Chemistry
Unit C3: Chemistry in Action
Foundation Tier

Wednesday 22 June 2016 – Morning
Time: 1 hour

You must have:
Calculator, ruler

Information
The total mark for this paper is 60.
The marks for each question are shown in brackets
– use this as a guide as to how much time to spend on each question.
Questions labelled with an asterisk (*) are ones where the quality of your
written communication will be assessed
– you should take particular care with your spelling, punctuation and grammar, as
well as the clarity of expression, on these questions.

Advice
– Read each question carefully before you start to answer it.
– Try to answer every question.
– Check your answers if you have time at the end.
The Periodic Table of the Elements

<table>
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<tr>
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<th>3</th>
<th>4</th>
<th>5</th>
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<th>7</th>
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<tbody>
<tr>
<td>H</td>
<td>He</td>
<td>Li</td>
<td>Be</td>
<td>B</td>
<td>C</td>
<td>N</td>
<td>O</td>
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<td>D</td>
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<td>I</td>
<td>J</td>
<td>K</td>
<td>L</td>
<td>M</td>
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</tbody>
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Key
- **relative atomic mass**
- **atomic symbol**
- **atomic (proton) number**

Elements with atomic numbers 112-116 have been reported but not fully authenticated.

* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.
Answer ALL questions

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Water

1. Water from reservoirs is treated and tested before it is supplied to our homes.
   (a) Give a reason why water is tested before it is supplied to our homes. (1)
   ..................................................................................................................................
   ..................................................................................................................................
   ..................................................................................................................................
   ..................................................................................................................................
   ..................................................................................................................................

   (b) Water taken from reservoirs can be hard or soft.
       You are given samples of hard water and soft water.
       (i) Explain how you could show which sample was hard water and which sample was soft water.

       Use the words from the box in your answer.
       lather     scum     soap (3)
       ..................................................................................................................................
       ..................................................................................................................................
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(ii) Which of these ions causes hardness in water?

Put a cross (X) in the box next to your answer.

- [ ] A potassium ions
- [ ] B magnesium ions
- [ ] C chloride ions
- [ ] D hydroxide ions

(iii) Hardness in water can be either temporary or permanent.

Describe a test to show whether the hardness in a sample of water is temporary or permanent.

.......................................................................................................................... ...
.......................................................................................................................... ...
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(c) Complete the sentence by putting a cross (X) in the box next to your answer.

1000 cm$^3$ of a solution contained 1.0 g of dissolved solid.
The concentration of the solid in g dm$^{-3}$ is

- [ ] A 0.1
- [ ] B 1.0
- [ ] C 2.0
- [ ] D 10.0

(Total for Question 1 = 8 marks)
Solutions and tests for ions

2 (a) (i) Describe how you would make a solution of sodium chloride from sodium chloride crystals and distilled water.

(ii) A test for chloride ions is carried out on the sodium chloride solution. P, Q, R and S are involved in tests for ions.

- P: add silver nitrate solution to the solution
  - a white precipitate forms
- R: add sodium hydroxide solution to the solution
- S: add dilute nitric acid to the solution

Only three of these form part of the test for chloride ions. Identify the three and place them in the order they occur in the test.

1 ............................
2 ............................
3 ............................
(b) The test for ammonium ions is

- add sodium hydroxide solution to a solution of the salt
- warm the mixture
- test the ammonia gas given off with damp red litmus paper.

(i) Choose the formula of sodium hydroxide.

Put a cross (X) in the box next to your answer.

- [ ] A KOH
- [ ] B NaO
- [ ] C NaOH
- [ ] D SOH

(ii) Complete the sentence by putting a cross (X) in the box next to your answer.

When the ammonia gas is tested with damp red litmus paper, the litmus paper turns blue.

This shows that the ammonia gas is

- [ ] A acidic
- [ ] B alkaline
- [ ] C neutral
- [ ] D an indicator

(c) Two tests are carried out on a solid.

- In a flame test, a yellow flame is seen.
- When some dilute hydrochloric acid is added to the solid, a gas is evolved.
  The gas turns limewater milky.

Give the name of the solid.

(Total for Question 2 = 8 marks)
Electrolysis and metal ions

3 (a) Some metals are extracted by the electrolysis of a molten compound.

(i) Complete the sentences about the electrolysis of a molten compound using words from the box.

| decomposed | electricity | electrons | ions | molecules | purified |

Each word may be used once, more than once or not at all.

(2)

The compound has to be molten so that the ____________________________ can move.

When a molten compound is electrolysed its elements are formed. During electrolysis the compound is ____________________________.

(ii) Which of the following statements about electrolysis is correct?

Put a cross (X) in the box next to your answer.

☐ A an anion is positively charged
☐ B an anode is negatively charged
☐ C a cation is positively charged
☐ D a cathode is positively charged
(b) (i) When molten zinc chloride is electrolysed, a solid forms at one electrode and a pale green gas forms at the other electrode.

Use this information to complete the word equation for the reaction that takes place when molten zinc chloride is electrolysed.

\[
\text{zinc chloride} \rightarrow \text{...................................................} + \text{...................................................}
\]

(ii) In this electrolysis, chloride ions lose electrons to form the pale green gas.

State the type of reaction that occurs when electrons are lost.

(c) Copper chloride dissolves in water.

Describe what you see when sodium hydroxide solution is added to a solution containing copper ions, \( \text{Cu}^{2+} \).

(d) Sodium is manufactured by the electrolysis of molten sodium chloride.

Explain a large-scale use of sodium.

(Total for Question 3 = 10 marks)
Nitrogen, hydrogen and ammonia

4 (a) In industry, ammonia gas, NH\textsubscript{3}, is manufactured from nitrogen gas, N\textsubscript{2}, and hydrogen gas, H\textsubscript{2}.

(i) Give the name of the industrial process used to manufacture ammonia. (1)

(ii) State the main source of the nitrogen and of the hydrogen used in this process. (2)

source of nitrogen

source of hydrogen

(iii) Write the balanced equation for the reaction between nitrogen and hydrogen to produce ammonia. (2)

(iv) State why the following hazard symbol is seen on a bottle of concentrated ammonia solution. (1)
(b) The formula of a molecule of ammonia is \( \text{NH}_3 \).

Use the formula to describe the atoms combined in one molecule of ammonia.

(2)

(c) Explain why ammonium compounds are important in agriculture.

(2)

(Total for Question 4 = 10 marks)
Ethanoic acid

5 (a) A few drops of phenolphthalein indicator are added to dilute ethanoic acid.

Choose the colour of this mixture.

Put a cross (\(\square\)) in the box next to your answer.

☐ A colourless
☐ B orange
☐ C pink
☐ D yellow

(b) Sodium ethanoate can be made by reacting ethanoic acid solution with a solution of the alkali sodium hydroxide.
Water is also formed.

(i) Give the name of the type of reaction that occurs when ethanoic acid reacts with sodium hydroxide.

(ii) Write the word equation for this reaction.

(c) Ethanoic acid is present in vinegar.

(i) State why vinegar is sprinkled on some foods.

(ii) State why other foods are stored in vinegar.
Magnesium ethanoate is a salt which is soluble in water. It can be made by reacting magnesium carbonate powder with dilute ethanoic acid. Magnesium carbonate is insoluble in water.

The equation for the reaction is

\[
\text{ethanoic acid (aq)} + \text{magnesium carbonate (s)} \rightarrow \text{magnesium ethanoate (aq)} + \text{carbon dioxide (g)} + \text{water (l)}
\]

You are given some dilute ethanoic acid and magnesium carbonate powder.

Describe how you would prepare a pure solution of magnesium ethanoate and how you would obtain pure, dry magnesium ethanoate crystals from that solution.
**Organic compounds**

6 (a) The formula of a molecule of ethanol is C₂H₅OH.

(i) State how you know, from its formula, that ethanol is **not** a hydrocarbon.

(ii) A dilute solution of ethanol can be produced by the fermentation of a carbohydrate.

Starting from sugar (a carbohydrate), describe how a dilute solution of ethanol can be produced.

(iii) Complete the sentence by putting a cross (X) in the box next to your answer.

When ethanol reacts with ethanoic acid, ethyl ethanoate is formed.

Ethyl ethanoate is

- [ ] A an alkali
- [ ] B an acid
- [X] C an ester
- [ ] D an enzyme

(iv) When one molecule of ethanol reacts with one molecule of ethanoic acid, one molecule of ethyl ethanoate and one molecule of another substance are formed.

Complete the equation.

\[ \text{C}_2\text{H}_6\text{O} + \text{C}_2\text{H}_4\text{O}_2 \rightarrow \text{C}_4\text{H}_8\text{O}_2 + \underline{\text{ }} \]

ethanol  ethanoic acid  ethyl ethanoate
* (b) The alkanes and the alkenes are two examples of homologous series.

Name and draw the structures of some alkanes and of some alkenes and use them to show how members of a homologous series are similar in their general formula, names and structures of their molecules.