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 XeO_2F_2 and BrF_3. Also indicate the state of hybridization of the central atom in each case. 5

(c) Between $SrSO_4$ and $MgSO_4$, which one is more soluble in water and why? 2

(d) Why is the melting point of CuCl (422°C) less than that of KCl (776°C)? 2

(e) Explain the variation in dipole moments of the following pairs: 3

(i) CO_2 and SO_2 (ii) NF_3 and 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) SOF_4 , (ii) PF_2Cl_3

(b) Between CsCl and AuCl, which one is more ionic and why? 2

(c) $N(SiH_3)_3$ is planar while $N(CH_3)_3$ is pyramidal — Explain using $d\pi$-$p\pi$ overlap. 2

(d) K^+ and F^- have comparable ionic sizes. Which one will have greater hydration energy and why? 2

(e) Explain the following: 3

(i) B-F bond distance in BF_3 is 1.29 Å, whereas that in $[BF_4]^-$ ion is 1.42 Å.

(ii) 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 CO 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^+ and NO^-

(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_2^+ and N_2^+. 2

4. (a) Draw M.O. diagram of CN^- and predict the bond order as well as magnetic properties. 2+2

(b) Give molecular orbital configuration of O_2, O_2^+ and O_2^-. Give order of stability with appropriate reasons. 4

(c) Using molecular orbital configurations indicate paramagnetic nature of B_2 and non-existence of Ne_2. 2+2

(d) Between H_2O and H_2S, 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 $_9F^{18}$ is unity. Comment on its stability. 1

(b) Complete and interpret the following reaction: 2

$$^{10}B_5 + {}^4He_2 = {}^{13}N^*_7 + \ ? = {}^{13}C_6 + \ ?$$

(c) If $_7N^{13}$ decays by positron emission and the maximum kinetic energy of the positron emission is 1.20 MeV, what is the mass of $_7N^{13}$ nucleus? (Given: mass of the nucleus for 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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