NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
BACHELOR OF SCIENCE HONOURS DEGREE
END OF FIRST SEMESTER EXAMINATIONS – FEBRUARY 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.

---

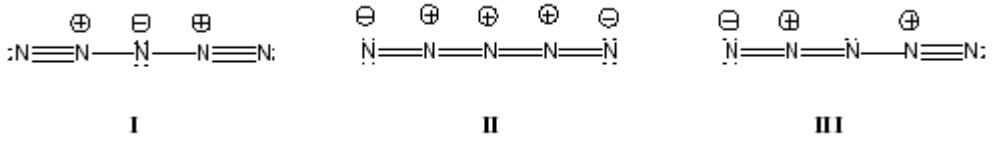
1. a) Element 110 was recently named Darmstadtium (Ds) for the town of Darmstadt, Germany where it was discovered. Using noble gas configuration, write the electron configuration for darmstadtium. (4 marks)

   b) Which of the following is lighter?: a dozen molecules of aspirin ($C_9H_8O_4$) or $3.0x10^{-22}$ mol oxygen gas (show your working) (3 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) $[Kr]5s^3 4d^1$ (3 marks)

   d) Draw the best Lewis structure for azide, $(N3)^-$. Explicitly show formal charges. (3 marks)

   e) Use VSEPR theory to determine which Lewis Structure(s) (I, II, and/or III) best represent(s) the $(N_5)^+$ cation. Your answer should include your reasoning for all three structures and must show your work.



I **II** **III**

(4 marks)

   f) Write a balanced equation of the reaction between ammonium phosphate and lead nitrate. (3 marks)

2. a) Sometimes the element hydrogen is placed in at the top of group 1A while other times, it is placed at the top of group 17A. Explain how hydrogen fits into each group using its electron configuration, electron affinity, ionization energy, the known compounds HCl and NaH, and the physical properties of the element hydrogen to support your claims. (12 marks)

b) Calculate the density of an air mix of nitrogen, argon and carbon dioxide, if the mass of the components is 15, 50 and 35% respectively. (M_{air} = 29) (3 marks)

c) What is the number of sigma (σ) and pi (π) bonds in the ethylene molecule $H_2C=CH_2$? Show the energy diagram. (5 marks)

3. a) For each of the following five molecules,
   i) Count the number of valence electrons;
   ii) Draw the Lewis Structures including all resonance structures;
   iii) Identify the hybridization of the center atom;
   iv) Draw out the shape of the molecule according to VSEPR; and
   v) Name the molecular geometry: i) XeF_6^{2+} ii) PCL_3 iii) CINO iv) CIF_2^{1-} v) XeF_4 (15 marks)

   c) Calculate the amount of barium sulphate formed from reacting 20.8g of barium chloride with 18.0g of sodium sulphate solutions. (5 marks)

4. a) Which of these elements -- Li, O, Ne, & Na -- has the largest atomic radius? (1 mark)

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

   Li (s) --> Li (g) heat of sublimation of Li(s) = 166 kJ/mol
   HCl (g) --> H (g) + Cl (g) bond energy of HCl = 427 kJ/mol
   $Li (g) \rightarrow Li^+ (g) + e^-$ ionization energy of Li (g) = 520. kJ/mol
   $Cl (g) + e- \rightarrow Cl^- (g)$ electron affinity of Cl (g) = -349 kJ/mol
   $Li^+ (g) + Cl^- (g) \rightarrow LiCl(s)$ lattice energy of LiCl(s) = -829 kJ/mol
   $H_2 (g) \rightarrow 2H (g)$ bond energy of H_2 = 432 kJ/mol

   Calculate the net change in energy for the reaction: $2Li (s) + 2HCl (g) \rightarrow 2LiCl (s) + H_2 (g)$ (8 marks)

   c) Calculate the lattice energy for LiF(s) given the following:
   sublimation energy for Li(s) +161 kJ/mol
   delta Hf 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 methane can be explained with the theory of

   hybridization (5 marks)

5. a) Identify the most probable electronic ground state of the nitrogen atom using the microstate theory. (15 marks)

b) Draw the crystal structure of calcium fluoride. (5 marks)

End of question Paper!!!