Please write clearly in block capitals.

Centre number __________  Candidate number __________

Surname ____________________________________________

Forename(s) __________________________________________

Candidate signature ____________________________________

GCSE CHEMISTRY
Foundation Tier  Unit Chemistry C3

Wednesday 14 June 2017  Morning  Time allowed: 1 hour

Materials
For this paper you must have:
• a ruler
• the Chemistry Data Sheet (enclosed).
You may use a calculator.

Instructions
• Use black ink or black ball-point pen.
• Fill in the boxes at the top of this page.
• Answer all questions.
• You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
• Do all rough work in this book. Cross through any work you do not want to be marked.

Information
• The marks for questions are shown in brackets.
• The maximum mark for this paper is 60.
• You are expected to use a calculator where appropriate.
• You are reminded of the need for good English and clear presentation in your answers.
• Question 6(c)(i) should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

Advice
• In all calculations, show clearly how you work out your answer.

For Examiner’s Use

Examiner’s Initials

<table>
<thead>
<tr>
<th>Question</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

TOTAL

CH3FP
1 This question is about elements and compounds.

1 (a) (i) Use the correct answer from the box to complete the sentence. [1 mark]

<table>
<thead>
<tr>
<th>densities</th>
<th>numbers</th>
<th>weights</th>
</tr>
</thead>
</table>

The elements in the modern periodic table are arranged in order of their atomic ________________.

1 (a) (ii) Use the correct answer from the box to complete the sentence. [1 mark]

<table>
<thead>
<tr>
<th>electrons</th>
<th>neutrons</th>
<th>protons</th>
</tr>
</thead>
</table>

The outer shells of atoms of elements in the same group have the same number of ________________.

1 (b) Figure 1 shows the position of five elements in the modern periodic table.

**Figure 1**

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cu</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Br</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 (b) (i) Which one of the elements in **Figure 1** is a gas at room temperature? [1 mark]

_______________________________
1 (b) (ii) Which one of the elements in Figure 1 is a transition metal?

____________________________________

[1 mark]

1 (b) (iii) Complete the sentence.

In the modern periodic table, bromine (Br) is in Group _______.

[1 mark]

1 (c) Bromine reacts with sodium iodide to produce iodine.

The word equation for the reaction is:

\[ \text{bromine} + \text{sodium iodide} \rightarrow \text{iodine} + \text{sodium bromide} \]

1 (c) (i) What type of reaction is this?

Tick (✓) one box.

- Combustion
- Displacement
- Neutralisation

[1 mark]

1 (c) (ii) Use the Chemistry Data Sheet to help you answer this question.

Which halogen would react with sodium chloride solution to produce chlorine?

Tick (✓) one box.

- Bromine
- Fluorine
- Iodine

[1 mark]
1 (d) Silver nitrate in the presence of dilute nitric acid is used to test for iodide ions.

What colour precipitate is produced? [1 mark]

Tick (✓) one box.

Cream
White
Yellow
1 (e) Propanoic acid is a compound containing carbon atoms.

1 (e) (i) **Figure 2** shows the displayed structure of propanoic acid. 

**Draw** a ring around the functional group of propanoic acid in **Figure 2**. [1 mark]

**Figure 2**

![Propanoic Acid Structure](attachment:image.png)

1 (e) (ii) Use the correct answer from the box to complete the sentence. [1 mark]

<table>
<thead>
<tr>
<th>carbon dioxide</th>
<th>hydrogen</th>
<th>oxygen</th>
</tr>
</thead>
</table>

Propanoic acid reacts with carbonates to produce ________________________.

1 (e) (iii) Use the correct answer from the box to complete the sentence. [1 mark]

<table>
<thead>
<tr>
<th>alkanes</th>
<th>esters</th>
<th>fuels</th>
</tr>
</thead>
</table>

Propanoic acid reacts with alcohols to produce pleasant smelling compounds called ________________________.
This question is about drinking water.

Water in reservoirs is filtered and sterilised to make it suitable for drinking.

Draw one line from each treatment to the reason for the treatment.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter</td>
<td>To kill microbes</td>
</tr>
<tr>
<td>Sterilise</td>
<td>To remove solids</td>
</tr>
<tr>
<td></td>
<td>To soften the water</td>
</tr>
<tr>
<td></td>
<td>To add dissolved salts</td>
</tr>
</tbody>
</table>

Which substance is used to sterilise the water?

Tick (✓) one box.

- Ammonia
- Chlorine
- Limewater
- Sodium carbonate
2 (b) Pure water can be produced by distillation.

Why is distillation expensive? [1 mark]

_____________________________________________________________________________________
_____________________________________________________________________________________

2 (c) Some water companies add fluoride to drinking water.

2 (c) (i) Give one benefit of adding fluoride to drinking water. [1 mark]

_____________________________________________________________________________________
_____________________________________________________________________________________

2 (c) (ii) There is a lot of evidence to support the benefit of adding fluoride to drinking water.

Suggest why some people disagree with adding fluoride to drinking water. [1 mark]

_____________________________________________________________________________________
_____________________________________________________________________________________

Turn over for the next question
This question is about the Haber process.

Figure 3 shows a flow diagram of the Haber process.

**Figure 3**

\[
\text{Nitrogen} \quad \text{Hydrogen} \\
\text{Reactor} \\
\text{Separator} \\
\text{Liquid ammonia} \quad \text{Unreacted nitrogen and hydrogen gas}
\]

3 (a) (i) Use the correct answer from the box to complete the sentence. [1 mark]

| air    | crude oil | natural gas | water |

Nitrogen for the Haber process is obtained from __________________________ .
3 (a) (ii) Iron is used as a catalyst in the reactor.

How does a catalyst speed up a reaction? [1 mark]
Tick (✓) one box.

Changes the pressure in the reactor

Lowers the activation energy

Makes the particles move faster

3 (a) (iii) Describe how the ammonia is separated from the other gases. [2 marks]

_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

3 (b) Complete the word equation for the reaction in the Haber process. [1 mark]

\[
\text{nitrogen} + \text{ } \rightarrow \text{ } \text{ } \Rightarrow \text{ }
\]

Question 3 continues on the next page
3 (c) Figure 4 shows how, in the Haber process, the rate of reaction changes as the temperature and pressure increase.

Table 1 shows the relative rate of reaction at 80 atmospheres at different temperatures.

<table>
<thead>
<tr>
<th>Temperature in °C</th>
<th>Relative rate of reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>0.0</td>
</tr>
<tr>
<td>150</td>
<td>0.5</td>
</tr>
<tr>
<td>200</td>
<td>1.0</td>
</tr>
<tr>
<td>250</td>
<td>1.7</td>
</tr>
<tr>
<td>300</td>
<td>2.0</td>
</tr>
</tbody>
</table>
3 (c) (i) Plot the data in Table 1 on the graph in Figure 4. [2 marks]

3 (c) (ii) Draw a straight line of best fit for the points you have plotted. [1 mark]

3 (c) (iii) What is the relative rate of reaction at 20 atmospheres and 300 °C?
Show your working on Figure 4. [2 marks]

Relative rate of reaction = ________________

3 (c) (iv) Describe how the rate of reaction changes as the pressure increases. [1 mark]

_____________________________________________________________________________________
_____________________________________________________________________________________

Turn over for the next question
There are no questions printed on this page
4 This question is about potassium and its compounds.

4 (a) Potassium reacts with water.

Figure 5 shows potassium being added to water.

**Figure 5**

The word equation for the reaction is:

\[
\text{potassium} + \text{water} \rightarrow \text{potassium hydroxide} + \text{hydrogen}
\]

Give two observations that can be seen when potassium is added to water. [2 marks]

_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
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Question 4 continues on the next page
Potassium hydroxide solution is used in titrations.

A student used the apparatus in Figure 6 to do a titration to find the concentration of some nitric acid.

**Figure 6**

Potassium hydroxide solution

A

Conical flask

Nitric acid

4 (b) (i) Name the piece of apparatus labelled A.

_______________________________________

[1 mark]

4 (b) (ii) What should the student add to the nitric acid before starting the titration?

_______________________________________

[1 mark]
4 (b) (iii) Describe how the student could use the apparatus in Figure 6 to complete the titration.

[3 marks]

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_____________________________________________________________________________________
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4 (b) (iv) The student did the titration four times.

Give one variable the student should keep the same for each titration.

[1 mark]

_____________________________________________________________________________________

Question 4 continues on the next page
4 (c) Table 2 shows the student’s results.

Table 2

<table>
<thead>
<tr>
<th>Volume of potassium hydroxide solution used in cm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Titration 1</td>
</tr>
<tr>
<td>Titration 2</td>
</tr>
<tr>
<td>Titration 3</td>
</tr>
<tr>
<td>Titration 4</td>
</tr>
<tr>
<td>Mean value</td>
</tr>
</tbody>
</table>

4 (c) (i) Calculate the mean volume of potassium hydroxide solution used.

Do not use any anomalous results in your calculation.

[2 marks]

_____________________________________________________________________________________
_____________________________________________________________________________________  
_____________________________________________________________________________________  
_____________________________________________________________________________________  
_____________________________________________________________________________________  

Mean volume of potassium hydroxide solution used = ____________________ cm³
4 (c) (ii) A second student repeated the experiment and recorded the results in Table 3.

**Table 3**

<table>
<thead>
<tr>
<th>Volume of potassium hydroxide solution used in cm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Titration 1</td>
</tr>
<tr>
<td>Titration 2</td>
</tr>
</tbody>
</table>

Look at Table 2 and Table 3.

Suggest two improvements the second student could make to obtain results that are more accurate.

[2 marks]

_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

Turn over for the next question
This question is about water.

Rainwater is soft water.

How is hard water formed from rainwater?

[2 marks]

A sample of hard water contains magnesium sulfate.

Figure 7 shows the solubility of magnesium sulfate at different temperatures.

![Figure 7](image)

What conclusions can be made from Figure 7?

Use patterns and values from the graph in your answer.

[3 marks]
5 (c) Give one advantage and one disadvantage of hard water. [2 marks]

Advantage

Disadvantage

5 (d) Describe and explain how hard water is softened using an ion exchange column. [3 marks]

_____________________________________________________________________________________

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_____________________________________________________________________________________

Turn over for the next question
There are no questions printed on this page
This question is about the combustion of alcohols.

6 (a) What is the structure of methanol? [1 mark]

Tick (√) one box.

CH_3OH

CH_3CH_2OH

CH_3CH_2CH_2OH

CH_3CH_2CH_2CH_2OH

6 (b) Figure 8 shows four energy level diagrams for the combustion of an alcohol. Which diagram, A, B, C, or D, shows an arrow for the overall energy change? [1 mark]

Tick (√) one box.

Figure 8

A

B

C

D

Question 6 continues on the next page
6 (c) **Figure 9** shows apparatus used to measure the energy released when an alcohol is burned.

![Figure 9](image)

6 (c) (i) In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Describe how a student could use the apparatus in **Figure 9** to compare the energy released when methanol and ethanol are burned.

You should include any measurements the student would need to make.

Do **not** describe how to do any calculations.

Do **not** describe any improvements to the apparatus.

[6 marks]
6 (c) (ii) The student calculated the energy released by the alcohols.

The calculated values were less than the values in a data book.

Explain how the apparatus in **Figure 9** could be improved to obtain more accurate results.

[2 marks]