

## 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]

## Question 2

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 cm<sup>3</sup> at 27 °C and a pressure of  $1.013 \times 10^5 \text{ Nm}^{-2}$ .

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.

Substance	Melting point/°C	Boiling point/°C	Solubility in water at 25°C
A	30	117	Insoluble
B	31	160	Insoluble
C	861	1200	Soluble

1. If A and B are miscible when melted and B and C react when heated, describe how a mixture of A, B and C could be separated.  
2. 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]

### Question 3

1. (a) (i) Define nuclear fission  
(ii) A certain natural decay series starts with  ${}^{238}\text{U}$  and ends with  ${}^{206}\text{Pb}$ .  
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:  
 $\text{A}_2(\text{g}) + 3\text{B}_2(\text{g}) \rightleftharpoons 2\text{AB}_3(\text{g}); \quad \text{H} = + \text{kJmol}^{-1}$   
Explain briefly the effect of each of the following changes on the equilibrium composition:

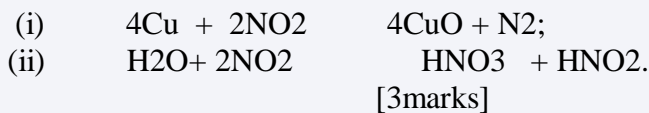
- increase in concentration of B;
  - decrease in pressure of the system;
  - addition of catalyst.
- [5marks]

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

Compound	NaF	NaBr	NaI
Lattice energy/ $\text{kJmol}^{-1}$	890	719	670

Explain briefly the trend.  
[3 marks]

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



- (e) Iron is manufactured in a blast furnace using iron ore ( $\text{Fe}_2\text{O}_3$ ), 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]

#### Question 4

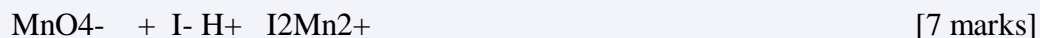
1. (a) (i) What is a structural isomer?  
(ii) Write all the structural isomeric alkanols with the molecular formula  $C_4H_{10}O$ .  
(iii) Which of the isomers from 4(a)(ii) above does not react easily on heating with acidified  $K_2Cr_2O_7$ ?
- (b) Chlorine reacted with excess pentane in the presence 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 ( $C_4H_8$ ) 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.  $CH_3CH(CH_3)CH = CH_2$ ;
  7.  $CH_2 = CHCOOH$ .
- [4 marks]
- (d) (i) Write the structure of the amino acid,  $CH_3CH(NH_2)COOH$  in:  
I. acidic medium;  
II. alkaline medium.
- (ii) On analysis, an ammonium salt of an alkanolic acid gave 60.5% carbon and 6.5% 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  
 $\text{Cu}^{2+}/\text{Cu}; = + 0.34$   
 $\text{Zn}^{2+}/\text{Zn}; = - 0.76$   
(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:



- (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:  $\text{HCl}$ ;  $\text{O}_2$ ;  $\text{Cl}_2$ .

Give reason(s) for your answer.

[4 marks]

## Chemistry Paper 1 (Practical) ,May/June 2012

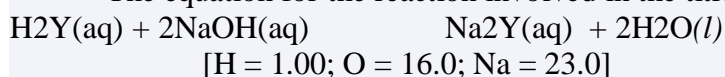
### Question 1

A is solution containing 6.22 g of an acid H<sub>2</sub>Y per dm<sup>3</sup>.

B contains 3.90 g of NaOH per dm<sup>3</sup> of solution.

(a) Put A into the burette and titrate it against 20.0 cm<sup>3</sup> or 25.0 cm<sup>3</sup> 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:



[10 marks]

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

(i) concentration of B in mol dm<sup>-3</sup>

(ii) concentration of A in mol dm<sup>-3</sup>;

(iii) molar mass of H<sub>2</sub>Y.

[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]

## Question 2

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 cm<sup>3</sup> portion of C, add NaOH(aq) in drops until in excess.

Warm the mixture.

(ii) To another 2 cm<sup>3</sup> portion of C, add HCl(aq) followed by BaCl<sub>2</sub>(aq).

[9 marks]

(b) (i) To about 2 cm<sup>3</sup> portion of D, add NH<sub>3</sub>(aq) in drops and then in excess.

1. To another 2 cm<sup>3</sup> portion of D, add AgNO<sub>3</sub>(aq) followed by HNO<sub>3</sub>(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 milky appearance 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 cm<sup>3</sup> of 0.15 mol dm<sup>-3</sup> 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 ]