2019

CHEMISTRY — HONOURS

Paper : CC-4

(Inorganic Chemistry - 2)

Full Marks : 50

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer ***question no.*** **1** (Compulsory) and
any eight questions from the rest. (question nos. **2** to **14**)

1. Answer the following questions : 1×10

(a) Which one is more soluble in water : $KClO_4$ or $NaClO_4$, and why?

(b) Write MO configuration of F_2^+.

(c) Give one example of 'K-electron Capture'.

(d) Identify *n* or *p* type semiconductor in the following :
V_2O_5 and CoO.

(e) Give the order of thermal stability among the following :
$CaCO_3$, $MgCO_3$, $BeCO_3$.

(f) Complete the following process :
$^{11}_{6}C \rightarrow$ ..... + ... + γ.

(g) Predict the number of unpaired electrons in O_2^+

(h) Explain : dipole moment of CO is exceedingly small.

(i) Predict the order of H-bond dissociation enthalpies of the following :
(i) FH.....F^- (ii) FH .... FH (iii) H–OH ..... F^-.

(j) Which of the following has smallest bond angle $H - \hat{X} - H$?
NH_3 and PH_3?

2. (a) Indicate the hybridisation of the central atom and predict the shapes of the following :
$IO_2F_2^-$, XeF_5^+, F_2SeO.

(b) Calculate the limiting radius ratio (r^+/r^-) of CaF_2 structure. 3+2

3. (a) Justify the feasibility of the formation of a hypothetical compound $NaCl_2$ by using the following data :

Lattice energy ($NaCl_2$) = 2154 kJ mol^{-1}

IP_1 and IP_2 of Na = 494 and 4563 kJ mol^{-1}

EA of Cl = – 347 kJ mol^{-1}

ΔH_{sub} (Na) = 109 kJ mol^{-1}.

(b) Dipole moment of R_3NO is much greater than that of R_3PO. — Justify. 3+2

4. (a) Predict and justify the larger bond angles in the following pairs :

(i) I_3^- and I_3^+

(ii) NO_2^+ and NO_2^-.

(b) $PbCl_4$ is liquid but $PbCl_2$ is solid. — Explain. 3+2

5. (a) Write the reasonable electron.dot structure and assign the formal charges for each of the following :

(i) ClF_3 (ii) NO_3^-

(b) ZnO is yellow when hot and white when cold. — Explain. 3+2

6. (a) The degree of covalency in the following compounds runs as :

$ZnX_2 < CdX_2 < Hg\ X_2$ (x = Cl, Br, I) — Explain.

(b) $\dot{C}H_3$ radical is planar but $\dot{C}H_2F$ radical is pyramidal. — Comment. 3+2

7. (a) Construct the M.O. diagram of NO^+ and find the bond order in the species.

(b) Predict and explain the order of boiling points in the following :

H_2O, CH_3OH, $CH_3–O–CH_3$. 3+2

8. (a) CO and N_2 are isoelectronic species but CO can act as a potential ligand while N_2 cannot. — Explain.

(b) HF_2^- exists but HBr_2^- does not. — Justify. 3+2

9. (a) Identify the nature of crystal defects found in KBr and AgI and explain.

(b) Both $NaHCO_3$ and H_3BO_3 have low solubility in water. — Comment. 3+2

10. (a) What are intrinsic and extrinsic semiconductors? Identify the type of semiconduction (*n* or *p*) expected from the following and explain.

(i) Ga doped Be

(ii) As doped Ge.

(b) In CH_2F_2, $\angle H - C - H$ is greater than that of $\angle F - C - F$. — Explain. 3+2

11. (a) Which of the molecules are expected to be stabilized by (i) addition of an electron *or*, (ii) removal of an electron. (i) C_2 (ii) O_2

(b) Comment on the trend in boiling points :

NF_3	<	NMe_3
– 129°C		3.5°C

3+2

12. (a) Fission of heavier nuclides and fusion of lighter nuclides are expected from the nuclear binding energy curve. — Explain.

(b) A piece of wood was found to have ^{14}C / ^{12}C ratio 0.7 times that in a living plant. Calculate the approximate period when the plant died. ($t_{1/2}$ = 5760 years) 3+2

13. (a) How meson-exchange theory explains the nuclear stability?

(b) $^{7}_{4}Be$ may be converted to $^{7}_{3}Li$ either by positron emission or by orbital electron capture. Comment on the feasibility of these processes from the following mass data : 3+2

$^{7}_{4}Be$: 7.01693 u

$^{7}_{3}Li$: 7.01600 u

e : 0.00055 u

14. (a) What do you mean by artificial transmutation? Give two examples with one application in each case.

(b) Calculate the energy liberated in the fission of 0.5 gm of ^{235}U. Average binding energy per nucleon (MeV) : ^{235}U = 7.6, Fission products = 8.5 3+2
