

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^+ .

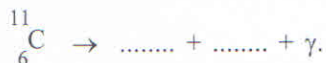
(c) Give one example of 'K-electron Capture'.

(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 :

(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) $\text{FH} \dots \text{F}^-$ (ii) $\text{FH} \dots \text{FH}$ (iii) $\text{H-OH} \dots \text{F}^-$.(j) Which of the following has smallest bond angle $\text{H} - \hat{\text{X}} - \text{H}$? 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

Please Turn Over

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 :
 $\text{ZnX}_2 < \text{CdX}_2 < \text{HgX}_2$ ($x = \text{Cl, Br, I}$) — Explain.
- (b) $\dot{\text{C}}\text{H}_3$ radical is planar but $\dot{\text{C}}\text{H}_2\text{F}$ 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 , $\text{CH}_3\text{-O-CH}_3$. 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 , $\angle \text{H-C-H}$ is greater than that of $\angle \text{F-C-F}$. — 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_4Be may be converted to 7_3Li either by positron emission or by orbital electron capture. Comment on the feasibility of these processes from the following mass data : 3+2
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|----------------------|
| 7_4Be : 7.01693 u |
| 7_3Li : 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
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