



**WEST BENGAL STATE UNIVERSITY**  
B.Sc. Honours 3rd Semester Examination, 2020, held in 2021

**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) Write Fajan's polarization rule. Use this rule to predict which of the following will be ionic or covalent: 2+2  
RbCl and AgCl
- (b) Using VSEPR theory, predict the shapes of  $\text{XeO}_2\text{F}_2$  and  $\text{BrF}_4^-$ . Also indicate the state of hybridization of the central atom in each case. 5
- (c) Between  $\text{SrSO}_4$  and  $\text{MgSO}_4$ , which one is more soluble in water and why? 2
- (d) Why is the melting point of  $\text{CuCl}$  ( $422^\circ\text{C}$ ) less than that of  $\text{KCl}$  ( $776^\circ\text{C}$ )? 2
- (e) Explain the variation in dipole moments of the following pairs: 3  
(i)  $\text{CO}_2$  and  $\text{SO}_2$       (ii)  $\text{NF}_3$  and  $\text{BF}_3$
2. (a) State Bent's rule. Predict the geometry of the following species with the help of Bent's rule and VSEPR theory: 5  
(i)  $\text{SOF}_4$  ,      (ii)  $\text{PF}_2\text{Cl}_3$
- (b) Between  $\text{CsCl}$  and  $\text{AuCl}$ , which one is more ionic and why? 2
- (c)  $\text{N}(\text{SiH}_3)_3$  is planar while  $\text{N}(\text{CH}_3)_3$  is pyramidal — Explain using  $d\pi-p\pi$  overlap. 2
- (d)  $\text{K}^+$  and  $\text{F}^-$  have comparable ionic sizes. Which one will have greater hydration energy and why? 2
- (e) Explain the following: 5  
(i) B-F bond distance in  $\text{BF}_3$  is  $1.29 \text{ \AA}$ , whereas that in  $[\text{BF}_4]^-$  ion is  $1.42 \text{ \AA}$ .  
(ii)  $\text{HgS}$  has a radius ratio value of 0.68 but it crystallizes in the Zinc blend structure.

**UNIT-II**

3. (a) Construct the MO energy level diagram of  $\text{CO}_2$  molecule showing the arrangement of electrons. Find out the number of bonding and non-bonding electrons. 4+1

- (b) Arrange with reason, the stability order of the following species: 3  
 NO, NO<sup>+</sup> and NO<sup>-</sup>
- (c) Explain the following: (any *two*) 3+3  
 (i) Alcohol is a better drying agent than acetone.  
 (ii) Density of ice is less than that of water.  
 (iii) *o*-nitrophenol is less soluble in water than *p*-nitrophenol.
- (d) Compare the bond lengths of O<sub>2</sub><sup>+</sup> and N<sub>2</sub><sup>+</sup>. 2
4. (a) Draw M.O. diagram of CN<sup>-</sup> and predict the bond order as well as magnetic properties. 2+2
- (b) Give molecular orbital configuration of O<sub>2</sub>, O<sub>2</sub><sup>+</sup> and O<sub>2</sub><sup>-</sup>. Give order of stability with appropriate reasons. 4
- (c) Using molecular orbital configurations indicate paramagnetic nature of B<sub>2</sub> and non-existence of Ne<sub>2</sub>. 2+2
- (d) Between H<sub>2</sub>O and H<sub>2</sub>S, which one has greater boiling point and why? 2
- (e) Mention the conditions for linear combination of atomic orbital related to the formation of molecular orbital. 2

### UNIT-III

5. (a) What do you mean by nuclear binding energy? What information can be obtained from the binding energy curve about nuclear fission and nuclear fusion? 4
- (b) Cite an example of mirror nucleus. 1
- (c) A sample of radioactive isotope shows an activity of 9500 counts/min at one time and 8050 counts/min 1 hour later. Calculate its half life. 3
6. (a) The n/p ratio of  ${}_{9}\text{F}^{18}$  is unity. Comment on its stability. 1
- (b) Complete and interpret the following reaction: 2  
 ${}^{10}\text{B}_5 + {}^4\text{He}_2 = {}^{13}\text{N}_7^* + ? = {}^{13}\text{C}_6 + ?$
- (c) If  ${}_{7}\text{N}^{13}$  decays by positron emission and the maximum kinetic energy of the positron emission is 1.20 MeV, what is the mass of  ${}_{7}\text{N}^{13}$  nucleus? (Given: mass of the nucleus for  $\text{C}^{13} = 13.00335$  amu and mass of electron = 0.00055 amu.) 3
- (d) What do you understand by magic numbers? Explain their significance. 2

**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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