



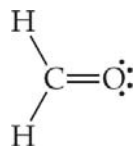
NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
BACHELOR OF SCIENCE HONOURS DEGREE
SUPPLEMENTARY EXAMINATIONS – AUGUST 2014
INORGANIC CHEMISTRY I – SCH 1101
TIME: 3 HOURS

INSTRUCTIONS TO CANDIDATES

This paper comprises four (4) questions. Attempt to answer ***all*** the questions. Each question carries twenty five (25) marks. Start your answer to each question on a new page.

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1. (a) Write the electronic configurations of the following elements in the periodic table and explain any anomalies you observed: Cr; Fe; Cu; Co; Ce. (10 marks)
 - (b) What are the values of n , l , m and s for the valence electron of a potassium atom in its ground state? (4 marks)
 - (c) Define ***term*** and ***multiplicity*** in electronic microstructure theory. Show examples. (6 marks)
 - (d) Specify the set of quantum numbers used to describe an orbital and state what values of each are possible. (5 marks)
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2. (a) The following are the approximate 1st ionization enthalpies of noble gases in kJ/mol: He (2372); Ne (2081); Ar (1521); Kr (1351); Xe (1170); Rn (1037). Plot a graph of the above data and using electronic structure of atoms explain the trend shown in your graph. (10 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. ($M_{\text{air}} = 29$) (4 marks)
 - (c) Draw the energy diagram of O_2 and explain which properties can be derived from the diagram. (6 marks)

- (d) Formaldehyde has the Lewis structure:



Describe how the bonds in formaldehyde are formed in terms of overlaps of hybrid and unhybridized orbitals. (5 marks)

3. (a) For each of the following five molecular species,
- count the number of valence electrons;
 - draw the Lewis Structures including all resonance structures;
 - identify the hybridization of the center atom;
 - draw out the shape of the molecule according to VSEPR; and
 - name the molecular geometry.
- (i) H_3PO_4
(ii) ICl_4^-
(iii) NNN^-
(iv) OSF_4
(v) $[\text{PtCl}_6]^{2-}$
- (15 marks)
- (b) Balance the following reactions
- $\text{Na}_2\text{O} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
 - $\text{HNO}_3 + \text{NH}_4\text{OH} \rightarrow \text{NH}_4\text{NO}_3 + \text{H}_2\text{O}$
 - $\text{Al}(\text{OH})_3 + \text{H}_2\text{SO}_4 \rightarrow \text{Al}_2(\text{SO}_4)_3 + \text{H}_2\text{O}$
- (3 marks)
- (c) In what relative positions would s and p orbitals have cancelling overlap? Show illustrations. (2 marks)
- (d) Which of the following bonds is most polar: S—Cl, S—Br, Se—Cl, or Se—Br ? (3 marks)
- (e) Draw two equivalent resonance structures for the formate ion, HCO_2^- . (2 marks)

4. (a) Calculate the formula weight of:
- (i) $\text{Al}(\text{OH})_3$ and
 - (ii) CH_3OH .
- (4 marks)
- (b) Write the balanced equations for the reaction that occurs when:
- (i) ethanol, $\text{C}_2\text{H}_5\text{OH}(l)$ and
 - (ii) methanol, $\text{CH}_3\text{OH}(l)$, burns in air.
- (4 marks)
- (c) Calculate the percentage of nitrogen, by mass, in $\text{Ca}(\text{NO}_3)_2$.
- (3 marks)
- (d) How many moles of sodium bicarbonate (NaHCO_3) are in 508 g of NaHCO_3 ?
- (2 marks)
- (e) Calculate the mass, in grams, of 0.433 mol of calcium nitrate.
- (2 marks)
- (f) Mesitylene, a hydrocarbon found in crude oil, has an empirical formula of C_3H_4 and an experimentally determined molecular weight of 121 amu. What is its molecular formula?
- (4 marks)
- (g) Ethylene glycol, used in automobile antifreeze, is 38.7% C, 9.7% H, and 51.6% O by mass. Its molar mass is 62.1 g/mol.
- (i) What is the empirical formula of ethylene glycol?
 - (ii) What is its molecular formula?
- (6 marks)

End of question Paper!!!