

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

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Forename(s)

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Candidate signature

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# 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.





**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.

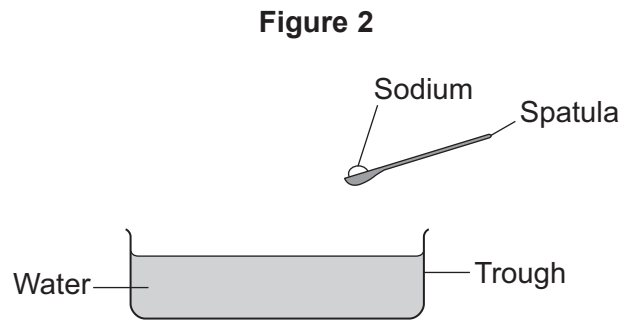
Iron forms ions that have different charges.

**Question 1 continues on the next page**

**Turn over ►**



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



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

[3 marks]

- 1 \_\_\_\_\_  
\_\_\_\_\_
- 2 \_\_\_\_\_  
\_\_\_\_\_
- 3 \_\_\_\_\_  
\_\_\_\_\_



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<sup>2+</sup>

H<sup>+</sup>

Na<sup>+</sup>

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

Turn over ►



**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**

carbon

improves taste

ion-exchange resin

adds fluoride

silver

reduces microbes

replaces water molecules

removes hardness



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ANSWER IN THE SPACES PROVIDED**

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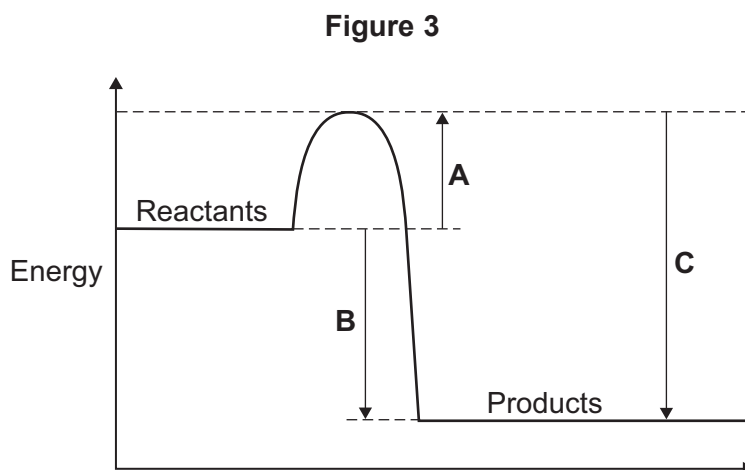
3 This question is about energy changes in chemical reactions.

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

[1 mark]

hydrogen + oxygen  $\longrightarrow$  \_\_\_\_\_

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



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 \_\_\_\_\_

\_\_\_\_\_





**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]

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**B** = \_\_\_\_\_ kJ

**Question 3 continues on the next page**

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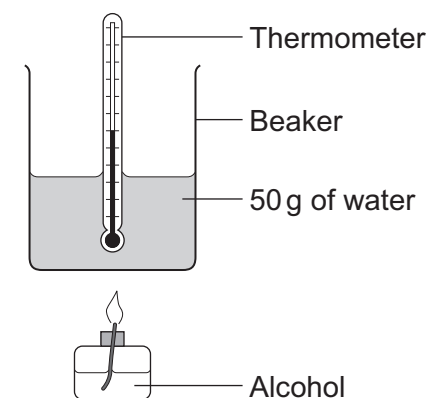


**3 (c)** Alcohols are used as fuels.

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**

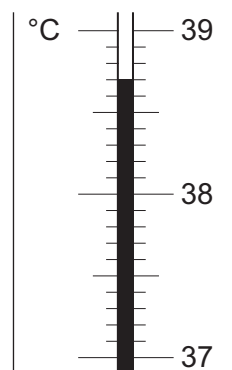
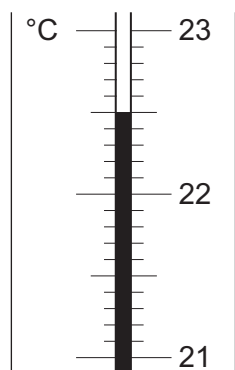


**3 (c) (i)** **Figure 5** shows the start temperature and the final temperature of the water.

**Figure 5**

**Start temperature**

**Final temperature**



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	



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

$$\text{Heat energy released} = m \times 4.2 \times \text{increase in temperature}$$

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]

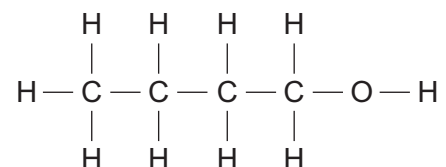
1 \_\_\_\_\_

\_\_\_\_\_

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

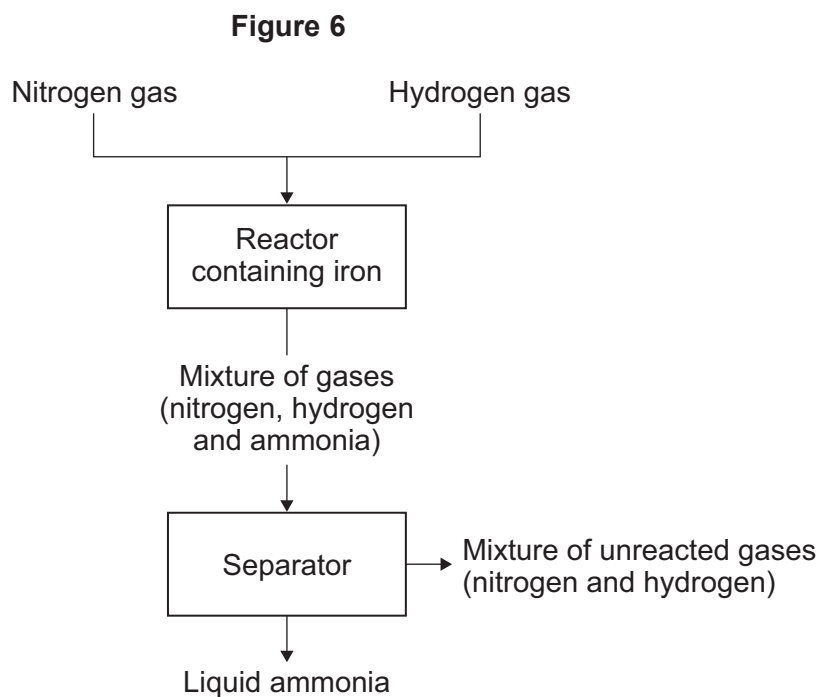
— C — H

— O — H



4 This question is about the Haber process.

Figure 6 shows a flow diagram for the Haber process.



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]

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

[2 marks]

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

[1 mark]

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

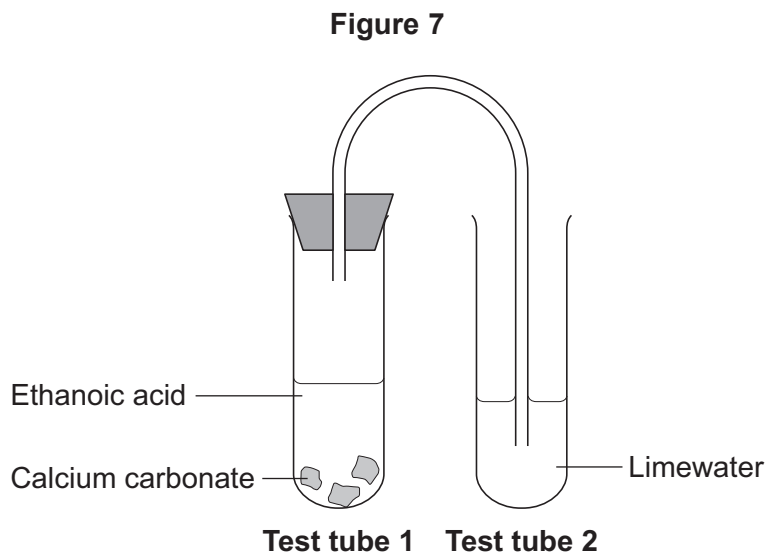
[2 marks]

nitrogen + \_\_\_\_\_



**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.



**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** \_\_\_\_\_

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**Test tube 2** \_\_\_\_\_

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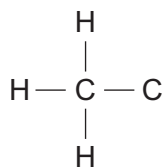
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5 (a) (ii) Complete the displayed structure of ethanoic acid.

[1 mark]



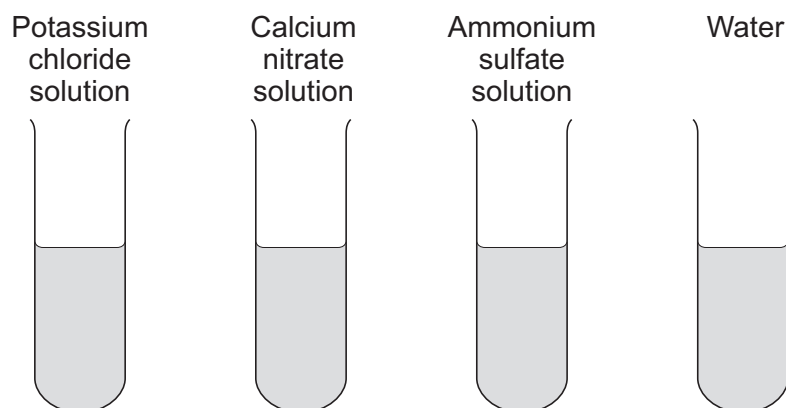
5 (a) (iii) Ethanoic acid is a carboxylic acid.  
Complete the sentence.

[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.





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]

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12

Turn over for the next question

Turn over ►



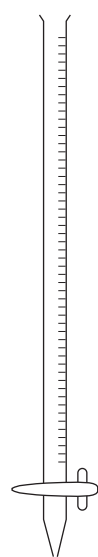
**6** In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

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

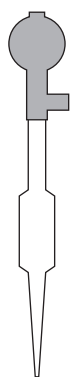
Describe how the student could use the apparatus and the solutions in **Figure 9** to carry out titrations.

[6 marks]

**Figure 9**



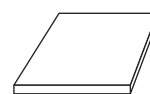
Burette



Pipette



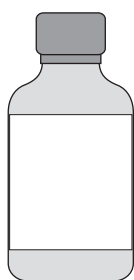
Conical flask



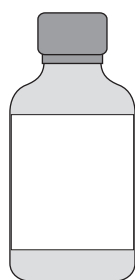
White tile



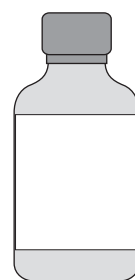
Indicator



Hydrochloric  
acid **A**



Hydrochloric  
acid **B**



Sodium  
hydroxide  
solution

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Extra space \_\_\_\_\_

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**END OF QUESTIONS**



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