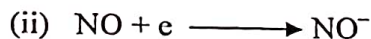
(i) BaSO_4 is insoluble in water.

(ii) Melting point of BaO is high.

UNIT-II

3. (a) Rationalize the bond lengths of CO (1.128 Å) and CO^+ (1.115 Å) with the help of MO diagram. Explain the ligating behaviour of CO . Explain why the dipole moment of CO is exceedingly small with the help of MO diagram. 3+1+2

- (b) What are the expected changes in bond order and bond distance that accompany the following ionisation processes? 3



- (c) Why are glass apparatus dried by cleaning with alcohol or acetone? Which one is more effective and why? 2+1

- (d) Which type of defects occurs when NiO is heated at 1500 K with excess of O_2 and the colour turns to black? 2

- (e) Explain the effect of temperature on the variation of conduction of metal and semiconductors. 2

4. (a) Construct the M.O energy level diagram for CO_2 . Calculate the bond order from it. 4+1

- (b) Between H_2O and H_2O_2 which one has higher boiling point and why? 2

- (c) From the view point of qualitative M.O. description indicate which of the given molecules are expected to be stabilized by: 2+2

(i) Addition of an electron, (ii) Removal of an electron.

(A) NO

(B) C_2

(C) CN and

(D) O_2

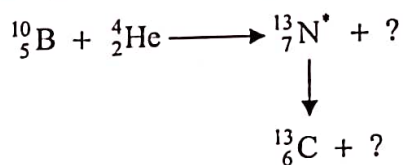
- (d) Explain the following variation of colour in the diatomic halogens from the view point of HOMO/LUMO concept. 3

F_2 (pale yellow), Cl_2 (greenish yellow), Br_2 (reddish brown) and I_2 (violet)

- (e) Explain the fact that in B_2H_6 , all hydrogens are not identical. 2

UNIT-III

5. (a) Is the ${}_8\text{O}^{16}$ isotope chemically identical with the ${}_8\text{O}^{18}$ isotope? Discuss. 2
- (b) Predict the mode of decay of the following nuclei: 3
 ${}_6\text{C}^{13}$ and ${}_{15}\text{P}^{30}$.
- (c) Calculate the binding energy per nucleon of the ${}_{18}\text{Ar}^{40}$ nucleus. The experimental mass of ${}_{18}\text{Ar}^{40}$ is 39.962384 u. $M_{\text{H}} = 1.007825$ u; $M_{\text{n}} = 1.008665$ u. 3
6. (a) Considering the following reaction profile how you would establish that entire oxygen is evolved from either PbO_2 or from H_2O_2 ? 2
- $$\text{PbO}_2 + \text{H}_2\text{O}_2 \longrightarrow \text{PbO} + \text{H}_2\text{O} + \text{O}_2$$
- (b) ${}^9_4\text{Be}$ is stable but ${}^9_5\text{B}$ is unstable — Why? 1
- (c) An Uranium mineral contains 15 g of lead (${}^{206}\text{Pb}$) for each 100 g of Uranium (${}^{238}\text{U}$) present. What is the age of the mineral? 3
 [$t_{1/2}$ of ${}^{238}\text{U} = 4.2 \times 10^9$ years]
- (d) Complete and then interpret the following nuclear reactions given below: 2



—x—