2020

CHEMISTRY (Honours)

Paper : CEMH-DC-T6

(Inorganic)

(CBCS)

Full Marks : 25 Time : Two Hours

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

1. Answer any *five* questions from the following : 1×5=5

(a) The molecular geometry of BrF_3 is :

(i) T-shaped

(ii) Triangular

(iii) Linear

(iv) V-shaped

(b) Which one of the following pairs of species has the same bond order?

(i) NO^+ and CN^+

(ii) CN^- and CN^+

(iii) CN^- and NO^+

(iv) O_2^- and CN^-

(c) The end product of (4*n*+1) disintegration series or neptunium series is —

(i) $^{208}_{82}Pb$

(ii) $^{209}_{83}Bi$

(iii) $^{207}_{82}Pb$

(iv) $^{206}_{82}Pb$

(d) Minimum radius ratio for coordination number four is —

(i) 0.414

(ii) 0.225

(iii) 0.155

(iv) 0.731

(e) *C–Cl* bond length is highest in —

(i) $CHCl_3$

(iii) CH_2Cl_2

(iii) CH_3Cl

(iv) CCl_4

(f) The set among the following in which all numbers are magic numbers of nucleons is —

(i) 20, 28, 50 and 126

(ii) 24, 28, 82 and 126

(iii) 20, 50, 80 and 184

(iv) 28, 50, 82 and 180

(g) The number of electron(s) present in the LUMO energy level of CO_2 M.O. diagram is/are —

(i) three

(ii) two

(iii) one

(iv) none

(h) Empty space in Face Centred Cubic unit cell is —

(i) 26%

(ii) 45%

(iii) 90%

(iv) 30%

2. Answer any *four* questions : 2×4=8

(a) Using **VSEPR** theory, predict (draw the structure and indicate the positions of lone pair/pairs of electrons) the shape of the following molecule/ion :

(i) XeF_4, (ii) I_3^-

(b) ZnO is white in cold but appears yellow when hot — Explain.

(c) Compare the dipole moment of NH_3 using hybridization and without hybridization.

(d) What do you mean by instantaneous dipole interaction?

(e) How will you prove the non-equivalent nature of two sulphur atoms in $Na_2S_2O_3$ using suitable radionuclide?

(f) $MgCO_3$ is thermally less stable than $CaCO_3$ — why?

(g) Draw a diagram to show the variation of binding energy per nucleon with the mass number. Explain the nature of the curve.

(h) Explain the respective mode of decay of the radionuclei $^{14}C_6$ & $^{13}N_7$.

3. Answer any *two* questions : 2×6=12

(a) (i) Construct the M.O. energy level diagram for HF molecule and discuss on which atom the bonding and anti-bonding orbitals are concentrated.

(ii) Explain why the conductivity of *Ge* is enhanced manifolds when trace amount of As is added to it.

(iii) What do you mean by K-electron capture? 3+2+1

(b) (i) Calculate the electron affinity of chlorine with the help of given data : heat of formation of $RbCl$ = – 441 $kJmol^{-1}$, heat of sublimation of Rb = 80 $kJmol^{-1}$, bond dissociation energy of Cl_2 = 243 $kJmol^{-1}$, first ionization energy of Rb = 403 $kJmol^{-1}$, lattice energy of $RbCl$ = – 680 $kJmol^{-1}$.

(ii) Water has higher boiling point than hydrogen fluoride though their hydrogen-bond strengths are in reverse order. Explain.

(iii) $SnCl_4$ is low boiling liquid but $SnCl_2$ is high melting solid — Comment. 3+2+1

(c) (i) Arrive at the Born-Lande expression for lattice energy for *NaCl* type of crystal.

(ii) A small amount of radioactive material got inadvertently spread in an area adjoining a nuclear power plant making the level of radiation 40 times the permissible safety level. If $t_{1/2}$ of the radioactive species be 20 days, after how many days will the place be safe to life?

(iii) Explain why liquid O_2 sticks to magnetic pole. 3+2+1

(d) (i) The binding energy per nucleon for $C^{12}{}_6$ is 7.68 MeV and that for $C^{13}{}_6$ is 7.47 MeV. Calculate the energy required to remove a neutron from $C^{13}{}_6$.

(ii) The F-S-F bond angle in NSF_3 is small — Comment.

(iii) Comment on the trend in solubility of $MClO_4$ ($M = Li, Na$). 3+2+1