Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

General Certificate of Secondary Education
Higher Tier
June 2014

Further Additional Science

Unit 2 Chemistry C3

FAS2HP

H

Thursday 15 May 2014 9.00 am to 10.00 am

For this paper you must have:
- a ruler
- the Chemistry Data Sheet (enclosed).

You may use a calculator.

Time allowed
- 1 hour

A

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(b)(ii) 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.

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

1 Water in Britain is taken from reservoirs to use as drinking water.

Water from the reservoir is treated to make it suitable for drinking.

Figure 1

1 (a) One way to make water from the reservoir suitable for drinking is by distillation.

Describe how water is distilled.

[4 marks]

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1 (b) Distillation is **not** an economic method to make water suitable for drinking.

Water treatment using filtration and chlorination is much cheaper.

1 (b) (i) Why is water from the reservoir filtered?

[1 mark]

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1 (b) (ii) Why is water from the reservoir treated with chlorine?

[1 mark]

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1 (c) Some people use water filters in the home to treat water before drinking it.

Water filters contain ion exchange resins and particles of carbon.

1 (c) (i) Why do water filters contain ion exchange resins?

[1 mark]

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1 (c) (ii) Suggest why water filters contain particles of carbon.

[1 mark]

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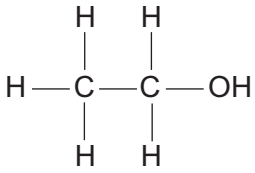
8

Turn over for the next question

2 (a) The structure of an alcohol is shown in **Figure 2**.

Figure 2



2 (a) (i) Draw a circle around the functional group in the structure of the alcohol.

[1 mark]

2 (a) (ii) What is the chemical name of this alcohol?

[1 mark]

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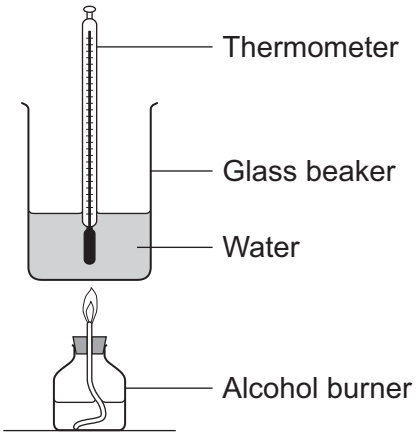
2 (b) Alcohols are used as fuels.

A student plans an experiment to find the energy released per gram of alcohol burned.

The student uses the apparatus shown in **Figure 3**.

Figure 3



2 (b) (i) Suggest **two** ways that this apparatus could be improved to obtain accurate results.

[2 marks]

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

Describe how the student should do this experiment.

You should include any measurements the student should make.

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

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

[6 marks]

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Extra space .....

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3 In 1869, Dmitri Mendeleev produced his periodic table of the elements.

Mendeleev placed the alkali metals in the same group.

3 (a) What evidence did Mendeleev use to decide that the alkali metals should be in the same group?

[1 mark]

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3 (b) Describe how the elements in the modern periodic table are arranged:

3 (b) (i) in terms of protons

[1 mark]

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3 (b) (ii) in terms of electrons.

[1 mark]

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3 (c) State **two** properties of transition elements that make them more useful than alkali metals for making water pipes.

[2 marks]

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3 (d) Describe and explain the trend in reactivity of the alkali metals (Group 1).

[4 marks]

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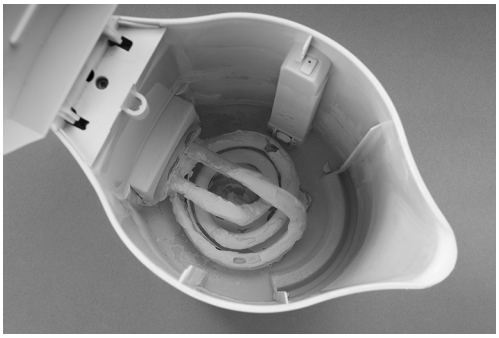
9

Turn over for the next question

4 Hard water causes scale in kettles, as shown in **Figure 4**.

Figure 4



4 (a) Acids are used to remove scale.

4 (a) (i) Give the name of a carbonate in scale.

[1 mark]

.....

4 (a) (ii) When acids react with scale a gas is produced.

What is the name of the gas?

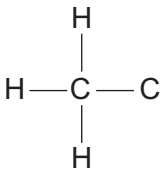
[1 mark]

.....

4 (b) Ethanoic acid is used to remove scale.

Complete the displayed structure of ethanoic acid (CH_3COOH).

[1 mark]



4 (c) A student compared the rates at which ethanoic acid and hydrochloric acid react with scale.

Both acids had the same concentration.

4 (c) (i) The student found that hydrochloric acid reacts faster than ethanoic acid with scale.

Explain why hydrochloric acid reacts faster than ethanoic acid.

[2 marks]

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4 (c) (ii) Hydrochloric acid should **not** be used to dissolve scale in kettles.

Suggest why.

[1 mark]

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4 (d) A student does a titration to find the concentration of a solution of hydrochloric acid.

The student titrates 25.00 cm^3 of hydrochloric acid with sodium hydroxide solution of concentration 0.200 moles per dm^3. The equation for the reaction is:

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

The student added 28.60 cm^3 of sodium hydroxide solution to neutralise the hydrochloric acid.

Calculate the concentration of the hydrochloric acid.

[3 marks]

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Concentration = ... moles per dm^3

9

5 In 1909 Fritz Haber invented a process to produce ammonia from nitrogen and hydrogen.

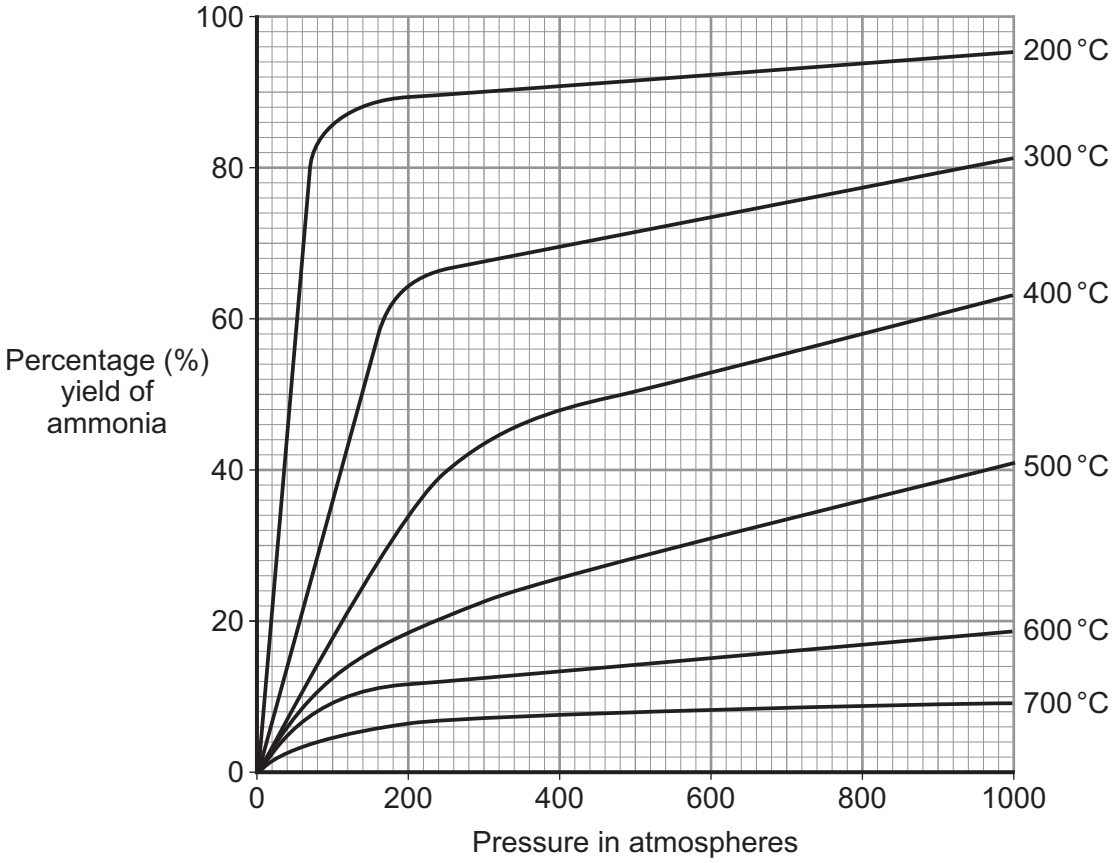
5 (a) Complete and balance the chemical equation for the production of ammonia from nitrogen and hydrogen.

[2 marks]

$$N_2 + 3H_2 \rightleftharpoons \text{.....}$$

5 (b) **Figure 5** shows how the equilibrium yield of ammonia changes with pressure at different temperatures.

Figure 5



5 (b) (i) Use the information in **Figure 5** to complete the sentence.

[1 mark]

The temperature on the graph that gives the highest yield of ammonia is ..... °C.

5 (b) (ii) The temperature used in the Haber process for the production of ammonia is 450 °C.

Why is a temperature much lower than 450 °C **not** used for the Haber process?

[1 mark]

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5 (b) (iii) Use the information in **Figure 5** to answer this question.

Draw a ring around the pressure that gives the highest yield of ammonia.

[1 mark]

100 **200** **300** **400**

5 (b) (iv) The pressure used in the Haber process for the production of ammonia is 200 atmospheres.

Why is a pressure lower than 200 atmospheres **not** used for the Haber process?

[1 mark]

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5 (c) Explain how ammonia is separated from unreacted nitrogen and hydrogen in the Haber process.

[2 marks]

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Turn over for the next question

6 Some cars are powered by hydrogen fuel cells.

Figure 6

6 (a) What type of energy is released by hydrogen fuel cells?

[1 mark]

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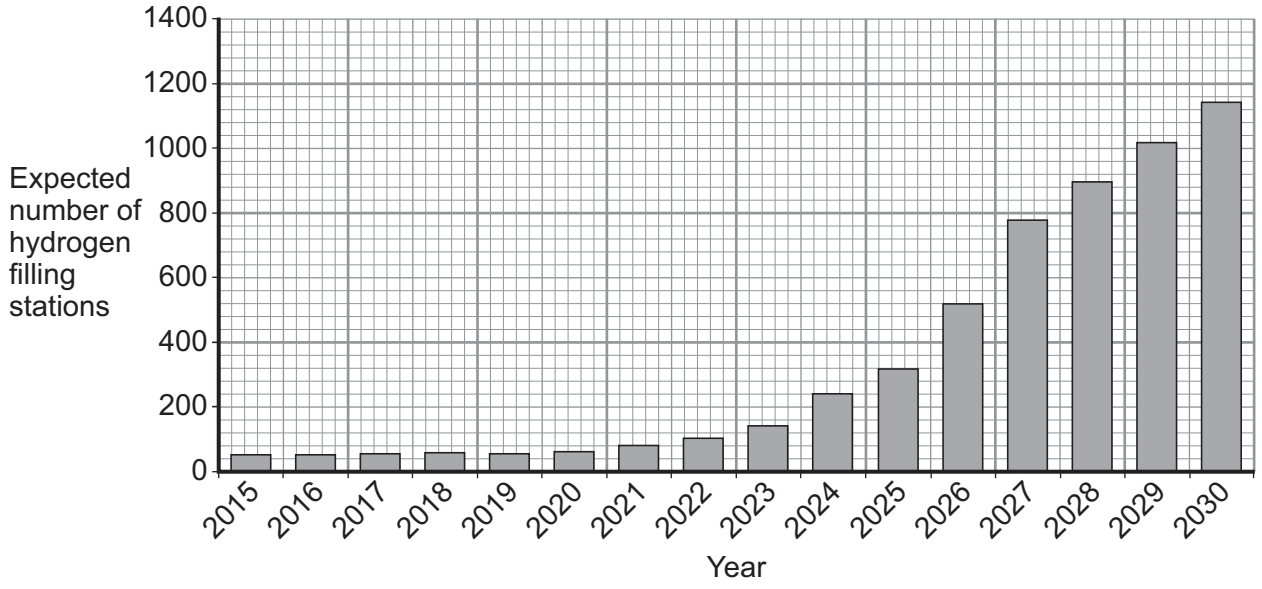
6 (b) Owners of cars powered by fuel cells buy hydrogen from hydrogen filling stations.

Figure 7 shows how the number of hydrogen filling stations in the UK is expected to increase up to the year 2030.

Figure 7



Use the information in **Figure 7** and your own knowledge to answer this question.

Suggest **two** reasons why the UK government might encourage the building of more hydrogen filling stations.

[2 marks]

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Question 6 continues on the next page

6 (c) The equation for the reaction of hydrogen with oxygen is:

$$2H_2 + O_2 \longrightarrow 2H_2O$$

During the reaction, energy is used to break the bonds of the reactants.

Energy is released when new bonds are made to form the product.

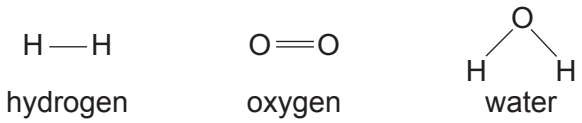
Bond energies for the reaction are given in **Table 1**.

Table 1

Bond	Bond energy in kJ
H—H	436
O=O	498
O—H	464

The structures of the reactants and product are shown in **Figure 8**.

Figure 8



6 (c) (i) Calculate the energy change for the reaction:

$$2H_2 + O_2 \longrightarrow 2H_2O$$

[3 marks]

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Energy change = ... kJ

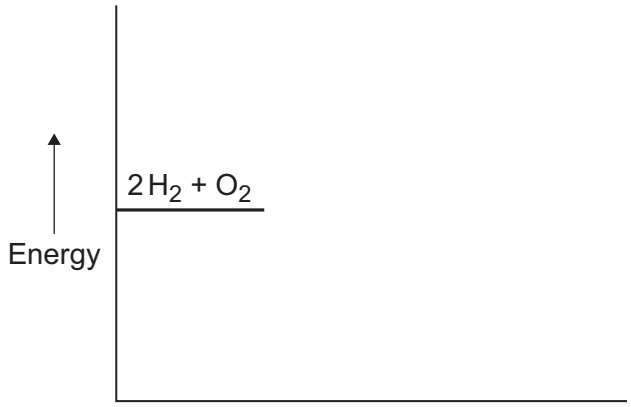
6 (c) (ii) The reaction of hydrogen with oxygen is exothermic.

Complete the energy level diagram for this reaction on **Figure 9**.

Clearly label the activation energy.

[3 marks]

Figure 9



9

Turn over for the next question

7 The colours of fireworks are produced by chemicals.

Figure 10

7 (a) Information about four chemicals is given in **Table 2**.

Complete **Table 2**.

[2 marks]

Table 2

Chemical	**Colour produced in firework**
barium chloride	.....
..... nitrate	crimson
sodium carbonate	yellow
calcium sulfate	red

7 (b) Describe a test to show that sodium carbonate contains carbonate ions.

Give the result of the test.

[2 marks]

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7 (c) A student did two tests on a solution of compound **X**.

Test 1
Sodium hydroxide solution was added.
A green precipitate was formed.

Test 2
Dilute nitric acid was added.
Silver nitrate solution was then added.
A yellow precipitate was formed.

The student concluded that compound **X** is iron(II) bromide.

Is the student's conclusion correct?

Explain your answer.

[3 marks]

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7

END OF QUESTIONS

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