THE OPEN UNIVERSITY OF SRI LANKA
B.Sc/B.Ed DEGREE PROGRAMME 2012/2013
Level 4 - CMU2122/CME4122
INORGANIC CHEMISTRY
ASSIGNMENT TEST I (NBT)

18th February 2013. 4.00 - 5.30 p.m.

Part A - 20 Multiple Choice Questions (60 Marks)

Answer all questions
Select the most correct answer to each question given below and mark a cross ***X*** over the answer on the **given answer sheet.** Any answer with more than one ***X*** will not be counted.

1. What is the most likely **geometry** of dicarbonylglycinatooxalatocobalt(III)?
   1) Trigonal planar 2) Square pyramidal 3) Octahedral
   4) Tetrahedral 5) Square planar

2. Consider the following ligands/ions,
   (a) gly^- (b) en (c) $C_2O_4^{2-}$
   The **bidentate** ligand/s is/are
   1) (b) only 2) (a) & (b) only 3) (a) & (c) only.
   4) (b) & (c) only. 5) (a), (b) & (c)

3. The IUPAC name of the complex $[FeCl_2(en)(CO)_2]$ is
   1) Dicarbonyldichloro(ethylenediamine)ferrate(II)
   2) Dichloro(ethylenediamine)dicarbonyliron(II)
   3) Dichlorodicarbonyl(ethylenediamine)iron(II)
   4) Dicarbonyldichloro(ethylenediamine)iron(II)
   5) Dicarbonyldichloro(ethylenediamine)ferrous(II)

4. The number of **geometric** isomers of the complex with the formula $[FeCl_2(en)(CO)_2]$ are,
   1) 2 2) 3 3) 4 4) 5 5) 6

5. Which of the following statements is **true** about $[NiCl_2(PPh_3)_2]$?
   1) The secondary valency of Ni is +2.
   2) It shows *cis-trans* isomerism
   3) The molar conductivity of this complex is not zero.
   4) The primary valency of Ni is 4.
   5) None of the above is true.

6. Pick the **correct** statement from the following statements about $[Mo(CO)_6]$ of which $\mu = 0$ BM. (Group number of Mo = 6)
   1) It is an s^1d^5 complex. 2) It is a paramagnetic complex.
   3) It is an inner-orbital complex. 4) It is a high-spin complex.
   5) Hybridization of the metal centre is sp^3d^2.

7. Predict the spin only **magnetic moment** in BM of the complex ion $[RhCl_4]^-$. Chloride is a **weak ligand** and $\mu = [n(n+2)]^{1/2}$ B.M. (Group number of Rh = 9)

1) 1.73 2) 2.83 3) 3.88 4) 4.89 5) 0

8. The **Crystal field splitting** of a metal depends on,

(a) the period in which it is located
(b) the oxidation state of the metal
(c) the Group number of the metal

The **correct** statement/s is/are

1) (c) only 2) (a) & (c) only 3) (b) & (c) only
4) (a) & (b) only 5) (a), (b), & (c)

9. Consider statements regarding isomerism.

(a) $[PdCl_2(CO)_2]$ does not show geometric isomerism.
(b) Complex $[Ru(NCS)(CO)_5]Cl_2$ & $[Ru(SCN)(CO)_5]Cl_2$ are coordination isomers.
(c) $[PtCl(Br)(CO)(H_2O)]$ do not exhibit optical isomerism, because they have a plane of symmetry.

The **correct** statement/s is/are

1) (c) only 2) (b) only 3) (a) & (b) only
4) (b) & (c) only 5) answer is not given

10. Which of the following statements is **not true** about $[CoCl_2(en)_2]$?

1) The IUPAC name of this complex is dichlorobis(ethylenediamine)cobalt(II)
2) This complex does not show optical isomerism.
3) The molar conductivity of this complex is zero.
4) The secondary valency of Co is 6.
5) This complex does show geometrical isomerism.

11. The reaction, $[CoH(PPh_3)_3] + CH_2{=}CH_2 \rightarrow [Co(CH_2CH_3)(PPh_3)_3]$ can be classified as

1) an oxidation reaction. 2) a redox reaction.
3) an insertion reaction. 4) an association reaction.
5) none of the above

12. Consider the following statements.

(a) Equilibrium constants of a substitution reaction vary $K_1 > K_2 > K_3$ .....
(b) Larger the β value higher the thermodynamic stability of the complex.
(c) $[Fe(H_2O)_2(en)_2]Cl_3$ is more stable than $[Fe(H_2O)_2(NH_3)_4]Cl_3$.

The **correct** statement/s is/are

1) (b) only 2) (b) & (c) only 3) (a) & (c) only
4) (a) & (b) only 5) (a), (b), & (c)

13. Match A, B, C, D with a, b, c, d.

A.	Ionic solids	a. Diamond and Silicon
B.	Molecular solids	b .Cu,Zn,Na
C.	Covalent solids	c. Solid CO_2 and I_2
D.	Metallic solids	d. KCl and Na_2SO_4

The correct answer is

	A	B	C	D
1	a	b	c	d
2	b	c	a	d
3	d	c	a	b
4	a	c	d	b
5	d	c	b	a

14. The units which occupy lattice points in covalent solids are
    1) Molecules 2) Ions 3) Atoms
    4) Covalent bonds 5) Ions and atoms

15. The type of attractions present between molecules in ice are
    1) van der Waal attractions 2) Covalent bonds 3) Hydrogen bonds
    4) Ionic bonds 5) Both Hydrogen bonds and van der Waal attractions

16. The number of atoms per a single body centred cubic unit cell is
    1) one 2) two 3) four 4) nine 5) eight

17. Bragg's law is given by the equation
    1) $n\lambda = 2\theta\sin\theta$ 2) $n\lambda = 2d\sin\theta$ 3) $E = h\upsilon$
    4) $2n\lambda = 2d\sin\theta$ 5) $n\lambda/2 = 2d\sin\theta$

18. Most crystals show good cleavage because their atoms, ions or molecules are:
    1) Weakly bonded together 2) Strongly bonded together 3) Spherically symmetrical
    4) Arranged in planes 5) Not placed in a regular pattern

19. The formula of wustite ranges from $Fe_{0.93}O$ to $Fe_{0.96}O$ instead of FeO. It is due to the presence of
    1) Frenkel defect 2) Schottky defect 3) Metal deficiency defect
    4) Metal excess defect 5) F-centres

20. The unit cell present in ABAB.....type of closest packing of atoms is
    1) Tetragonal 2) Hexagonal 3) Face centred cubic
    4) Primitive cubic 5) Rhombic

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B. Sc DEGREE PROGRAMME 2012/2013
CMU2122/CME4122 – INORGANIC CHEMISTRY- LEVEL 4
ASSIGNMENT TEST-I (Part A)

MCQ ANSWER SHEET: Mark a cross (X) over the most suitable answer.

Part A	
Part B	
Total %	

Reg. No. | | For Examiners Use

Marks

Correct Answers		
Wrong Answers		
Total		

1.	1	2	3	4	5	2.	1	2	3	4	5	3.	1	2	3	4	5
4.	1	2	3	4	5	5.	1	2	3	4	5	6.	1	2	3	4	5
7.	1	2	3	4	5	8.	1	2	3	4	5	9.	1	2	3	4	5
10.	1	2	3	4	5	11.	1	2	3	4	5	12.	1	2	3	4	5
13.	1	2	3	4	5	14.	1	2	3	4	5	15.	1	2	3	4	5
16.	1	2	3	4	5	17.	1	2	3	4	5	18.	1	2	3	4	5
19.	1	2	3	4	5	20.	1	2	3	4	5						

Part B- Structured Essay (40 Marks)

Answer all questions only in the SPACE provided. Attached sheets will not be graded.

1. (a) (i) Give the IUPAC name of $[CrBr(NH_3)_2(H_2O)_3]Cl_2$.

.....

(ii) **Draw** the **structures** of the **three** isomers of $[FeBr_2(ox)(NH_3)_2]$ (ox = oxalate). **(clearly indicate the geometry)**

(iii) Write the **chemical formula** of potassium diaquacarbonyltrifluoorochromate(II).

.....

(b) Using **Crystal Field Theory,**

(i) Determine the **d-electron** configuration (number of e_g and t_{2g} electrons) of Rh in $[RhF_6]^{3-}$. (Group number. of Rh = 9; Assume F^- as a **weak** ligand)

(ii) Calculate the **Crystal Field Stabilization Energy** (CFSE) in kJ mol^{-1} if Δ_o = 200 kJ mol^{-1}.

(c) Using **Valence Bond Theory,** determine the hybridization of Rh in the **paramagnetic** complex ion $[RhF_6]^{3-}$. (Group number of Rh = 9)

(20 marks)

2. In the crystal structure of an ionic crystalline substance **AB**, positions occupied by the **cation** and **anion** are as follows: **Cations**: corners of the cube and the centre of each face. **Anions**: half way of cubic edge and one in the centre of the cube.

(i) Draw the unit cell of **AB**. (5 marks)

(ii) At higher temperatures **AB** shows Frenkel defect. Sketch a labeled diagram to show the defect. (5 marks)

(i) **(ii)**

(iii) What is the main difference between the Schottky defect and the Frenkel defect? (2 marks)

(iv) If the unit cell dimension **a**, of AB is 564 pm calculate the density of AB in kg m^{-3}. (8 marks)

Registration No. :.....

Name :.....

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.....

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B.Sc. Degree Program 2012/2013
CMU2122 - Inorganic Chemistry - Level 4
Assignment Test - I Answer Guide

Part A – MCQ ANSWERS

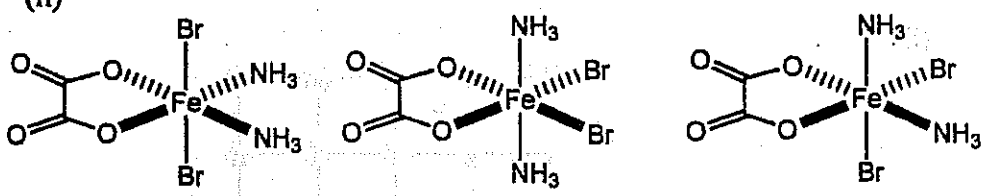
1. (3) **2.** (5) **3.** (4) **4.** (2) **5.** (2) **6.** (3) **7.** (4) **8.** (5) **9.** (1) **10.** (2)

11. (3) **12.** (5) **13.** (3) **14.** (3) **15.** (5) **16.** (2) **17.** (2) **18.** (4) **19.** (3) **20.** (2)

Part B

1. (a) (i) diamminetriaquabromochromium(III) chloride

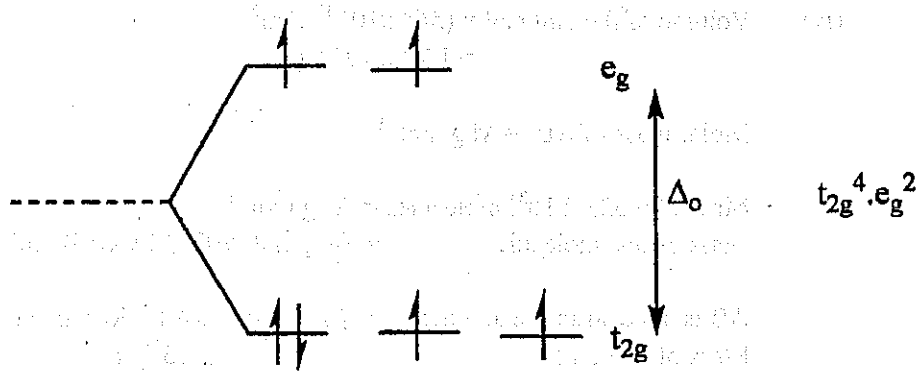
(ii)



Br *trans* to Br NH_3 *trans* to NH_3 NH_3 *trans* to Br

(iii) $K[CrF_3(CO)(H_2O)_2]$

(b) (i) $Rh^0 - d^9$; $Rh^{3+} - d^6$ (Octahedral arrangement in a weak field)

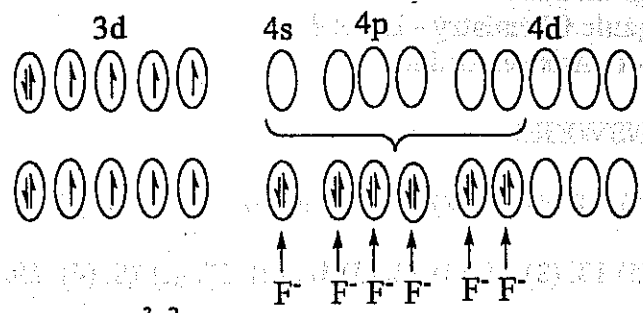


(ii) CFSE $= -0.4 \times 4 \times \Delta_o + 0.6 \times 2 \times \Delta_o$

$= -0.4\ \Delta_o = -0.4 \times 200\ kJ\ mol^{-1}$

$= -80\ kJ\ mol^{-1}$

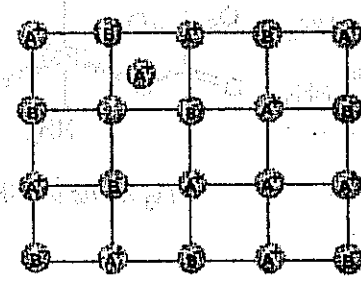
(iii) Since compound is paramagnetic, it has unpaired electrons.
$Rh^{3+} - d^6$



Hybridization = sp^3d^2

2) (i) A unit cell structure similar to NaCl in Unit III-Page 25 (Figure 2.3)
Should be a properly labeled diagram to show the anion and cation positions.

(ii)



(iii)The Frenkel defect causes a cation to leave its own lattice and go to another, while Sckhotty defect depicts that an equal number of cations and anions must be absent to maintain charge neutrality.

(iv) Volume of the unit cell = $(564 \times 10^{-12})^3$ m^3
$= 1.79 \times 10^{-28} m^3$

Molar mass of AB = M g mol^{-1}

Mass of 6.023×10^{23} molecules = M g mol^{-1}
Mass of one molecule = M g mol^{-1}/(6.023×10^{23}) mol^{-1}

AB is a fcc structure and there are 4 A^+ ions and 4 B^- ions in a unit cell.
Mass of one unit cell = $4M/(6.023 \times 10^{23})$ g
= $4M/(6.023 \times 10^{26})$ kg

Density = Mass/Volume

Density of AB = $4M / (6.023 \times 10^{26})(1.79 \times 10^{-28})$ kg m^{-3}
= $37.1M$ kg m^{-3}