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
January 2013

Additional Science CH2FP
Unit Chemistry C2

Chemistry F
Unit Chemistry C2

Thursday 24 January 2013 9.00 am to 10.00 am

For this paper you must have:
- 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 8(d) should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

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

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

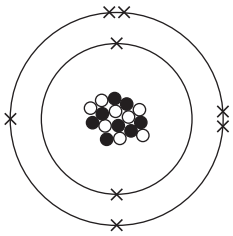
1 This question is about atoms and molecules.

1 (a) Complete the table to show the relative masses of the particles in atoms.

Name of particle	Relative mass
Proton	.....
Neutron	1
Electron	.....

(2 marks)

1 (b) The diagram shows an oxygen atom.



Key
- ● Proton
- ○ Neutron
- × Electron

Use the correct number to complete each sentence.

8	**16**	**18**	**24**

The atomic (proton) number of the oxygen atom shown above is ..... .

The mass number of the oxygen atom shown above is ..... .

(2 marks)

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

Oxygen atoms with different numbers of neutrons are called

isotopes.

molecules.

polymers.

(1 mark)

1 (c) (ii) An oxygen atom with a different number of neutrons has 10 neutrons.

Draw a ring around the symbol which represents this atom.

$^{16}_{8}O$ $^{18}_{10}O$ $^{18}_{8}O$

(1 mark)

1 (d) A water molecule contains hydrogen and oxygen atoms.

1 (d) (i) Use the correct answer to complete the sentence.

a compound	**an element**	**a mixture**

Water is ..... .

(1 mark)

1 (d) (ii) Draw a ring around the correct structure of a water molecule.

H — O — H **O — H — H** **O — H — O**

(1 mark)

1 (d) (iii) Draw a ring around the type of bonding in a water molecule.

covalent **ionic** **metallic**

(1 mark)

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

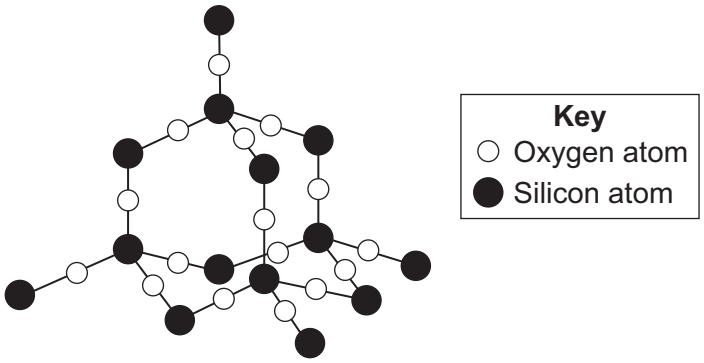
The bonds in a water molecule are formed by | gaining / losing / sharing | electrons.

(1 mark)

10

Turn over for the next question

2 The diagram shows a small part of the structure of silicon dioxide.



2 (a) Use the diagram above to answer the question.

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

In silicon dioxide, each silicon atom is bonded with | two | three | four | oxygen atoms.

The bonds in silicon dioxide are | ionic. | covalent. | metallic.

(2 marks)

2 (b)

Silicon dioxide is used as the inside layer of furnaces.

Suggest why.

.....

.....

(1 mark)

2 (c) Nanowires can be made from silicon dioxide.

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

The word 'nano' means the wires are very

brittle.
thick.
thin.

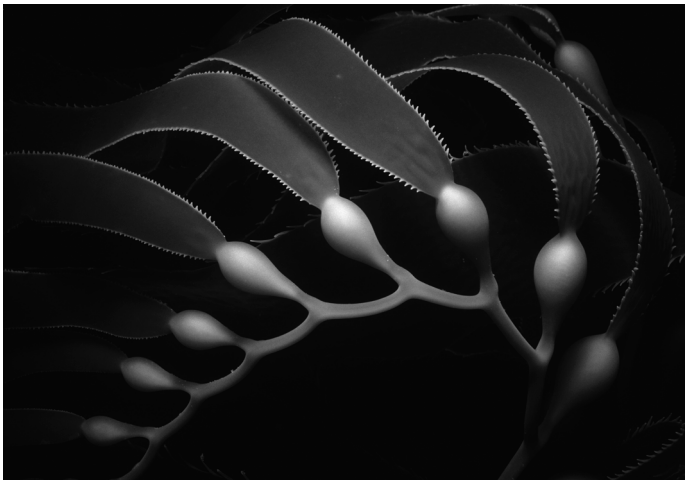
(1 mark)

4

Turn over for the next question

3 Kelp is a seaweed.

Kelp can be burned to give out energy.



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

Reactions which give out energy are

endothermic.

exothermic.

reversible.

(1 mark)

3 (b) Which **two** of the following questions **cannot** be answered by scientific experiments alone?

Tick (✓) **two** boxes.

Question	Tick (✓)
How much carbon dioxide is produced when 100 g of kelp is burned?	
Does kelp give out more heat energy than coal when burned?	
Should people use kelp instead of oil as an energy source?	
Will kelp be more popular than coal in the next 10 years?	

(2 marks)

3 (c) Potassium iodide can be produced from kelp.

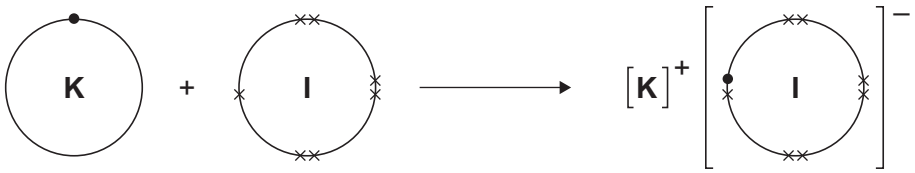
3 (c) (i) Potassium can be reacted with iodine to produce potassium iodide.

potassium + iodine → potassium iodide

The diagram shows how this happens.

Only the outer electrons are shown.

The dots (●) and crosses (×) are used to represent electrons.



Use the diagram to help you answer this question.

Describe, as fully as you can, what happens when potassium reacts with iodine to produce potassium iodide.

To get full marks you should use the words atom, electron and ion in your answer.

.....

.....

.....

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(4 marks)

Question 3 continues on the next page

3 (c) (ii) Potassium iodide reacts with lead nitrate.

$$2\,KI(aq) + Pb(NO_3)_2(aq) \rightarrow 2\,KNO_3(aq) + PbI_2(s)$$

Why is this reaction a precipitation?

.....

.....

(1 mark)

3 (c) (iii) How can the precipitate be removed from the reaction mixture?

.....

.....

(1 mark)

9

4 Thermosoftening polymers can be used to make plastic bottles and food packaging.

4 (a) Why are thermosoftening polymers **not** suitable for storing very hot food?

.....

.....

(1 mark)

4 (b) The reaction to produce the polymers uses a catalyst.

Why are catalysts used in chemical reactions?

.....

.....

(1 mark)

4 (c) Compounds from food packaging must not get into food.

Gas chromatography can be used to separate compounds in food.

The output from the gas chromatography column can be linked to an instrument which can identify the compounds.

4 (c) (i) Name the instrument used to identify the compounds.

.....

.....

(1 mark)

4 (c) (ii) Give **one** reason why instrumental methods of analysis are used to identify the compounds.

.....

.....

(1 mark)

4 (d) Poly(ethene) is a thermosoftening polymer.

Poly(ethene) can be made with different properties. The properties depend on the conditions used when poly(ethene) is made.

Suggest **two** conditions which could be changed when poly(ethene) is made.

.....

.....

(2 marks)

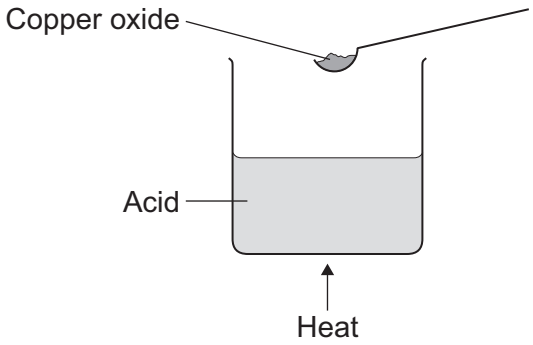
6

5 A student added copper oxide to an acid to make copper sulfate.

The student heated the acid.

The student added copper oxide until no more reacted.

5 (a) The diagram shows the first stage in the experiment.



5 (a) (i) Complete the word equation.

Copper oxide + ... acid → copper sulfate + water

(1 mark)

5 (a) (ii) Which **one** of these values could be the pH of the acid?

Draw a ring around the correct answer.

1 **7** **11**

(1 mark)

5 (a) (iii) Why is the acid heated?

.....

.....

(1 mark)

5 (b) After the reaction is complete, some solid copper oxide remains.
Why?

.....

.....

(1 mark)

5 (c) The student removed the solid copper oxide from the solution.

Suggest what the student should do to the solution to form copper sulfate crystals.

.....

.....

(1 mark)

5 (d) The mass of copper sulfate crystals was less than the student expected.

Tick (✓) the **one** statement that explains why the mass of copper sulfate crystals was less than expected.

Statement	Tick (✓)
Some copper sulfate may have been lost during the experiment.	
The student added too much copper oxide.	
The copper sulfate crystals were wet when they were weighed.	

(1 mark)

6

Turn over for the next question

6 Printed pictures can be made using etchings.

An etching can be made when a sheet of brass reacts with iron chloride solution.

6 (a) Brass is a mixture of two metals, copper and zinc.

6 (a) (i) A mixture of two metals is called ..... .

(1 mark)

6 (a) (ii) Draw a ring around the correct answer to complete the sentence.

Copper and zinc atoms are different sizes.

This makes brass | harder / more flexible / softer | than the pure metals.

(1 mark)

6 (b) Iron chloride has the formula $FeCl_3$

Relative atomic masses (A_r): Cl = 35.5; Fe = 56.

6 (b) (i) Calculate the relative formula mass (M_r) of iron chloride ($FeCl_3$).

.....

.....

.....

Relative formula mass (M_r) of iron chloride = ...

(2 marks)

6 (b) (ii) Calculate the percentage of iron in iron chloride ($FeCl_3$).

.....

.....

.....

Percentage of iron in iron chloride = ...%

(2 marks)

6

Turn over for the next question

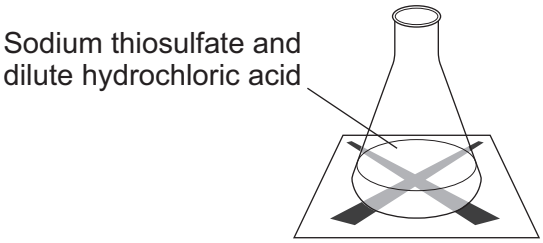
7 A student investigated the rate of reaction between sodium thiosulfate and dilute hydrochloric acid.

The student placed a conical flask over a cross on a piece of paper.

The student mixed the solutions in the flask.

The solution slowly went cloudy.

The student timed how long it took until the cross could not be seen.



The equation for the reaction is:

$$Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + SO_2(g) + S(s)$$

sodium thiosulfate + hydrochloric acid → sodium chloride + water + sulfur dioxide + sulfur

7 (a) Explain why the solution goes cloudy.

.....

.....

.....

.....

(2 marks)

7 (b) The student repeated the experiment with different concentrations of sodium thiosulfate.

Concentration of sodium thiosulfate in moles per dm^3	Time taken until the cross could not be seen in seconds			
	Trial 1	Trial 2	Trial 3	Mean
0.040	71	67	69	69
0.060	42	45	45	44
0.080	31	41	33	

7 (b) (i) Calculate the mean time for 0.080 moles per dm^3 of sodium thiosulfate.

.....

.....

.....

Mean = ... seconds

(2 marks)

7 (b) (ii) Describe and explain, in terms of particles and collisions, the effect that increasing the concentration of sodium thiosulfate has on the rate of the reaction.

.....

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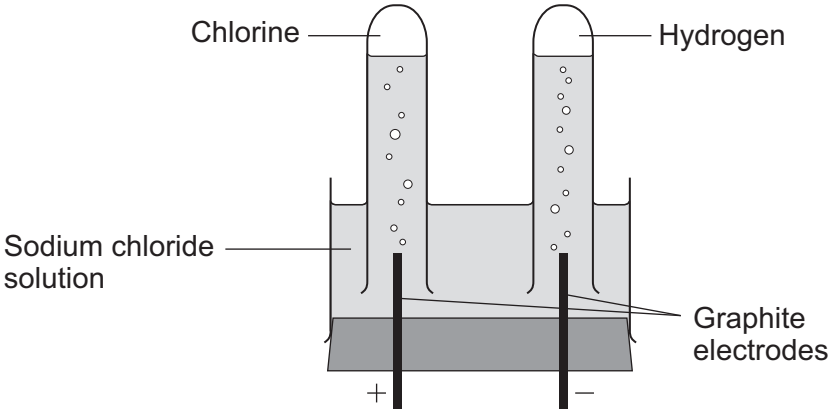
(3 marks)

7

Turn over for the next question

8 The electrolysis of sodium chloride solution is an industrial process.

The diagram shows the apparatus used in a school experiment.



8 (a) One of the products of the electrolysis of sodium chloride solution is hydrogen.

8 (a) (i) Why do hydrogen ions move to the negative electrode?

.....

.....

(1 mark)

8 (a) (ii) How does a hydrogen ion change into a hydrogen atom?

.....

.....

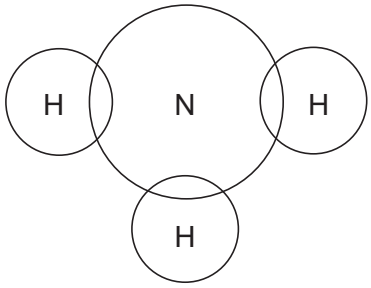
(1 mark)

8 (b) Hydrogen is used to make ammonia (NH_3).

Complete the diagram to show the bonding in ammonia.

Use dots (●) and crosses (x) to show electrons.

Show only outer shell electrons.



(2 marks)

8 (c) The table shows the ions in sodium chloride solution.

Positive ions	Negative ions
hydrogen	chloride
sodium	hydroxide

In industry, some of the waste from the electrolysis of sodium chloride solution is alkaline and has to be neutralised.

8 (c) (i) Which ion makes the waste alkaline?

.....

(1 mark)

8 (c) (ii) This waste must be neutralised.

Write the ionic equation for the neutralisation reaction.

.....

(1 mark)

Question 8 continues on the next page

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

The electrolysis of sodium chloride solution also produces chlorine and sodium hydroxide.

In industry, the electrolysis of sodium chloride solution can be done in several types of electrolysis cell.

Some information about two different types of electrolysis cell is given below.

	Mercury cell	**Membrane cell**
Cost of construction	Expensive	Relatively cheap
Additional substances used	Mercury, which is recycled. Mercury is toxic so any traces of mercury must be removed from the waste.	Membrane, which is made of a polymer. The membrane must be replaced every 3 years.
Amount of electricity used for each tonne of chlorine produced in kWh	3400	2950
Quality of chlorine produced	Pure	Needs to be liquefied and distilled to make it pure.
Quality of sodium hydroxide solution produced	50% concentration. Steam is used to concentrate the sodium hydroxide solution produced.	30% concentration. Steam is used to concentrate the sodium hydroxide solution produced.

Use the information and your knowledge and understanding to compare the environmental and economic advantages and disadvantages of these **two** types of electrolysis cell.

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(6 marks)

12

END OF QUESTIONS

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