EXAMINATIONS COUNCIL OF ZAMBIA
Examination for School Certificate Ordinary Level

Chemistry
PAPER 2 Theory
Thursday 15 OCTOBER 2015

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 paper 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 in 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.

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This question paper consists of 14 printed pages.
Section A: [50 marks]
Answer all questions in the spaces provided.

A1  The kinetic theory of matter explains the way in which solids, liquids and gases behave.

Describe the movement of particles in

(a) solids

(b) liquids

(c) gases

[Total 6]
The apparatus below was used in the extraction of ethanol from fermented maize grain.

![Diagram of distillation process]

**Figure 2.1**

(a) Name the apparatus labelled Y. .......................................................... [1]

(b) What improvement can be made to the above arrangement to get pure ethanol? .......................................................... [1]

(c) State the purpose of the cold water which passes through Y. .......................................................... [1]

(d) Name the separation technique being used above. .......................................................... [1]

(e) State an industrial application for the technique shown in the diagram above. .......................................................... [1]

[Total 5]
An element has 3 types of atoms. Two of these are shown below:

**Key**

- Proton
- Neutron
- Electron

**Figure 3.1**

(a) What is different about these two atoms?

........................................................................................................................................... [1]

(b) What term is used to describe such atoms?

........................................................................................................................................... [1]

(c) What is the difference in nucleon number between atoms A and B?

........................................................................................................................................... [1]

(d) Atom B is radioactive. Explain what this means.

........................................................................................................................................... [2]

[Total 5]
A sample of iron filings had partly rusted upon being left under damp conditions. 3.5g of the iron filings were added to 50cm$^3$ of aqueous copper (II) sulphate. All the copper in copper (II) sulphate was displaced according to the equation below:

$$\text{CuSO}_4(\text{aq}) + \text{Fe}(\text{s}) \rightarrow \text{Cu}(\text{s}) + \text{FeSO}_4(\text{aq})$$

3.2g of copper was formed.

(a) Write the ionic equation for the above equation.

....................................................................................................................................................... [1]

(b) If neither the iron nor the copper (II) sulphate was in excess, calculate

(i) the mass of iron which was present in the iron filings sample.

....................................................................................................................................................... [3]

(ii) the percentage by mass of rust in the iron filings sample.

....................................................................................................................................................... [2]

(iii) the concentration of the copper (II) sulphate solution in moles per dm$^3$

....................................................................................................................................................... [3]

[Total 9]

[Turn over]
A5 Use the Periodic Table to help you answer the following questions about the element selenium, atomic number 34.

(a) In which Period is selenium?

........................................................................................................... [1]

(b) In an atom of selenium, how many

(i) valency electrons are present?

........................................................................................................... [1]

(ii) neutrons are present?

........................................................................................................... [1]

(c) Would you expect selenium to be a metal or a non-metal? Give one reason for your answer.

........................................................................................................... ........................................................................

........................................................................................................... ........................................................................ [2]

(d) Write the formula of the compound formed between selenium and calcium.

........................................................................................................... ........................................................................

........................................................................................................... [1]

[Total 6]
A6  Study the diagrams below and answer the questions which follow.

1. Zinc sulphate solution

2. Silver nitrate solution

3. Magnesium sulphate solution

4. Silver nitrate solution

(a) In which test tube(s) do the following occur?

(i) Zinc atoms become zinc ions.

(ii) Silver ions [Ag⁺] become silver atoms.

(iii) There is no reaction.

(iv) Metal atoms are oxidised.

(b) Write a chemical equation for one reaction from any tube.

[Total 5]
A7 (a) Diesel and Petrol are used in many different ways.

(i) In which way are the two similar in their use?

............................................................................................................ [1]

............................................................................................................ [1]

(ii) What general term is used to describe such substances.

............................................................................................................ [1]

(b) A certain hydrocarbon has molecular mass of 58. 11.6g of this hydrocarbon is completely burnt.

(i) Calculate the number of moles of the hydrocarbon that were burnt.

............................................................................................................ [2]

............................................................................................................ [2]

(ii) If one mole of this hydrocarbon produced 2880KJ of heat on complete combustion, how much energy would 11.6g of the hydrocarbon produce on complete combustion?

............................................................................................................ [2]

............................................................................................................ [2]

(iii) Why is it dangerous to burn coal in a limited supply of air?

............................................................................................................ [1]

............................................................................................................ [1]

[Total 7]
When chlorine gas is bubbled through iron (II) chloride, the following reaction occurs:

\[ 2 \text{FeCl}_2(aq) + \text{Cl}_2(g) \rightarrow 2 \text{FeCl}_3(aq) \]

(a) What colour change is observed in this reaction? 

........................................................................................................................ [1]

(b) The above reaction is a redox reaction. State with a reason which substance is

(i) reduced.

........................................................................................................................ [2]

........................................................................................................................ [2]

(ii) the oxidising agent.

........................................................................................................................ [2]

........................................................................................................................ [2]

(c) Write an ionic equation for the reaction above.

........................................................................................................................ [2]

........................................................................................................................ [2]

[Total 7]
Section B (45 marks)

Answer three questions from this section.
Write your answers in the Answer Booklet provided.

B9 When an acid reacts with an alkali, a salt and water are formed.

(a) What term is used to describe a reaction between an acid and an alkali?
Write an ionic equation for this reaction. [3]

(b) Acids can be classified as 'weak' or 'strong'. Explain what is meant by the
terms 'weak' and 'strong' when referred to acids. Give one example of each
type of acid. [4]

(c) The word equation for the reaction used to form the insoluble salt barium
sulphate, is shown below.

Barium nitrate + Sodium sulphate $\rightarrow$ Barium sulphate + Sodium nitrate

(i) Write an ionic equation for this reaction.
(ii) Describe how a pure, dry sample of Barium sulphate can be obtained
from the reaction mixture.
(iii) What term is used to describe the method used to prepare the
Barium sulphate? [5]

(d) Oxides are classified as acidic, basic or amphoteric.

(i) What is an amphoteric oxide?
(ii) What products are formed when a basic oxide reacts with an acid.
(iii) Which of the oxides below is likely to be an acidic oxide?

$\text{MgO, CuO, SiO}_2, \text{Al}_2\text{O}_3, \text{Na}_2\text{O}$ [3]

[Total 15]
B10  The diagram below shows apparatus used in the silver-plating of an iron article. During the electroplating, a current of 5A was passed through the aqueous electrolyte for 8.0 minutes.

(a)  (i)  What is meant by electroplating?
(ii)  State one reason why electroplating is used.  [2]
(b)  State the names of electrode X and electrolyte Y which must be used in order for successful plating to occur.  [3]
(c)  Write equations for the reactions occurring at the electrodes.  [2]
(d)  What mass of silver is deposited on the iron article?  [3]
(e)  What change is seen at the anode during the electrolysis of electrolyte Y?  [1]
(f)  If the iron article was to be coated with copper instead of silver, state the materials needed to be used for electrode X and electrolyte Y.  [2]
(g)  State two other applications of electrolysis.  [2]

[Total 15]
Ammonia is an essential industrial product which is manufactured by the Haber process.

(a) Give **two** reasons why ammonia is an essential product. [2]

(b) Write the equations for the reaction in which ammonia is produced by the Haber Process. Include state symbols. [2]

(c) State the raw materials from which the two reactants used to make ammonia are obtained. [2]

(d) State the conditions needed to obtain a satisfactory yield of ammonia by the Haber Process. [3]

(e) Ammonia can be prepared in the laboratory by heating a mixture of calcium hydroxide and ammonium sulphate as shown in the diagram below.

![Diagram of ammonia preparation](image)

(i) Write the equation for the reaction of calcium hydroxide with ammonium sulphate. [2]

(ii) Describe a chemical test for ammonia gas. [2]

(iii) Explain why concentrated sulphuric acid is not suitable for drying the ammonia gas. [2]

[Total 15]
The table shows the first four members of a particular homologous series.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Molecular formula</th>
<th>Relative molecular mass</th>
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<td>Ethanol</td>
<td>C₂H₅OH</td>
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<tr>
<td>Propanol</td>
<td>C₃H₇OH</td>
<td>60</td>
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<tr>
<td>Butanol</td>
<td>C₄H₉OH</td>
<td>?</td>
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</table>

(a) (i) Name the homologous series to which these compounds belong. [1]

(ii) Deduce the general formula of this homologous series.

(iii) State the relative molecular mass of butanol.

(b) Ethanol can be manufactured from either ethene or glucose.

(i) Construct an equation for the production of ethanol from ethene using structural formulae. [2]

(ii) State the conditions necessary for the reaction in b(i) above.

(iii) The fermentation of glucose can be represented by the following equation.

\[
\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}_2
\]

Calculate the maximum mass of ethanol that can be made from 72 tonnes of glucose. [3]

(c) State a use of ethanol, other than in alcoholic drinks. [1]

(d) Ethanol can be oxidized to form ethanoic acid.

(i) Draw the structure of ethanoic acid, showing all the bonds. [1]

(ii) Name the organic compound formed when ethanol reacts with ethanoic acid.

(iii) Draw the structure of the compound you have named in d(ii) above.

(iv) State one condition necessary for the reaction of ethanol with ethanoic acid. [1]

[Total 15]
**DATA SHEET**

The Periodic Table of the Elements

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*a = relative atomic mass
b = proton (atomic) number

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