Uva Wellassa University, Sri Lanka

BTech. Degree Programme 2006/07

End Semester Examination - Semester 1

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 = $1.0967 \times 10^7\ m^{-1}$) (5 marks)

c) Draw the molecular orbital diagram for N_2 (5 marks)

d) Born-Lande equation for ionic lattices is given below. Define all terms. (5 marks)

$$U = \frac{N_0 A Z^+ Z^- e^2}{4\pi\varepsilon_0 r_0} [1-1/n]$$

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)

$Cs(s) \rightarrow Cs(g)$	$\Delta H = +79.9$ kJ/mol
$Cs(g) \rightarrow Cs^+(g)$	$\Delta H = +374.05$ kJ/mol
$Cl_2(g) \rightarrow 2\ Cl(g)$	$\Delta H = +241.84$ kJ/mol
$Cl(g) + e \rightarrow Cl^-(g)$	$\Delta H = -397.90$ kJ/mol
$Cs(s) + \frac{1}{2}\ Cl_2(g) \rightarrow CsCl(s)$	$\Delta H = -623.00$ kJ/mol

b) Chemical properties of Li are more similar to Mg than rest of the elements in the group. Discuss this statement by giving three examples. (5 marks)

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 → 0.35
each electron in the same (n-1) group → 0.85
each electron in the same (n-2) group → 1.00)

d) Name the chemicals produced by different industrial processes on sea water (2 marks)

[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)

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

i) Hypochlorous acid
ii) Perchloric acid
iii) $HBrO_2$
iv) $HBrO_3$

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

i) $Na_3[Ag(S_2O_3)_2]$
ii) $Li[AlH_4]$

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

i) Triamminechlorocyanonitrocobalt(III)
ii) Potassium pentacyanonitrosylferrate(II)

c) Identify and draw all the possible isomers of $[Co(NH_3)_4(NO_2)_2]NO_3$ complex. (10 marks)

d) Explain Jahn-Teller effect in octahedral complexes taking $[Mn(H_2O)_6]^{3+}$ as an example. (5 marks)

[5] a) Given that the maximum absorption peak for d-d transitions for $[Cr(H_2O)_6]^{3+}$ is at 17830 cm^{-1}.

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

ii) Calculate the crystal field stabilization energy (10 marks)

iii) Predict whether the absorption peak for following complexes are greater or less than that for $[Cr(H_2O)_6]^{3+}$. Give reasons for your choice. (5 marks)

a) $[Cr(Cl)_6]^{3-}$
b) $[Cr(CN)_6]^{3-}$

b) Give reasons for following observations (5 marks)

i) Zn^{2+} compounds are typically white where as Cu^{2+} compounds are colored.
ii) $Cr_2O_7^{2-}$ ion is intensely orange colored.