AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

GCSE CHEMISTRY

H

Higher Tier Unit Chemistry C3

Wednesday 14 June 2017 Morning Time allowed: 1 hour

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

You may use a calculator.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 2(c)(i) 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.

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

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

1 This question is about water.

1 (a) Rainwater is soft water.

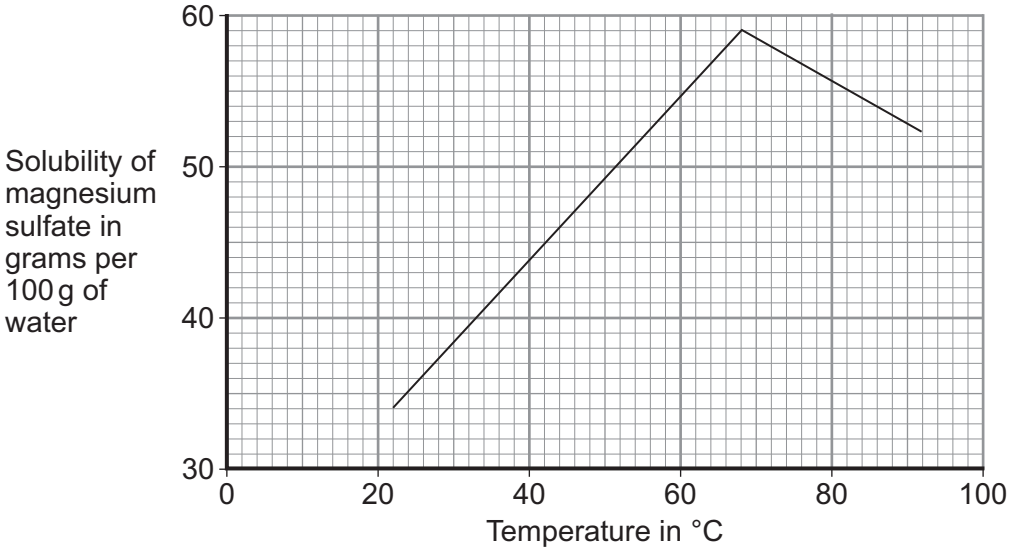
How is hard water formed from rainwater?

[2 marks]

1 (b) A sample of hard water contains magnesium sulfate.

Figure 1 shows the solubility of magnesium sulfate at different temperatures.

Figure 1



What conclusions can be made from **Figure 1**?

Use patterns and values from the graph in your answer.

[3 marks]

1 (c) Give **one** advantage and **one** disadvantage of hard water.

[2 marks]

Advantage _____

Disadvantage _____

1 (d) Describe and explain how hard water is softened using an ion exchange column.

[3 marks]

10

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

2 This question is about the combustion of alcohols.

2 (a) What is the structure of methanol?

[1 mark]

Tick (✓) **one** box.

CH_3OH ☐

CH_3CH_2OH ☐

$CH_3CH_2CH_2OH$ ☐

$CH_3CH_2CH_2CH_2OH$ ☐

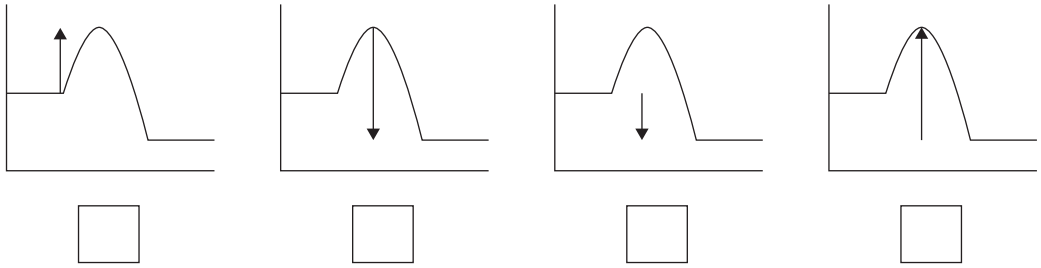
2 (b) **Figure 2** shows four energy level diagrams for the combustion of an alcohol.

Which diagram, **A**, **B**, **C**, or **D**, shows an arrow for the overall energy change?

[1 mark]

Tick (✓) **one** box.

Figure 2

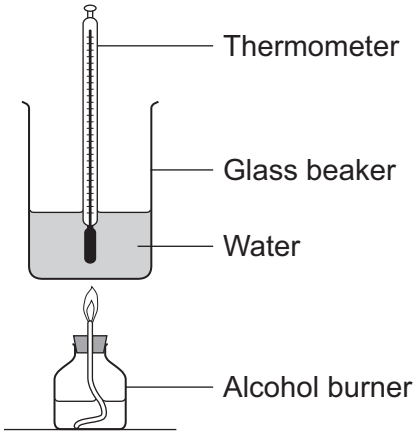


☐ **A** ☐ **B** ☐ **C** ☐ **D**

Question 2 continues on the next page

2 (c) **Figure 3** shows apparatus used to measure the energy released when an alcohol is burned.

Figure 3



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

Describe how a student could use the apparatus in **Figure 3** to compare the energy released when methanol and ethanol are burned.

You should include any measurements the student would need to make.

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

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

[6 marks]

Extra space

2 (c) (ii) The student calculated the energy released by the alcohols.

The calculated values were less than the values in a data book.

Explain how the apparatus in **Figure 3** could be improved to obtain more accurate results.

[2 marks]

10

Turn over for the next question

3 This question is about elements and compounds.

3 (a) In 1869 Mendeleev produced an early version of the periodic table.

Figure 4 shows part of Mendeleev's periodic table.

Figure 4

H						
Li	Be	B	C	N	O	F
Na	Mg	Al	Si	P	S	Cl
K	Ca		Ti	V	Cr	Mn

3 (a) (i) Why did Mendeleev leave gaps in his periodic table?

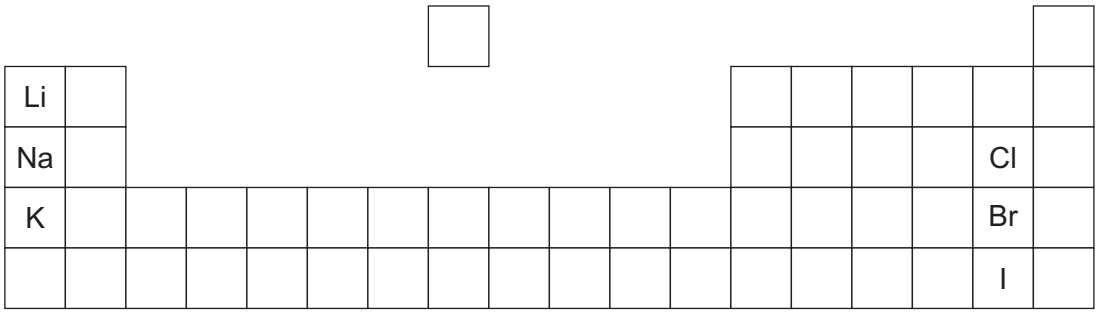
[1 mark]

3 (a) (ii) Give **one** reason why the elements Ti, V, Cr and Mn should **not** be where Mendeleev placed them.

[1 mark]

3 (b) **Figure 5** shows an outline of the modern periodic table.

Figure 5



3 (b) (i) Why, in terms of electrons, is bromine in Group 7?

[1 mark]

3 (b) (ii) Bromine reacts with sodium iodide.

The word equation for the reaction is:

bromine + sodium iodide ⟶ sodium bromide + iodine

This reaction shows that bromine is more reactive than iodine.

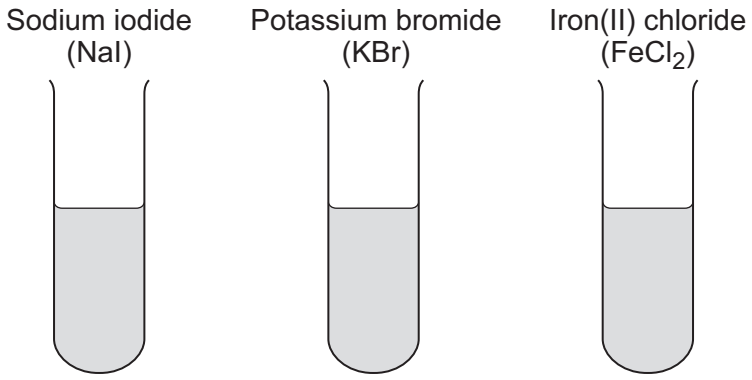
Explain why, in terms of electrons.

[3 marks]

Question 3 continues on the next page

3 (c) **Figure 6** shows test tubes containing solutions of sodium iodide, potassium bromide and iron(II) chloride.

Figure 6



3 (c) (i) A student tested each solution with silver nitrate in the presence of dilute nitric acid.

Write the result for sodium iodide solution in **Table 1**.

[1 mark]

Table 1

	Sodium iodide solution	**Potassium bromide solution**	**Iron(II) chloride solution**
Result of adding silver nitrate		Cream precipitate	White precipitate

3 (c) (ii) The student tested new samples of each solution with sodium hydroxide solution.

Write the result for iron(II) chloride solution in **Table 2**.

[1 mark]

Table 2

	Sodium iodide solution	**Potassium bromide solution**	**Iron(II) chloride solution**
Result of adding sodium hydroxide solution	No precipitate	No precipitate	

3 (d) A flame test is done on a mixture of sodium iodide and potassium bromide.

Why would a flame test **not** show the presence of both sodium ions and potassium ions in the mixture?

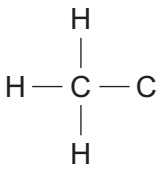
[1 mark]

3 (e) Carboxylic acids are compounds containing carbon.

3 (e) (i) Complete **Figure 7** to show the displayed structure of ethanoic acid.

[1 mark]

Figure 7



3 (e) (ii) Explain why ethanoic acid has a higher pH value than hydrochloric acid of the same concentration.

[2 marks]

12

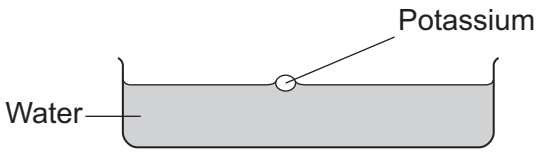
Turn over for the next question

4 This question is about potassium and its compounds.

4 (a) (i) Potassium reacts with water to produce potassium hydroxide solution and a gas.

Figure 8 shows the apparatus used for the reaction.

Figure 8



Complete and balance the equation for the reaction.

[2 marks]

___ K + ___ H_2O ⟶ ___ KOH + _____

4 (a) (ii) Potassium and lithium are in Group 1 of the periodic table.

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

[2 marks]

_____

_____

_____

_____

4 (b) Describe how a student could do titrations to find the mean volume of potassium hydroxide solution which would neutralise 25.00 cm^3 of nitric acid.

[5 marks]

4 (c) The student found that 26.25 cm^3 of potassium hydroxide solution with a concentration of 0.20 moles per dm^3 neutralises 25.00 cm^3 of nitric acid.

The equation for the reaction is:

$$KOH + HNO_3 \longrightarrow KNO_3 + H_2O$$

Calculate the concentration of the nitric acid.

[3 marks]

Concentration of nitric acid = _____ moles per dm^3

12

5 This question is about sulfuric acid and sulfates.

5 (a) One reaction in the industrial production of sulfuric acid is:

$$2SO_2\,(g) + O_2\,(g) \rightleftharpoons 2SO_3\,(g)$$

The forward reaction is exothermic.

5 (a) (i) Explain why a moderately high temperature, instead of a low temperature, is used for this reaction.

Use the information above and your knowledge.

[3 marks]

5 (a) (ii) Explain why you would expect this reaction to be carried out at high pressure.

[2 marks]

5 (a) (iii) This reaction is carried out at atmospheric pressure.

Suggest **one** advantage, other than cost, of using atmospheric pressure and **not** a high pressure for this reaction.

[1 mark]

5 (b) Sulfuric acid is used to produce sulfates.

Describe how sodium hydroxide solution is used to distinguish between a solution of magnesium sulfate and a solution of aluminium sulfate.

[2 marks]

_____

_____

_____

_____

8

Turn over the for the next question

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6 This question is about ammonia and a compound produced from ammonia.

6 (a) Ammonia is produced by the Haber process.

6 (a) (i) The reactants in the Haber process are nitrogen and hydrogen.

Give the source of the hydrogen used for the Haber process.

[1 mark]

_____

6 (a) (ii) The Haber process produces a mixture of the gases ammonia, hydrogen and nitrogen.

Table 3 shows boiling points for ammonia, hydrogen and nitrogen.

Table 3

	Boiling point in °C
Ammonia	–33
Hydrogen	–260
Nitrogen	–196

Explain how to separate ammonia from the mixture of gases.

Use the information in **Table 3** to help you.

[2 marks]

_____

_____

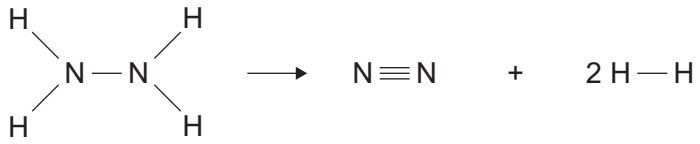
_____

_____

Question 6 continues on the next page

6 (b) Ammonia is used to produce hydrazine (N_2H_4).

6 (b) (i) The equation for the decomposition of hydrazine is:



Bond energies are given in **Table 4**.

Table 4

Bond	Bond energy in kJ
N — N	160
N — H	391
N ≡ N	941
H — H	432

Calculate the energy change for the decomposition of hydrazine.

[3 marks]

Energy change = _____ kJ

6 (b) (ii) The decomposition of hydrazine is exothermic.

Explain why, in terms of bond making and bond breaking.

[2 marks]

_____

_____

_____

_____

8

END OF QUESTIONS

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