AQA GCSE CHEMISTRY (4402)

CHEMISTRY



EXAM QUESTION PACK

UNIT C3 FOUNDATION TIER CH3FP PAPERS

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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.

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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]

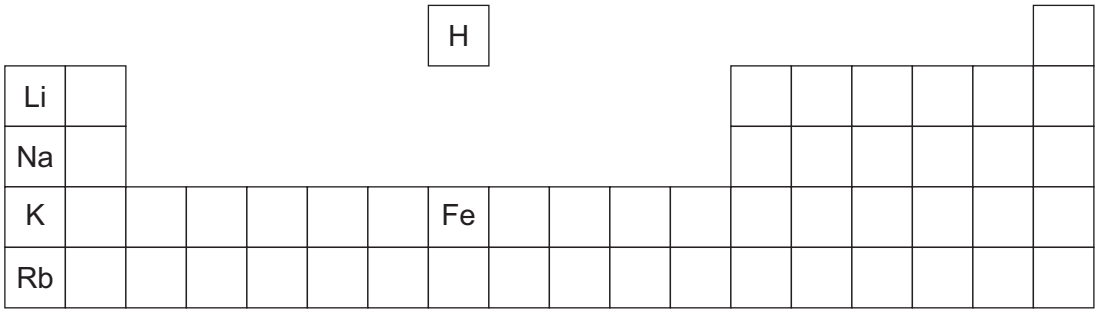
atoms	**atomic weights**	**electrons**	**proton numbers**

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. ☐

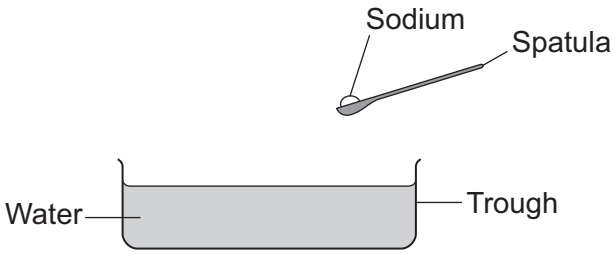
Iron forms ions that have different charges. ☐

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

Do not write outside the box

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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ANSWER IN THE SPACES PROVIDED

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3 This question is about energy changes in chemical reactions.

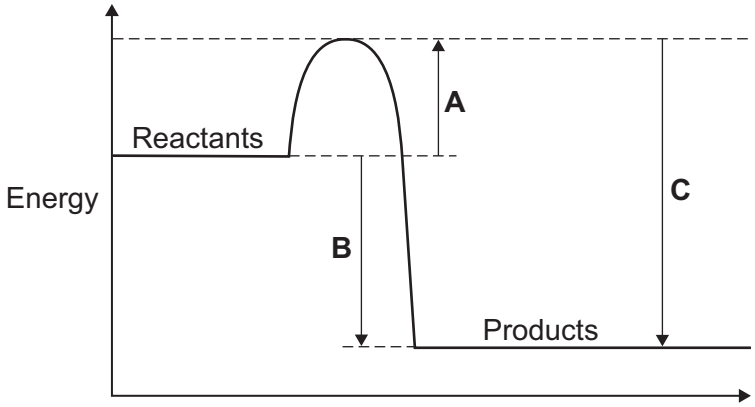
3 (a) Complete the word equation for the combustion of hydrogen.

[1 mark]

hydrogen + oxygen ⟶ _____

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

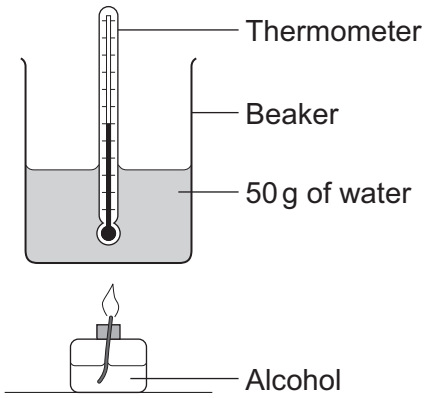
Question 3 continues on the next page

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3 (c) Alcohols are used as fuels.

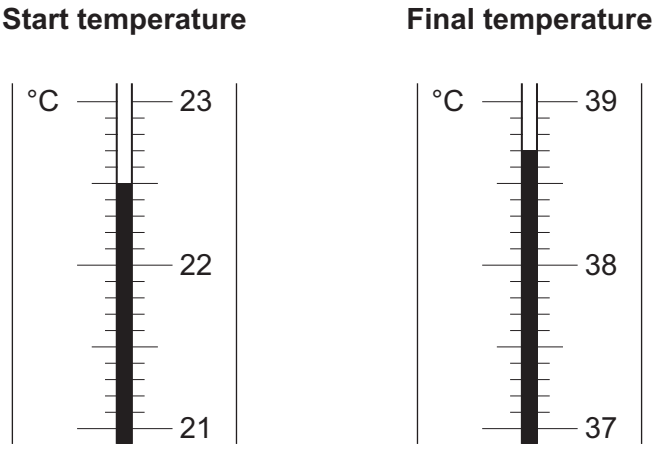
A group of students investigated the amount of energy released when different alcohols are burned.
The students used the apparatus shown in **Figure 4**.

Figure 4



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

Figure 5



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

Do not write outside the box

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]

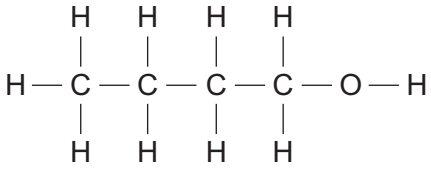
1 _____

_____

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 ☐

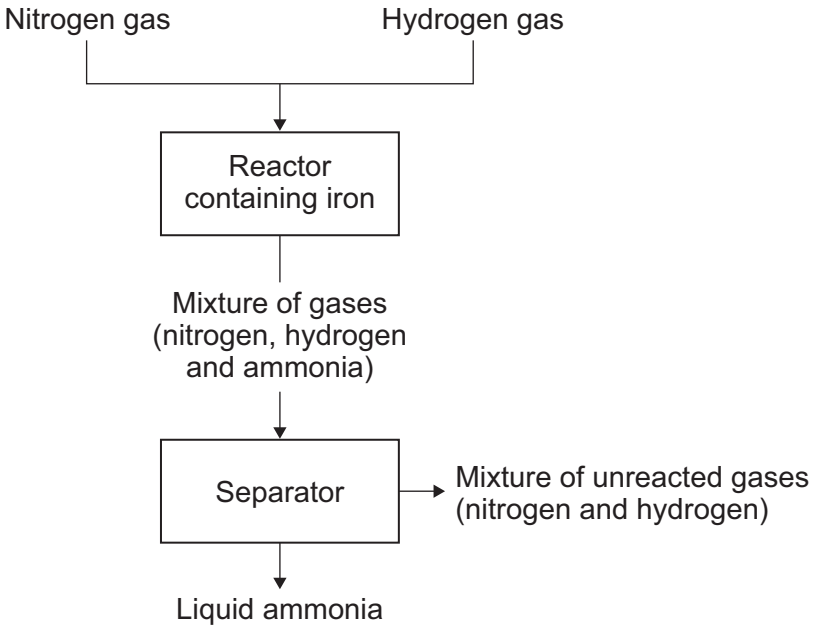
14

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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

Turn over ▶

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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 + _____

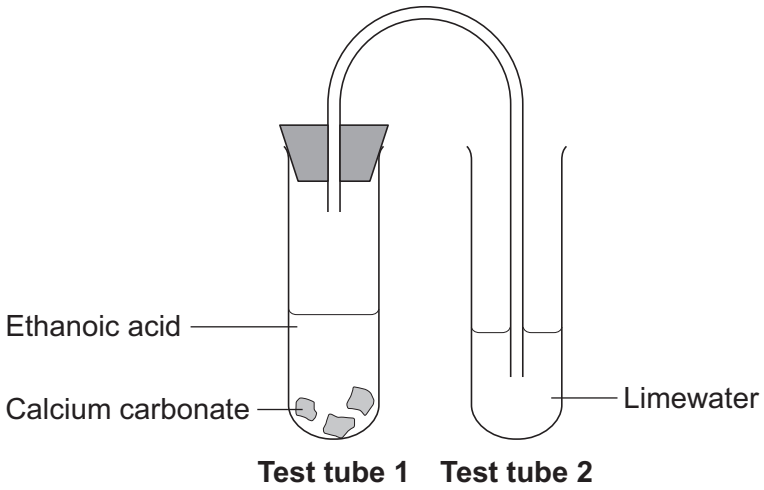
9

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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 _____

_____

_____

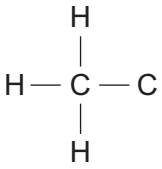
_____

Question 5 continues on the next page

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

[1 mark]



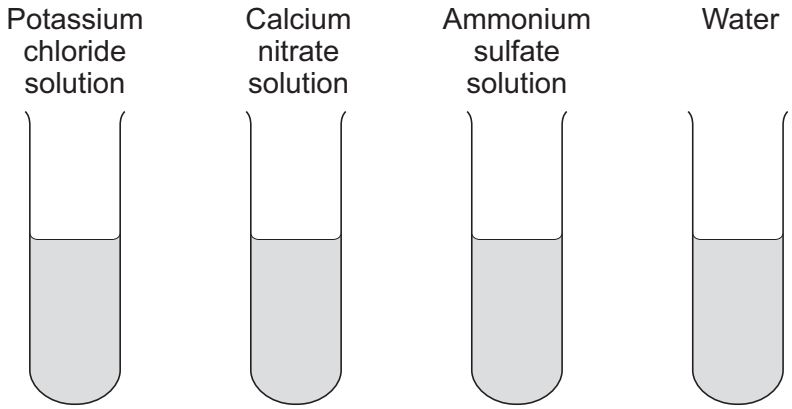
5 (a) (iii) Ethanoic acid is a carboxylic acid.
Complete the sentence.

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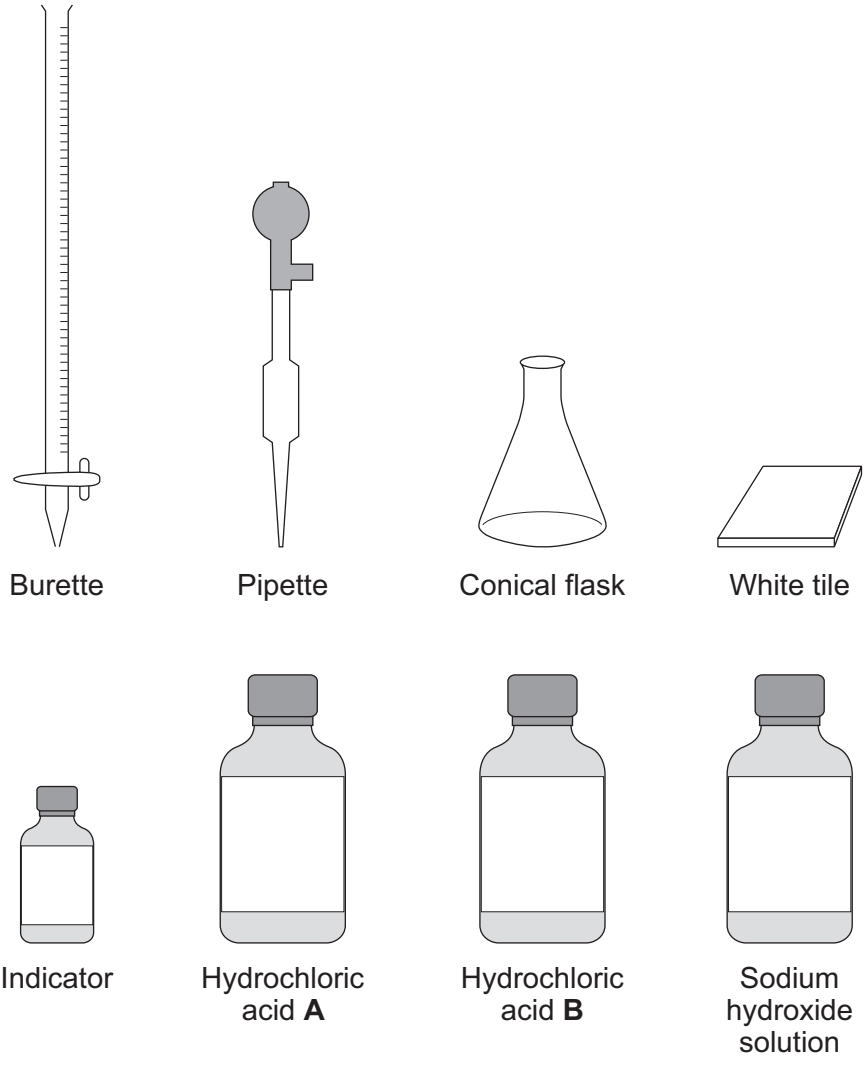
6 **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

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

END OF QUESTIONS

6

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AQA

GCSE

Chemistry

CH3FP

Mark scheme

4402

June 2016

Version/Stage: 1.0 Final

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It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.
At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.
In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**.
Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation 'ecf' in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Accept / allow

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

3.9 Ignore / Insufficient / Do not allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain a marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

4. Quality of Written Communication and levels marking

In Question 6 students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level.

Level 1: Basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: Clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: Detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately
- The answer shows almost faultless spelling, punctuation and grammar.

Question	Answers	Extra information	Mark	AO / SpecRef
1(a)	atomic weights electrons proton numbers	must be in this order	1 1 1	AO1 3.1.1a, 3.1.2a
1(b)(i)	H/hydrogen	allow H_2 or h	1	AO3 3.1.3b,c
1(b)(ii)	one / 1	allow alkali metals	1	AO2 3.1.3a
1(b)(iii)	Potassium (K)		1	AO1 3.1.3b
1(b)(iv)	Iron has a higher density than potassium Iron forms ions that have different charges		1 1	AO1/AO2 3.1.3c,d
1(c)	any **three** from: • melts • fizzes / bubbles / effervesces • sodium floats • size of the sodium decreases • sodium moves	allow gas produced allow dissolves / disappears allow two marks for moves around on the surface of the water	3	2AO1 / 1AO2 3.1.3a
Total			**11**	

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Question	Answers	Extra information	Mark	AO / SpecRef
2(a)(i)	Ca^{2+}		1	AO1 3.2.1b
2(a)(ii)	advantage: hard water is good for the development of bones disadvantage: hard water needs more soap to form lather		1 1	AO3 3.2.1a, 3.2.1f
2(b)(i)	scum		1	AO1 3.2.1a
2(b)(ii)	soft water		1	AO1 3.2.1c
2(c)	carbon: improves taste ion-exchange resin: removes hardness silver: reduces microbes		1 1 1	AO1/AO2/AO3 3.2.2b
Total			**8**	

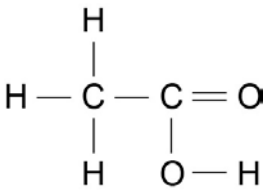
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Question	Answers	Extra information	Mark	AO / SpecRef
3(a)	water / H_2O	allow steam or hydrogen oxide	1	AO1 3.3.1i
3(b)(i)	A		1	AO2 3.3.1d
3(b)(ii)	exothermic products (energy) lower than reactants (energy)		1 1	AO2/AO3 3.3.1d,e
3(b)(iii)	1860 (kJ)		1	AO2 3.3.1d
3(c)(i)	22.5 38.7 16.2	 allow ecf for correct subtraction	1 1 1	AO2 3.3.1a
3(c)(ii)	50 (g)		1	AO2 3.3.1a
3(c)(iii)	20.1 (kJ)	allow propanol ignore 3	1	AO3 3.3.1a
3(c)(iv)	as the number of carbon atoms (in one molecule of alcohol) increases the heat energy given out increases (when the alcohol is burned)		1	AO3 3.3.1a
3(c)(v)	any **two** from: • no lid • no insulation • no draught shield • incomplete combustion • inaccurate measurement • no repeats (to calculate a mean)	Allow heat / energy loss to surroundings for any one of these marks	2	AO3 3.3.1a
3(c)(vi)	-O-H		1	AO1 3.6.1a
Total			**14**	

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Question	Answers	Extra information	Mark	AO / SpecRef
4(a)(i)	nitrogen: air hydrogen: natural gas		1 1	AO1 3.5.1a
4(a)(ii)	as a catalyst so the reaction speeds up	 allow lowers activation energy or so a lower temperature can be used	1 1	AO1/AO2 3.5.1b
4(a)(iii)	cooled ammonia condenses / liquefies	 allow nitrogen **and** hydrogen remain in the gaseous state	1 1	AO1/AO2 3.5.1b
4(a)(iv)	recycled	allow reused or returned to the reactor	1	AO1 3.5.1b
4(b)	reversible arrows hydrogen **and** ammonia		1 1	AO1 3.5.1b
Total			**9**	

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Question	Answers	Extra information	Mark	AO / SpecRef
5(a)(i)	fizz / effervescence / bubbles	allow calcium carbonate decreases in size or dissolves	1	AO2/AO3 3.4.1d, 3.6.2b
	because carbon dioxide produced / released	allow because gas produced / released	1	
	limewater turns cloudy / milky / white		1	
	because (a precipitate of or solid) calcium carbonate forms	allow because of carbon dioxide if not already credited	1	
5(a)(ii)		allow –OH do not allow lower case 'h'	1	AO1 3.6.2a
5(a)(iii)	acid	must be in this order ignore any name of an acid	1	AO1 3.6.2b
	ester(s)		1	
5(b)	white (precipitate) no change no change no change	all four correct 2 marks any two correct 1 mark	2	AO2 3.4.1e,f
5(c)(i)	lilac red	must be in this order allow purple	1 1	AO1 3.4.1a
5(c)(ii)	colours are masked / changed by each flame colour		1	AO3 3.4.1a
Total			**12**	

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<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / SpecRef</th></tr>
<tr><td>6</td><td></td><td></td><td>6</td><td rowspan="6">2AO1 / 3AO2 / 1AO3
3.4.1g</td></tr>
<tr><td colspan="4">Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a ‘best-fit’ approach to the marking.</td></tr>
<tr><td colspan="4"><table>
<tr><th>0 marks</th><th>Level 1 (1–2 marks)</th><th>Level 2 (3–4 marks)</th><th>Level 3 (5–6 marks)</th></tr>
<tr><td>No relevant content.</td><td>There is a simple description of using some of the apparatus.</td><td>There is a description of an experimental method including addition of acid to alkali which may include an indicator or colour change and may include a measurement of volume.</td><td>There is a description of titrations that would allow a comparison to be made between the two solutions of hydrochloric acid.</td></tr>
</table></td></tr>
<tr><td colspan="4">examples of chemistry points made in the response could include:
• acid in burette or flask
• alkali/sodium hydroxide or acid in burette or flask
• volume of acid or alkali measured using the pipette
• indicator in flask
• white tile under the flask
• slow addition
• swirling/mixing
• colour change of indicator
• burette volume measured</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Total</td><td></td><td></td><td>6</td><td></td></tr>
</table>

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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	
8	
9	
10	
TOTAL	

General Certificate of Secondary Education
Foundation Tier
June 2015

Chemistry
Unit Chemistry C3

CH3FP

F

Thursday 14 May 2015 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 10(b) 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.

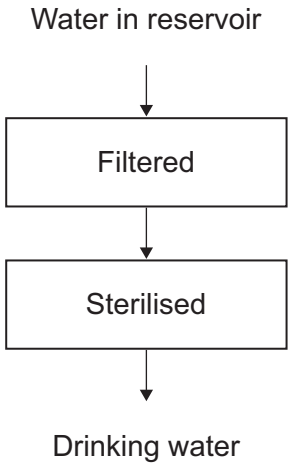
Do not write outside the box

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

1 This question is about drinking water.

1 (a) The flow diagram in **Figure 1** shows how water is made suitable for drinking.

Figure 1



1 (a) (i) What is removed when the water is filtered?

[1 mark]

Tick (✓) **one** box.

Gases ☐

Liquids ☐

Solids ☐

Do not write outside the box

1 (a) (ii) What is used to sterilise the water?

[1 mark]

Tick (✓) **one** box.

Carbon ☐

Chlorine ☐

Sodium chloride ☐

1 (a) (iii) Why is the water sterilised?

[1 mark]

.....

.....

1 (b) Water can be purified by distillation.

Drinking water is **not** usually purified by distillation because distillation is expensive.

Complete the sentence.

[1 mark]

Distillation is expensive because it requires a lot of ..... .

1 (c) Why do some water companies add fluoride to drinking water?

[1 mark]

.....

.....

5

Turn over for the next question

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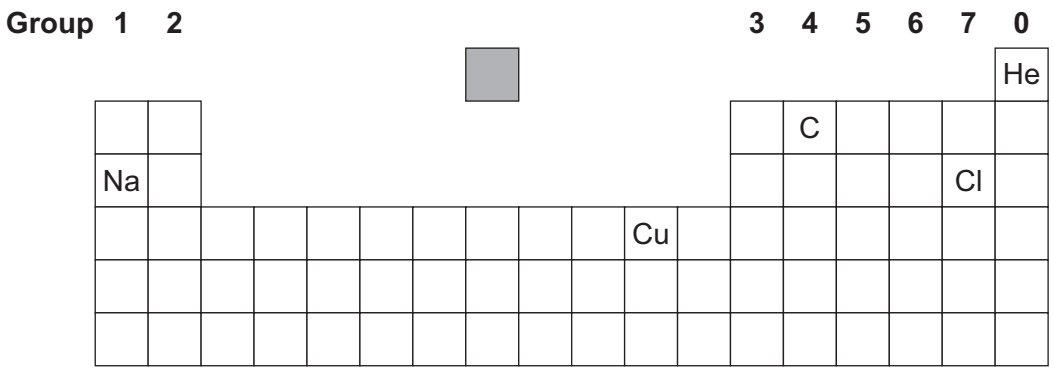
There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

2 **Figure 2** shows the chemical symbols of five elements in the periodic table.

Figure 2



2 (a) Choose the correct chemical symbol from **Figure 2** to complete each sentence.

2 (a) (i) The element that is an alkali metal is ..... .

[1 mark]

2 (a) (ii) The element that is a transition metal is ..... .

[1 mark]

2 (a) (iii) The element in Group 4 is ..... .

[1 mark]

2 (a) (iv) The element with a full outer energy level (shell) of electrons is ..... .

[1 mark]

2 (b) Which other element goes in the shaded box in **Figure 2**? .....

[1 mark]

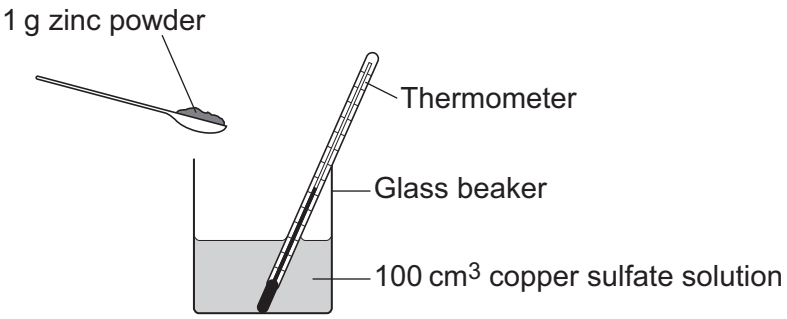
5

Turn over for the next question

Do not write outside the box

3 A student investigates the energy released when zinc powder reacts with copper sulfate solution. The student uses the apparatus shown in **Figure 3**.

Figure 3



The student:

- measures 100 cm^3 copper sulfate solution into a beaker
- measures the temperature of the copper sulfate solution
- puts 1 g zinc powder into the beaker
- stirs the mixture with a thermometer
- measures the highest temperature.

The student's results were:

Starting temperature = 21 °C
Highest temperature = 32 °C

3 (a) (i) Calculate the change in temperature.

[1 mark]

.....

Change in temperature = ... °C

3 (a) (ii) Calculate the energy released in the reaction.

Use the equation

$$\text{energy released in J} = \text{volume of solution in } cm^3 \times 4.2 \times \text{temperature change in °C}$$

[2 marks]

.....

.....

Energy released = ... J

Do not write outside the box

3 (b) The reaction of zinc with copper sulfate is exothermic.

How can you tell from the student's results that the reaction is exothermic?

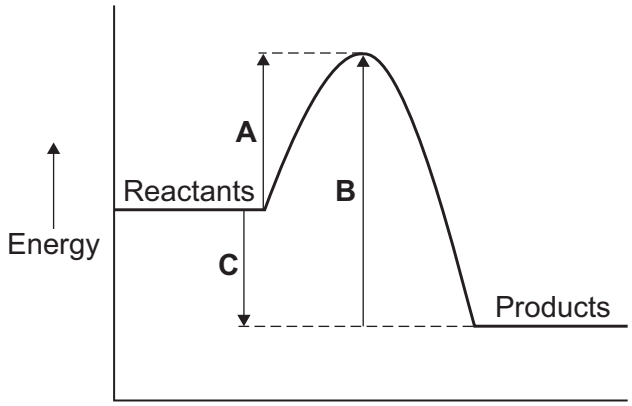
[1 mark]

.....

.....

3 (c) The energy diagram for the reaction is shown in **Figure 4**.

Figure 4



3 (c) (i) How can you tell from the energy diagram that the reaction is exothermic?

[1 mark]

.....

.....

3 (c) (ii) Which arrow shows the activation energy in **Figure 4**?

[1 mark]

Tick (✓) **one** box.

A ☐

B ☐

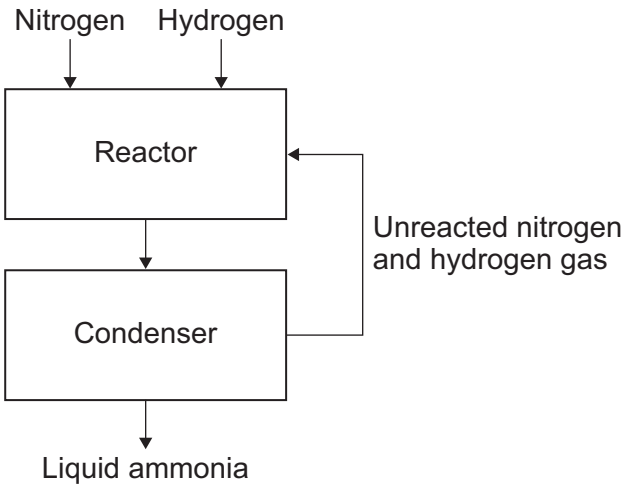
C ☐

6

Do not write outside the box

4 **Figure 5** shows a flow diagram of the Haber process.
The Haber process produces ammonia from nitrogen and hydrogen.

Figure 5



4 (a) Use the correct answer from the box to complete the sentence.

[1 mark]

air	limestone	natural gas

Hydrogen is obtained from ..... .

4 (b) In the reactor, nitrogen and hydrogen at a high pressure are heated and passed over a catalyst.

4 (b) (i) Use the correct answer from the box to complete the sentence.

[1 mark]

25	100	450

The temperature in the reactor is ..... °C

4 (b) (ii) Use the correct answer from the box to complete the sentence.

[1 mark]

copper	iron	nickel

The catalyst used in the reactor is ..... .

Do not write outside the box

4 (b) (iii) How does a catalyst speed up a reaction?

[1 mark]

Tick (✓) **one** box.

The catalyst lowers the activation energy. ☐

The catalyst gives the reactants extra energy. ☐

The catalyst increases the pressure in the reactor. ☐

4 (c) A mixture of gases leaves the reactor.

The mixture contains ammonia, nitrogen and hydrogen.

Describe what happens to this mixture of gases in the condenser.

Use **Figure 5** to help you.

[3 marks]

.....

.....

.....

.....

.....

.....

7

Turn over for the next question

Do not write outside the box

5 This question is about organic compounds.

5 (a) Ethanol burns in air.

Use the correct answer from the box to complete the word equation for the reaction.

[1 mark]

carbon	hydrogen	oxygen

ethanol + ... → carbon dioxide + water

5 (b) Use the correct answer from the box to complete the sentence.

[1 mark]

milk	hard water	vinegar

Ethanoic acid is in ..... .

5 (c) Ethanoic acid is a carboxylic acid.

Which diagram, **A**, **B** or **C**, has a ring around the functional group of a carboxylic acid?

Write your answer in the box.

[1 mark]

Diagram A

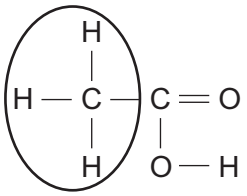


Diagram B

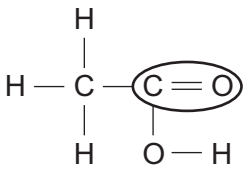


Diagram C

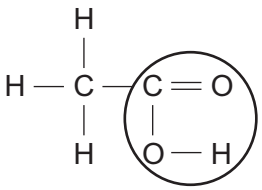


Diagram ☐

Do not write outside the box

5 (d) Ethyl propanoate is produced by reacting ethanol with propanoic acid.

What type of organic compound is ethyl propanoate?

[1 mark]

Tick (✓) **one** box.

Alcohol ☐

Carboxylic acid ☐

Ester ☐

5 (e) Organic compounds such as ethyl propanoate are used in perfumes.

Give **two** properties of these compounds that make them suitable for use in perfumes.

[2 marks]

.....

.....

6

Turn over for the next question

Do not write outside the box

6 This question is about chemical tests.

6 (a) Solutions of copper(II) ions and iron(III) ions produce coloured precipitates with sodium hydroxide solution.

Draw **one** line from each metal ion to the colour of the precipitate it produces.

[2 marks]

Metal ion	Colour of precipitate
Copper(II) (Cu^{2+})	Blue
	Brown
	Green
Iron(III) (Fe^{3+})	White

6 (b) Sodium hydroxide solution was added to a solution containing ions of a metal.

A white precipitate was produced. The white precipitate dissolved in excess sodium hydroxide solution.

Use the correct answer from the box to complete the sentence.

[1 mark]

aluminium	**magnesium**	**potassium**

The ions in the solution were ions of ..... .

Do not write outside the box

6 (c) Low sodium salt contains sodium chloride and potassium chloride.

A student used a flame test on low sodium salt.

6 (c) (i) What is the colour produced by sodium ions in a flame test?

[1 mark]

.....

6 (c) (ii) What is the colour produced by potassium ions in a flame test?

[1 mark]

.....

6 (c) (iii) Why is it **not** possible to tell from the flame test that both ions are present in low sodium salt?

[1 mark]

.....

.....

6

Turn over for the next question

Do not write outside the box

7 Some pollutants cause acid rain.

A student tested 25.0 cm^3 samples of three types of rainwater, **P**, **Q** and **R**.
The student titrated the samples with sodium hydroxide solution (an alkali).

The student recorded the volume of sodium hydroxide solution needed to neutralise the rainwater. The student's results are shown in **Table 1**.

Table 1

	Volume of sodium hydroxide needed to neutralise the rainwater in cm^3				
Type of rainwater	**Titration 1**	**Titration 2**	**Titration 3**	**Titration 4**	**Mean value**
P	18.0	15.5	14.5	15.0	15.0
Q	13.0	10.0	11.0	10.5	10.5
R	23.0	19.5	18.5	19.0	19.0

7 (a) (i) The student calculated the mean value for rainwater **R** as 19.0 cm^3.

Show how the student calculated the mean value for rainwater **R**.

[2 marks]

.....

.....

.....

.....

7 (a) (ii) Write down **P**, **Q** and **R** in order of their acidity.

[2 marks]

Most acidic .....

.....

Least acidic .....

Do not write outside the box

7 (b) A second student repeated the experiment and recorded the results in **Table 2**.

Table 2

	Volume of sodium hydroxide needed to neutralise the rainwater in cm^3	
Type of rainwater	**Titration 1**	**Titration 2**
P	17	15
Q	11	9
R	20	18

Use **Table 1** and **Table 2** to suggest **two** improvements the second student could make to obtain more accurate results.

[2 marks]

.....

.....

.....

.....

7 (c) The results of the two students show that the experiment is reproducible.

Give the reason why.

[1 mark]

.....

.....

7

Turn over for the next question

Do not write outside the box

8 In 1866 John Newlands produced an early version of the periodic table.

Part of Newlands' periodic table is shown in **Figure 6**.

Figure 6

Column	1	2	3	4	5	6	7
	H	Li	Be	B	C	N	O
	F	Na	Mg	Al	Si	P	S
	Cl	K	Ca	Cr	Ti	Mn	Fe

Newlands' periodic table arranged all the known elements into columns in order of their atomic weight.

Newlands was trying to show a pattern by putting the elements into columns.

8 (a) Iron (Fe) does **not** fit the pattern in column 7.

Give a reason why.

[1 mark]

.....

.....

8 (b) In 1869 Dmitri Mendeleev produced his version of the periodic table.

Why did Mendeleev leave gaps for undiscovered elements in his periodic table?

[1 mark]

.....

.....

Do not write outside the box

8 (c) Newlands and Mendeleev placed the elements in order of atomic weight.

Complete the sentence.

[1 mark]

The modern periodic table places the elements in order of ..... .

8 (d) Lithium, sodium and potassium are all in Group 1 of the modern periodic table.

Explain why.

[2 marks]

.....

.....

.....

.....

5

Turn over for the next question

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There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

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9 This question is about the halogens (Group 7).

9 (a) How do the boiling points of the halogens change down the group from fluorine to iodine?

[1 mark]

.....

.....

9 (b) Sodium bromide is produced by reacting sodium with bromine.

Sodium bromide is an ionic compound.

9 (b) (i) Write down the symbols of the **two** ions in sodium bromide.

[1 mark]

.....

9 (b) (ii) Chlorine reacts with sodium bromide solution to produce bromine and one other product.

Complete the word equation for the reaction.

[1 mark]

chlorine + sodium bromide ⟶ bromine + ...

9 (b) (iii) Why does chlorine displace bromine from sodium bromide?

[1 mark]

.....

.....

9 (b) (iv) Use the Chemistry Data Sheet to help you to answer this question.

Suggest which halogen could react with sodium chloride solution to produce chlorine.

[1 mark]

.....

5

Turn over for the next question

Do not write outside the box

10 This question is about water.

10 (a) Rainwater is soft.

How is hard water produced from rainwater?

[2 marks]

.....

.....

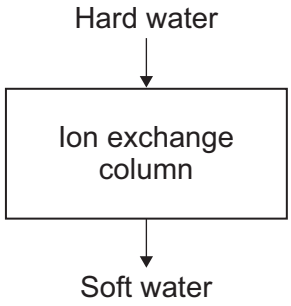
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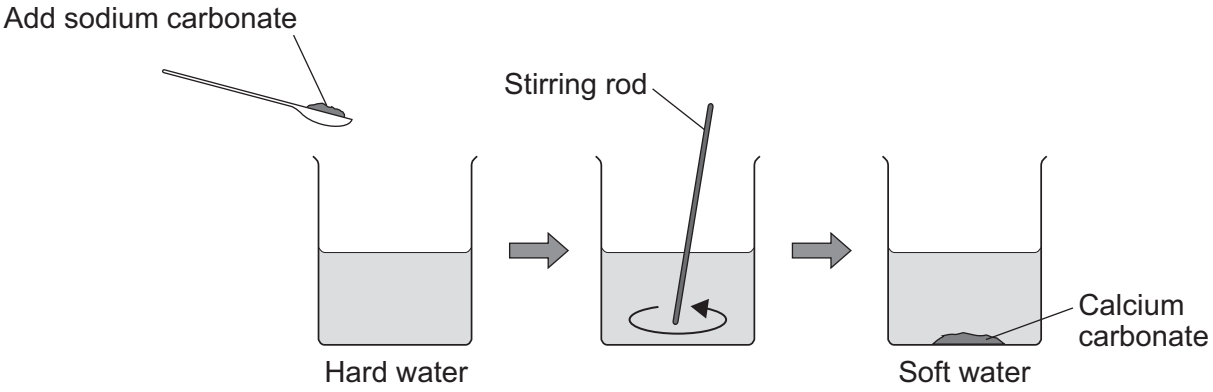
10 (b) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Hard water can be softened by two different methods.

Method 1: Ion exchange



Method 2: Adding sodium carbonate (washing soda)



Do not write outside the box

Describe how each method softens water **and** compare the advantages of these two methods.

[6 marks]

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Extra space .....

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8

END OF QUESTIONS

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AQA

GCSE

Chemistry

CH3FP

Mark scheme

4402

June 2015

Version/Stage: 1.0 Final

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Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from aqa.org.uk

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Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

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Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient are used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

Quality of Written Communication and levels marking

In Question 10(b) students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)(i)	Solids		1	**AO1** 3.2.2.a
1(a)(ii)	Chlorine		1	**AO1** 3.2.2.c
1(a)(iii)	kill microbes/bacteria	allow to make the water safe to drink ignore disinfect ignore remove / get rid of microbes	1	**AO1** 3.2.2.a,c
1(b)	energy	allow heat	1	**AO1** 3.2.2.d
1(c)	improve dental health	allow reduce tooth decay allow (local) government requirement allow help teeth	1	**AO1** 3.2.2.c
Total			**5**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)(i)	Na	allow sodium	1	**AO1** 3.1.3.a
2(a)(ii)	Cu	allow copper	1	**AO2** 3.1.3.c
2(a)(iii)	C	allow carbon	1	**AO2** 3.1.2.b
2(a)(iv)	He	allow helium	1	**AO1** 3.1.2.b
2(b)	H	allow hydrogen do **not** allow H_2	1	**AO2** 3.1.2.b
Total			**5**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)(i)	11		1	**AO2** 3.3.1.c
3(a)(ii)	4620 (J)	correct answer gains **2** marks with or without working allow 4.62kJ for **2** marks if answer is incorrect: 100 x 4.2 x 11 gains 1 mark **or** 100 x 4.2 x (their temp. rise) gains **1** mark **or** 100 x 4.2 x (their temp. rise) correctly calculated gains **2** marks	2	**AO2** 3.3.1.c
3(b)	the temperature increases	allow gets hotter allow heat / energy is given off	1	**AO2** 3.3.1.c
3(c)(i)	(energy of) products lower than (energy of) reactants	allow converse allow arrow C points downwards	1	**AO2** 3.3.1.d
3(c)(ii)	A		1	**AO2** 3.3.1.d
Total			**6**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	natural gas	allow correct answer shown in box if answer line blank	1	**AO1** 3.5.1.a
4(b)(i)	450	allow correct answer shown in box if answer line blank	1	**AO1** 3.5.1.b
4(b)(ii)	iron	allow correct answer shown in box if answer line blank	1	**AO1** 3.5.1.b
4(b)(iii)	The catalyst lowers the activation energy.		1	**AO1** 3.3.1.h
4(c)	(the gases are) cooled ammonia condenses nitrogen and hydrogen are recycled	 allow ammonia liquefies if no other mark awarded allow ammonia is separated for **1** mark	1 1 1	**AO1/ AO2** 3.5.1.b
Total			**7**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	oxygen	allow correct answer shown in box if answer line blank	1	**AO2** 3.6.1.b
5(b)	vinegar	allow correct answer shown in box if answer line blank	1	**AO1** 3.6.1.c
5(c)	C		1	**AO1** 3.6.2.a
5(d)	Ester		1	**AO2** 3.6.3.a
5(e)	pleasant smell volatile	 allow low boiling point / evaporates	1 1	**AO1** 3.6.3.a
Total			**6**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)	copper (II) → blue iron (III) → brown	more than one line from any box negates the mark	1 1	**AO1** 3.4.1.c
6(b)	aluminium	allow correct answer shown in box if answer line blank	1	**AO1** 3.4.1.b
6(c)(i)	yellow	allow orange	1	**AO1** 3.4.1.a
6(c)(ii)	lilac	allow purple	1	**AO1** 3.4.1.a
6(c)(iii)	one colour masks the other	allow colours mixed	1	**AO2** 3.4.1.a
Total			**6**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)(i)	(19.5 + 18.5 + 19.0)/3	allow (23.0 +19.5 + 18.5 + 19.0)/4 for **1** mark	2	**AO2/ AO3** 3.4.1.g
7(a)(ii)	R P Q	allow Q P R for **1** mark	2	**AO3** 3.4.1.g
7(b)	any **two** from: • repeat more times • calculate a mean • measure to one decimal place		2	**AO3** 3.4.1.g
7(c)	both students get similar results / similar pattern		1	**AO3** 3.4.1.g
Total			**7**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
8(a)	(iron) is a metal	accept transition element allow (iron) had different properties (to oxygen and sulfur) ignore electrons	1	**AO2** 3.1.1.a
8(b)	so that elements with similar properties could be placed together	allow to make the pattern fit ignore undiscovered elements	1	**AO1** 3.1.1.b
8(c)	atomic number(s)	allow proton number(s)	1	**AO1** 3.1.2.a
8(d)	all have one electron in the outer shell (highest energy level) (so they) have similar properties **or** react in the same way	allow same number of electrons in the outer shell (highest energy level) allow specific reactions e.g. with water	1 1	**AO1** 3.1.2.b
Total			**5**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
9(a)	increase		1	**AO1** 3.1.3.f
9(b)(i)	Na^+ **and** Br^-	both required	1	**AO1** 3.1.3.a/e
9(b)(ii)	sodium chloride	allow NaCl do **not** allow sodium chlorine	1	**AO2** 3.1.3.g
9(b)(iii)	chlorine is more reactive than bromine	allow converse argument allow symbols Cl, Cl_2, Br and Br_2 allow chlorine / it is more reactive. do **not** allow chloride **or** bromide	1	**AO1** 3.1.3.g
9(b)(iv)	fluorine	allow F / F_2. do **not** allow fluoride.	1	**AO2** 3.1.3.g
Total			**5**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
10(a)	(calcium or magnesium) ions causing water hardness are dissolved	ignore named anions	1	**AO1/ AO2** 3.2.1.b
	from rocks	allow limestone	1	

10(b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking.

AO1/ AO3 3.2.1.g 3.2.2.b

0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)
No relevant content	There is a statement about one of the methods **or** one advantage of one of the methods	There is a description of one method of water softening **and** one advantage of a method is given	There is a description of both methods of water softening **and** a comparison of the two methods by giving an advantage of at least one of them

general:

- hard water contains calcium/magnesium (ions)
- softening water involves removal of calcium/magnesium (ions)

ion exchange:

- resin
- contains sodium/hydrogen ions
- which are exchanged with calcium/magnesium ions
- resin needs periodic replenishment with sodium ions/hydrogen ions or sodium chloride (disadvantage)
- increases sodium content of water (if sodium ions used) (disadvantage)
- easy/quick method to use (advantage)
- continuous process (advantage)

sodium carbonate:

- sodium carbonate is added to hard water
- calcium/magnesium ions precipitate out
- as calcium/magnesium carbonate
- batch process (disadvantage)
- leaves a residue of precipitated carbonate in the water (disadvantage)
- increases sodium content of water (disadvantage)
- easy method to use (advantage)
- relatively cheap (advantage)

Total			8

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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	
8	
TOTAL	

General Certificate of Secondary Education
Foundation Tier
June 2014

Chemistry
Unit Chemistry C3

CH3FP

F

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 8(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.

Do not write outside the box

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

1 This question is about the periodic table of elements.

Use the Chemistry Data Sheet to help you to answer these questions.

In 1869 Dmitri Mendeleev produced an early version of the periodic table.

1 (a) Draw a ring around the correct answer to complete each sentence.

1 (a) (i) Mendeleev first arranged the elements in order of their

atomic weight.

date of discovery.

electron number.

[1 mark]

1 (a) (ii) Mendeleev then placed elements with similar properties in columns called

groups.

periods.

shells.

[1 mark]

1 (a) (iii) When the next element did not fit the pattern,

Mendeleev

ignored the element.

left a gap.

put the element at the end of the row.

[1 mark]

1 (a) (iv) Mendeleev was not able to include the noble gases (Group 0) in his periodic table

because the noble gases

are not elements.

are not reactive.

had not been discovered by 1869.

[1 mark]

Do not write outside the box

1 (b) Use the correct word from the box to complete each sentence.

[2 marks]

electrons	molecules	neutrons	protons

In the modern periodic table elements are arranged in order of the number of ..... in their nucleus. Elements in the same group have the same number of ..... in their highest energy level (outer shell).

1 (c) Sodium (Na) is in Group 1 of the periodic table.

Nickel (Ni) is a transition element.

Tick (✓) **two** correct statements about sodium and nickel.

[2 marks]

Statement	Tick (✓)
Sodium and nickel are both metals.	
Sodium has a higher melting point than nickel.	
Sodium is more reactive than nickel.	
Sodium is harder than nickel.	

1 (d) Chlorine, bromine and iodine are in Group 7 of the periodic table.

Chlorine is more reactive than bromine.

1 (d) (i) Complete the word equation for the reaction between chlorine and sodium bromide.

[1 mark]

chlorine + sodium bromide ⟶ ..... + sodium chloride

1 (d) (ii) Why does iodine **not** react with sodium bromide solution?

[1 mark]

.....

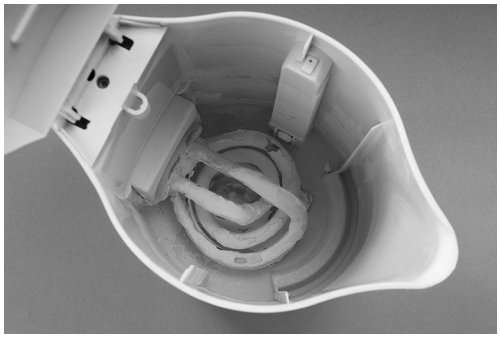
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10

Do not write outside the box

2 Hard water causes scale to form in kettles, as shown in **Figure 1**.

Figure 1



2 (a) The sentences describe how water becomes hard and causes scale.

The sentences are in the wrong order.

A Water is heated.

B Water flows over rocks.

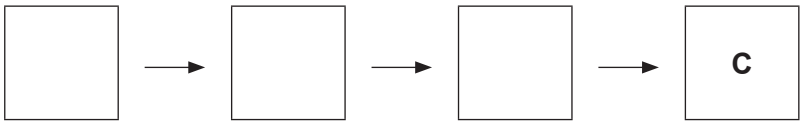
C Scale forms.

D Ions causing hardness dissolve in the water.

Complete the boxes to show the correct order of the sentences.

The last box has been done for you.

[2 marks]



2 (b) Draw a ring around the correct answer to complete the sentence.

[1 mark]

Hardness in water is caused by dissolved

- calcium ions.
- chloride ions.
- sodium ions.

Do not write outside the box

2 (c) Vinegar is used to remove scale in kettles.

Vinegar contains the acid with the formula CH_3COOH

2 (c) (i) Draw a ring around the correct answer to complete the sentence.

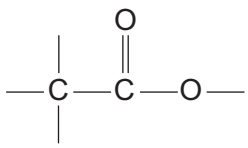
[1 mark]

Vinegar contains

ethanoic acid.
nitric acid.
sulfuric acid.

2 (c) (ii) Complete the displayed structure of the acid CH_3COOH

[1 mark]



2 (c) (iii) Scale in kettles contains calcium carbonate.

When vinegar reacts with scale, a gas is produced.

Name the gas.

[1 mark]

.....

2 (d) Why does removing the scale from a kettle save money?

[1 mark]

.....

.....

2 (e) Hard water reacts with soap.

Complete the sentence.

[1 mark]

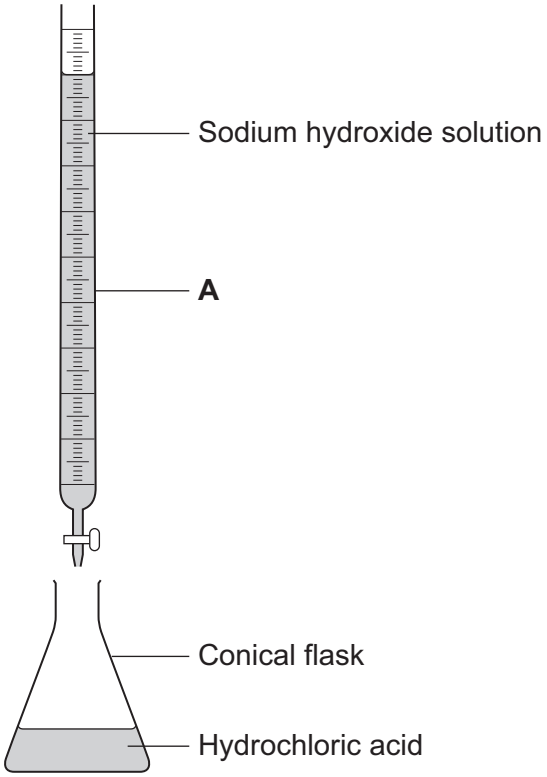
When hard water reacts with soap, it forms ..... .

8

Do not write outside the box

3 A student used the apparatus in **Figure 2** to do a titration.

Figure 2



3 (a) (i) What is the name of the piece of apparatus labelled **A**?

Draw a ring around the correct answer.

[1 mark]

burette **measuring cylinder** **test tube**

3 (a) (ii) What should the student add to the acid in the conical flask?

Draw a ring around the correct answer.

[1 mark]

catalyst **indicator** **water**

3 (a) (iii) What would the student see when the end point of the titration has been reached?

[1 mark]

.....

Do not write outside the box

3 (b) The student does the titration three times.

3 (b) (i) State **one** variable that the student needs to keep the same to make it a fair test.

[1 mark]

.....

3 (b) (ii) The student's results are shown in **Table 1**.

Table 1

Titration	Volume of sodium hydroxide solution added in cm^3
1	22.40
2	22.20
3	22.30

Calculate the mean volume of sodium hydroxide solution added.

[1 mark]

..... cm^3

5

Turn over for the next question

Do not write outside the box

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

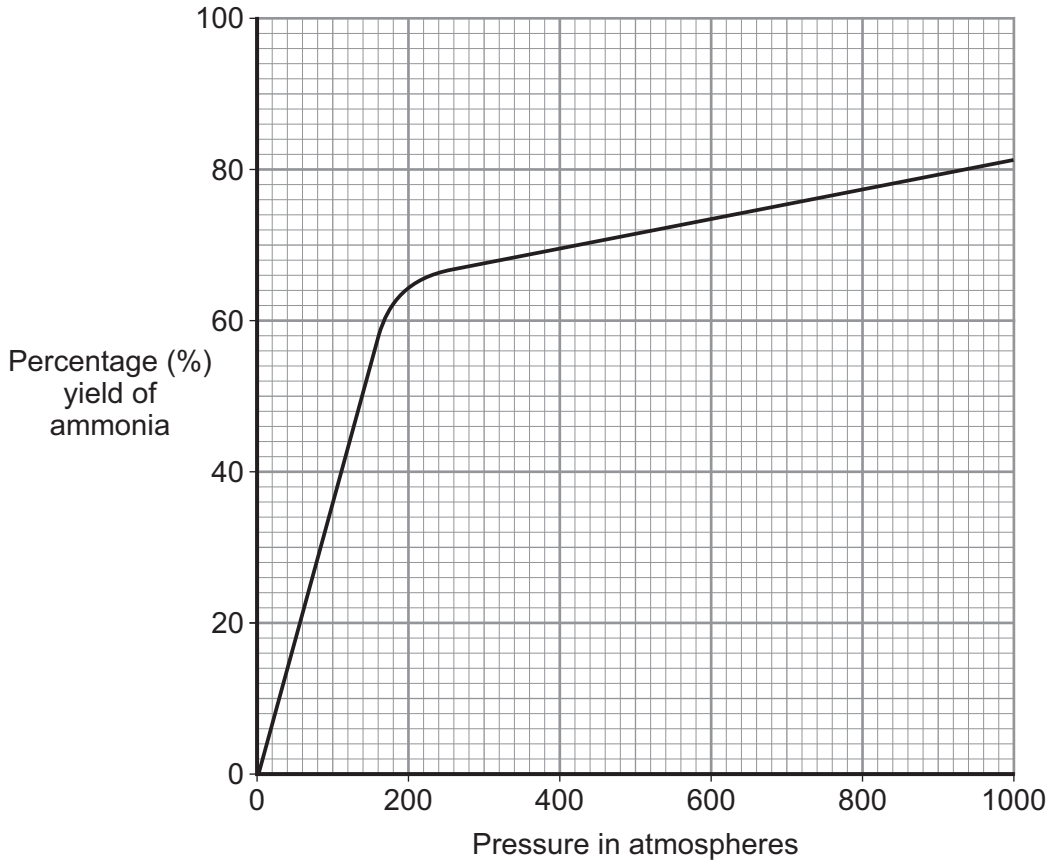
4 (a) Complete the word equation, showing that the reaction is reversible.

[2 marks]

nitrogen + hydrogen ....

4 (b) **Figure 3** shows how the yield of ammonia at 300 °C changes with pressure.

Figure 3



Describe how the yield of ammonia changes as the pressure increases.

[3 marks]

.....

.....

.....

.....

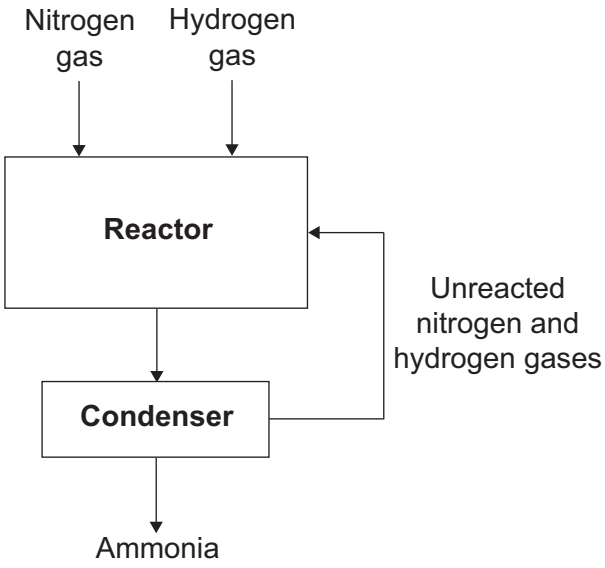
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Do not write outside the box

4 (c) **Figure 4** represents the Haber process.

Figure 4



How does the Haber process avoid wasting nitrogen and hydrogen?

[1 mark]

.....

.....

4 (d) Before the Haber process, nitrates had been mined in South America. Nitrates are used for making fertilisers.

The Haber process allowed nitrates to be produced on a large scale, anywhere in the world.

4 (d) (i) Suggest what effect the Haber process had on the miners in South America.

[1 mark]

.....

.....

4 (d) (ii) Suggest **one** advantage of producing nitrates on a large scale.

[1 mark]

.....

.....

8

Turn over ▶

Do not write outside the box

5 Some cars are powered by hydrogen fuel cells.

Figure 5



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

Draw a ring around the correct answer.

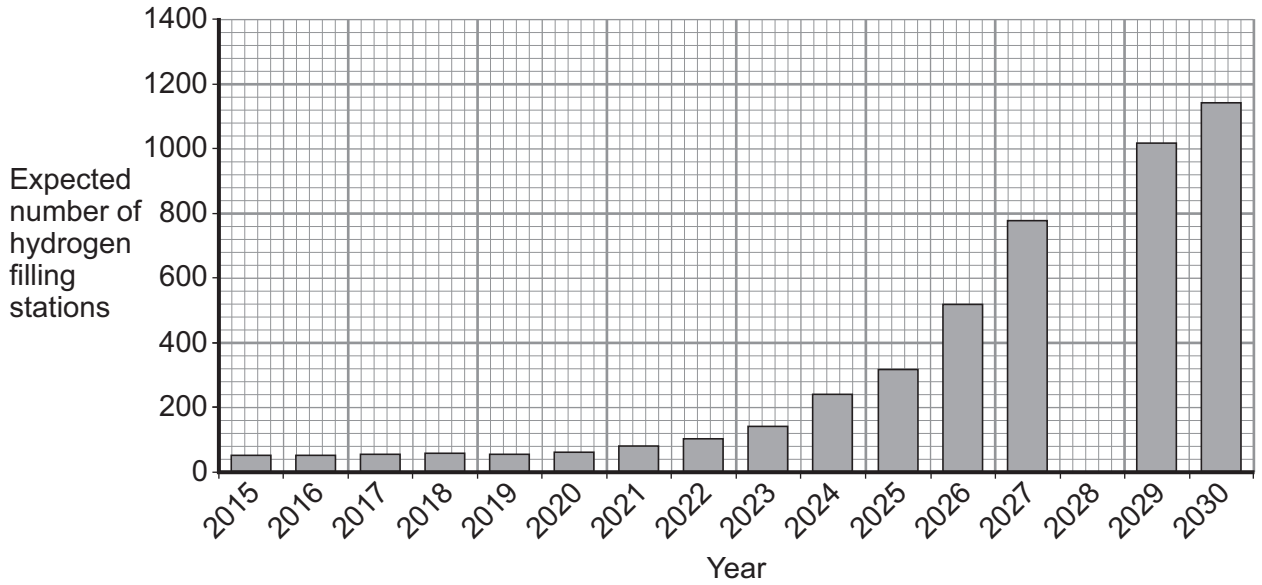
[1 mark]

chemical **electrical** **light**

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

Figure 6 shows how the number of hydrogen filling stations in the UK is expected to increase up to the year 2030.

Figure 6



Do not write outside the box

5 (b) (i) Suggest the total number of hydrogen filling stations expected in 2028.

[1 mark]

.....

5 (b) (ii) The number of hydrogen filling stations will still be very low compared with the number of petrol filling stations.

Suggest **one** reason why.

[1 mark]

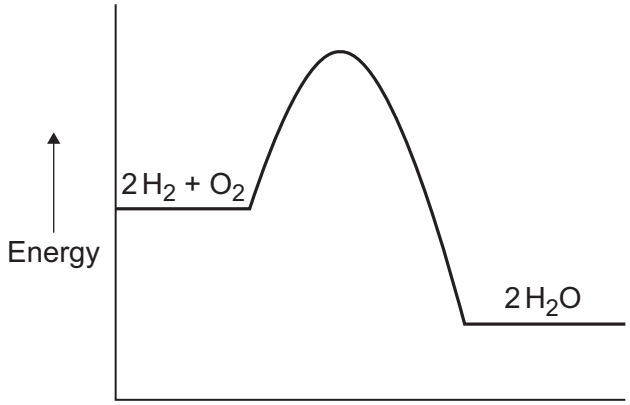
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5 (c) Hydrogen reacts with oxygen to produce water.

The energy level diagram for this reaction is shown in **Figure 7**.

Figure 7



Mark clearly with a cross (×) on **Figure 7** where bond breaking happens.

[1 mark]

4

Turn over for the next question

Do not write outside the box

6 (a) The colours of fireworks are produced by chemicals.

Figure 8



Three of these chemicals are lithium sulfate, potassium chloride and sodium nitrate.

6 (a) (i) A student wants to carry out flame tests on these three chemicals.

Describe how to carry out a flame test.

[2 marks]

.....

.....

.....

.....

6 (a) (ii) Draw **one** line from each chemical to the correct flame colour.

The first one has been done for you.

[2 marks]

Chemical	Flame colour
lithium sulfate	crimson
potassium chloride	
sodium nitrate	
	green
	yellow
	lilac

Do not write outside the box

6 (a) (iii) Dilute nitric acid and silver nitrate solution are added to solutions of the three chemicals.

A white precipitate forms in one of the solutions.

Which chemical produces the white precipitate?

[1 mark]

.....

6 (b) The student tests a fourth chemical, **X**.

6 (b) (i) The student adds sodium hydroxide solution to a solution of chemical **X**.

A blue precipitate is formed.

Which metal ion is in chemical **X**?

[1 mark]

.....

6 (b) (ii) The student adds dilute hydrochloric acid to a solution of chemical **X** and then adds barium chloride solution.

A white precipitate is formed.

Which negative ion is in chemical **X**?

Draw a ring around the correct answer.

[1 mark]

chloride **nitrate** **sulfate**

7

Turn over for the next question

Do not write outside the box

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

Figure 9



7 (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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Do not write outside the box

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

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

What is in water filters that removes hardness from water?

[1 mark]

.....

.....

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

[1 mark]

.....

.....

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

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

[1 mark]

.....

.....

7 (d) Drinking hard water has health benefits.

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

[1 mark]

.....

.....

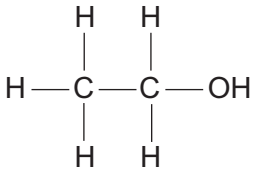
8

Turn over for the next question

Do not write outside the box

8 (a) The structure of an alcohol is shown in **Figure 10**.

Figure 10



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

[1 mark]

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

[1 mark]

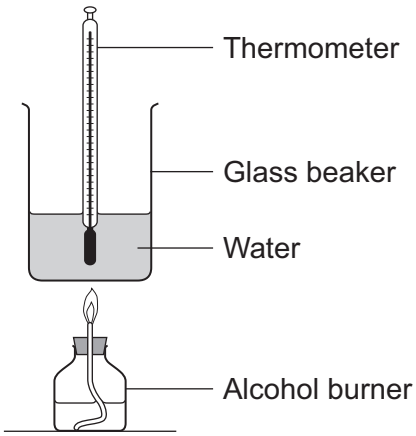
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8 (b) Alcohols are used as fuels.

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

The student uses the apparatus shown in **Figure 11**.

Figure 11



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

[2 marks]

.....

.....

.....

.....

Do not write outside the box

8 (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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10

END OF QUESTIONS

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GCSE
CHEMISTRY

CH3FP
Mark scheme

4402
June 2014

Version: 1.0 Final

STEMUP.CO.UK

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from aqa.org.uk

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Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

Quality of Written Communication and levels marking

In Question 8(b)(ii) students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: Basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: Clear

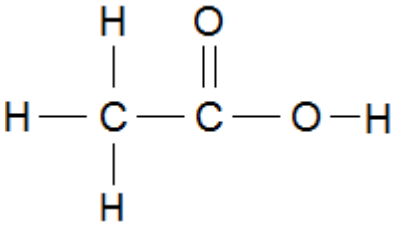
- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: Detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
1(a)(i)	atomic weight		1	1 / 3.1.1a	A
1(a)(ii)	groups		1	1 / 3.1.1a	A
1(a)(iii)	left a gap		1	1 / 3.1.1b	A
1(a)(iv)	had not been discovered by 1869		1	3 / 3.1.1b	A
1(b)	protons electrons	*must be in correct order*	1 1	1 / 3.1.2a/b	G
1(c)	sodium and nickel are both metals sodium is more reactive than nickel		1 1	1 / 3.1.3c	A
1(d)(i)	bromine	allow Br_2 / *Br* do **not** allow bromide	1	2 / 3.1.3g	E
1(d)(ii)	iodine is less reactive (than bromine)	*it = iodine* allow converse do **not** allow bromide	1	1 / 3.1.3g	E
Total			**10**		

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Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
2(a)	B D A (C)	allow **one** mark for one letter in correct position	2	2 / 3.2.1b/e	G
2(b)	calcium ions		1	1 / 3.2.1b	A
2(c)(i)	ethanoic acid		1	1 / 3.6.1c	A
2(c)(ii)			1	2 / 3.6	E
2(c)(iii)	carbon dioxide	allow CO_2	1	1 / 3.4.1d	G
2(d)	more efficient heating	allow saves energy *allow takes less time to boil*	1	1 / 3.2.1e	E
2(e)	scum	*accept calcium stearate* *accept magnesium stearate* *accept (white) precipitate*	1	1 / 3.2.1a	G
Total			**8**		

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Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
3(a)(i)	burette		1	1 / 3.4.1g	A
3(a)(ii)	indicator		1	1 / 3.4.1g	A
3(a)(iii)	colour change		1	1 / 3.4.1g	E
3(b)(i)	any **one** from: • volume of (hydrochloric) acid • concentration of (hydrochloric) acid • concentration of (sodium) hydroxide	*allow amount of (hydrochloric) acid* allow concentration of alkali	1	3 / 3.4.1g	E
3(b)(ii)	22.3(0)		1	2 / 3.4.1g	G
Total			**5**		

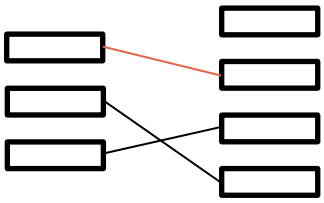
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Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
4(a)	⇌ ammonia	 allow NH_3	1 1	2 / 3.5.1b	E
4(b)	increases quickly at first *then slows* *at any number in range from 160 – 220 (atmospheres)*	 *ignore* levels off allow *rate of increase slows for first two marking points* *allow any number in range 60 – 66 (%)*	1 1 1	2 / 3.5	E
4(c)	(nitrogen and hydrogen) recycled	*allow (nitrogen and hydrogen) reused*	1	1 / 3.5.1b	E
4(d)(i)	*jobs lost*	accept mines closed **or** local economy damaged	1	3 / 3.5	E
4(d)(ii)	any **one** from: • *nitrates* / fertilisers cost less • more crops / food can be grown • food costs less • *nitrates / fertilisers more widely available*		1	3 / 3.5	E
Total			**8**		

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Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
5(a)	electrical		1	1 / 3.3.1i	A
5(b)(i) **view with graph**	900	accept any answer between *840* and *960*	1	2 / 3.3	G
5(b)(ii)	any **one** from: • little demand • few hydrogen cars • *changeover from petrol to hydrogen will take time*	*allow answers in terms of petrol*	1	3 / 3.3	E
5(c)	X on rising section of *line*		1	2 / 3.3.1d	E
Total			**4**		

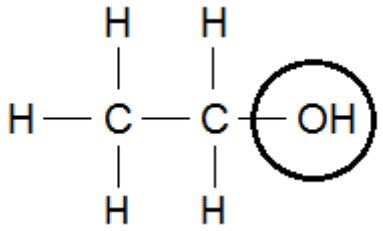
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Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
6(a)(i)	*method of introducing sample into flame* *clean wire or colourless flame*	*e.g. wire/splint/spray* *allow blue / roaring flame*	1 1	1 / 3.4	E
6(a)(ii)			1 1	2 / 3.4.1a	G
6(a)(iii)	(potassium) chloride	allow KCl **or** Cl^-	1	2 / 3.4.1e	E
6(b)(i)	copper	allow Cu^{2+}	1	2 / 3.4.1c	E
6(b)(ii)	sulfate		1	2 / 3.4.1f	A
Total			**7**		

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Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
7(a)	filter to remove *solids* ***or*** *insoluble particles* ***OR*** *add coagulant (1)* flocculation / settling / remove solids (1) (add) chlorine to reduce the number of microbes	 *accept ozone / UV* accept to kill microbes / bacteria / germs accept sterilise *allow disinfect* *ignore remove microbes*	1 1 1 1	1 / 3.2.2a/c	E
7(b)(i)	ion exchange resin	allow ion exchange column *allow sodium ions / Na^+* *allow hydrogen ions / H^+*	1	1 / 3.2.2b	E
7(b)(ii)	prevent growth of microbes	*accept sterilise* *accept to kill microbes / bacteria / germs* *accept to reduce the number of microbes* *ignore remove microbes*	1	1 / 3.2.2b	E
7(c)	high cost of energy / *heating*	*allow uses a lot of energy*	1	2 / 3.2.2d	E
7(d)	any **one** from: • helps to develop / maintain bones • helps to develop / maintain teeth • reduces heart disease	 allow any suitable positive effect on bones allow any suitable positive effect on teeth	1	1 / 3.2.1f	E
Total			**8**		

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Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
8(a)(i)			1	1 / 3.6	G
8(a)(ii)	ethanol	*allow ethyl alcohol* *do **not** accept ethanal* *ignore all formulae*	1	1 / 3.3.1a	G
8(b)(i)	any **two** from: • lid • *metal* calorimeter • insulation (around sides of beaker) • excluding draughts • stirrer	 allow *metal* beaker do **not** allow flammable insulation / beaker *allow stirring*	2	3 / 3.3.1a	E

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<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th><th>ID</th></tr>
<tr><td colspan="4">
8(b)(ii) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a ‘best-fit’ approach to the marking.
<table>
<tr><th>0 marks</th><th>Level 1 (1–2 marks)</th><th>Level 2 (3–4 marks)</th><th>Level 3 (5–6 marks)</th></tr>
<tr><td>No relevant content</td><td>There is a description of part of an experimental method or a measurement which should be taken.</td><td>There is a description of some parts of an experimental method and a measurement which should be taken.</td><td>There is a description of an experimental method and measurements which should be taken.</td></tr>
<tr><td colspan="4">Examples of the point that may be made in the response</td></tr>
<tr><td colspan="4">

light ethanol and heat water
extinguish ethanol
after suitable temperature rise or after a suitable time
stir water
measure mass / volume of water
measure initial temperature of water
measure final temperature of water
measure temperature rise
measure initial mass of ethanol (and burner)
measure final mass of ethanol (and burner)
measure change in mass of ethanol

</td></tr>
</table>
</td><td></td><td>1 + 3 / 3.3.1a</td><td>E</td></tr>
<tr><td>Total</td><td></td><td></td><td>9</td><td></td><td></td></tr>
</table>

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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	
8	
9	
TOTAL	

General Certificate of Secondary Education
Foundation Tier
June 2013

Chemistry

CH3FP

Unit Chemistry C3

F

Written Paper

Monday 20 May 2013 1.30 pm to 2.30 pm

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 9 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.

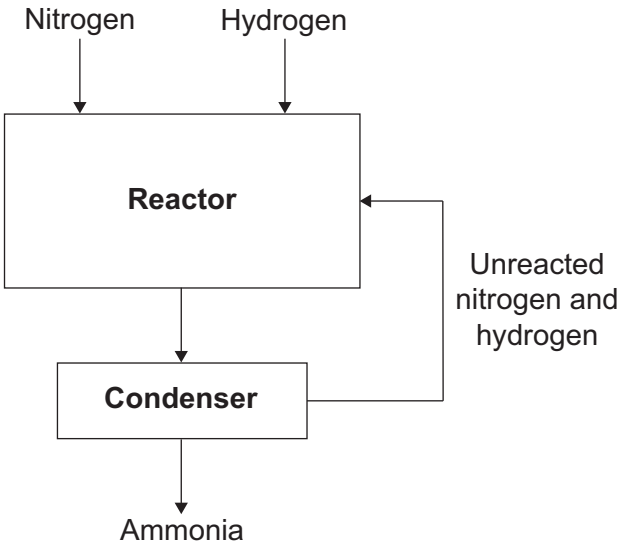
Advice
- In all calculations, show clearly how you work out your answer.

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Do not write outside the box

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

1 The flow diagram shows the Haber process. In the Haber process ammonia is produced from nitrogen and hydrogen.



1 (a) The word equation for the production of ammonia is:

nitrogen + hydrogen $\rightleftharpoons$ ammonia

Draw a ring around the correct answer to complete the sentence.

The symbol $\rightleftharpoons$ in the word equation shows the reaction is

exothermic.

reversible.

slow.

(1 mark)

Do not write outside the box

1 (b) The reactor contains iron.

Complete the sentence.

The iron speeds up the reaction because it is a ..... .

(1 mark)

1 (c) What happens to the unreacted nitrogen and hydrogen?

.....

.....

(1 mark)

1 (d) The sentences describe how ammonia is produced in the Haber process.

The sentences are in the wrong order.

P Ammonia is separated as a liquid.

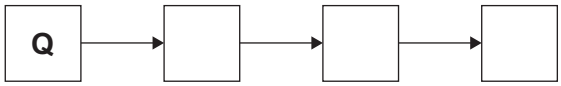
Q Nitrogen and hydrogen are mixed together.

R A mixture of gases enters the condenser.

S Nitrogen and hydrogen react to produce ammonia.

Complete the boxes below to show the correct order of the sentences.

The first box has been done for you.



(2 marks)

5

Turn over for the next question

Do not write outside the box

2 Low sodium salt is used on food. This label is from a packet of low sodium salt.

Low Sodium Salt

Ingredients:

Sodium chloride
Potassium chloride
Drying agent: magnesium carbonate

A chemist tests the low sodium salt for the substances on the label.

2 (a) The chemist tests for sodium ions and potassium ions using a flame test.

Draw a ring around the correct answer to complete each sentence.

2 (a) (i) In a flame test, sodium ions produce a [lilac / red / yellow] colour.

(1 mark)

2 (a) (ii) In a flame test, potassium ions produce a [lilac / red / yellow] colour.

(1 mark)

Do not write outside the box

2 (b) The chemist added hydrochloric acid to low sodium salt. Carbon dioxide gas was produced.

Describe the test for carbon dioxide and give the result of the test.

.....

.....

.....

.....

(2 marks)

2 (c) The chemist made a solution of low sodium salt.

2 (c) (i) Tick (✓) **one** box to show the chemical used to test for chloride ions.

	Tick (✓)
Barium chloride solution	
Silver nitrate solution	
Sodium sulfate solution	

(1 mark)

2 (c) (ii) Sodium hydroxide solution is used to test for magnesium ions.

Draw a ring around the colour of precipitate produced by this test.

brown **green** **white**

(1 mark)

6

Turn to page 7 for the next question

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

3 This question is about the periodic table.

Use the Chemistry Data Sheet to help you answer these questions.

3 (a) Complete the sentences.

Elements in the periodic table are arranged in order of atomic ..... .

The elements in Group ..... are called the noble gases.

(2 marks)

3 (b) Calcium (Ca) is in Group 2.

Name **one** other element in Group 2.

.....

(1 mark)

3 (c) Draw a ring around the correct answer to complete each sentence.

3 (c) (i) Sodium (Na) is

an alkali metal.

a non-metal.

a transition metal.

(1 mark)

3 (c) (ii) Nickel (Ni) is

an alkali metal.

a non-metal.

a transition metal.

(1 mark)

3 (d) In 1869 Mendeleev produced his periodic table.

Why did Mendeleev leave gaps in his periodic table?

.....

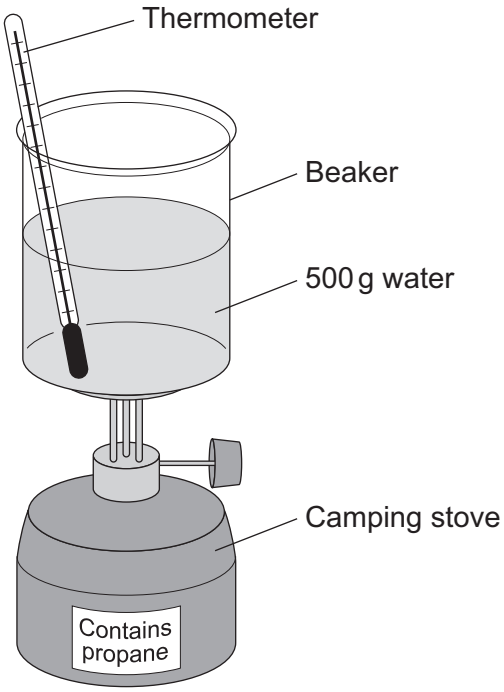
.....

(1 mark)

6

Do not write outside the box

4 A camping stove uses propane gas.



4 (a) A student did an experiment to find the energy released when propane is burned.

The student:

- put 500 g water into a beaker
- measured the temperature of the water
- heated the water by burning propane for 1 minute
- measured the temperature of the water again.

The student found the temperature change was 20 °C.

The student can calculate the energy released, in joules (J), using the equation:

energy released (J) = mass of water (g) × 4.2 × temperature change (°C)

4 (a) (i) Use the student's result to calculate the energy released in joules (J).

.....

.....

Energy released = ... J

(2 marks)

Do not write outside the box

4 (a) (ii) State **two** safety precautions that the student should take during the experiment.

1 .....

.....

2 .....

.....

(2 marks)

4 (a) (iii) Tick (✓) **two** boxes which describe how the student could make his result more accurate.

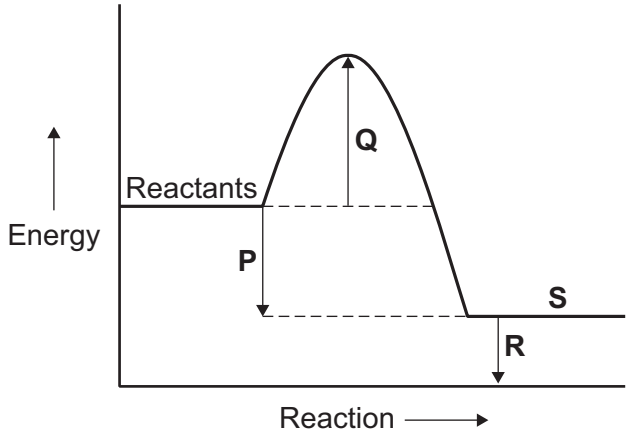
	Tick (✓)
Stir the water before measuring the temperature.	
Heat the water until it boils.	
Place a lid on the beaker.	
Use a larger beaker for the water.	

(2 marks)

Question 4 continues on the next page

Do not write outside the box

4 (b) The change in energy when propane is burned can be shown in an energy level diagram.



Draw **one** line from each description to the correct letter.

Description	Letter
products	P
activation energy	Q
energy released by the reaction	R
	S

(3 marks)

Do not write outside the box

4 (c) Propane and hydrogen are both used as fuels.

Some information about propane and hydrogen is given in the table.

Fuel	Resource	Products formed when fuel burned
propane	crude oil	carbon dioxide and water
hydrogen	water	water

Use the information in the table to suggest **two** disadvantages that propane has as a fuel compared to hydrogen.

1 .....

.....

2 .....

.....

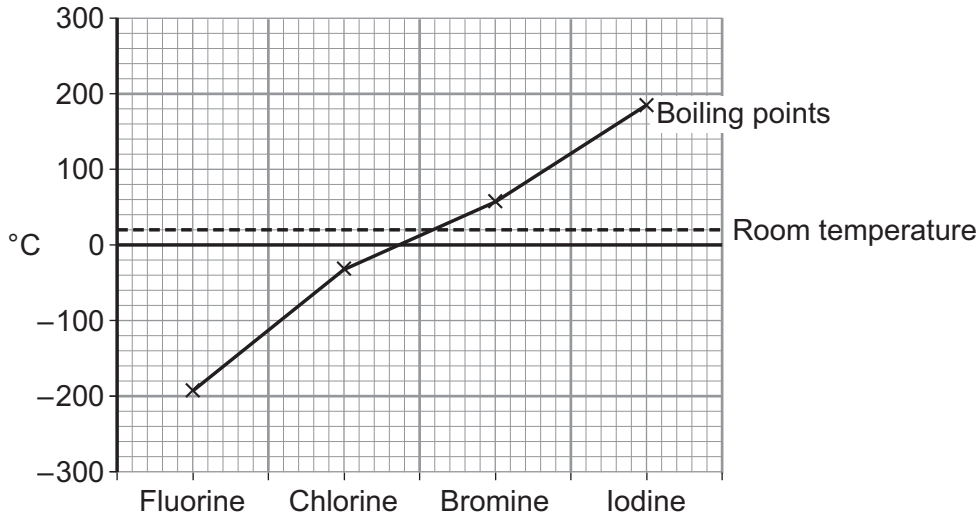
(2 marks)

11

Turn over for the next question

Do not write outside the box

5 The graph shows the boiling points of the halogens.



5 (a) Use the graph to help you answer these questions.

5 (a) (i) Use the correct answer from the box to complete the sentence.

gas	liquid	solid

At room temperature chlorine is a ..... .

(1 mark)

5 (a) (ii) Describe the trend in boiling point from fluorine to iodine.

.....

.....

(1 mark)

5 (b) Chlorine reacts with metals to produce metal chlorides.

5 (b) (i) When a chlorine atom forms a chloride ion it gains one electron.

What is the charge on a chloride ion?

.....

(1 mark)

5 (b) (ii) Write a word equation for the reaction between sodium and chlorine.

.....

(1 mark)

Do not write outside the box

5 (c) In the UK water companies add chlorine to tap water.

Why is chlorine added to tap water?

.....

(1 mark)

5 (d) Water companies add fluoride to tap water in some parts of the UK.
Fluoride is added to improve dental health.

Suggest **one** reason why some people are against adding fluoride to tap water.

.....

.....

.....

(1 mark)

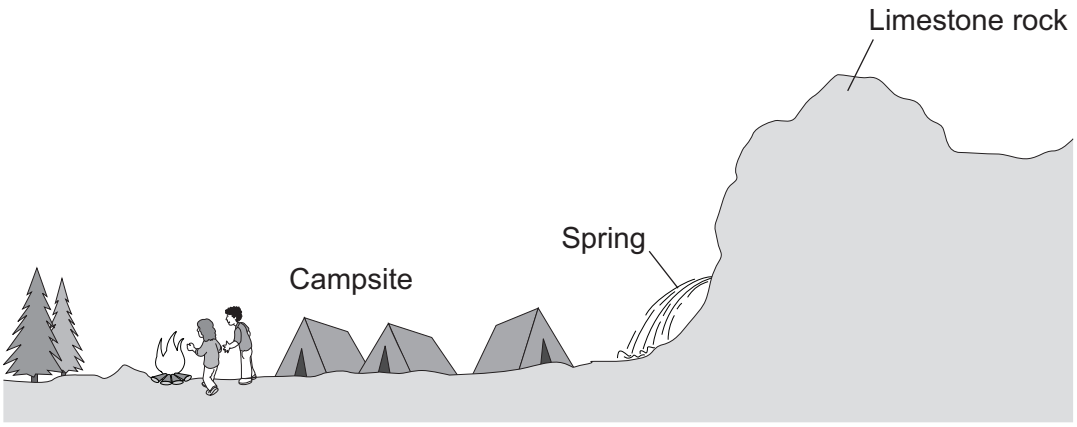
6

Turn over for the next question

Do not write outside the box

6 This question is about hard water.

6 (a) A campsite has a spring, where water flows out of limestone rock.



6 (a) (i) The water from the spring is hard because it contains calcium ions.

How do the calcium ions get into the spring water?

.....

.....

(1 mark)

6 (a) (ii) A student at the campsite boils some of the spring water in a pan. The inside of the pan becomes coated with a white solid.

What is the white solid?

.....

(1 mark)

6 (a) (iii) When the student uses soap to wash in the spring water, scum forms.
Scum is **not** formed if the spring water has been boiled and allowed to cool.

Draw a ring around the correct answer to complete the sentence.

The hardness in the spring water is

acidic.
permanent.
temporary.

(1 mark)

Do not write outside the box

6 (b) In a laboratory, a student compared the hardness of three different samples of water.

The student measured 20 cm^3 of water into a boiling tube.
The student then:

- added a drop of soap solution
- shook the boiling tube for 10 seconds
- looked to see if a permanent lather had formed.

The student repeated the procedure until a permanent lather formed.

The results are shown in the table.

Water sample	Number of drops of soap solution needed to form a permanent lather			
	Test 1	Test 2	Test 3	Mean
Spring water	13	11	6	
Tap water	7	5	6	6
Distilled water	1	1	1	1

6 (b) (i) Calculate the correct mean for spring water.

.....

Mean = ... drops
(2 marks)

6 (b) (ii) Which of the three sources of water was hardest?

Draw a ring round the correct answer.

distilled water **spring water** **tap water**

Use the results in the table to give a reason for your answer.

.....

.....

.....
(2 marks)

Question 6 continues on the next page

Do not write outside the box

6 (c) Ion exchange columns are used to soften hard water.



6 (c) (i) Draw a ring around the correct answer to complete each sentence.

The ion exchange column softens water by [dissolving / evaporating / removing] calcium ions.

Calcium ions in the water exchange with [chloride / magnesium / sodium] ions in the column.

(2 marks)

6 (c) (ii) After a few weeks sodium chloride solution needs to be passed through the ion exchange column.

Suggest why.

.....

.....

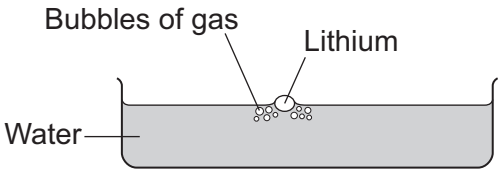
(1 mark)

10

Do not write outside the box

7 Lithium is in Group 1 of the periodic table.

Lithium reacts with water to produce a gas and an alkaline solution.



7 (a) (i) Name the gas produced.

.....

(1 mark)

7 (a) (ii) Which ion causes the solution to be alkaline?

.....

(1 mark)

7 (b) Potassium is also in Group 1 of the periodic table.
Potassium reacts with water in a similar way to lithium.

Write down **two** differences you would see between the reactions of potassium and lithium with water.

1 .....

.....

2 .....

.....

(2 marks)

4

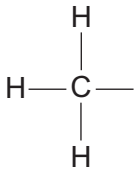
Turn over for the next question

Do not write outside the box

8 This question is about organic compounds.

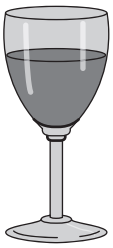
8 (a) Wine contains ethanol (CH_3CH_2OH).

8 (a) (i) Complete the displayed structure of ethanol.



(1 mark)

8 (a) (ii) Wine left in a glass for several days turns sour.
The sour taste is caused by ethanoic acid.



Complete the sentences.

The ethanoic acid is produced from a reaction between ethanol

and ..... .

This type of reaction is ..... .

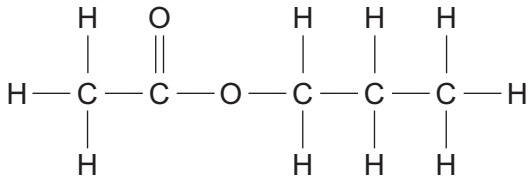
(2 marks)

Do not write outside the box

8 (b) Propyl ethanoate, a fragrance, can be produced by reacting ethanoic acid with an alcohol.

Propyl ethanoate is a member of a series of organic compounds. The members of the series all have the same functional group.

The displayed structure of propyl ethanoate is:



8 (b) (i) Draw a ring around the functional group for this series on the displayed structure of propyl ethanoate.

(1 mark)

8 (b) (ii) Name the series of organic compounds with this functional group.

.....

(1 mark)

8 (b) (iii) The alcohol used to make propyl ethanoate has the formula $CH_3CH_2CH_2OH$

Name this alcohol.

.....

(1 mark)

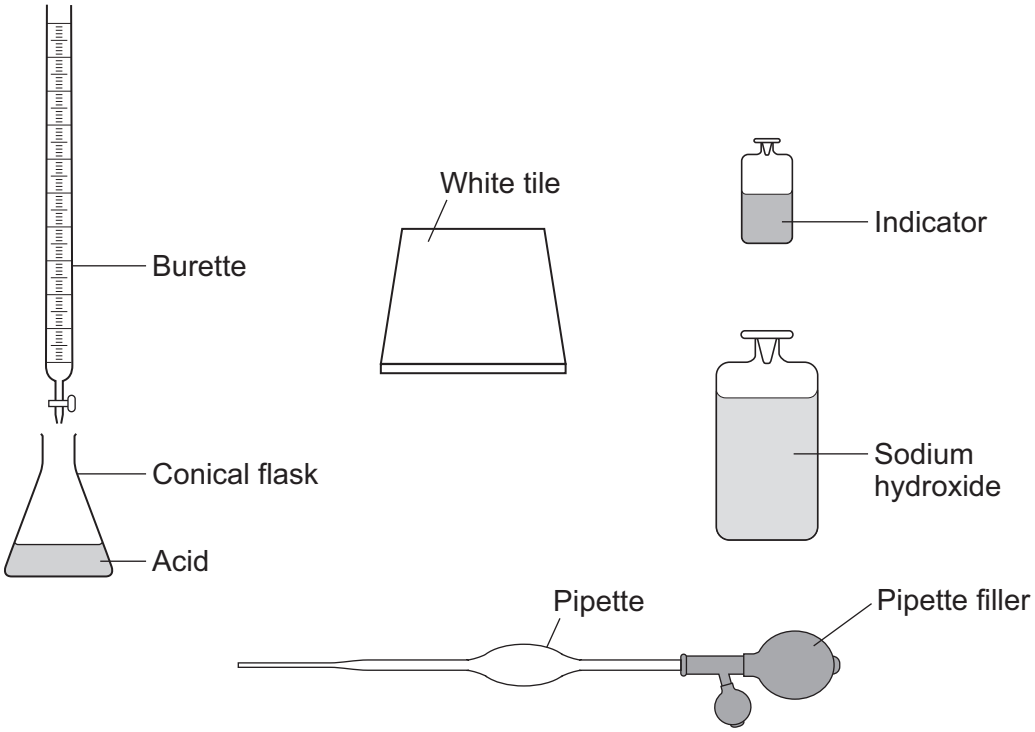
6

Turn over for the next question

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

A student used the equipment shown to do a titration.



Describe how the student should use this equipment to find the volume of sodium hydroxide solution that reacts with a known volume of acid.
Include any measurements the student should make.

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

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(6 marks)

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END OF QUESTIONS

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Version 1.0



General Certificate of Secondary Education
June 2013

Chemistry CH3FP

(Specification 4402)

Unit 3: Chemistry 3

Final

Mark Scheme

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from: aqa.org.uk

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Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

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Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Ignore / Insufficient / Do not allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

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Quality of Written Communication and levels marking

In Question 9 candidates are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Candidates will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

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Question 1

question	Answers	extra information	Mark
1(a)	reversible		1
1(b)	catalyst		1
1(c)	recycled	allow re-used	1
1(d)	(Q) S R P	allow **1** mark if one letter in correct place.	2
Total			**5**

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Question 2

question	Answers	extra information	Mark
2(a)(i)	yellow		1
2(a)(ii)	lilac		1
2(b)	(bubble through) limewater cloudy	 allow white / milky	1 1
2(c)(i)	silver nitrate solution		1
2(c)(ii)	white		1
Total			**6**

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Question 3

question	Answers	extra information	Mark
3(a)	number 0	 allow 8	1 1
3(b)	beryllium **or** magnesium **or** strontium **or** barium **or** radium	allow correct symbols	1
3(c)(i)	an alkali metal		1
3(c)(ii)	a transition metal		1
3(d)	for undiscovered elements	accept so elements with similar properties were in the same groups accept so elements fitted the pattern of properties	1
Total			**6**

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Question 4

question	Answers	extra information	Mark
4(a)(i)	42 000	correct answer gains **2** marks with or without working allow 42 kJ if answer incorrect : correct substitution 500 x 4.2 x 20 gains **1** mark	2
4(a)(ii)	any **two** from: • eye protection • lab coat • heat-proof mat • (heat-proof) gloves • (long) hair tied back • stand up • secure the beaker		2
4(a)(iii)	Stir the water before measuring the temperature. Place a lid on the beaker.		1 1
4(b)	the products → S the activation energy → Q the energy released by the reaction → P		1 1 1
4(c)	carbon dioxide produced (crude oil / propane) non-renewable	it =propane allow converse arguments allow greenhouse gas / global warming / atmospheric pollution allow crude oil running out	1 1
Total			**11**

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Question 5

question	Answers	extra information	Mark
5(a)(i)	gas		1
5(a)(ii)	Increases		1
5(b)(i)	–1	allow Cl^- allow – allow negative	1
5(b)(ii)	sodium + chlorine → sodium chloride	allow correct symbol equation	1
5(c)	reduce microbes	accept sterilise accept prevent diseases allow disinfect allow kill bacteria / germs / microbes/micro-organisms allow to make it safe to drink ignore get rid of bacteria	1
5(d)	any **one** from: • no freedom of choice • fluoride in toothpaste • too much can cause fluorosis	 allow unethical allow too much can cause damage to teeth	1
Total			**6**

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Question 6

question	Answers	extra information	Mark
6(a)(i)	limestone dissolves	accept rock dissolves allow references to the process e.g. hydrogencarbonate ion formation	1
6(a)(ii)	calcium carbonate	accept (lime)scale ignore limestone do **not** accept scum	1
6(a)(iii)	temporary		1
6(b)(i)	12	correct answer with or without working = **2** marks evidence of (13+11)/2 gains **1** mark allow 10 for **1** mark	2
6(b)(ii)	spring water most soap (solution) needed	 depends on first marking point comparison required allow highest number of drops	1 1
6(c)(i)	removing sodium		1 1
6(c)(ii)	to replenish sodium (ions in resin)	accept Na^+ allow 'so sodium ions do not run out' allow 'to remove calcium / magnesium ions'	1
Total			**10**

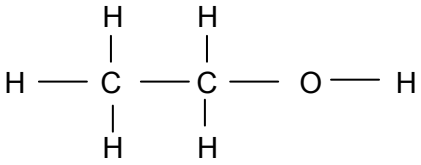
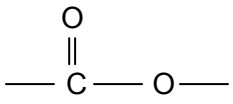
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Question 7

question	Answers	extra information	Mark
7(a)(i)	hydrogen	accept H_2 allow H	1
7(a)(ii)	hydroxide	accept OH^- allow OH do **not** accept lithium hydroxide	1
7(b)	any **two** from: potassium: • reacts / dissolves faster • bubbles / fizzes faster • moves faster (on the surface) • melts • produces (lilac / purple) flame	'it' = potassium accept converse for lithium allow reacts more vigorously / quickly / violently / explodes ignore reacts more allow fizzes more allow more gas allow moves more allow forms a sphere allow catches fire / ignites do **not** accept other colours	2
Total			**4**

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Question 8

question	Answers	extra information	Mark
8(a)(i)		allow other arrangements provided connectivity is correct allow —OH	1
8(a)(ii)	oxygen oxidation	accept O_2 allow O allow oxidisation / oxidising / oxidised allow redox	1 1
8(b)(i)	ring around 		1
8(b)(ii)	ester(s)	do **not** allow ether(s)	1
8(b)(iii)	propanol	accept propan-1-ol allow propyl alcohol	1
Total			**6**

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Question 9

question	answers	extra information	Mark
9	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5.		6

0 marks	**Level 1 (1-2 marks)**	**Level 2 (3-4 marks)**	**Level 3 (5-6 marks)**
No relevant content.	There is a simple description of using some of the equipment.	There is a description of an experimental method involving a measurement, **or** including addition of alkali to acid (or vice versa).	There is a description of a titration that would allow a successful result to be obtained.

examples of chemistry points made in the response could include:

- acid in (conical) flask
- volume of acid measured using pipette
- indicator in (conical) flask
- sodium hydroxide in burette
- white tile under flask
- slow addition
- swirling
- colour change
- volume of sodium hydroxide added

Extra information

- allow acid in the burette to be added to sodium hydroxide in the (conical) flask
- allow any specified indicator

colour change need not be specified

Total			**6**

UMS Conversion Calculator: www.aqa.org.uk/umsconversion

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