AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
Chemistry

F

Foundation Tier Unit Chemistry C3

Wednesday 15 June 2016 Afternoon 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 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.

Do not write outside the box

Answer **all** questions in the spaces provided.

1 This question is about elements and the periodic table.

1 (a) Use the correct answers from the box to complete the sentences.

[3 marks]

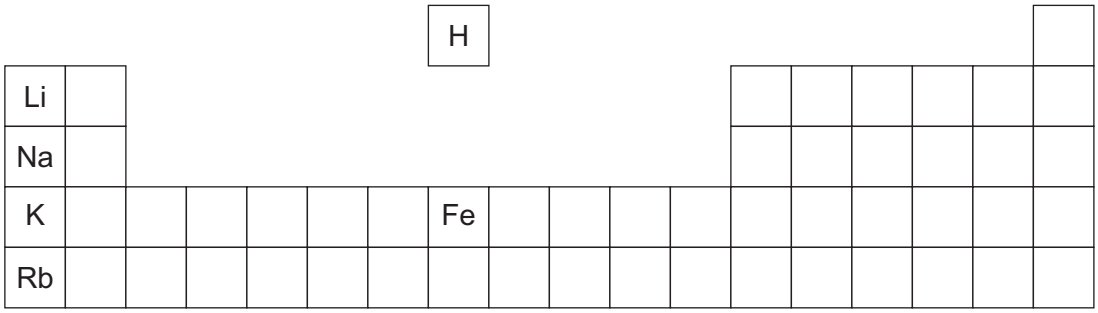
atoms	**atomic weights**	**electrons**	**proton numbers**

Newlands' and Mendeleev's periodic tables show the elements in order of their _____ .

Following the discovery of protons and _____, the modern periodic table shows the elements in order of their _____ .

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

Figure 1



1 (b) (i) Which **one** of these six elements has the lowest boiling point?

[1 mark]

_____

1 (b) (ii) Complete the sentence.

[1 mark]

In the periodic table, rubidium (Rb) is in Group _____ .

Do not write outside the box

1 (b) (iii) Which of these three elements is the most reactive?

[1 mark]

Tick (✓) **one** box.

Lithium (Li) ☐

Sodium (Na) ☐

Potassium (K) ☐

1 (b) (iv) Which **two** statements are correct?

[2 marks]

Tick (✓) **two** boxes.

Iron has a higher density than potassium. ☐

Iron is softer than potassium. ☐

Iron reacts vigorously with water. ☐

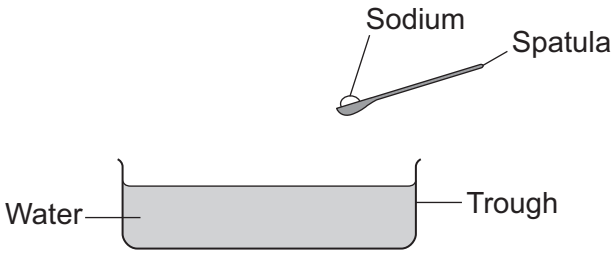
Iron forms ions that have different charges. ☐

Question 1 continues on the next page

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1 (c) **Figure 2** shows sodium being put into water.

Figure 2



Describe **three** observations that can be seen when sodium is put into water.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

11

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2 This question is about water.

2 (a) Hard water contains dissolved compounds.

2 (a) (i) Which ion causes water to be hard?

[1 mark]

Tick (✓) **one** box.

Ca^{2+} ☐

H^{+} ☐

Na^{+} ☐

2 (a) (ii) The table has three statements about hard water.

Tick (✓) **one** advantage and tick (✓) **one** disadvantage of using hard water.

[2 marks]

	Advantage Tick (✓)	**Disadvantage Tick (✓)**
Hard water is good for the development of bones.		
Hard water can be distilled to make pure water.		
Hard water needs more soap to form lather.		

2 (b) The two types of hard water are permanent hard water and temporary hard water.

2 (b) (i) What forms when permanent hard water reacts with soap?

[1 mark]

Tick (✓) **one** box.

drinking water ☐

scale ☐

scum ☐

Do not write outside the box

2 (b) (ii) What forms when temporary hard water is boiled?

[1 mark]

Tick (✓) **one** box.

distilled water ☐

pure water ☐

soft water ☐

2 (c) Water filters used in the home remove some dissolved compounds and improve the quality of the tap water.

Draw **one** line from each substance in the water filter to the improvement it makes to tap water.

[3 marks]

Substance in the water filter	**Improvement to tap water**
	improves taste
carbon	adds fluoride
ion-exchange resin	reduces microbes
silver	replaces water molecules
	removes hardness

8

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3 This question is about energy changes in chemical reactions.

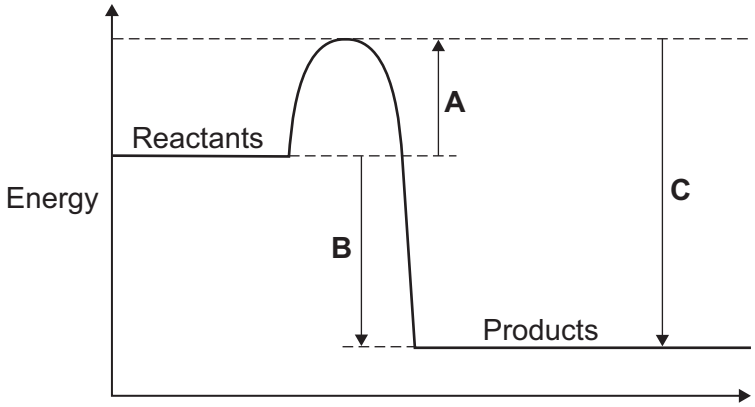
3 (a) Complete the word equation for the combustion of hydrogen.

[1 mark]

hydrogen + oxygen ⟶ _____

3 (b) **Figure 3** shows a simple energy level diagram.

Figure 3



3 (b) (i) Which arrow, **A**, **B** or **C**, shows the activation energy?

[1 mark]

Tick (✓) **one** box.

A ☐

B ☐

C ☐

3 (b) (ii) What type of reaction is shown by the energy level diagram in **Figure 3**?
Give a reason for your answer.

[2 marks]

Type of reaction _____

Reason _____

_____

Do not write outside the box

3 (b) (iii) For a reaction, the value of **A** is 1370 kJ and **C** is 3230 kJ.
Calculate the value of **B**.

[1 mark]

B = _____ kJ

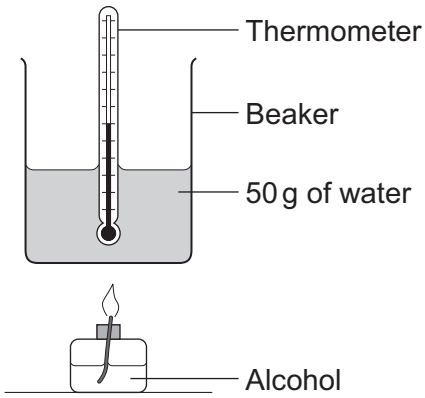
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3 (c) Alcohols are used as fuels.

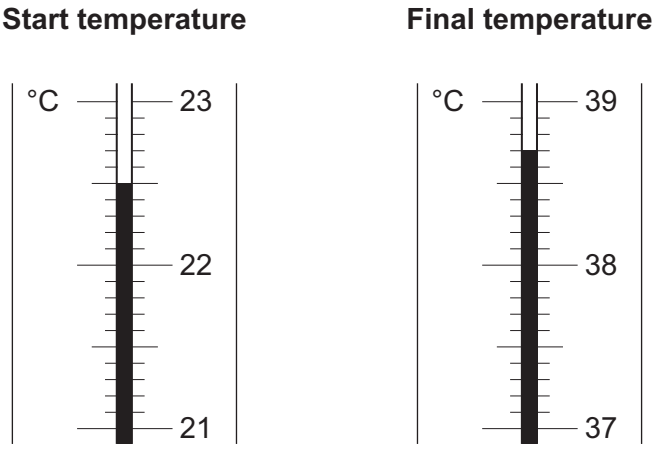
A group of students investigated the amount of energy released when different alcohols are burned.
The students used the apparatus shown in **Figure 4**.

Figure 4



3 (c) (i) **Figure 5** shows the start temperature and the final temperature of the water.

Figure 5



Write the start temperature and the final temperature of the water in **Table 1**.
Work out the increase in temperature to complete **Table 1**.

[3 marks]

Table 1

Start temperature of the water in °C	
Final temperature of the water in °C	
Increase in temperature in °C	

Do not write outside the box

3 (c) (ii) The students worked out the heat energy released by burning 1 g of each alcohol.
The students used the equation:

Heat energy released = m × 4.2 × increase in temperature

Look at **Figure 4**. What is the value of m?

[1 mark]

m = _____ g

3 (c) (iii) **Table 2** shows the students' results.

Table 2

Name of alcohol	Number of carbon atoms in one molecule of alcohol	Heat energy released when 1 g of alcohol is burned in kJ
Methanol	1	11.4
Ethanol	2	14.5
Propanol	3	20.1
Butanol	4	16.8
Pentanol	5	17.2

Which value of heat energy released is anomalous?

[1 mark]

_____

3 (c) (iv) Look at **Table 2**.
What is the relationship between the number of carbon atoms in one molecule of alcohol and the heat energy released when 1 g of the alcohol is burned?

[1 mark]

_____

_____

Question 3 continues on the next page

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3 (c) (v) The value in a data book for the amount of heat energy released when 1 g of butanol is burned completely is 36.2 kJ.

Suggest **two** reasons why the students' result for butanol is lower than the data book value.

[2 marks]

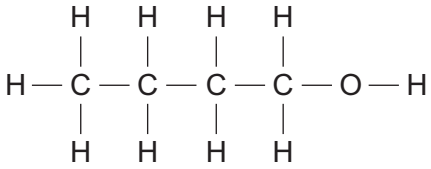
1 _____

_____

2 _____

_____

3 (c) (vi) The displayed structure of butanol is:



What is the functional group of the alcohol?

[1 mark]

Tick (✓) **one** box.

— C — C ☐

— C — H ☐

— O — H ☐

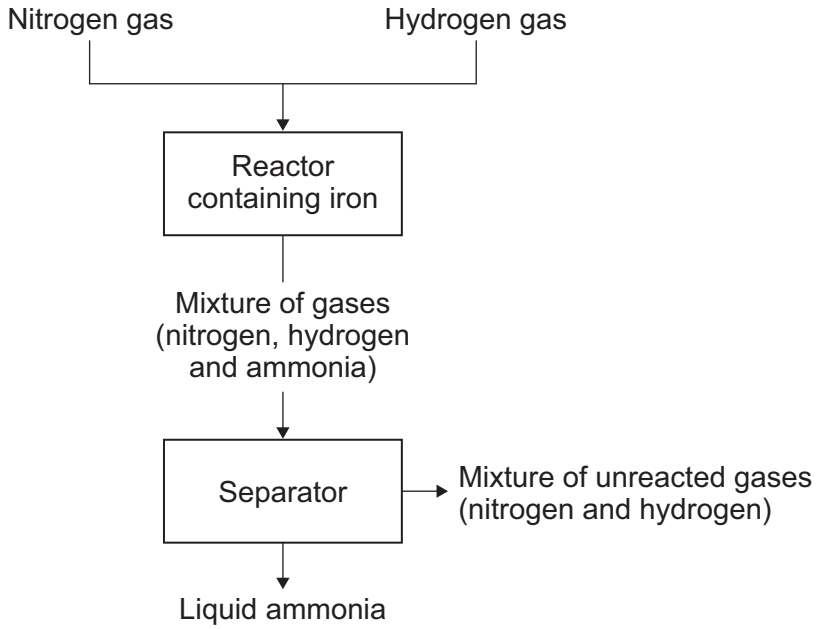
14

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4 This question is about the Haber process.

Figure 6 shows a flow diagram for the Haber process.

Figure 6



4 (a) (i) Nitrogen gas and hydrogen gas are obtained from different sources.
Draw **one** line from each gas to its source.

[2 marks]

Gas	Source
	Air
Nitrogen	Iron ore
Hydrogen	Limestone
	Natural gas

Question 4 continues on the next page

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4 (a) (ii) Explain why iron is used in the reactor for the Haber process.

[2 marks]

4 (a) (iii) Describe how the ammonia is separated from the other gases.

[2 marks]

4 (a) (iv) What happens to the mixture of unreacted gases (nitrogen and hydrogen)?

[1 mark]

4 (b) The reaction to produce ammonia is reversible.
Complete the word equation for this reaction.

[2 marks]

nitrogen + _____

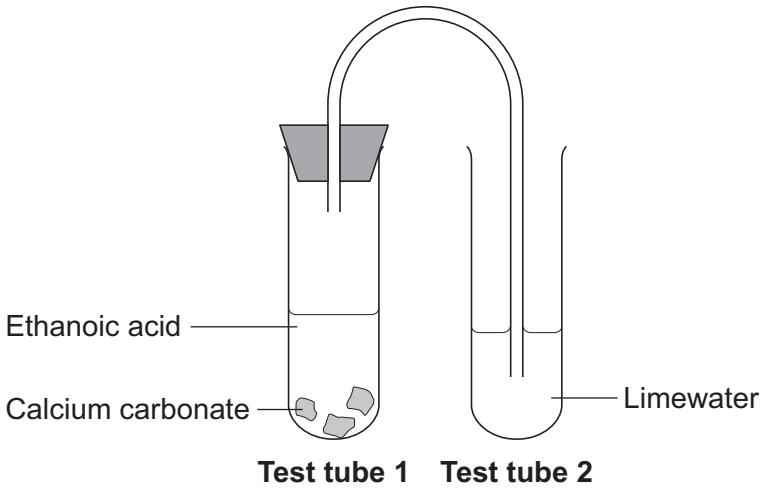
9

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5 This question is about reactions of ethanoic acid and the analysis of salts.

5 (a) **Figure 7** shows the apparatus used to investigate the reaction of ethanoic acid with calcium carbonate.

Figure 7



5 (a) (i) Describe a change that would be seen in each test tube.

Give a reason for each change.

[4 marks]

Test tube 1 _____

_____

_____

_____

Test tube 2 _____

_____

_____

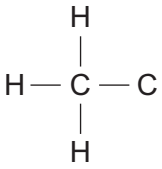
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5 (a) (ii) Complete the displayed structure of ethanoic acid.

[1 mark]



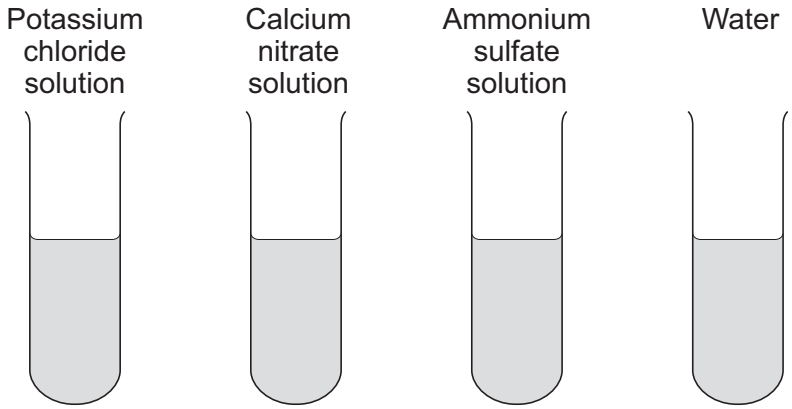
5 (a) (iii) Ethanoic acid is a carboxylic acid.
Complete the sentence.

[2 marks]

Carboxylic acids react with alcohols in the presence of an _____ catalyst to produce pleasant-smelling compounds called _____ .

5 (b) **Figure 8** shows four test tubes containing three different salt solutions and water.

Figure 8



Each solution and the water was tested with:

- silver nitrate in the presence of dilute nitric acid
- barium chloride in the presence of dilute hydrochloric acid.

Do not write outside the box

Complete the table of results.

[2 marks]

	Potassium chloride solution	**Calcium nitrate solution**	**Ammonium sulfate solution**	**Water**
Test with silver nitrate in the presence of dilute nitric acid			no change	no change
Test with barium chloride in the presence of dilute hydrochloric acid		no change	white precipitate	

5 (c) Flame tests can be used to identify metal ions.

5 (c) (i) Complete the following sentences.

[2 marks]

The flame colour for potassium ions is _____ .

The flame colour for calcium ions is _____ .

5 (c) (ii) Give **one** reason why a flame test would **not** show the presence of both potassium ions and calcium ions in a mixture.

[1 mark]

_____

_____

_____

12

Turn over for the next question

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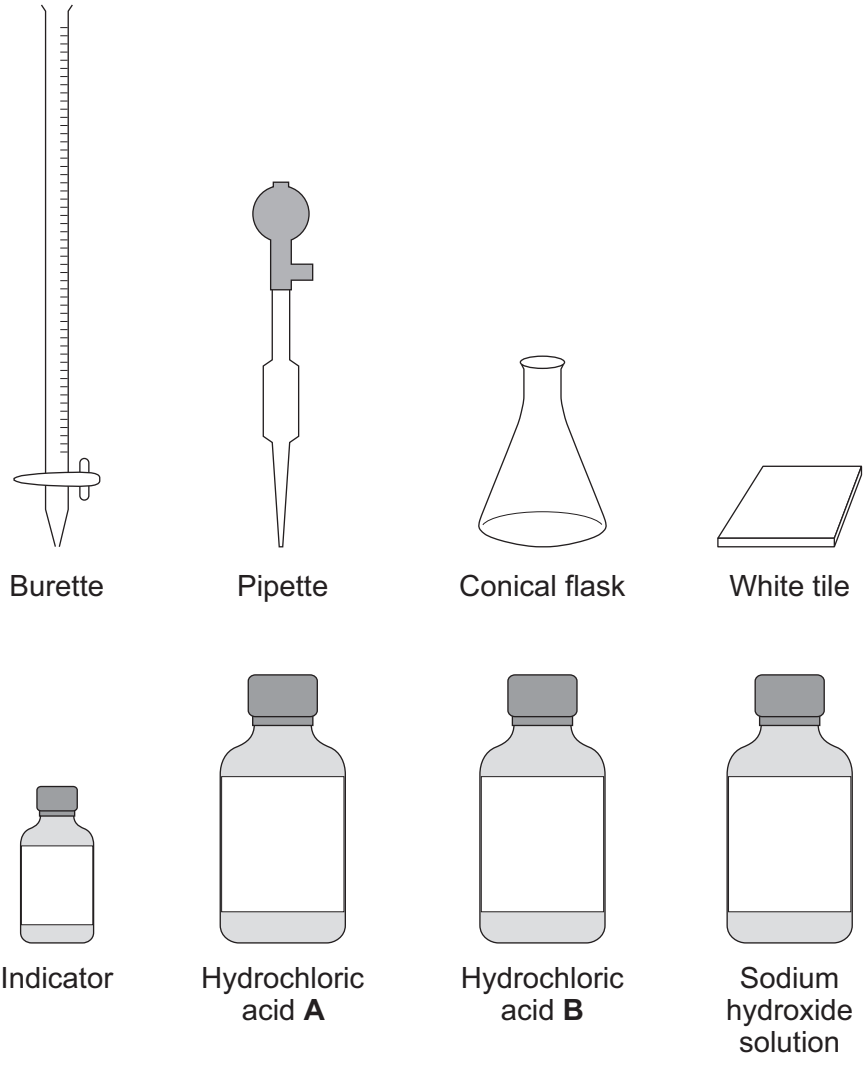
6 **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

A student has to check if two samples of hydrochloric acid, **A** and **B**, are the same concentration.

Describe how the student could use the apparatus and the solutions in **Figure 9** to carry out titrations.

[6 marks]

Figure 9



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Extra space

6

END OF QUESTIONS

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