Chemistry Paper 2 (Essay) ,May/June 2012

Question 1

- 1. (i) What is the structure of the atom as proposed by Rutherford?
- (ii) Distinguish between the atomic number and the mass number of an element.
- (iii) Explain briefly why the relative atomic mass of chlorine is not a whole number.

[7 marks]

- (i) What is meant by first ionization energy?
- (ii) List three properties of electrovalent compounds
- (iii) Consider the following pairs of elements:
 - 9F and 17CL;
 - 12Mg and 20Ca.

Explain briefly why the elements in each pair have similar chemical properties. [7marks]

- Explain briefly the following terms using an appropriate example in each case
- homologous series;
- heterolytic fission.

- [5 marks]
- State the indicator(s) which could be used to determine the end-point of the following titrations:
- dilute hydrochloric acid against sodium hydroxide solution;
- dilute hydrochloric acid against ammonium hydroxide solution;
- ethanoic acid against sodium hydroxide solution. [3 marks]
- A solid chloride E which sublimed on heating reacted with an alkali F to give a

choking gas G. G turned moist red litmus paper blue. Identify E,F and G. [3 marks]

1. (a) (i) What is diffusion?

- (ii) State Charles' law.
- (iii) Sketch a graph to illustrate Charles' law.

(iv) A given mass of a gas occupied 150 cm3 at 27 0C and a pressure of 1.013 x 105 Nm-2.

Calculate the temperature at which its volume will be double at the same pressure.

- (v) Arrange the three states of matter in order of increasing:
 - (i) kinetic energy;
 - (ii) forces of cohesion. [11 marks]

(b) (i) State Le Chatelier's principle.

(ii) A metal M forms two oxides containing 11.1% and 20.0% of oxygen. Show that these figures agree with the law of multiple proportions.

[7marks]

(c) The table below shows the physical properties of substances A,B and C.

	Melting point/oC	Boiling point/oC	Solubility in
Substance			water at 25oC
A	30	117	Insoluble
В	31	160	Insoluble
С	861	1200	Soluble

- 1. If Aand B are miscible when melted and B and C react when heated, describe how a mixture of A, B and C could be separated.
- When 25.25g of the mixture A, B and C was separated, 7.52 g of A and 8.48 g of B were recovered. Assuming that there was no loss of components during the separation, calculate the percentage by mass of C in the mixture.
 [7 marks]

- 1. (a) (i) Define nuclear fission
 - (ii) A certain natural decay series starts with and ends with .

Each step involves the loss of an alpha or a beta particle. Using the given information,

deduce how many alpha and beta particles were emitted. [5marks]

(b) Consider the equilibrium reaction represented by the following equation: A2(g) + 3B2(g) 2AB3(g); H = + kJmol-1 Explain briefly the effect of each of the following changes on the equilibrium

composition:

- increase in concentration of B;
- o decrease in pressure of the system;
- o addition of catalyst.

(c) The lattice energies of three sodium halides are as follows:

Compound	NaF	NaBr	NaI
Lattice energy/kJmol-1	890	719	670

Explain briefly the trend.

[3 marks]

(d) State the property exhibited by nitrogen (IV) oxide in each of the following reactions:

(i)	4Cu + 2NO2	4CuO + N2;
(ii)	H2O+ 2NO2	HNO3 + HNO2.
		[3marks]

- (e) Iron is manufactured in a blast furnace using iron ore (Fe2O3), coke and limestone. Write the equation for the reaction(s) at the:
 - top of the furnace;
 - middle of the furnace;
 - bottom of the furnace. [5 marks]
- (f) (i) Name two products of destructive distillation of coal.
 (ii) Give one use of each product in 3(f)(i). [4 marks]

[5marks]

	1.	(a)	(i)	What is a structural isomer?
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(ii) Write all the structural isomeric alkanols with the molecular formula C4H10O.

(iii) Which of the isomers from 4(a)(ii) above does not react easily on heating with acidified K2Cr2O7?

(b) Chlorine reacted with excess pentane in the presence of light. Chloropentane and a gas

which fumes on contact with air were produced.

- 1. Write an equation for the reaction.
- 2. Draw the structure of the major product.
- 3. What is the role of light in the reaction?
- 4. If a mixture of pentane and the major product is heated, which compound would

distil off first? Give a reason for your answer.

5. Write the formula of the main product that would have been formed

If but -1- ene (C4H8) has been used instead of pentane. [7 marks]

(c) Give the name and structural formula of the product which would be formed by hydration

of each of the following compounds:

- 6. CH3CH(CH3)CH = CH2;
- 7. CH2 = CHCOOH. [4 marks]
- (d) (i) Write the structure of the amino acid, CH3CH(NH2)COOH in: I. acidic medium; II. alkaline medium.

(ii) On analysis, an ammonium salt of an alkanoic acid gave 60.5% carbon and6.5%

hydrogen. If 0.309 g of the salt yielded 0.0313 g of nitrogen, determine the empirical

formula of the salt. [H = 1.00; C = 12.0; N= 14.0; O=16.0] [7 marks]

Question 7

1. (a) (i) Define standard electrode potential

- (ii) State two factors that affect the value of standard electrode potential
- (iii) Give two uses of the values of standard electrode potential
- (iv) Draw and label a diagram for an electrochemical cell made up of Cu2+/Cu; = + 0.34 Zn2+/Zn; = - 0.76
- (v) Calculate the e.m.f of the cell in 7(a)(iv) above

[12marks]

- (b) (i) In terms of electron transfer, define
 - I. oxidation;
 - II. oxidizing agent.
 - (ii) Balance the following redox reaction:

MnO4- + I-H+ I2Mn2+

[7 marks]

- (c) Classify each of the following oxides as basic, amphoteric, acidic or neutral:
 - (i) Carbon (II) oxide;
 - (ii) Sulphur(IV) oxide;
 - (iii) Aluminium oxide;
 - (iv) Lithium oxide. [4 marks]
- (d) What is hydrogen bonding? [2marks]

Question 8

- 1. (a) (i) Define each of the following terms:
 - I. biotechnology;
 - II. biogas.

(ii)	State two applications of biotechnology.	[6 marks]

- (b) (i) Describe briefly the production of ethanol from sugar cane juice
 - (ii) State the by-product of the process in 8(b)(i).
 - (iii) Mention two uses of the by-product.
 - (iv) Ethanol can be produced from both cane sugar and petroleum.
 Explain briefly why the ethanol from cane sugar is renewable but that from petroleum is non-renewable.
 [9 marks]
- (c) Distinguish between heavy chemicals and fine chemicals. Give one example of each chemical[6 marks]
- (d) Arrange the following gases in increasing order of deviation from ideal gas behaviour: HCl; O2; CI2.

[4 marks]

Chemistry Paper 1 (Practical) ,May/June 2012

Question 1

A is solution containing 6.22 g of an acid H2Y per dm3.

B contains 3.90 g of NaOH per dm3 of solution.

(a) Put A into the burette and titrate it against 20.0 cm3 or 25.0 cm3 portions of B using methyl orange as indicator. Repeat the titration to obtain consistent titres. Tabulate your burette readings and calculate the average volume of acid A used.

The equation for the reaction involved in the titration is:

$$\begin{array}{ll} H2Y(aq) + 2NaOH(aq) & Na2Y(aq) + 2H2O(l) \\ [H = 1.00; O = 16.0; Na = 23.0] & [10 \text{ marks}] \end{array}$$

(b) From your result and the information provided above, calculate the:

(i) concentration of B in moldm-3

(ii) concentration of A in moldm-3;

(iii) molar mass of H2Y.

[9 marks]

(c) State whether the pH of each of the following solutions is lower than 7, greater than 7 or equal to 7. The:

1. solution A before titration;

2. solution B before titration.

[2 marks]

C and D are two aqueous solutions. Carry out the following exercises on C and D. record your observations and identify any gas(es) evolved. State the conclusion you draw from the result of each test.

(a) (i) To about 2 cm3 portion of C, add NaOH(aq) in drops until in excess.

Warm the mixture.

(ii)To another 2 cm3 portion of C, add HCl(aq) followed by BaCl2(aq).

[9 marks]

(b) (i) To about 2 cm3 portion of D, add NH3(aq) in drops and then in excess.

1. To another 2 cm3 portion of D, add AgNO3(aq) followed by HNO3(aq).

[8 marks]

Question 3

(a) Explain briefly the observations in each of the following processes:

(i) when carbon(IV) oxide is bubbled through lime water, it turns milky but the milkiness disappears when the gas is bubbled for a long time;

(ii) a precipitate of calcium hydroxide is insoluble in excess sodium hydroxide solution whereas that of lead (II) hydroxide is soluble.

[5 marks]

(b) (i) What is a *primary standard solution*?

(ii) Calculate the mass of sodium trioxocarbonate(IV) required to prepare 250 cm3 of 0.15 moldm-3 solution.

[Na = 23.0; O = 16.0; C = 12.0]

[5 marks]

- (c) Name one gas that can be collected by:
- 1. upward displacement of air;

2. downward displacement of air.

[2 marks]