



**WEST BENGAL STATE UNIVERSITY**  
B.Sc. Honours 3rd Semester Examination, 2021-22

**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) Find out the limiting radius ratio for octahedral coordination in a close packed lattice. HgS has a radius ratio value of 0.68 but it crystallizes in the Zinc blend structure. Explain. 2+2
- (b) Write down Kapustinskii equation for lattice energy and mention the importance of this equation. 2
- (c) Draw the resonating structures of  $\text{CNO}^-$  and  $\text{NCO}^-$  ions showing the formal charge and comment on their relative stability. 2+2
- (d) Explain the following: 2×3
  - (i) The dipole moment of carbon monoxide molecule is smaller than expected.
  - (ii)  $\text{HgI}_2$  is less soluble in water than  $\text{HgCl}_2$ .
  - (iii) Melting point of  $\text{AgCl}$  is  $455^\circ\text{C}$  while that of  $\text{KCl}$  is  $776^\circ\text{C}$  though the radii of  $\text{K}^+$  and  $\text{Ag}^+$  ions are comparable.
2. (a) Using VSEPR theory predict the shapes of  $\text{XeOF}_4$  and  $[\text{ICl}_4]^-$ . 3
- (b) Calculate the lattice energy of  $\text{ThO}_2$  using Born Lande equation. Madelung constant = 2.519, Born exponent for  $\text{Th}^{4+}$  is 14. Radii are:  $\text{Th}^{4+} = 108 \text{ pm}$  and  $\text{O}^{2-} = 126 \text{ pm}$ . 3
- (c)  $\text{CH}_3$  radical is planar where as  $\text{CF}_3$  radical is pyramidal — Explain with Bent's rule. 2
- (d) Differentiate between Schottky defect and Frenkel defect with example. 4
- (e) Cite two examples where the VSEPR theory fails to predict the shape of a molecule. 2
- (f) Explain the solubility trends: 2



## UNIT-II

3. (a) Draw MO diagram for NO molecule. Compare the bond dissociation energies of  $3+1\frac{1}{2} +1\frac{1}{2}$  NO<sup>+</sup> and NO<sup>-</sup> species and explain the difference.
- (b) Distinguish between intrinsic and extrinsic semiconductors with examples. 4
- (c) The sequence of boiling point of the following compounds is: 3  
NH<sub>3</sub> >> PH<sub>3</sub> < AsH<sub>3</sub> < SbH<sub>3</sub> — Explain.
- (d) From the view point of MO theory, explain why BeH<sub>2</sub> is a linear molecule. 3
4. (a) Construct the MO diagram for H<sub>2</sub>O. Calculate the bond order from it. 4+1
- (b) Addition of antimony with Germanium produces which type of semiconductor. Discuss. 3
- (c) How can you correlate the colour of CdS with the Band Theory? 2
- (d) PH<sub>3</sub> is more volatile than NH<sub>3</sub>. — Explain. 2
- (e) From MO theory explain why NO<sub>2</sub><sup>+</sup> is linear but NO<sub>2</sub> is bent. 2
- (f) Explain why the O-O bond length varies as O<sub>2</sub><sup>+</sup> < O<sub>2</sub> < O<sub>2</sub><sup>-</sup>. 2

## UNIT-III

5. (a) What is radioactive equilibrium? How does it differ from chemical equilibrium? 2+1
- (b) Write notes on (any *one*): 3  
(i) Radio carbon dating, (ii) Uses of isotopes in tracer technique.
- (c) A small amount of radioactive material of half life period 20 days got inadvertently spread in a laboratory making the level of radiation 40 times the permissible safety level. After how many days the laboratory would be safe for use? 2
6. (a) Complete the following artificial transmutations 3
- $$\begin{array}{l}
 {}_{24}\text{Cr}^{50} (\alpha, n) \longrightarrow \\
 {}_4\text{Be}^9 + {}_1\text{H}^1 \longrightarrow + {}_2\text{He}^4 \\
 {}_{13}\text{Al}^{27} (n, p) \longrightarrow
 \end{array}$$
- (b) Distinguish between nuclear fission and nuclear spallation reaction. 2
- (c) Half life of one radio-element is 231 minute. How long would it take for 9/10th fraction decay of the element? 3

**N.B. :** Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within 1 hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.

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