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| Centre Number | | | | | | Candidate Number | | | | |
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| For Examiner's Use | |
| Examiner's Initials | |
| Question | Mark |
| 1 | |
| 2 | |
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| TOTAL | |



General Certificate of Secondary Education
Higher Tier
June 2014

Chemistry

Unit Chemistry C3

CH3HP

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

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.



J U N 1 4 C H 3 H P O 1

G/KL/98983/Jun14/E6

CH3HP

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

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

Figure 1



1 (a) What are the **two** main steps used to treat water from reservoirs?

Give **one** reason for each step.

[4 marks]

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1 (b) Some people use water filters to treat water before drinking it.

1 (b) (i) Water filters remove hardness from hard water.

What is in water filters that removes hardness from water?

[1 mark]

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1 (b) (ii) Suggest why water filters used in the home contain particles of silver.

[1 mark]

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1 (c) Pure water can be produced by distillation.

Why is distillation **not** usually an economic method of treating water for drinking?

[1 mark]

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1 (d) Drinking hard water has health benefits.

State **one** health benefit of drinking hard water.

[1 mark]

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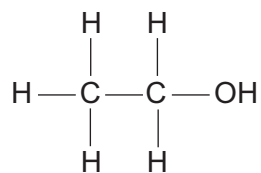
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- 2 (a) The structure of an alcohol is shown in **Figure 2**.

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]

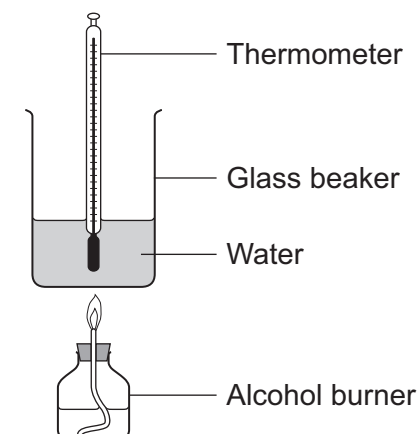
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- 2 (b) Alcohols are used as fuels.

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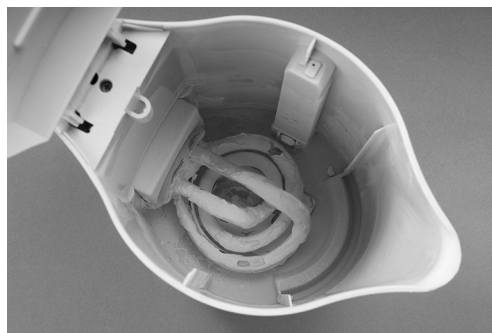
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- 4 Hard water causes scale in kettles, as shown in **Figure 4**.

Figure 4



- 4 (a) Acids are used to remove scale.

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

[1 mark]

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

What is the name of the gas?

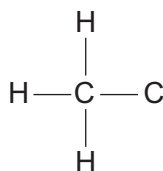
[1 mark]

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- 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.

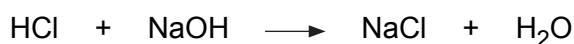
Suggest why.

[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 cm³ of hydrochloric acid with sodium hydroxide solution of concentration 0.200 moles per dm³. The equation for the reaction is:



The student added 28.60 cm³ 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 dm³

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

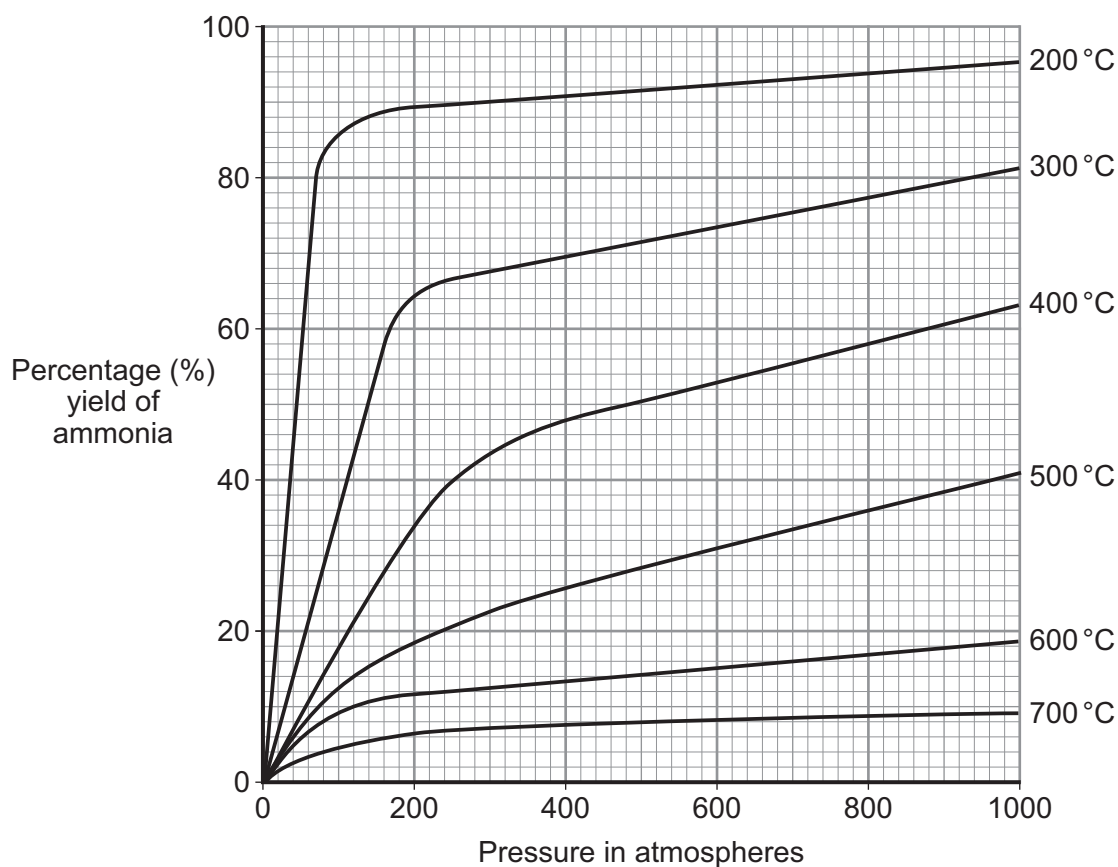
5 (a) Complete and balance the chemical equation for the production of ammonia from nitrogen and hydrogen.

[2 marks]



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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6 Some cars are powered by hydrogen fuel cells.

Figure 6



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

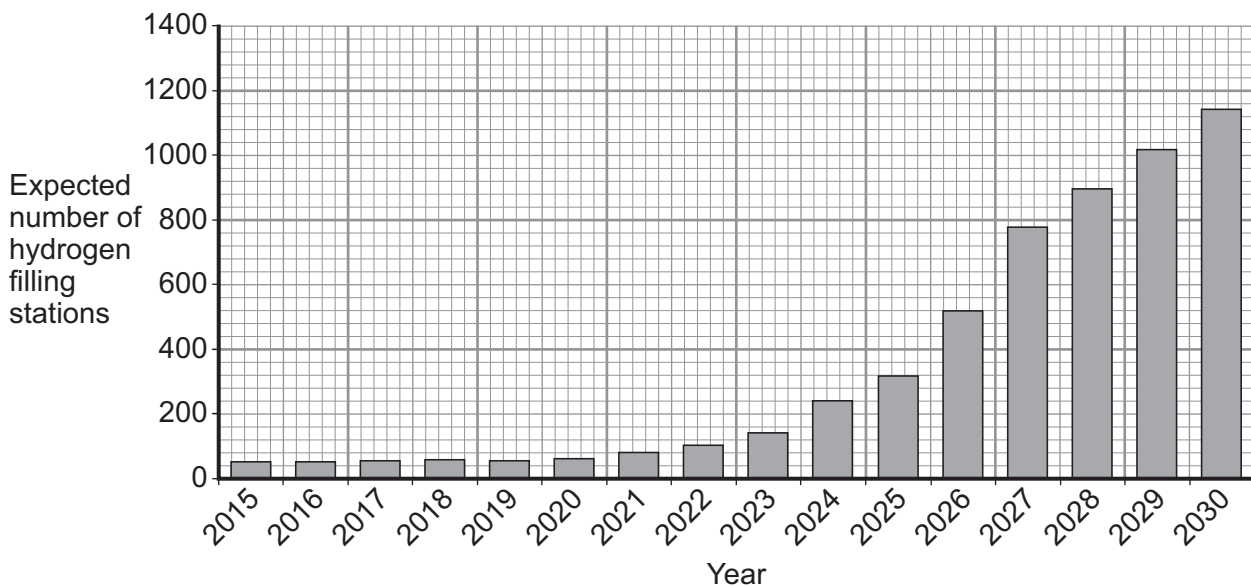
[1 mark]

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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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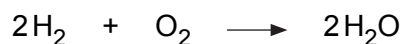
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Question 6 continues on the next page

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



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.

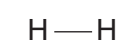
Bond energies for the reaction are given in **Table 1**.

Table 1

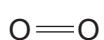
| Bond | Bond energy in kJ |
|------|-------------------|
| H—H | 436 |
| O=O | 498 |
| O—H | 464 |

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

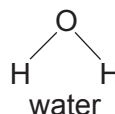
Figure 8



hydrogen

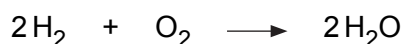


oxygen



water

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



[3 marks]

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Energy change = kJ

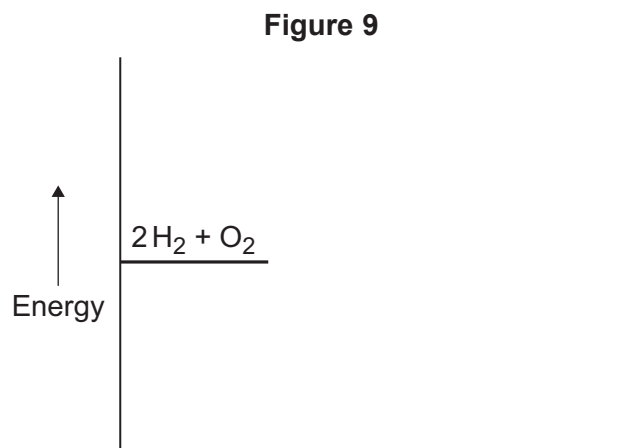


6 (c) (ii) The reaction of hydrogen with oxygen is exothermic.

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

Clearly label the activation energy.

[3 marks]



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Turn over for the next question

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- 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 | green |
| carbonate | crimson |
| sodium nitrate | |
| calcium sulfate | red |



7 (b) Describe a test to show that barium chloride solution contains chloride 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 blue precipitate was formed.

Test 2

Dilute hydrochloric acid was added.
Barium chloride solution was then added.
A white precipitate was formed.

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

Is the student's conclusion correct?

Explain your answer.

[3 marks]

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END OF QUESTIONS



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