REV-00 2017/12
MSC/113/132

M. Sc. CHEMISTRY
FIRST SEMESTER
INOGRANIC CHEMISTRY
MSC – 103

Duration: 3 Hrs. Marks: 70

Part : A (Objective) = 20
Part : B (Descriptive) = 50

[PART-B : Descriptive]

Duration: 2 Hrs. 40 Mins. Marks: 50

[Answer question no. One (1) & any four (4) from the rest]

1. i. Write the MO electron configuration for NO^- ion. Will the bond length be shorter than in NO? 2+3+5 =10

ii. The bond angles H-C-H and F-C-F in CH_2F_2 are 112 and 108.5°. Calculate the 's' character used by the carbon atom in the orbitals directed to hydrogen and fluorine atoms and discuss the results in terms of Bent's rule.

iii. Use VSEPR model to predict the probable structures of the following: I_5^-, XeO_3, XeO_2F_2, XeF_6 and IF_7.

2. i. Why are the compounds of Ti^{4+} and Zn^{2+} typically white? Why are the Mn^{2+} compounds very pale in colour? 2+3+5 =10

ii. Draw the σ-bond molecular orbital diagram for a complex of octahedral symmetry.

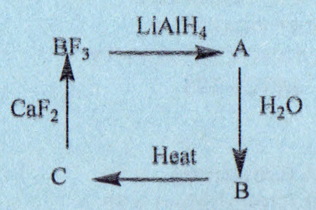
iii. Justify which of the following complexes are expected to show Jahn-Teller distortion

a. $K_4[Cr(CN)_6]$ b. $K_4[Fe(CN)_6]$

c. $K_3[Co(CN)_6]$ d. $K_4[Mn(CN)_6]$

3. i. Why does CO_2 molecule exist as discrete molecule whereas SiO_2 as three dimensional structures? 2+3+5 =10

ii. Identify compounds A, B and C



iii. Write a preparation method of diborane. Describe the structure and bonding of B_2H_6. Complete the reaction of B_2H_6 with H_2O and Cl_2 (at 25 °C).

4. i. Write a preparation method of diborane. Describe the structure and bonding of B_2H_6. Complete the reaction of B_2H_6 with H_2O and Cl_2 (at 25 °C) 2+3+5 =10

ii. Solutions of $[Cr(OH_2)_6]^{3-}$ ions are pale blue-green but the chromate ion, CrO_4^{2-}, is an intense yellow. Justify the origins of the transitions.

iii. When visible light passes through a solution of nickel(II) sulfate, a green solution results. What are the spin-allowed transitions responsible for this color? Would you expect a Jahn-Teller distortion for this complex?

5. i. Chromium(II) fluoride and manganese(II) fluoride both have a central metal ion surrounded by six fluoride ligands. The Mn–F bond lengths are equidistant, but four of the Cr–F distances are long and two are short. Justify the observation 3+3+4 =10

ii. Calculate the number of microstates for d^2 configuration. Deduce the ground state term symbol for same configuration.

iii. Draw the structures of $Si_2O_7^{6-}$ and $Si_6O_{18}^{12-}$

6. i. What are the major advantages of Faraday method over Gouy method for experimental determination of magnetic susceptibility? 2+3+5 =10

ii. Briefly write on-

a. Spin-orbit coupling b. quenching or orbital angular momenta.

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iii. The complexes $[Mn(H_2O)_6]^{2+}$, $[Fe(H_2O)_6]^{3+}$, $[MnCl_4]^{2-}$ and $[FeCl_4]^-$ all have magnetic moments of nearly 5.92 BM. Comment on the geometric and electronic structures of the complexes. Why is the spin-only formula so precise in these cases?

7. i. What are biodegradable and non-biodegradable pollutants? What are the sources of dissolved oxygen in water? 5+5=10

ii. What is photochemical smog? From where does ozone come in the photochemical smog?

8. Write a brief note on the catalytic regulation and utilization of green house gases. 10

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[PART-A : Objective]

Choose the correct answer from the following: 1×20=20

1. The number of valence electron pairs in BrF_3 is -
   a. 1
   b. 2
   c. 4
   d. 3

2. Among the molecular ions the $d\pi$–$p\pi$ bond is possible in -
   a. NO_3^-
   b. NO_2^-
   c. PO_4^{3-}
   d. CO_3^{2-}

3. The optical absorption spectrum of $[Ti(H_2O)_6]^{3+}$ has its absorption maximum at 20300 cm^{-1}. The magnitude of CFSE in cm^{-1} is-
   a. 16240
   b. 8120
   c. 24360
   d. 50750

4. The Pi bonding type in coordination compounds with CO as ligand is-
   a. $p_\pi - d_\pi$
   b. $d_\pi - \sigma^*$
   c. $d_\pi - d_\pi$
   d. $d_\pi - \pi^*$

5. For which of the following ground state terms, Jahn-Teller distortion is not observed in ML_6 complexes?
   a. $^3A_{2g}$
   b. $^3T_{1g}$
   c. ^2E_g
   d. $^2T_{2g}$

6. For transition metal series, Δ_o values follow the order
   a. 3d>4d<5d
   b. 3d<4d>5d
   c. 3d<4d<5d
   d. 3d>4d>5d

7. The CFSE of d^4 configuration in high spin cases will be
   a. $-1.6\ \Delta_o$
   b. Δ_o
   c. $-0.4\ \Delta_o$
   d. $-0.6\ \Delta_o$

8. The spin-only (μ_S) and spin plus orbital (μ_{S+L}) magnetic moments of $[CrCl_6]^{3-}$ are
   a. 3.87 BM and 6.34 BM
   b. 2.84 BM and 5.20 BM
   c. 3.87 BM and 5.20 BM
   d. 2.84 BM and 6.34 BM

9. The ground state term symbol and calculated magnetic moment of Ce^{3+} in $Ce_2Mg_3(NO)_3{\cdot}24H_2O$ are –
   a. $^2F_{5/2}$ and 1.73BM
   b. $^2F_{5/2}$ and 2.54 BM
   c. $^2F_{7/2}$ and 2.54 BM
   d. $^2F_{7/2}$ and 1.60 BM

10. The correct d-electron configuration showing spin-orbit coupling is
    a. $t_{2g}^6\ e_g^2$
    b. $t_{2g}^6\ e_g^0$
    c. $t_{2g}^4\ e_g^0$
    d. $t_{2g}^3\ e_g^2$

11. The d–d transitions in an octahedral $[NiX_6]^{2+}$ complex are-
    a. Laporte forbidden but spin allowed
    b. Both laporte and spin forbidden
    c. Both laporte and spin allowed
    d. Laporte allowed but spin forbidden

12. $B_5O_6(OH)_4^-$ contains ……BO_4 unit(s)
    a. 2
    b. 1
    c. 3
    d. 4

13. C_{60} possess the geometry of
    a. Truncated octahedron
    b. Trigonalbipyramidal
    c. Tetrahedron
    d. Truncated icosahedron

14. How many BH_2 units are there in B_4H_{10}?
    a. 1
    b. 2
    c. 3
    d. 0

15. XeF_6 on reaction with CsF gives-
   a. $[XeF_5]^+[CsF_2]^-$
   b. XeF_8
   c. $Cs^+[XeF_7]^-$
   d. $[XeF_4]^{2+}[CsF_3]^{2-}$

16. The correct set of pseudohalide anions is
   a. CN^-, ClO_4^-, BF_4^-, PF_6^-
   b. N_3^-, NO_3^-, HSO_4^-, AsF_6^-
   c. SCN^-, PO_4^{3-}, $H_2PO_4^-$, N_3^-
   d. CN^-, N_3^-, SCN^-, NCN^{2-}

17. The geometries of $[Br_3]^+$ and $[I_5]^+$, respectively, are
   a. tetrahedral and trigonalbipyramidal
   b. trigonal and tetrahderal
   c. tetrahedral and tetrahedral
   d. linear and trigonal pyramidal

18. Biochemical Oxygen Demand, (BOD) is a measure of organic material present in water. BOD value less than 5 ppm indicates a water sample to be __________
   a. highly polluted
   b. poor in dissolved oxygen
   c. rich in dissolved oxygen
   d. not suitable for aquatic life

19. Density of water becomes maximum at
   a. 10°C
   b. 4°C
   c. 5°C
   d. 12°C

20. Depletion of ozone is more during the month-
   a. September-November
   b. January-March
   c. July-August
   d. April-June

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UNIVERSITY OF SCIENCE & TECHNOLOGY, MEGHALAYA

[PART (A) : OBJECTIVE]

Duration : 20 Minutes

Serial no. of the main Answer sheet

Course : ....

Semester : .... **Roll No :** ....

Enrollment No : .... **Course code :** ....

Course Title : ....

Session : 2017-18 **Date :** ....

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Instructions / Guidelines

- ➢ The paper contains twenty (20) / ten (10) questions.
- ➢ Students shall tick (✓) the correct answer.
- ➢ No marks shall be given for overwrite / erasing.
- ➢ Students have to submit the Objective Part (Part-A) to the invigilator just after completion of the allotted time from the starting of examination.

Full Marks	Marks Obtained
20	

------------------------- *Scrutinizer's Signature*

------------------------- *Examiner's Signature*

------------------------- *Invigilator's Signature*