



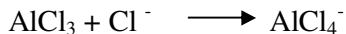
NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
BACHELOR OF SCIENCE HONOURS DEGREE
SUPPLEMENTARY EXAMINATIONS – AUGUST 2010
INORGANIC CHEMISTRY I - SCH 1101
TIME: 3 HOURS

Instructions to candidates

This paper comprises five (5) questions. Attempt to answer **all** the questions. Each question carries twenty (20) marks. Start your answer to each question on a new page.

1, a) Using noble gas configuration, write the electron configuration for nobelium.
(4 marks)

b) Consider the reaction



Describe the change (if any) in hybridization of the aluminum atom and the change in geometry (if any) of the aluminum/chlorine species. **Show orbital diagrams to support your answer.**
(5 marks)

c) Write the elements represented by the following electronic configurations:

i) $1s^2 2s^2 2p^6 3s^2$ ii) $1s^2 1p^6 2s^2 2p^6 3s^2$ iii) $[\text{Kr}]5s^3 4d^1$
(3 marks)

d) Draw the best Lewis structure for $(\text{SO}_3)^-$.
(3 marks)

e) Use VSEPR theory to determine the best Lewis Structure(s) for the P_4 . Your answer should include your reasoning for all the possible structures and must show your work.
(5 marks)

2. a) Predict which of the following bonds are covalent or ionic. For those which are covalent differentiate between polar and non-polar covalent bonds:

a) HF b) H_2O c) Ra-S d) O-Cl e) S-C
(5 marks)

b) Sulphur trioxide can have resonant structures. Draw all Lewis resonant structures of this compound.
(5 marks)

- c) What is the number of sigma and pi bonds in the ethane molecule $\text{H}_3\text{C}-\text{CH}_3$?
 Show the energy diagram. (7 marks)
- d) Write a balanced equation of the reaction between Nitrogen Dioxide and Water.
 (3 marks)

3. a) For each of the following three molecules, i) count the number of valence electrons; ii) draw the Lewis Structures including all resonance structures; iii) draw out the shape of the molecule according to VSEPR; iv) name the electron pair geometry, and v) name the molecular geometry. XeO_3F_2 , HClO_4 , BrF_5
 (15 marks)

- b) Write a balanced net-ionic reaction, and tell what type of reaction it is.
 (*reaction occurs in aqueous solution*)

Potassium chloride + silver nitrate (5 marks)

4. a) Which atom in the ground state has three unpaired electrons in its outermost principal energy level? Li; B; N; (1 mark)

- b) Given the following information (equations can be reversed, if necessary):

$\text{Li (s)} \rightarrow \text{Li (g)}$ heat of sublimation of $\text{Li(s)} = 166 \text{ kJ/mol}$

$\text{HCl (g)} \rightarrow \text{H (g)} + \text{Cl (g)}$ bond energy of $\text{HCl} = 427 \text{ kJ/mol}$

$\text{Li (g)} \rightarrow \text{Li}^+ \text{ (g)} + \text{e}^-$ ionization energy of $\text{Li (g)} = 520. \text{ kJ/mol}$

$\text{Cl (g)} + \text{e}^- \rightarrow \text{Cl}^- \text{ (g)}$ electron affinity of $\text{Cl (g)} = -349 \text{ kJ/mol}$

$\text{Li}^+ \text{ (g)} + \text{Cl}^- \text{ (g)} \rightarrow \text{LiCl(s)}$ lattice energy of $\text{LiCl(s)} = -829 \text{ kJ/mol}$

$\text{H}_2 \text{ (g)} \rightarrow 2\text{H (g)}$ bond energy of $\text{H}_2 = 432 \text{ kJ/mol}$

Calculate the net change in energy for the reaction: $2\text{Li (s)} + 2\text{HCl (g)} \rightarrow$

$2\text{LiCl (s)} + \text{H}_2 \text{ (g)}$ (8 marks)

- c) Calculate the lattice energy for LiF(s) given the following:

sublimation energy for Li(s) +161 kJ/mol

ΔH_f for F(g) +77 kJ/mol

first ionization energy of Li(g) +520. kJ/mol

electron affinity of F(g) -328 kJ/mol
enthalpy of formation of LiF(s) -617 kJ/mol

(6 marks)

d) What properties of ethane can be explained with the theory of hybridization
(5 marks)

5. a) Draw the crystal lattice structures of the following compounds: MgO, KBr
and LiCl. (Show all your workings) [15 marks]

b) What types of intermolecular forces would you expect for each of these?

a. CCl₄ b. OCS (carbon is central) c. NH₃ d. H₂ e. CO₂
(5 marks)

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