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

SCIENCE

PAPER 3 (CHEMISTRY)

Friday 6 NOVEMBER 2009 1 hour 15 minutes

Time: 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number at the top of this page and all separate answer paper used.

There are 12 questions in this question paper.

Section A

Answer all the questions.

Write your answers in the spaces provided on the question paper.

Section B

Answer any two questions.

Write your answers on the separate answer paper provided.

1. Fasten the separate answer paper securely to the question paper.

2. Enter the numbers of the Section B questions you have answered in the grid.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

A copy of the Periodic Table is on page 10.

This question paper consists of 11 printed pages.
Cell phones are not allowed in the Examination room.

Section A

[45 MARKS]

Answer all the questions in this section.

Write your answers in the spaces provided.

1 Study the diagram below and answer questions that follow.

![Diagram with nodes labeled C, B, A, and arrows labeled f, d, e]

NB: d, e, f are processes.

(a) Name the processes d, e and f,

   d  
   e  
   f  

   [1]  
   [1]  
   [1]  

(b) Describe what you would do to convert substance A to B.

   
   [1]  

(c) State one of the basic units of matter.

   
   [1]  

Total [5]
Part of the process for the extraction of Uranium uses the reaction of Uranium Tetrafluoride (UF₄) with magnesium.

\[ UF_4 + 2Mg \rightarrow 2MgF_2 + U \]

(a) State whether Uranium is more or less reactive than Magnesium, explain your answer.

______________________________________________________________________________________________________

[1]

(b) (i) Calculate the relative molecular mass of Uranium Tetrachloride (UF₄)

______________________________________________________________________________________________________

[1]

(ii) How many tonnes of Uranium can be produced in the above reaction using 24 tonnes of magnesium?

______________________________________________________________________________________________________

______________________________________________________________________________________________________

[2]

(c) Natural Uranium has several Isotopes. Define the term Isotopes.

______________________________________________________________________________________________________

______________________________________________________________________________________________________

[1]

Total [5]
3. (a) Work out the relative formula mass, M_r, of the following:
(i) Ca(HCO_3)_2 ____________________________ [1]
(ii) Al_2(SO_4)_3 ____________________________ [1]

(b) When water containing dissolved calcium hydrogen carbonate is boiled, the calcium hydrogen carbonate decomposes according to the equation below:
Ca(HCO_3)_2(aq) → CaCO_3(s) + H_2O (l) + CO_2(g)

(i) Name the white solid formed in this reaction.
_________________________________________ [1]

(ii) If the water boiled contained 16.2g of Calcium hydrogen carbonate, Calculate the mass of CaCO_3 formed
_________________________________________ [2]

Total [5]

4. The diagrams below show the electron arrangement in the outer shell of five elements A to E. All elements are from Period 3 of the Periodic Table.

(a) Put the letters A to E in the table to show which elements are metals and which are non-metals.

<table>
<thead>
<tr>
<th>Metals</th>
<th>Non-Metals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[2]

(b) Which element is most likely to be in Group VI of the Periodic Table?
_________________________________________ [1]

(c) Which element will form an ion of the type X^{2+}?
_________________________________________ [1]

(d) Which element has an atomic number of 15?
_________________________________________ [1]

Total [5]
5. The diagrams below show sections of the polymer chain of two condensation polymers.

nylon

\[
\begin{array}{c}
\text{H} \\
\text{N-C-} \\
\text{O}
\end{array}
\begin{array}{c}
\text{=O} \\
\text{C-} \\
\text{N}
\end{array}
\begin{array}{c}
\text{H} \\
\text{N-C-} \\
\text{O}
\end{array}
\begin{array}{c}
\text{-} \\
\text{=O} \\
\text{C-} \\
\text{N}
\end{array}
\text{...}
\]

Terylene

\[
\begin{array}{c}
\text{O} \\
\text{-O-C-} \\
\text{=O}
\end{array}
\begin{array}{c}
\text{-O-C-} \\
\text{-O-C-} \\
\text{-O-C-}
\end{array}
\text{...}
\]

(a) (i) Draw a circle around an amide linkage in the diagram. Label this amide linkage. [1]

(ii) Draw a circle around an ester linkage in the diagram. Label this ester linkage. [1]

(b) Name a type of naturally occurring polymer that has a similar linkage to nylon. [1]

(c) Why are nylon and terylene known as condensation polymers? [1]

(d) Fishing nets used to be made of natural fibres but many nets are now made from nylon. Suggest one advantage other than strength and one disadvantage of using nylon in place of natural fibres to make fishing nets.

Advantage

Disadvantage

Total [6]

6. Nitrogen and oxygen are the two main gases present in the air. Both gases are obtained from air.

(a) By what process are the two gases obtained from the air? [1]

(b) Nitrogen is used in the manufacture of ammonia by the Haber Process. State any 2 important conditions for the reaction in which ammonia is formed by the Haber Process.


[2]

(c) State one important use of ammonia [1]

Total [4]

[Turn over
7 Barium sulphate is an insoluble. Describe briefly how a pure, dry sample of barium sulphate can be prepared using sodium sulphate as one of the reagents.

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

[5]
Total [5]

8 The reaction below takes place during the production of calcium oxide when calcium carbonate is thermally decomposed.

\[ \text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g}) \]

(a) Give a common name for:
   (i) Calcium carbonate.
       ____________________________________________________________________________________
       [1]
   (ii) Calcium oxide.
        __________________________________________________________________________________
        [1]
   (iii) Calcium hydroxide.
        __________________________________________________________________________________
        [1]

(b) What is the Chemical Formula of Calcium hydroxide.
    ____________________________________________________________________________________
    [1]
Total [4]
The following experiment was set up to investigate the effect of damp air on iron filings. The graduated cylinder contained 50cm³ of air at the start.

![Diagram of apparatus at the start and after 1 week]

1] (a) State two changes which would be observed after 1 week.

__________________________________________________________

__________________________________________________________ [2]

(b) What volume of air was in the graduated cylinder after 1 week?

__________________________________________________________ [1]

(c) Calculate the % of air used up in the experiment.

__________________________________________________________

__________________________________________________________ [2]

Total [5]
Section B
[20 MARKS]
Answer any two questions in this section.

Write your answers on the separate answer paper provided.

10 A student set up an experiment to produce ethanol from glucose, she dissolved glucose in warm water, added yeast and left the mixture in a warm place for about 7 days in the apparatus shown below.

![Apparatus diagram]

(a) Write a word equation for the formation of ethanol from glucose. [1]

(b) What is the scientific name for this reaction. [1]

(c) Suggest a suitable temperature at which the process occurs. [1]

(d) The airlock prevents air from going into the flask but allows carbon dioxide gas to go out.
   (i) Why must air not be allowed into the flask?
   (ii) Describe the change which will be seen in the airlock. [3]

(e) Ethanol can be oxidised to ethanoic acid by boiling ethanol with acidified potassium dichromate (VI). Give two reasons why the conversion of ethanol to ethanoic acid is an oxidation process. [2]

(f) When concentrated sulphuric acid is added to ethanol, the following reaction occurs.

\[
\text{H}_2\text{C}-\text{C}=\text{O}-\text{H} \rightarrow \text{C}=\text{C}+\text{H}_2\text{O}
\]

   ethanol   ethene

   (i) What type of reaction is this?
   (ii) What test can be done to show that ethene is formed? [2]

Total [10]
11 (a) When magnesium is heated in a stream of steam, it reacts vigorously forming a white solid and hydrogen gas.

(a) Complete the diagram to show how hydrogen gas can be collected. [2]

(b) Write a balanced chemical equation for the reaction of magnesium with steam. [3]

(c) Choose two other metals from the reactivity series of metals which will also react with steam and one metal which will not react with steam. [3]

(d) Suggest a method which can be used to extract magnesium from its ores. [1]

(e) When a piece of magnesium is added to copper(II) sulphate solution, copper metal is formed according to the word equation below:

Magnesium + Copper (II) sulphate → magnesium sulphate + copper.

(i) Write a balanced chemical equation for the reaction. [1]

(ii) What type of a reaction is this? [1]

Total [10]
12  (a) The increase in industrial activity in Zambian cities has results in high levels of atmosphere (air) pollution. Carbon monoxide is one of the pollutants of the air.

(i) How is carbon monoxide produced? [1]
(ii) Explain why carbon monoxide is a dangerous gas. [1]
(iii) Name the pollutant gas which is mainly responsible for producing acid rain. [2]

(b) (i) State the two main stages in the purification of domestic water supply.
(ii) Give two industrial uses of water. [2]

(c) When steam is passed over very hot carbon, a mixture of carbon monoxide and hydrogen gas is formed.

\[ \text{H}_2\text{O (g)} + \text{C (s)} \rightarrow \text{H}_2\text{(g)} + \text{CO (g)}. \]

State which substance is

(i) reduced. [2]
(ii) oxidised.

Total [10]
The periodic table of the elements

<table>
<thead>
<tr>
<th>Group</th>
<th>Period</th>
<th>Element</th>
<th>Atomic Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1</td>
<td>H</td>
<td>1</td>
</tr>
<tr>
<td>II</td>
<td>2</td>
<td>He</td>
<td>2</td>
</tr>
<tr>
<td>III</td>
<td>3</td>
<td>Li</td>
<td>3</td>
</tr>
<tr>
<td>IV</td>
<td>4</td>
<td>Be</td>
<td>4</td>
</tr>
<tr>
<td>V</td>
<td>5</td>
<td>B</td>
<td>5</td>
</tr>
<tr>
<td>VI</td>
<td>6</td>
<td>C</td>
<td>6</td>
</tr>
<tr>
<td>VII</td>
<td>7</td>
<td>N</td>
<td>7</td>
</tr>
<tr>
<td>VIII</td>
<td>8</td>
<td>O</td>
<td>8</td>
</tr>
<tr>
<td>IX</td>
<td>9</td>
<td>F</td>
<td>9</td>
</tr>
<tr>
<td>X</td>
<td>10</td>
<td>Ne</td>
<td>10</td>
</tr>
<tr>
<td>XI</td>
<td>11</td>
<td>Na</td>
<td>11</td>
</tr>
<tr>
<td>XII</td>
<td>12</td>
<td>Mg</td>
<td>12</td>
</tr>
</tbody>
</table>

Key:
- a = atomic number
- q = q (atomic number)

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (RT²P).
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