सार्थं विद्यायाम्

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 $CsF > RbF > KF > NaF > LiF$, 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 Å. Calculate the partial charge on the bonded atoms and find out the percentage of ionic character. [$e = 1.60\times10^{-19}$ 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: $NH_3 >> PH_3 < AsH_3 < SbH_3$. 3

(d) Explain with example, dipole-dipole and ion-dipole interactions. 4

4. (a) Draw approximate MO diagram of CO and hence explain it's π-acidic nature. 4

(b) Justify the change of colour in the halogen series – 3

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

(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 3

H_2O (100°C) > CH_3OH (63°C) > CH_3-O-CH_3 (– 5°C).

(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}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: $^{6}Li\,(^{2}H, n)\,^{7}Be$ (atomic masses in amu are $^{6}Li = 6{\cdot}01697$, $^{7}Be = 7{\cdot}01907$, $^{2}H = 2{\cdot}01474$ and $^{1}_{0}n = 1{\cdot}00899$) 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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