



THE OPEN UNIVERSITY OF SRI LANKA
B.Sc/B.Ed DEGREE PROGRAMME - 2011/2012
Level 4 - CMU2122/CME4122
INORGANIC CHEMISTRY
ASSIGNMENT TEST I (NBT)

19th September 2011 (Monday)

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. 1/6 th of a mark will be deducted for each incorrect answer.

- Consider the following ligands/ions,
(a) Cyanide (b) Glycinate (c) ethylenediamine
The **monoanionic** ligand/s is/are
1) (a) only 2) (a) & (b) only 3) (a) & (c) only.
4) (b) & (c) only. 5) (a), (b) & (c)
- The **IUPAC name** of the complex $[\text{CoCl}_2(\text{CO})(\text{NH}_3)_2]$ is
1) Dichlorocarbonyldiammincobalt(II)
2) Diamminecarbonyldichlorocobalt(II)
3) Diamminedichlorocarbonylcobaltate(II)
4) Carbonyldichlorodiammincobalt(II)
5) Diamminecarbonyldichlorocobalt(III)
- What is the most likely **geometry** of trioxalatoiron(III)?
1) Octahedral 2) Tetrahedral 3) Square planar
4) Square pyramidal 5) Trigonal planar
- Which of the following statements is **true** about $[\text{PtCl}_4(\text{NH}_3)_2]$?
1) The IUPAC name of this complex is diamminetetrachloroplatinum(II)
2) This complex does show optical isomerism.
3) The molar conductivity of this complex is not zero.
4) The primary valency of Pt is 6.
5) This complex does show geometrical isomerism.
- What is the **coordination number** of Co in $[\text{CoSO}_4(\text{acac})(\text{NH}_3)_2]$? (acac = acetylacetonate ion)
1) 4 2) 5 3) 6 4) +3 5) +2
- Predict the spin only **magnetic moment** (in BM) of the complex $[\text{CoCl}_4]^-$. Assume chloride as a **weak field ligand** (Atomic no. of Co = 27)
1) 1.73 2) 2.83 3) 3.88 4) 4.89 5) 0

7. Pick the **correct** statement from the following statements about $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$. Assume ammonia as a **strong field ligand** and $\mu = 0 \text{ BM}$.

- 1) It is a paramagnetic complex. 2) Oxidation state of Co is +2.
3) It is a high-spin complex. 4) It is an outer-orbital complex.
5) Hybridization of the metal centre is d^2sp^3 .

8. Which of the following complex would give the **lowest** molar conductivity measurement?

- 1) $[\text{CoCl}(\text{NH}_3)_5]\text{Cl}_2$ 2) $[\text{CoCl}_2(\text{NH}_3)_4]\text{Cl}$ 3) $[\text{Fe}(\text{H}_2\text{O})_6]\text{Cl}_3$
4) $[\text{Pt}(\text{NH}_3)_4][\text{PtCl}_4]$ 5) $[\text{FeCl}_3(\text{NH}_3)_3]$

9. Consider the following statements regarding the complex $[\text{CoCl}_2(\text{NH}_3)_3]$.

- (a) Oxidation and coordination numbers of Co are +2 and 5, respectively.
(b) It can show either square pyramidal or trigonal planar geometry.
(c) It is a paramagnetic complex.

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

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

10. Consider the following statements regarding the complex $\text{K}[\text{CuCl}_2]$.

- (a) The geometry of the **complex ion** is linear.
(b) It obeys the EAN rule. ($\text{Cu} = 29$, $\text{Kr} = 36$)
(c) Magnetic moment of this complex is zero.

The **correct** statement is/are

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

11. Consider the following statements regarding the complex $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$.

- (a). CFSE of this complex is equal to the CFSE that of $[\text{Cr}(\text{CO})_6]\text{Cl}_3$.
(b). Both complexes have the same magnetic moment.
(c). CFSE of $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$ is $-1.2\Delta_0$.

The **correct** statement is/are

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

12. The reaction, $[\text{RhMe}(\text{PPh}_3)_3] + \text{CO} \rightarrow [\text{Rh}(\text{COMe})(\text{PPh}_3)_3]$ can be classified as

- 1) an insertion reaction. 2) an oxidative addition reaction.
3) an association reaction. 4) an oxidation reaction.
5) a redox reaction.

13. Which of the following statements is **incorrect** regarding crystalline solids?

- 1) Molecules or atoms in molecular solids are held together via intermolecular forces.
2) Metallic solids have atoms in the points of the crystal lattice.
3) Ionic solids have formula units in the point of the crystal lattice.
4) Atoms in covalent-network solids are connected via a network of covalent bonds.
5) None of the above.

14. The number of unit cells that share an atom represented by the filled circle in the diagram below is



- 1) 1 2) 2 3) 4 4) 8 5) 16

15. Which of the following may **not** give rise to a crystal defect?

- 1) an ion dislocated to an interstitial site
- 2) formation of a hole in the lattice.
- 3) a plane shift
- 4) substitution of a cation M^{2+} by M^{3+} .
- 5) passing X-rays through a crystal.

16. Consider the following statements regarding a chemical defect in a crystal.

- (a) composition of the lattice is changed due to new chemicals incorporated.
- (b) ruby is an example of a crystal lattice with chemical impurity
- (c) crystal colour may be due to the incorporation of transition metal ions.

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

- 1) (a) only 2) (a) and (b) only 3) (a) and (c) only
4) (a), (b), (c) 5) None of (a), (b), (c)

17. Repeatable entity of a crystal structure is known as

- 1) Crystal 2) Lattice 3) Unit cell
4) Miller indices 5) interstitial atom

18. A line imperfection in a crystal is called

- 1) Schottky defect 2) Frenkel defect 3) Edge dislocation
4) F-centre 5) None of the above

19. Coordination number for closest packed crystal structure is

- 1) 16 2) 12 3) 8 4) 4 5) 6

20. Schottky-defect in ceramic material is

- 1) Interstitial impurity 2) Vacancy- interstitial pair of cations
3) Pair of nearby cation and anion vacancies 4) Substitutional impurity
5) None of the above



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CMU2122/CME4122 – INORGANIC CHEMISTRY- LEVEL 4
ASSIGNMENT TEST-I (Part A)

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

Reg. No.

For Examiners Use

Marks

Part A	
Part B	
Total %	

Unanswered		
Correct Answers		
Wrong Answers		
Total		

1.

1	2	3	4	5
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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) The substance with the composition $\text{CoCl}_3 \cdot 4\text{NH}_3$ has a molar conductivity value of $100 \text{ m}^2\text{ohm}^{-1}\text{mol}^{-1}$. Write the **chemical formula** of this substance?

.....

- (ii) Write the **IUPAC name** of $\text{K}[\text{CoCl}_3\text{Br}(\text{H}_2\text{O})_2]$.

.....

- (iii) **Draw and identify** the structures of the **three isomers** of $[\text{CoCl}_3\text{Br}(\text{NH}_3)_2]$.

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

- (i) Determine the **d-electron configuration** (number of e_g and t_{2g} electrons) of cobalt in $[\text{CoCl}_4]^-$. (Group No. of Co = 9; Assume chloride as a **weak field ligand**)

- (ii) Calculate the **Crystal Field Stabilization Energy (CFSE)** in kJ mol^{-1} if $\Delta_o = 220 \text{ kJ mol}^{-1}$.

- (iii) Calculate the **Total Stabilization Energy (TSE)** in kJ mol^{-1} if the **Pairing Energy (P)** = 230 kJ mol^{-1} .

(20 marks)

2(a). Select amorphous substance/s out of the following list.

potassium chloride, glass, diamond, cesium chloride, natural rubber

.....

(b). (i) Does solid Potassium chloride conduct electricity? Give reasons for your answer.

(ii) Suggest a possible way of making the compound electrically conductive.

(c) At room temperature and atmospheric pressure all the alkali metal halides adopt the rock salt (NaCl) structure except cesium compounds CsCl, CsBr and CsI. Comment on this in the light of the following ionic radii:

	Li⁺	Na⁺	K⁺	Rb⁺	Cs⁺
r_{M⁺}/pm	60	95	133	149	169
	F⁻	Cl⁻	Br⁻	I⁻	
r_{X⁻}/pm	136	181	195	215	

(d) Which one of the following wavelength/s is suitable to be used in the structure determination of potassium chloride?

450 nm, 700 nm, 10 nm, 300 nm, 15 nm

.....

Give reasons for your answer.

(e) Write down the **equation** that is used to determine the atomic spacing in potassium chloride crystal and **identify** all terms.

(f) A metal having a cubic structure has a density of 2.6 g/cm^3 and a molar mass of 87.62 g/mol . The length of the unit cell is 6.0849 \AA . One atom is associated with each lattice point.

(i) Determine the crystal structure of the metal.

(ii) Draw the unit cell

(20 marks)

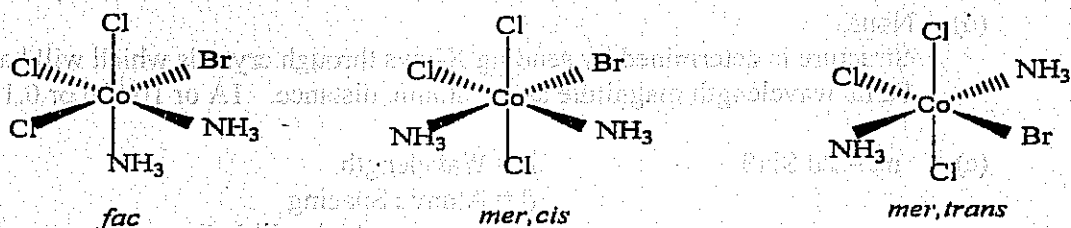
The Open University of Sri Lanka
 B.Sc. Degree Program 2011/2012
 CMU2122 - Inorganic Chemistry - Level 4
 Assignment Test - I Answer Guide

Part A – MCQ ANSWERS

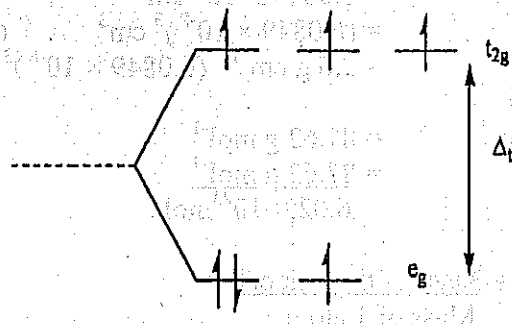
1. (2) 2. (2) 3. (1) 4. (5) 5. (3) 6. (4) 7. (5) 8. (5) 9. (2) 10. (4)
 11. (3) 12. (1) 13. (3) 14. (4) 15. (5) 16. (4) 17. (3) 18. (3) 19. (2) 20. (3)

Part B

1. (a) (i) $[\text{CoCl}_2(\text{NH}_3)_4]\text{Cl}$
 (ii) Potassium diaquabromotrichlorocobaltate(III)
 (iii)



- (b) (i) $\text{Co}^0 - d^9$; $\text{Co}^{3+} - d^6$



(ii) $\text{CFSE} = (-0.6 \times 3 + 0.4 \times 3) \Delta_t$
 $= -0.6 \Delta_t = -0.6 \times 220 \text{ kJ mol}^{-1}$
 $= -132 \text{ kJ mol}^{-1}$

(iii) $\text{TSE} = \text{CFSE} + m \text{ Pairing Energy (Here } m = \text{Number of paired electrons)}$
 $= (-132 \text{ kJ mol}^{-1} + 230) \text{ kJ mol}^{-1}$
 $= +98 \text{ kJ mol}^{-1}$

2 (a) Glass, Natural Rubber

(b) (i) No,
Solid NaCl does not have free ions to carry electricity

(ii) 1. Dissolve in water – ions will be free

2. Heat → Molten Stage – ions will be free

*If you consider solid NaCl with defects it may conduct electricity to a small extent. Also making a defective NaCl lattice will make it conductive.

(c) The arrangement will depend on how many cations can be packed around –ve ions and how many –ve ions can be packed around +ve cations. In other words Radius ratio r_+/r_- is the important factor to decide on the packing of solids. Except for CsCl, CsBr and CsI this ratio is almost equal. For other halides, which will take the NaCl structure

(d) None,
Structure is determined by sending X-rays through crystals which will have the Same wavelength magnitude as the atomic distance. 1Å or 10^{-10}m or 0.1nm

(e) $n\lambda = 2d \sin\theta$

$\lambda =$ Wavelength.

$d =$ Atomic Spacing.

$n =$ Integer which will indicate the order.

$\theta =$ Angle formed by the incident wave.

(f) Length of the unit cell
Volume of the unit cell
Mass of the unit cell

$$= 6.0849 \times 10^{-8} \text{ cm}$$

$$= (6.0849 \times 10^{-8})^3 \text{ cm}^3$$

$$= 2.6 \text{ g cm}^{-3} \times (6.0849 \times 10^{-8})^3 \text{ cm}^3$$

Mass of 1 mol (6.023×10^{23})

$$= 87.62 \text{ g mol}^{-1}$$

Mass of 1 atom

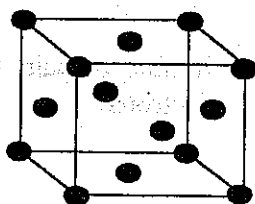
$$= \frac{87.62 \text{ g mol}^{-1}}{6.023 \times 10^{23} \text{ mol}^{-1}}$$

Number of atoms in the unit cell = $\frac{\text{Mass of the unit cell}}{\text{Mass of 1 atom}}$

$$= \frac{2.6 \text{ g cm}^{-3} \times (6.0849 \times 10^{-8})^3 \text{ cm}^3 \times 6.023 \times 10^{23} \text{ mol}^{-1}}{87.62 \text{ g mol}^{-1}} = \frac{2.6 \times 225.29 \times 10^{-24} \times 6.023 \times 10^{23}}{87.62}$$

$$= \frac{3527.996 \times 10^{-1}}{87.62} = 4.026 = 4 \text{ It is a FCC crystal structure}$$

$$8 \times \frac{1}{8} = 1; \quad 6 \times \frac{1}{2} = 3$$



FCC unit cell