Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

General Certificate of Secondary Education
Higher Tier
June 2013

Chemistry

CH3HP

Unit Chemistry C3

H

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 3 should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

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

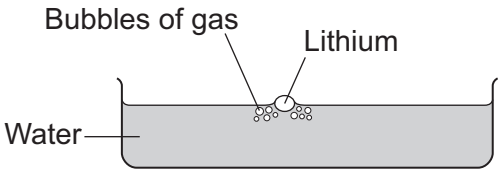
There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

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

1 Lithium is in Group 1 of the periodic table.

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



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

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(1 mark)

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

.....

(1 mark)

1 (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 .....

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2 .....

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(2 marks)

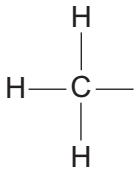
4

Turn over for the next question

2 This question is about organic compounds.

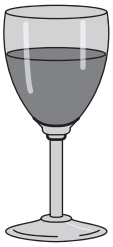
2 (a) Wine contains ethanol (CH_3CH_2OH).

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



(1 mark)

2 (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 ..... .

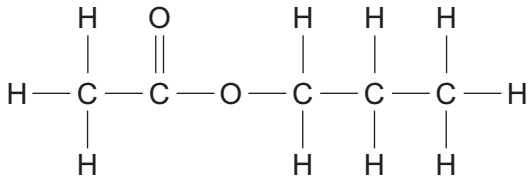
This type of reaction is ..... .

(2 marks)

2 (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:



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

(1 mark)

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

.....

(1 mark)

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

Name this alcohol.

.....

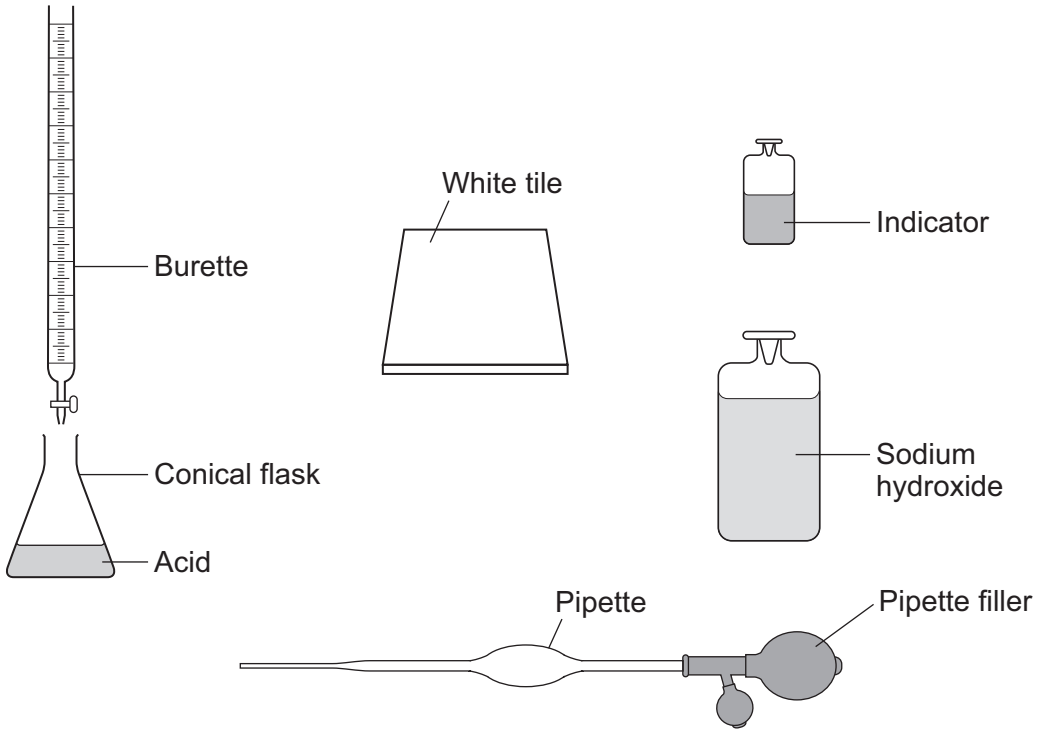
(1 mark)

6

Turn over for the next question

3 *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 a 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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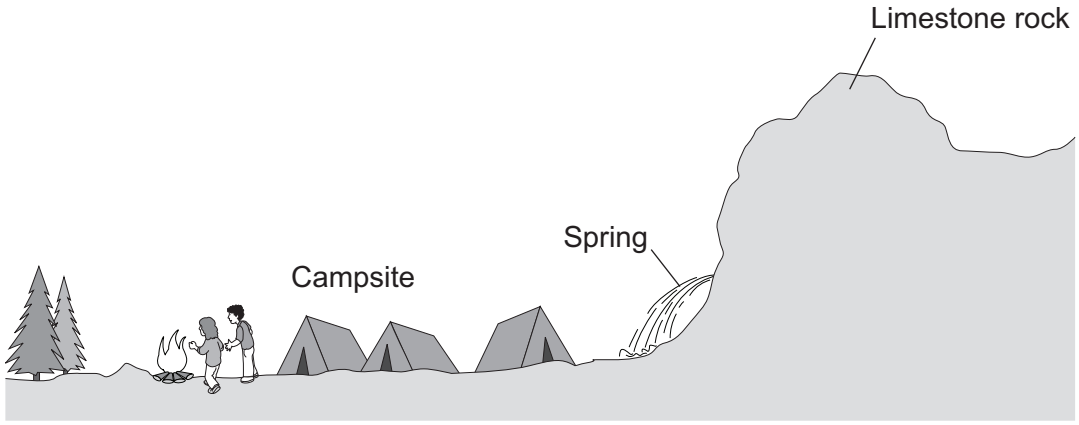
(6 marks)

6

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



A student compared the hardness of the spring water with two other 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 (from the campsite)	13	11	6	
Tap water	7	5	6	6
Distilled water	1	1	1	1

4 (a) (i) Calculate the correct mean for spring water.

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Mean = ... drops

(2 marks)

4 (a) (ii) What conclusion could the student make from her results?

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

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(2 marks)

4 (a) (iii) Another student at the campsite boils some of the hard spring water in a pan. The inside of the pan becomes coated with a white solid.

Explain how the white solid is produced.

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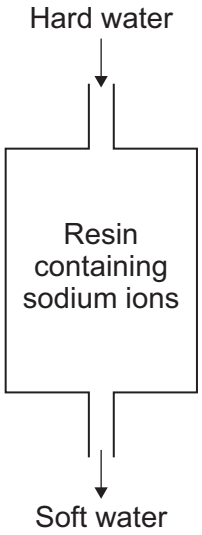
(3 marks)

Question 4 continues on the next page

4 (b) Ion exchange columns can be used to soften hard water.



4 (b) (i) Describe how an ion exchange column softens water.

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(3 marks)

4 (b) (ii) An ion exchange column is used for a few weeks.

Sodium chloride solution now needs to be passed through the ion exchange column.

Suggest why.

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(1 mark)

4 (c) Tap water in the UK is safe to drink because water companies add chlorine to sterilise the water.

Suggest **one** argument for and **one** argument against water companies adding chlorine to sterilise water.

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(2 marks)

13

Turn over for the next question

5 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 student tests the low sodium salt for the substances on the label.

5 (a) (i) The same test can be used to identify sodium ions and potassium ions.

Describe the test.

Give the result of the test for sodium ions and for potassium ions.

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(3 marks)

5 (a) (ii) It is difficult to identify potassium ions when sodium ions are present.

Suggest why.

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(1 mark)

5 (b) Describe how the student would test a solution of the low sodium salt for chloride ions.

Give the result of the test.

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(3 marks)

5 (c) To test for magnesium ions, the student adds a few drops of sodium hydroxide solution to a solution of the low sodium salt.

A white precipitate is produced.

This test also gives a white precipitate with aluminium ions and calcium ions.

5 (c) (i) Describe how the student could confirm that the low sodium salt contains magnesium ions and **not** aluminium ions.

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(2 marks)

5 (c) (ii) Describe a test the student could do to confirm that the low sodium salt does **not** contain calcium ions.

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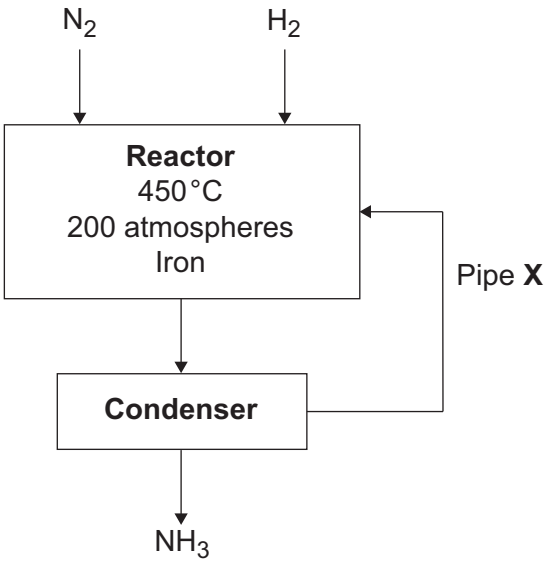
(2 marks)

11

Turn over ▶

6 The flow diagram shows the Haber process. In the Haber process, ammonia (NH_3) is produced from nitrogen (N_2) and hydrogen (H_2).



6 (a) Which raw material is nitrogen obtained from?

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(1 mark)

6 (b) What is the purpose of Pipe **X**?

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(2 marks)

6 (c) Balance the chemical equation below for the production of ammonia.

N_2 + ...H_2 $\rightleftharpoons$ .....NH_3

(1 mark)

6 (d) A temperature of 450 °C is used in the reactor.
The reaction of nitrogen with hydrogen is reversible.
The forward reaction is exothermic.

Explain why a temperature of 450 °C is the optimum temperature for the Haber process.

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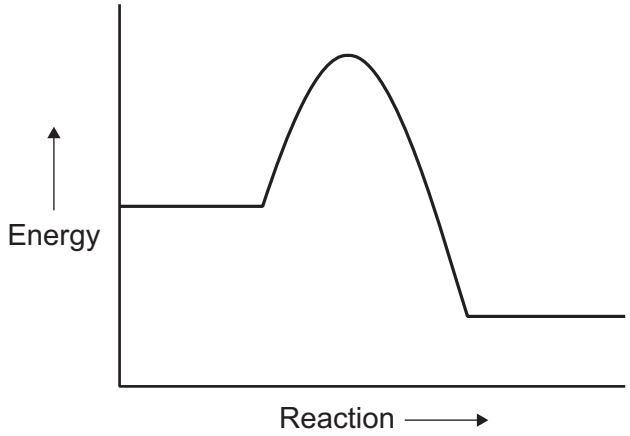
(2 marks)

6 (e) An energy level diagram for the reaction between nitrogen and hydrogen is shown below.



6 (e) (i) How does the energy level diagram show this reaction is exothermic?

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(1 mark)

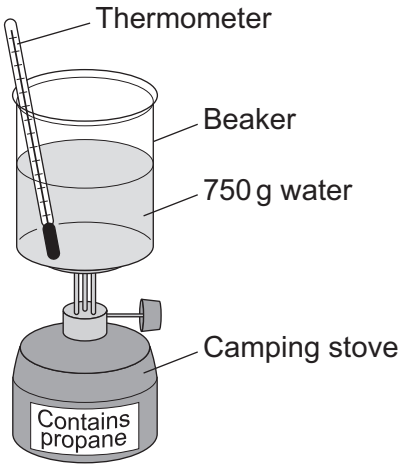
6 (e) (ii) In the Haber process iron is used as a catalyst.

Draw a line on the energy level diagram to show the effect of adding a catalyst.

(1 mark)

8

7 A camping stove uses propane gas.



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

The student:

- put 750 g water into a beaker
- measured the temperature of the water, which was 17 °C
- heated the water by burning propane
- measured the temperature of the water again, which was then 64 °C.

The student calculated the energy released using the equation

$$Q = m \times 4.2 \times \Delta T$$

Where:
Q = energy released (J)
m = mass of water (g)
ΔT = temperature change (°C)

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

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Energy released = ... J

(3 marks)

7 (a) (ii) To find how much propane had been used the student weighed the camping stove before and after the experiment. The mass of the camping stove decreased by 6.0 g.

Using this information and your answer to part **7(a)(i)**, calculate the energy in kJ released when 1 mole of propane burns.

(If you have no answer for part **7(a)(i)**, assume the energy released during the experiment is 144 000 J. This is **not** the answer to part **7(a)(i)**.)

Relative formula mass (M_r) of propane = 44.

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Energy released = ... kJ

(2 marks)

7 (a) (iii) Suggest **two** things the student could do to make his results more accurate.

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(2 marks)

7 (a) (iv) The student's method does **not** give accurate results.

However, this method is suitable for comparing the energy released by different fuels.

Suggest why.

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(1 mark)

Question 7 continues on the next page

7 (b) The student used bond energies to calculate the energy released when propane is burned.

The equation for the combustion of propane is:

$$C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$$

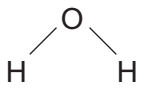
Some bond energies are given in the table.

Bond	Bond Energy in kJ per mole
C ═ O	803
O — H	464

The displayed structures of the products are:

carbon dioxide O ═ C ═ O

water



7 (b) (i) Calculate the energy released by bond making when the products are formed.

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Energy released = ... kJ per mole
(3 marks)

7 (b) (ii) The energy used for bond breaking of the reactants in the equation is 6481 kJ per mole.

Calculate the overall energy change of this reaction.

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Overall energy change = ... kJ per mole
(1 mark)

12

END OF QUESTIONS

There are no questions printed on this page

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