EXAMINATIONS COUNCIL OF ZAMBIA
Joint Examination for the School Certificate and General Certificate of Education Ordinary Level

CHEMISTRY 5070/2
Paper 2 Theory
Thursday 16 OCTOBER 2014

Candidates answer on the question paper.
Additional materials:
Answer Booklet
Mathematical tables or calculator (non programmable)
Graph paper

TIME: 2 hours

INSTRUCTIONS TO CANDIDATES
Write your name, centre number and candidate number in the spaces at the top of this page and on any separate Answer Booklet used.
There are 12 questions in this paper.

Section A
Answer all questions.
Write your answers in the spaces provided on the question paper.

Section B
Answer any three questions.
Write your answers on the separate Answer Booklet provided.
At the end of the examination, fasten your Answer Booklets securely to the question paper.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets [ ] at the end of each question or part question.
The Periodic Table is printed on page 14.
Cell phones are not allowed in the examination room.

FOR EXAMINER'S USE
Section A
B 9
B 10
B 11
B 12
TOTAL

This question paper consists of 14 printed pages.
Section A
[50 marks]

Answer all questions in the spaces provided.

A1 (a) By describing the movement of particles, explain what is meant by diffusion.

(b) When a perfume is sprayed in one corner of a room, the smell spreads to all parts of the room after a few minutes. The perfume particles move at about 600 m/s. Why then does it take so long for the perfume particles to spread?

(c) Explain why solids and liquids are difficult to compress whereas gases can easily be compressed.
The diagram shows four sets of apparatus used in the Laboratory experiments.

Which of the letters A to E correspond to each of the following descriptions:

(a) residue
(b) sublimate
(c) Saturated solution
(d) filtrate
(e) distillate

[Total 5]
A3 You are given two diagrams representing elements X and Y. Study the diagrams and answer the questions which follow.

(a) In which group and period are elements X and Y?

X: Period _______ Group _______  
Y: Period _______ Group _______  

[2]

(b) State the valences of X and Y

X: _______ Y _______  

[2]

(c) Write the chemical formula of a compound of X and Y.

_________________________  

[1]

(d) If the atomic masses of X and Y are 40 and 37 respectively, what is the number of neutrons in each element?

X: _______ Y _______  

[2]

(e) (i) Would the compound of X and Y be ionic or covalent?

_________________________  

[1]

(ii) Explain your answer to (e) (i) above.

_________________________  

[1]

[Total 9]
A4 An iron salt was analysed and found to have the following percentage composition by mass:
20.2% Fe; 11.5% S; 23.0% O and 45.3% H₂O of crystallization.

The relative formula mass of the compound is 278.

(a) Work out the formula of the salt.

(b) 6.95g of the hydrated salt were dissolved in distilled water to make 250cm³ of solution. Calculate the concentration of the solution in mol/dm³.
The diagram shows some elements in the Periodic Table.

(a) What determines the order of the elements in the Periodic Table?

__________________________________________________________________________

(b) To which Period does magnesium belong?

__________________________________________________________________________

(c) Choose from the elements shown in the table above to answer these questions:

(i) Which element is an alkali metal?

__________________________________________________________________________

(ii) Which element has three electrons in its outer shell?

__________________________________________________________________________

(iii) Which element reacts with oxygen to form a basic oxide?

__________________________________________________________________________

(d) State one use of chlorine.

__________________________________________________________________________

[Total 6]
Zinc is used to galvanize iron and steel objects. It is a component of many alloys.

(a) (i) Explain what it means to 'galvanize'

__________________________________________________________________________ [1]

(ii) What is the reason for galvanizing iron and iron objects?

__________________________________________________________________________ [1]

(b) Name an alloy containing Zinc.

__________________________________________________________________________ [1]

(c) State two differences and one similarity between Zinc and the alloy it forms.

Difference 1: ____________________________________________________________

 Difference 2: ___________________________________________________________

Similarity: _______________________________________________________________

__________________________________________________________________________ [3]

[Total 6]
A7 A student adds ammonia solution, little by little, to dilute sulphuric acid in a beaker. The student measures the pH value of the mixture during the addition of ammonia solution.

(a) Describe how the pH value changes as the ammonia solution is added to the sulphuric acid solution.

(b) Write the ionic equation to represent the reaction between ammonia solution and dilute sulphuric acid.

(c) Ammonia solution is a weak alkali.
   (i) What is meant by the term weak alkali?

   (ii) Give an example of a strong alkali.

(d) Dilute sulphuric acid reacts with calcium carbonate to form carbon dioxide gas.
   (i) State what you would see during the reaction.

   (ii) Write the chemical equation for the reaction of dilute sulphuric acid and calcium carbonate.

[Total 6]
A8 The diagram below shows an energy level diagram for the burning of hydrogen.

\[ \text{Energy / KJ} \]

\[ \Delta H = -494 \text{KJ} \]

reaction pathway

(a) What energy change occurs when hydrogen burns?

__________________________

[1]

(b) What is the enthalpy of combustion of hydrogen?

__________________________

[1]

(c) Is the reaction which occurs in burning hydrogen exothermic or endothermic? Give a reason for your answer.

__________________________

[2]

(d) What is X and why is it important?

__________________________

[2]

(e) State the enthalpy change of reaction for the reaction represented by the chemical equation below:

\[ 2\text{H}_2\text{O(g)} \rightarrow 2\text{H}_2(g) + \text{O}_2(g) \]

__________________________

[1]

[Total 7]

[Turn over]
Section B
[45 marks]
Answer three questions from this section
Write your answers on the separate Answer Booklet provided.

B9 A copper (II) sulphate solution is electrolysed using carbon electrodes.

(a) Give the formulae of all the ions present in the solution. [4]

(b) Copper metal is plated on the cathode, and a gas is evolved at the anode.

(i) Write a half equation for the formation of copper at the cathode. [2]

(ii) Describe the identity test of the gas evolved at the anode. [2]

(c) After some time, the blue colour of the aqueous copper (II) sulphate fades and the pH of the solution decreases.

Explain briefly why these changes take place. [3]

(d) The graph below shows the relationship between the mass of copper formed and the total charge passed through the electrolyte.

(i) What mass of copper is formed when a charge of 230 coulombs is passed through the solution? [2]

(ii) What charge is needed to deposit 0.13g of copper at the cathode? [2]

[Total 15]
B10 Hydrochloric acid reacts with marble chips (calcium carbonate).

\[
\text{CaCO}_3(s) + 2\text{HCl}(aq) \rightarrow \text{CaCl}_2(aq) + \text{H}_2\text{O}(l) + \text{CO}_2(g)
\]

A 50 cm\(^3\) sample of dilute hydrochloric acid was added in excess to a small quantity of marble chips in an evaporating dish, which was placed on the pan of a balance. The mass of the dish and its contents was recorded every 30 seconds. The results are shown in the graph below:

![Graph showing mass of dish and contents over time](image)

(a) (i) Draw a smooth curve through the points on the grid.
(ii) Which result appears to be incorrect? Why have you selected this result? [2]

(b) Use the graph to answer the following questions.
(i) How long did the reaction last? [1]
(ii) What mass of carbon dioxide was produced? [1]

(c) Sketch on the grid the curve you would expect if 50 cm\(^3\) of more concentrated hydrochloric acid had been used in the Experiment. [2]

(d) What apparatus could be used, instead of an evaporating dish, to reduce any loss of acid by splashing? [1]

(e) Reversible reactions can come to a state of dynamic equilibrium.
(i) Explain the term 'dynamic equilibrium'. [2]
(ii) For the equilibrium reaction below:

\[
2\text{AB}_2(g) \rightleftharpoons 2\text{A}_2(g) + \text{B}_2(g)
\]

Explain fully the effect of adding a catalyst and increasing the pressure. [4]

[Total 15]

[Turn over]
B11 An ester is made from a carboxylic acid and an alcohol. The carboxylic acid has molecular formula $C_4H_8O_2$.

(a) (i) Name the carboxylic acid.

(ii) Draw the structural formula of the carboxylic acid.

(iii) What is the empirical formula of the carboxylic acid? \[3\]

(b) Analysis of the alcohol shows it has the following percentage composition by mass. 52.2% carbon, 13.0% hydrogen, 34.8% oxygen.

(i) Work out the empirical and molecular formulae of the alcohol (Mr = 46). \[5\]

(ii) Draw the full structural formula of the alcohol and state its name. \[2\]

(c) (i) Write a chemical equation of the reaction between the carboxylic acid in (a) (i) and alcohol in (b) (ii) using structural diagrams. \[2\]

(ii) Terylene is a polyester used to make clothing material. Draw part of the structure of terylene showing at least 3 monomer units. \[2\]

(iii) Which natural macromolecules contain the ester linkages? \[1\]

[Total 15]

B12 (a) Silicon is a typical non-metallic element in Group IV of the Periodic Table.

(i) State the number of protons, neutrons and electrons in an atom of Silicon. \[3\]

(ii) State one chemical and one physical property which shows that Silicon is a non-metal. \[2\]

(b) A sample of Silicon was prepared in the laboratory by heating Silicon dioxide (Sand) with Magnesium metal according to the equation below.

$$2\text{Mg}(s) + \text{SiO}_2(s) \rightarrow 2\text{MgO}(s) + \text{Si}(s)$$

(i) Describe briefly how pure Silicon can be obtained from the mixture of products. \[3\]

(ii) State any two important uses of Silicon. \[2\]
(c) Silicones are intermediates between organic macromolecules and inorganic macromolecules such as silicates. The silicones have structures similar to that shown below but with different hydrocarbon groups attached to the silicon atoms.

\[
\begin{array}{ccc}
\text{CH}_3 & \text{CH}_3 & \text{CH}_3 \\
\text{Si} & \text{O} & \text{Si} & \text{O} & \text{Si} & \text{O} & \cdots \\
\text{CH}_3 & \text{CH}_3 & \text{CH}_3 & \\
\end{array}
\]

(i) State any two large scale uses of Silicones. [2]
(ii) Encircle the simplest repeating unit on a copy of the structure of the Silicone. [1]
(iii) Explain why silicones have fire resistant properties. [2]

[Total 15]
The Periodic Table of the Elements

<table>
<thead>
<tr>
<th>Group</th>
<th>I</th>
<th>II</th>
</tr>
</thead>
</table>
|       |  | 7  | Li Lithium  
|       |  | 9  | Be Germanium  
|       | 11 | Na Sodium  
|       |  |  | Mg Magnesium  
|       | 12 | K Potassium  
|       |  | 13 | Ca Calcium  
|       |  | 14 | Sc Scandium  
|       |  | 15 | Ti Titanium  
|       |  | 16 | V Vanadium  
|       |  | 17 | Cr Chromium  
|       |  | 18 | Mn Manganese  
|       |  | 19 | Fe Iron  
|       |  | 20 | Co Cobalt  
|       |  | 21 | Ni Nickel  
|       |  | 22 | Cu Copper  
|       |  | 23 | Zn Zinc  
|       |  | 24 | Ga Germanium  
|       |  | 25 | Ge Germanium  
|       |  | 26 | As Arsenic  
|       |  | 27 | Se Selen  
|       |  | 28 | Br Bromine  
|       |  | 29 | Kr Krypton  
|       |  | 30 | Rb Rubidium  
|       |  | 31 | Sr Strontium  
|       |  | 32 | Y Yttrium  
|       |  | 33 | Zr Zirconium  
|       |  | 34 | Nb Niobium  
|       |  | 35 | Mo Molybdenum  
|       |  | 36 | Tc Technetium  
|       |  | 37 | Ru Ruthenium  
|       |  | 38 | Rh Rhodium  
|       |  | 39 | Pd Palladium  
|       |  | 40 | Ag Silver  
|       |  | 41 | Cd Cadmium  
|       |  | 42 | In Indium  
|       |  | 43 | Sn Tin  
|       |  | 44 | Sb Antimony  
|       |  | 45 | Te Tellurium  
|       |  | 46 | I Iodine  
|       |  | 47 | Xe Xenon  
|       |  | 48 | Cs Cesium  
|       |  | 49 | Ba Barium  
|       |  | 50 | La Lanthanum  
|       |  | 51 | Hf Hafnium  
|       |  | 52 | Ta Tantalum  
|       |  | 53 | W Wolfram  
|       |  | 54 | Re Rhenium  
|       |  | 55 | Os Osmium  
|       |  | 56 | Ir Iridium  
|       |  | 57 | Pt Platin  
|       |  | 58 | Au Gold  
|       |  | 59 | Hg Mercury  
|       |  | 60 | Tl Thallium  
|       |  | 61 | Pb Lead  
|       |  | 62 | Bi Bismuth  
|       |  | 63 | Po Polonium  
|       |  | 64 | At Astatine  
|       |  | 65 | Rn Radon  
|       |  | 66 | Fr Francium  
|       |  | 67 | Ra Radon  
|       | 68 | Actinium  

*58-71 Lanthanoid series
+90-103 Actinoid series

Key

- a = relative atomic mass
- X = atomic symbol
- b = proton (atomic) number

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.) and 22.4 dm³ at standard temperature and pressure (s.t.p).

Avogadro's Number, \( N_A = 6.0 \times 10^{23} \text{mol} \).  
1 Faraday = 96500C
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