

Please write clearly in block capitals.

Centre number

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# GCSE Chemistry

# H

Higher 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 2 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.



**There are no questions printed on this page**

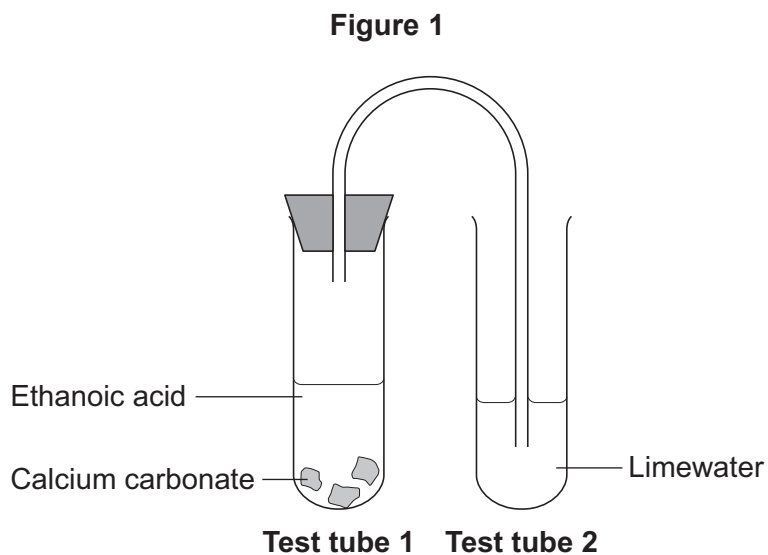
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ANSWER IN THE SPACES PROVIDED**



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

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

**1 (a)** **Figure 1** shows the apparatus used to investigate the reaction of ethanoic acid with calcium carbonate.



**1 (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** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

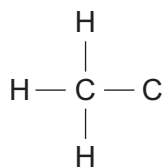
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1 (a) (ii) Complete the displayed structure of ethanoic acid.

[1 mark]



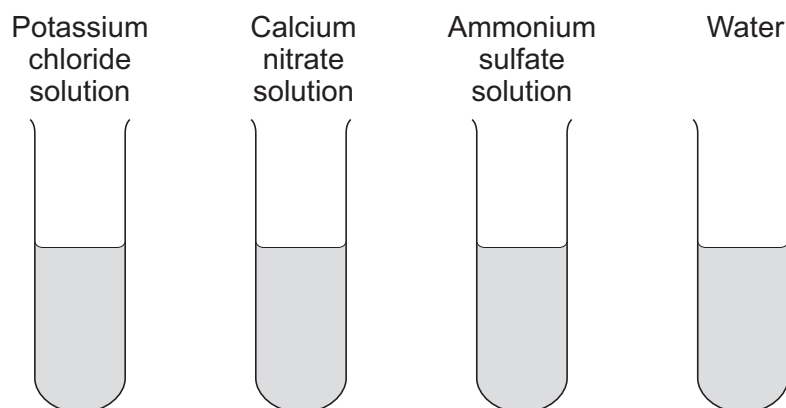
1 (a) (iii) Ethanoic acid is a carboxylic acid.  
Complete the sentence.

[2 marks]

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

1 (b) **Figure 2** shows four test tubes containing three different salt solutions and water.

**Figure 2**



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	

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

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

[2 marks]

The flame colour for potassium ions is \_\_\_\_\_ .

The flame colour for calcium ions is \_\_\_\_\_ .

1 (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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Turn over for the next question

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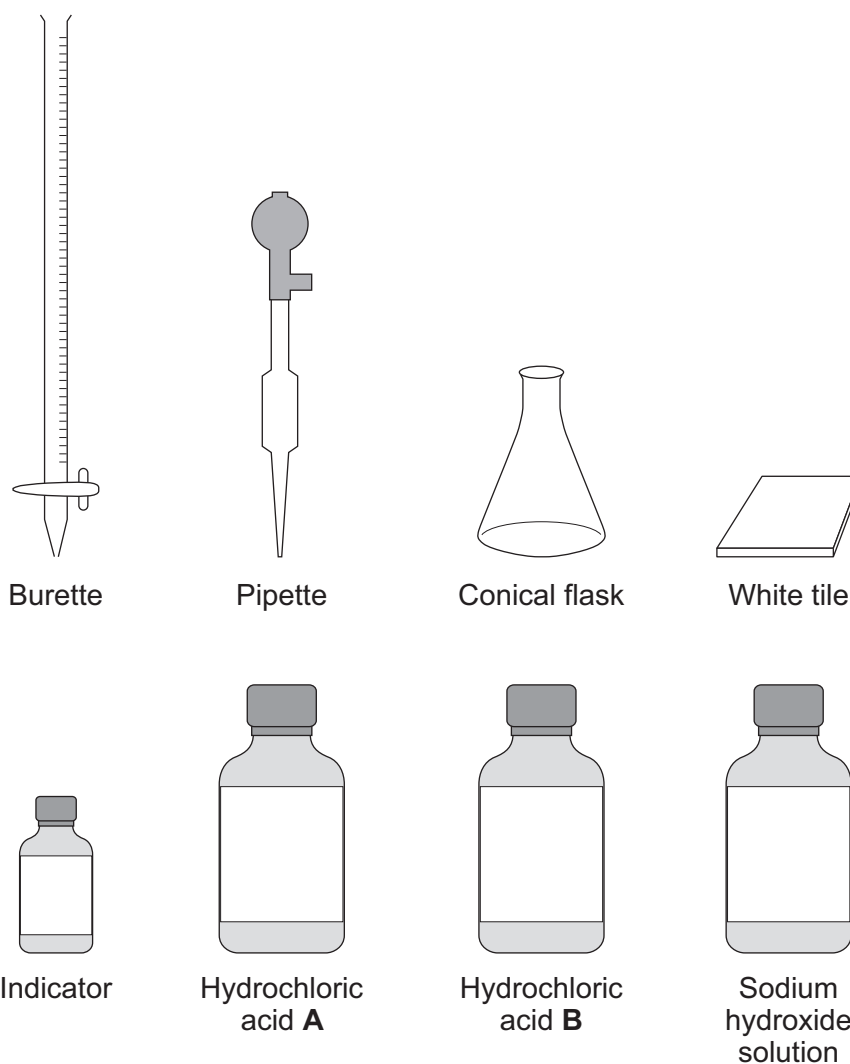
2 In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

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 3** to carry out titrations.

[6 marks]

Figure 3



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<b>6</b>

**Turn over for the next question**

**Turn over ▶**



3 This question is about elements and the periodic table.

3 (a) Newlands and Mendeleev both produced early versions of the periodic table.

3 (a) (i) Complete the sentence.

[1 mark]

In their periodic tables, Newlands and Mendeleev arranged the elements in order of

\_\_\_\_\_ .

3 (a) (ii) Name the particle that allowed the elements to be arranged in order of their atomic number in the modern periodic table.

[1 mark]

\_\_\_\_\_

3 (b) **Figure 4** shows the position of nine elements in the modern periodic table.

**Figure 4**

	Li																F	
	Na																Cl	
	K								Cu								Br	
	Rb																I	

3 (b) (i) Which **one** of the nine elements shown in **Figure 4** has the lowest boiling point?

[1 mark]

\_\_\_\_\_

3 (b) (ii) Copper and potassium have different melting points and boiling points.  
Give **one other** difference between the properties of copper and potassium.

[1 mark]

\_\_\_\_\_

\_\_\_\_\_





**3 (b) (iii)** Explain why the reactivity of the elements increases going down Group 1 from lithium to rubidium but decreases going down Group 7 from fluorine to iodine.

**[4 marks]**

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4 This question is about water.

4 (a) Hard water contains dissolved compounds.  
Explain **one** benefit of drinking hard water.

[2 marks]

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4 (b) What is the name of the solid formed when hard water reacts with soap?

[1 mark]

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4 (c) Using temporary hard water in an electric kettle reduces the efficiency of the kettle.  
Describe how this happens.

[4 marks]

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- 4 (d)** Water filters used in homes contain ion exchange resins.  
Explain how an ion exchange resin changes the dissolved compounds in tap water to improve the water.

**[3 marks]**

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5 This question is about energy changes in chemical reactions.

5 (a) Balance the chemical equation for the combustion of methane.

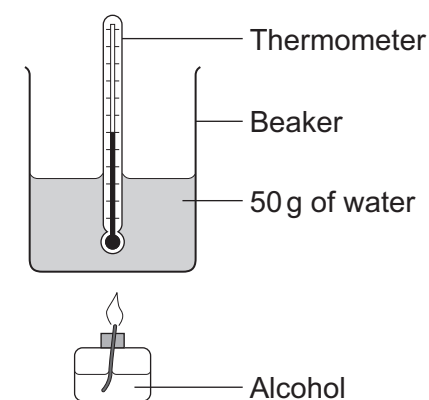
[1 mark]



5 (b) Alcohols are used as fuels.

A group of students investigated the amount of energy released when an alcohol was burned. The students used the apparatus shown in **Figure 5**.

**Figure 5**



In one experiment the temperature of 50 g of water increased from 22.0 °C to 38.4 °C. The mass of alcohol burned was 0.8 g.

Calculate the heat energy (Q) in joules, released by burning 0.8 g of the alcohol. Use the equation:

$$Q = m \times c \times \Delta T$$

Specific heat capacity (c) = 4.2 J/g/°C

[3 marks]

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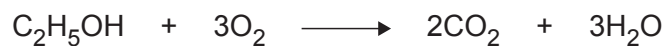


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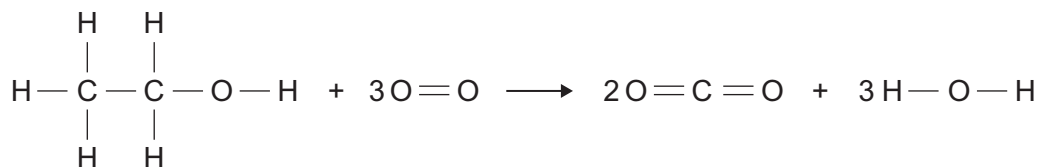
Heat energy (Q) = \_\_\_\_\_ J



5 (c) The chemical equation for the combustion of ethanol is:



5 (c) (i) The equation for the reaction can be shown as:



Bond	Bond energy in kJ per mole
C—H	413
C—C	347
C—O	358
C=O	799
O—H	467
O=O	495

Use the bond energies to calculate the overall energy change for this reaction.

[3 marks]

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Overall energy change = \_\_\_\_\_ kJ per mole

Question 5 continues on the next page

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**5 (c) (ii)** The reaction is exothermic.  
Explain why, in terms of bonds broken and bonds formed.

[2 marks]

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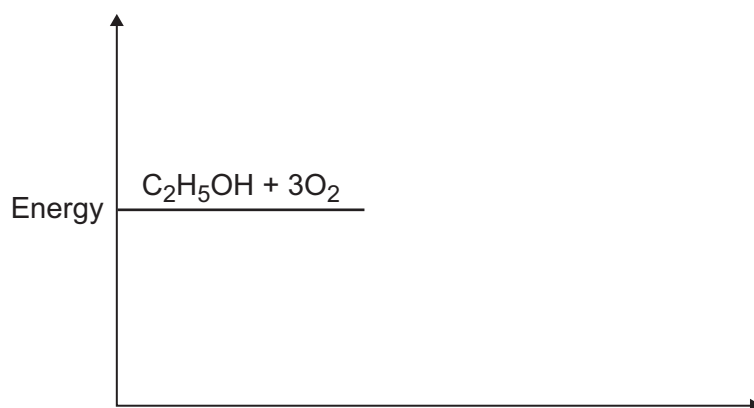
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**5 (c) (iii)** Complete the energy level diagram for the combustion of ethanol.

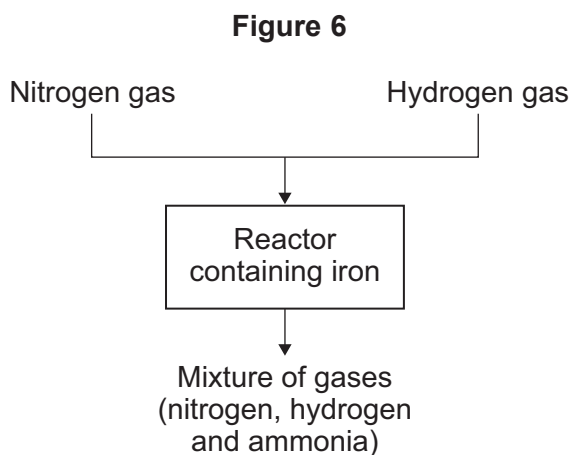
[3 marks]

On the completed diagram, label:

- activation energy
- overall energy change.



6 **Figure 6** shows a flow diagram for the Haber process.



6 (a) (i) Hydrogen gas is obtained from methane.  
Name **one** source of methane.

[1 mark]

\_\_\_\_\_

6 (a) (ii) Air is the source used to produce nitrogen for the Haber process.  
Suggest why air must **not** get into the reactor.

[2 marks]

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

6 (a) (iii) Describe what happens to the mixture of gases from the reactor.

[3 marks]

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

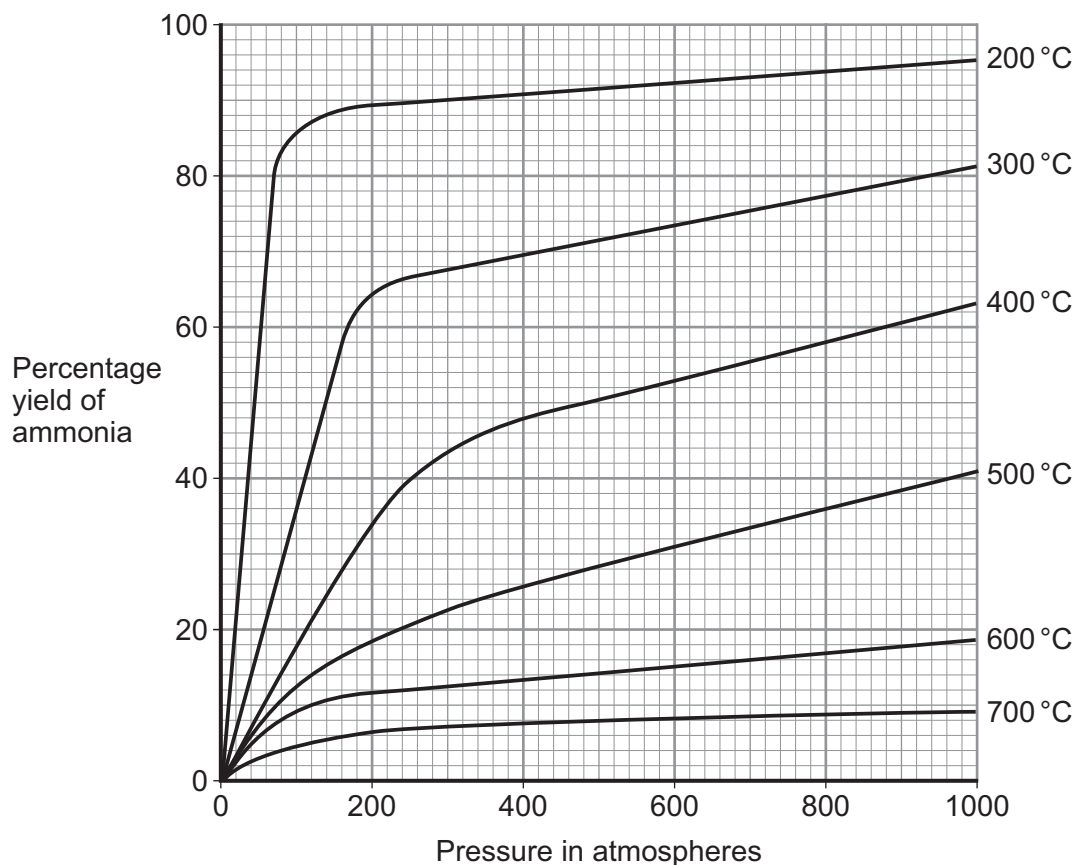
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- 6 (b) The graph in **Figure 7** shows the percentage yield of ammonia using different conditions.

**Figure 7**



- 6 (b) (i) Use **Figure 7** to suggest the conditions that produce the greatest yield of ammonia.

[1 mark]

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**6 (b) (ii)** Use **Figure 7** to suggest and explain why the conditions used to produce ammonia in the Haber process are a temperature of 450 °C and a pressure of 200 atmospheres.

**[5 marks]**

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**END OF QUESTIONS**



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