



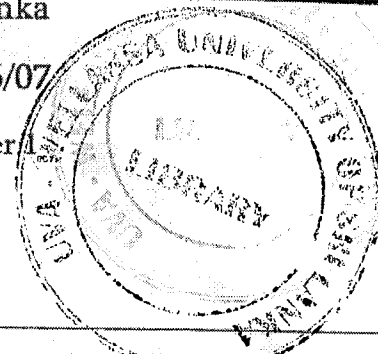
Uva Wellassa University, Sri Lanka

BTech. Degree Programme 2006/07

End Semester Examination - Semester I

January 2008

CHE 241-2 Inorganic Chemistry

Answer 4 questions only

Time Allowed: Two hour

- [1] a) Explain the Bohr model of Hydrogen atom. What are the drawbacks of this model? (10 marks)
- b) Calculate wave lengths corresponding to H_{α} , H_{β} , H_{γ} in atomic spectra of Hydrogen atom. (Rydberg constant = $1.0967 \times 10^7 \text{ m}^{-1}$) (5 marks)
- c) Draw the molecular orbital diagram for N_2 (5 marks)
- d) Born-Landé equation for ionic lattices is given below. Define all terms. (5 marks)

$$U = \frac{N_0 A Z^+ Z^- e^2}{4\pi\epsilon_0 r_0} [1 - 1/n]$$

Use this equation to explain following lattice energies.

LiF(s)	-1004 kJ/mol
CsI(s)	-527 kJ/mol

- [2] a) Calculate the lattice energy of CsCl(s) using following data (10 marks)
- | | |
|-------------------------------------------------------------------------------|-------------------------------------|
| $\text{Cs(s)} \rightarrow \text{Cs(g)}$ | $\Delta H = +79.9 \text{ kJ/mol}$ |
| $\text{Cs(g)} \rightarrow \text{Cs}^+(\text{g})$ | $\Delta H = +374.05 \text{ kJ/mol}$ |
| $\text{Cl}_2(\text{g}) \rightarrow 2 \text{Cl}(\text{g})$ | $\Delta H = +241.84 \text{ kJ/mol}$ |
| $\text{Cl}(\text{g}) + e \rightarrow \text{Cl}^-(\text{g})$ | $\Delta H = -397.90 \text{ kJ/mol}$ |
| $\text{Cs(s)} + \frac{1}{2} \text{Cl}_2(\text{g}) \rightarrow \text{CsCl(s)}$ | $\Delta H = -623.00 \text{ kJ/mol}$ |
- b) Chemical properties of Li are more similar to Mg than rest of the elements in the group. (5 marks)
Discuss this statement by giving three examples.
- c) i) What is meant by the effective nuclear charge? (3 marks)
- ii) Calculate the effective nuclear charge for valance electron in Oxygen (5 marks)
(For each electron in the same n group $\rightarrow 0.35$
each electron in the same (n-1) group $\rightarrow 0.85$
each electron in the same (n-2) group $\rightarrow 1.00$)
- d) Name the chemicals produced by different industrial processes on sea water (2 marks)

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- [3] a) i) Evaluate the Gibbs free energies of these ionic processes using their electrode potentials and state whether the reactions are spontaneous or not. (10 marks)

$\text{Al}^+(\text{aq}) / \text{Al}(\text{s})$	+0.55 V
$\text{Al}^{3+}(\text{aq}) / \text{Al}(\text{s})$	-1.66 V
$\text{Tl}^+(\text{aq}) / \text{Tl}(\text{s})$	-0.34 V
$\text{Tl}^{3+}(\text{aq}) / \text{Tl}(\text{s})$	+1.26 V

- ii) Using above data explain why lower oxidation states are more stable when going down the group. (5 marks)
- b) Use VSEPR theory to deduce the structures of following oxo acids of Chlorine and Bromine. (10 marks)
- Hypochlorous acid
 - Perchloric acid
 - HBrO_2
 - HBrO_3

- [4] a) Name the following coordination compounds according to IUPAC rules (5 marks)

- $\text{Na}_3[\text{Ag}(\text{S}_2\text{O}_3)_2]$
- $\text{Li}[\text{AlH}_4]$

- b) Write the formula of the following coordination complexes according to the IUPAC rules (5 marks)

- Triamminechlorocyanonitrocobalt(III)
- Potassium pentacyanonitrosylferrate(II)

- c) Identify and draw all the possible isomers of $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2]\text{NO}_3$ complex. (10 marks)

- d) Explain Jahn-Teller effect in octahedral complexes taking $[\text{Mn}(\text{H}_2\text{O})_6]^{3+}$ as an example. (5 marks)

- [5] a) Given that the maximum absorption peak for d-d transitions for $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ is at 17830 cm^{-1} .

- Calculate the crystal field splitting energy (5 marks)
(1 kJ/mol = 83.7 cm^{-1})

- Calculate the crystal field stabilization energy (10 marks)

- Predict whether the absorption peak for following complexes are greater or less than that for $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$. Give reasons for your choice. (5 marks)

- $[\text{Cr}(\text{Cl})_6]^{3-}$
- $[\text{Cr}(\text{CN})_6]^{3-}$

- b) Give reasons for following observations (5 marks)

- Zn^{2+} compounds are typically white where as Cu^{2+} compounds are colored.
- $\text{Cr}_2\text{O}_7^{2-}$ ion is intensely orange colored.