

14/12/19

1st



WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 3rd Semester Examination, 2019

CEMACOR06T-CHEMISTRY (CC6)

Time Allotted: 2 Hours

Full Marks: 40

*The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.*

Answer any three questions taking one from each unit

UNIT-I

1. (a) What do you mean by radius ratio in ionic crystal? Find out the limiting value of the radius ratio for tetrahedral coordination. 2+2
- (b) Write down Born-Landé equation for an ionic crystal and explain the terms involved therein. 3
- (c) State Fajan's rule. Which among MgCO_3 and CaCO_3 is thermally more stable and why? 2+2
- (d) NF_3 , BF_3 and BrF_3 have comparable molecular formula but their shapes are different. – Justify. 3
- (e) Carbon monoxide has unusually low dipole moment – Explain. 2
2. (a) What is meant by lattice energy of an ionic solid? Construct Born-Haber cycle for the formation of KCl crystal starting from solid potassium metal and gaseous chlorine. Calculate the lattice energy of crystalline KCl using the following data: 1+2+2

Sublimation energy of K (s)	= + 89 kJ mole ⁻¹
Bond dissociation energy of Cl_2 (g)	= + 244 kJ mole ⁻¹
Ionisation energy of K (g)	= + 425 kJ mole ⁻¹
Electron affinity of Cl (g)	= – 355 kJ mole ⁻¹
Heat of formation of KCl (s)	= – 438 kJ mole ⁻¹
- (b) Define formal charge. Draw the Lewis structure of carbonate ion and calculate the formal charges on each atom. 1+2
- (c) Solubility trend of fluorides of alkali metals in water are $\text{CsF} > \text{RbF} > \text{KF} > \text{NaF} > \text{LiF}$, but the trend is reverse for iodides – Explain. 3
- (d) Dipole moment of HBr is 2.60×10^{-30} Cm and the interatomic distance is $1.41 \text{ \AA}$. Calculate the partial charge on the bonded atoms and find out the percentage of ionic character. [$e = 1.60 \times 10^{-19}$ Coulomb] 2
- (e) Discuss the geometry of I_3^- and I_3^+ from the standpoint of VSEPR theory. 3

UNIT-II

3. (a) Draw the MO energy level diagram for HF molecule and discuss its polarity. Also find out the total number of bonding, non-bonding and antibonding electrons in HF. 6
- (b) Explain why the conductivity of Ge is enhanced manifolds when trace amount of As is added to it. 3
- (c) Explain the sequence of boiling point in the following series: $\text{NH}_3 \gg \text{PH}_3 < \text{AsH}_3 < \text{SbH}_3$. 3
- (d) Explain with example, dipole-dipole and ion-dipole interactions. 4
4. (a) Draw approximate MO diagram of CO and hence explain its π -acidic nature. 4
- (b) Justify the change of colour in the halogen series – F_2 (pale yellow), Cl_2 (greenish yellow), Br_2 (reddish brown) and I_2 (violet). 3
- (c) The first Ionisation Energy of atomic nitrogen is less than that of molecular nitrogen whereas the reverse is true for oxygen – Justify. 3
- (d) Justify the fact of boiling point H_2O (100°C) $>$ CH_3OH (63°C) $>$ $\text{CH}_3-\text{O}-\text{CH}_3$ (-5°C). 3
- (e) Discuss Dipole-Induced Dipole-interaction with proper example. 3

UNIT-III

5. (a) What is magic number? How does nuclear shell model explain the enhanced stability related to the magic number? 3
- (b) Distinguish between nuclear fission and spallation reaction. Give example. 2
- (c) An old piece of a wooden sample in a museum has a disintegration rate which is 30% of the disintegration shown by an equal weight of a new piece of wood. Find the age of the wooden sample. ($t_{1/2}$ for $^{14}\text{C} = 5740$ yrs.) 3
6. (a) State the radioactive decay law and discuss the physical significance of decay constant. Derive the expression for half-life of a radioelement from decay law. 3
- (b) Calculate the energy liberated in the reaction: $^6\text{Li}(^2\text{H}, n)^7\text{Be}$ (atomic masses in amu are $^6\text{Li} = 6.01697$, $^7\text{Be} = 7.01907$, $^2\text{H} = 2.01474$ and $^1_0\text{n} = 1.00899$) 3
- (c) 'Radio nuclide with $n : p$ ratio, above the stability ratio range, decays by β -emission and not by neutron emission' — Explain. 2

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