THE COLLEGE OF THE BAHAMAS
THE SCHOOL OF NATURAL SCIENCES AND ENVIRONMENTAL STUDIES
THE CHEMISTRY DEPARTMENT

COLLEGE CHEMISTRY I – CHEM 135
FINAL EXAMINATION SEMESTER 2002-04

3 Hours

Instructions
This exam script consists of two sections.
Section A : 20 Multiple Choice questions, each worth 1 mark.
Section B : Five Structured questions ,worth 60 marks in total.
You are instructed to answer ALL questions as indicated. Credit will be given for appropriate working in section B.

SECTION A : Mark your answers by shading in the appropriate space on the answer sheet. Use an HB or #2 pencil.

1. A 5.920 g sample of an oxide of manganese was found to contain 3.740 g of manganese. What is the percentage of oxygen in the compound?

   A 2.180 %
   B 3.680 %
   C 13.63 %
   D 36.82 %
   E 55.52 %

2. The mass of one mole of $(NH_4)_2SO_4$ is (RAMs N 14.0, S 32.0, O 16.0, H 1.00)

   A 608 g
   B 132 g
   C 100 g
   D 66 g
   E 6.02×10^{23} g

3. A 28.25 g portion of potassium nitrate KNO_3 , RFM 113.0 was dissolved in water and made up to 0.50 dm^3 of solution. What was the concentration of solution?

   A 0.50 M
   B 1.7 M
   C 8.0 M
   D 4.0 M
   E 14.3 M

4. A mixture of 3.00 mol of neon, 4.00 mol of hydrogen and 2.00 mol nitrogen exerts a pressure of 9.00 atmospheres. What is the partial pressure of the nitrogen ?

   A. 2.00 atm
   B. 2.57 atm
   C. 3.00 atm
   D. 4.00 atm
   E. 4.50 atm

5. A solid R was dissolved in water. When a portion of aqueous R was mixed with 2 drops of aqueous sodium hydroxide a red-brown ppt was formed, which was insoluble in excess hydroxide. Another portion of the solution produced a white ppt with barium nitrate solution. The ppt. was insoluble in dilute nitric acid. The most likely identity of R is

   A. Iron (III) sulphate
   B. Iron (II) carbonate
   C. Calcium dichromate
   D. Silver chloride
   E. Sodiim sulphate

6. A compound G gave a blue-white flame-test result. An aqueous solution of G gave no ppt with either barium chloride or silver nitrate solution. Which of the following substances would give these results ?

   A. potassium carbonate
   B. copper (II) nitrate
   C. copper (I) chloride
   D. lead (II) nitrate
   E. lead (II) sulphite

7. The rate of effusion for gas A is 4.0 times faster than the rate for gas B. It follows that ;

   A . RMM for A is greater than RMM for B.
   B . The RMM for B is 4 x RMM for A.
   C. The RMM for A is 0.25 x RMM for B.
   D. The average molecular speed in B is faster than in A.
   E. The RMM of B is 16 x RMM of A

8. What volume of 4.00M HCl is needed to prepare 250.0 cm^3 of 1.50 M HCl ?

   A 30.0 cm^3
   B 93.7 cm^3
   C 9.37 cm^3
   D 37.5 cm^3
   E 25.0 cm^3

9. What is the volume of 3.55 moles of chlorine gas at s.t.p ?

   A 0.31 dm^3
   B 6.31 dm^3
   C 22.4 dm^3
   D 79.5 dm^3
   E 159 dm^3

Questions 10-14 concern the following concern the following classifications of elements.

   A noble gases
   B alkaline earth metals
   C halogens
   D alkali metals
   E group 5

Select from **A to E** the location of an element which

10. has the electron configuration $1s\ 2s^2 2p^3$
11. does not react readily with other elements

12. has the electronic configuration $1s^2 2s^2 2p^6 3s^2\ 3p^6 4s^2$

13. the element whose **ANION** has the electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^6$

14. has the largest atomic radius in period three

15. Nitrogen (RAM = 14.0) and oxygen (RAM = 16.0) form a compound, 8.25 g of which contain 5.25 g of nitrogen. What is the empirical formula of the compound?

   A NO
   B NO_2
   C N_2O
   D NO_2
   E N_2O_3

16. Pentane C_5H_{12} has a higher boiling point than ethane C_2H_6 mostly due to the fact that

   A it is a covalent compound.
   B its molecules have a greater tendency to form hydrogen bonds.
   C it has a larger molecular mass.
   D it does not contain ionic bonds.
   E it has more dipole -dipole interactions

17. When the term equivalence point is used in a titration, it refers to

   A the point at which all of the standard has been used up but no extra has been added.
   B. the colour change that occurs.
   C. the mean titre volume.
   D.the point at which moles or reactants are equal to each other.
   E the final reading on the burette

18. As you go down group VII of the Periodic Table,

   A. ionization energy increases
   B. the number of electrons in the valence shell increases
   C.chemical reactivity increases
   D.ionic radius decreases
   E. electronegativity decreases

19. The standard enthalpy of combustion for hydrogen gas is - 285.83 kJ/mol. It follows that when 1.000 g of hydrogen gas undergoes combustion,

   A. 28.58 kJ are absorbed
   B. 28.58 kJ are released
   C. 142.91 kJ are released
   D. 142.91 kJ are absorbed
   E. not enough data is provided.

20.For which of the following is the enthalpy of formation zero ?

   A. Cu(l)
   B. NaF(s)
   C. $CaCO_3$
   D. Mg(l)
   E. $Cl_2(g)$

SECTION II: Structured Questions

Answer each of the following questions in the spaces provided on the question paper. There is a total of 60 marks for this section. Credit will be given for clear logical working.

1. THERMOCHEMISTRY :

   I. Write a thermochemical equation to represent each statement.

   a. The second electron affinity of sulphur is – 200 $kJmol^{-1}$. (2)

   b. The standard enthalpy of formation of ammonia NH_3 is – 46.11 $kJmol^{-1}$ (2)

II. Calculate the standard enthalphy of combustion of pentaborane , B_5H_9 . The overall reaction equation is : (4)

$B_5H_9(g) + 6\ O_2(g) \rightarrow 5/2\ B_2O_3(s) + 9/2\ H_2O(g)$

Enthalpies of formation (in kJ/mol) for the following may be useful:

$B_5H_9(g)$ 73.2 , $B_2O_3(s)$ -1272.77 , $H_2O(g)$ -241.82

III. State, with justification, whether the formation of B_2O_3 from B_5H_9(is an exothermic or an endothermic process. (2)

2. ATOMIC STRUCTURE AND BONDING

I. Give the electron configuration (in the form $1s^2 2s^2 2p^2$ etc.) for the following species :

a. K _____ (1)

b. Al^{3+} _____ (1)

II. Give the name of an element that has a cation that is ISOELECTRONIC with a neon atom. (1)

III. a. State the trend in ionization energy values as you move from left to right across the Periodic Table of elements. (1)

b. Give an explanation for the observed trend in ionization energy. (3)

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_____

_____

IV. A compound X was formed between an element in group 2 and an element in group 6.

a. Predict the type of bonding that the two elements would be most likely to use in bonding to each other. (1)

b. Justify your answer to part IV a. (2)

V. Use the Valence Shell Electron Pair Repulsion theory to complete the table below. (6)

MOLECULE / ION	LEWIS DOT AND CROSS DIAGRAM	MOLECULAR SHAPE
SCl_6		
H_3O^+		
CH_3Br		

VI. Butane C_4H_{10} (RMM 58) has a much lower boiling point than propanol C_3H_7OH (RMM 60). With reference to bonding and forces of attraction, explain this observation. (3)

3. QUALITATIVE ANALYSIS

A test solution R was divided into four portions and tested. The results were as follows :

a. When tested with dilute potassium hydroxide solution, a white precipitate was formed. This was soluble in excess hydroxide.

b. When tested with dilute ammonia solution, a precipitate was formed. This was insoluble in excess hydroxide.

c. The test solution gave a negative flame test result.

d. When a silver nitrate olution was added to solution R, a creamy precipitate was formed. This was insoluble in dilute ammonia but soluble in concentrated ammonia.

I. Write net ionic equations ALL of the reactions in a,b and d. (6)

_____

_____

_____

_____

_____

_____

II. Give the name of the chemical R. _____ (1)

4. GASES

I. When a gas is subjected to very high pressures, it no longer behaves ideally. Account for this behaviour, with reference to the kinetic theory of gases. (2)

II. Calculate the volume that 78.50 g of carbon dioxide gas (RMM 44) would occupy at 32.5° C and 1.22 atmospheres. (4)

III. Compare the rates of effusion of Propanone (RMM 58) with an unknown gas Q whose RMM is 37.2, under identical conditions of temperature and pressure. (3)

IV. A container contains 1.50 moles of nitrogen, 2.50 moles of neon and 3.75 moles of oxygen. If the total pressure of the mixture was 7.55 atmospheres, what would be the partial pressure of :

a. nitrogen (2)

b. oxygen (2)

5. STOICHIOMETRY

I. An organic compound W has a composition , by mass, as follows : 54.55% C, 9.09% H, and 36.36% O by mass. Use this information to determine the empirical formula of W. (4)

II. A 7.52g portion of aluminium oxide was mixed with 75.00 cm^3 of 0.400 M sulfuric acid. They reacted according to the equation below.

$$Al_2O_3(s) + 3H_2SO_4(aq) \rightarrow Al_s(SO_4)_3(aq) + 3H_2O(l)$$

a. Calculate the moles of aluminium oxide present in the 7.52 g provided. (2)

b. Calculate the moles of sulfuric acid present in 75.00 cm^3 iof the 0.400M solution. (1)

c. Use relevant calculations to identify the limiting reactant. (2)

d. Predict the total mass of aluminium sulphate that could be formed from this reaction. (2)

e. If the percent yield for this reaction was 82.5 %, predict the actual mass of aluminium sulphate that would be formed. (2)

END OF EXAMINATION