

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										



General Certificate of Secondary Education
Higher Tier
January 2013

Science A
Unit Chemistry C1

Chemistry
Unit Chemistry C1

Monday 14 January 2013 9.00 am to 10.00 am

For this paper you must have:

- a ruler
 - the Chemistry Data Sheet (enclosed).
- You may use a calculator.

Time allowed

- 1 hour

Instructions

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

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 3(c) 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	
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7	
8	
TOTAL	



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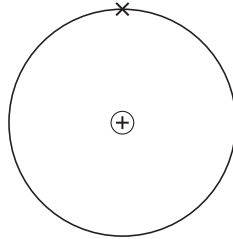
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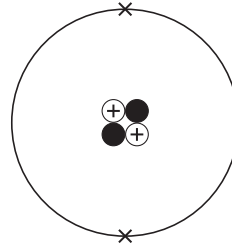
Answer **all** questions in the spaces provided.

- 1** The Sun produces helium atoms from hydrogen atoms by nuclear fusion reactions.

Hydrogen



Helium



- 1 (a)** Describe the differences in the atomic structures of a hydrogen atom and a helium atom.

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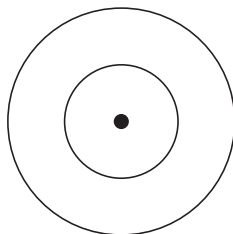
(3 marks)



- 1 (b)** The Sun consists of 73% hydrogen and 25% helium.
The rest is other elements.
One of the other elements in the Sun is neon.

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

- 1 (b) (i)** Complete the diagram to show the electronic structure of a neon atom.



(1 mark)

- 1 (b) (ii)** Why is neon in the same group of the periodic table as helium?

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(1 mark)

5

Turn over for the next question

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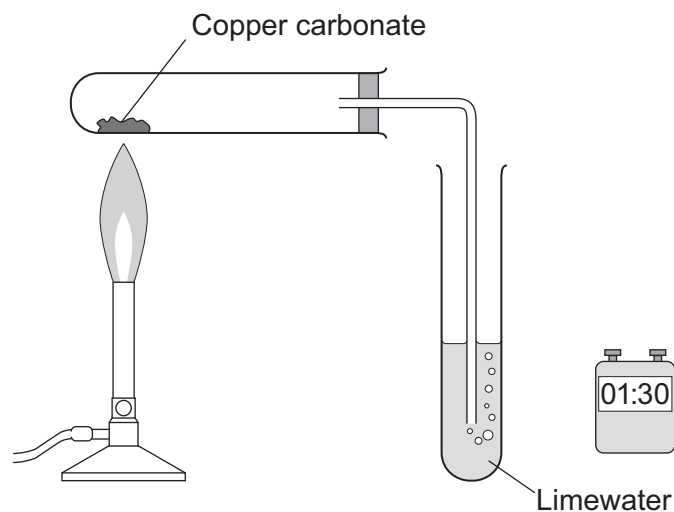


2 Carbon dioxide is produced when copper carbonate is heated.

A student investigated heating copper carbonate.

The student used the apparatus to measure how long it took for carbon dioxide to be produced.

The student also noted what happened during each minute for three minutes.

**2 (a)** The student used changes to the limewater to measure how long it took for carbon dioxide to be produced.

Describe how.

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(2 marks)



2 (b) The student wrote down her observations.

Time interval in minutes	Observations
Between 0 and 1	A slow release of gas bubbles. The limewater did not change. The solid in the test tube was green.
Between 1 and 2	A fast release of gas bubbles. The limewater changed at 1 minute 10 seconds.
Between 2 and 3	No release of gas bubbles. The solid in the test tube was black.

2 (b) (i) Suggest the reason for the student's observations between 0 and 1 minute.

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(2 marks)

2 (b) (ii) Explain the student's observations between 1 and 2 minutes.

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(2 marks)

2 (b) (iii) Explain the student's observations between 2 and 3 minutes.

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(2 marks)



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3 This question is about oil reserves.

3 (a) Diesel is separated from crude oil by fractional distillation.

Describe the steps involved in the fractional distillation of crude oil.

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(3 marks)

3 (b) Diesel is a mixture of lots of different *alkanes*.

What are *alkanes*?

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(2 marks)

Question 3 continues on the next page

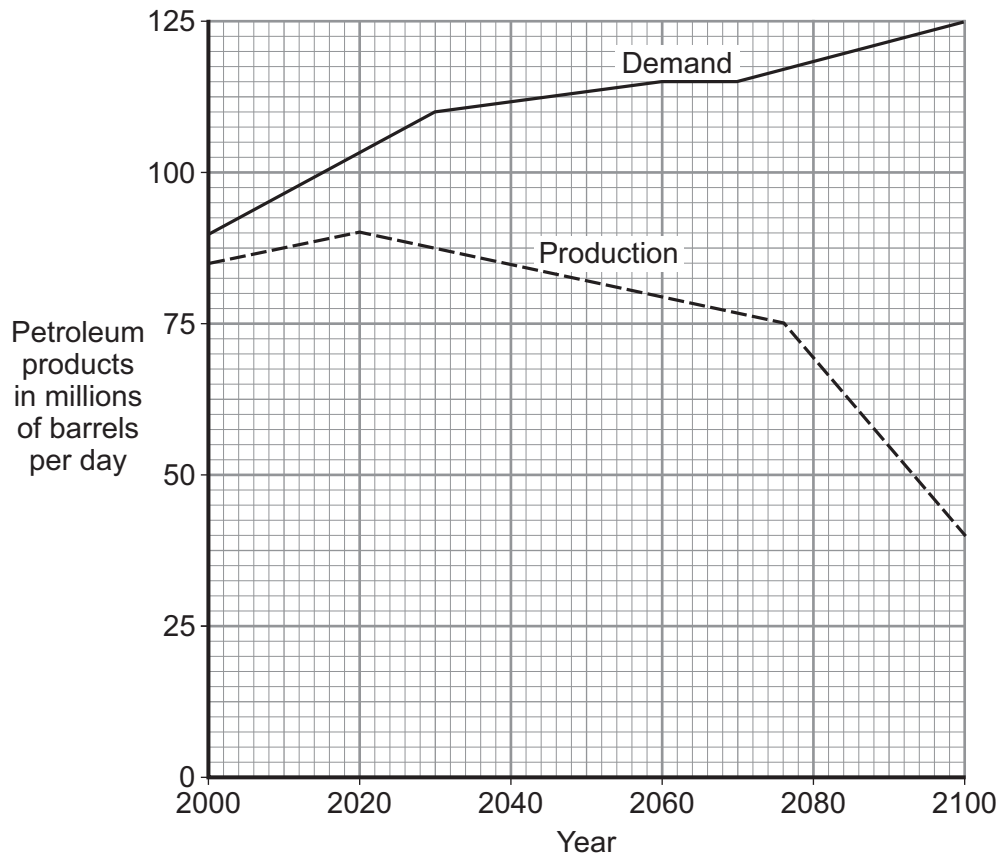
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- 3 (c)** *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Petroleum products, such as petrol, are produced from crude oil.

The graph shows the possible future production of petroleum products from crude oil and the expected demand for petroleum products.



Canada's oil sands hold about 20% of the world's known crude oil reserves.

The oil sands contain between 10 to 15% of crude oil. This crude oil is mainly bitumen.

In Canada the oil sands are found in the ground underneath a very large area of forest. The trees are removed. Then large diggers and trucks remove 30 metres depth of soil and rock to reach the oil sands. The oil sands are quarried. Boiling water is mixed with the quarried oil sands to separate the bitumen from the sand. Methane (natural gas) is burned to heat the water.

The mixture can be separated because bitumen floats on water and the sand sinks to the bottom of the water. The bitumen is cracked and the products are separated by fractional distillation.



[illegible]

11



4 Iceland has many volcanoes.

- 4 (a) Scientists are monitoring a volcano in Iceland, called Katla.
There has been an increase in the number of tremors (small earthquakes) in this area.



- 4 (a) (i) Why does Iceland have volcanoes?

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(1 mark)

- 4 (a) (ii) Scientists predict that Katla may erupt soon.
However, scientists do **not** know exactly when Katla will erupt.

Suggest **one** reason why.

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(1 mark)



- 4 (b)** During the first billion years of the Earth's existence its surface was covered with volcanoes.

Describe how this volcanic activity led to the formation of oceans.

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(2 marks)

- 4 (c)** The Earth has about 500 000 earthquakes each year.

Describe how activity within the Earth results in earthquakes.

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(3 marks)

7

Turn over for the next question

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5 Olive oil has a melting point of -6°C and a boiling point of 300°C .
Olive oil has a high content of healthy, unsaturated fats.

5 (a) Olive oil can be hardened by reacting it with hydrogen.

5 (a) (i) State the conditions needed for this reaction.

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(2 marks)

5 (a) (ii) A student said that hardening would make olive oil healthier.

Is this student's hypothesis correct?

Explain your answer in terms of what happens in the hardening process.

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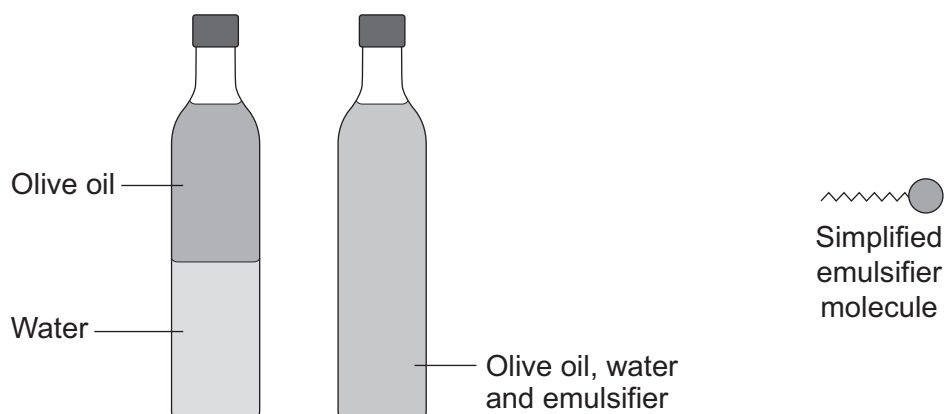
(2 marks)



5 (b)

Olive oil and water do not mix.

A salad dressing is made by shaking olive oil and water with an emulsifier.



Explain how these emulsifier molecules are able to produce a stable mixture after shaking olive oil and water.

Use the diagram of the simplified emulsifier molecule to help you to answer this question.

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(3 marks)

7

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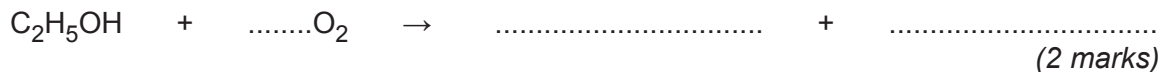
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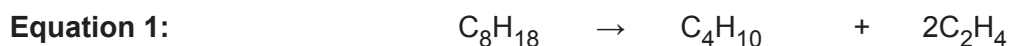
6 Most petrol used in cars contains about 5% ethanol ($\text{C}_2\text{H}_5\text{OH}$).

6 (a) The complete combustion of ethanol produces carbon dioxide and water.

Complete and balance the symbol equation for the complete combustion of ethanol.



6 (b) Ethanol can be produced from octane (C_8H_{18}).
The two chemical equations represent the production of ethanol from octane.



6 (b) (i) In **Equation 1** the products are a mixture of two gases.

Describe a chemical test that would indicate the presence of ethene (C_2H_4) in the mixture.

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(2 marks)



- 6 (b) (ii)** Describe, as fully as you can, the conditions used for the two reactions to produce ethanol from octane.

Use **Equation 1** and **Equation 2** to help you with your answer.

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(4 marks)

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7 Iron is produced from the ore haematite (iron oxide).

Titanium is produced from the ore rutile (titanium oxide).

Iron

Iron oxide is reacted with coke (carbon) at 1500 °C in a furnace to produce molten cast iron. Cast iron contains iron and about 4% carbon.



Oxygen is blown into molten cast iron and molten recycled iron at 1500 °C in a furnace to produce low-carbon steel. Low-carbon steel contains iron and about 0.1% carbon.

Titanium

Titanium oxide is reacted with chlorine at 1000 °C to produce titanium chloride. Titanium chloride is cooled and collected.



Titanium chloride is reacted with magnesium at 1100 °C in a sealed reactor for 3 days. The sealed reactor contains an atmosphere of argon gas.



The reactor is allowed to cool. The reactor is opened and the titanium is separated from the other product, magnesium chloride.

7 (a) The production of low-carbon steel uses oxygen but the production of titanium uses argon.

Explain why.

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(3 marks)



7 (b) There is less titanium than iron in the Earth's crust.

Apart from titanium's scarcity, explain why titanium costs much more than iron.

Use the two flow diagrams on page 16 to help you to answer this question.

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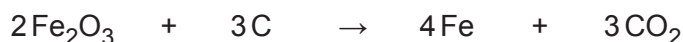
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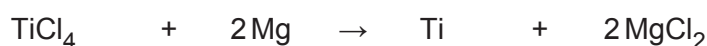
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7 (c) Many chemical reactions take place in the production of both metals.

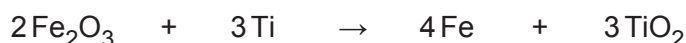
A chemical reaction in the production of iron is:



A chemical reaction in the production of titanium is:



Titanium can be used to produce iron from iron oxide. The chemical reaction is:



Use these three reactions and the Chemistry Data Sheet to answer this question.

Suggest the position of titanium in the Reactivity Series of Metals.

Explain your answer.

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(2 marks)



- 8** Scientists study the atmosphere on planets and moons in the Solar System to understand how the Earth's atmosphere may have evolved.

Titan is the largest moon of Saturn.

The table shows data about some substances in the atmosphere of Titan.

Substance	Melting point in °C	Boiling point in °C
Nitrogen	−210	−196
Methane	−183	−164
Argon	−189	−186
Hydrogen	−259	−253
Carbon monoxide	−205	−192

- 8 (a)** There is no water on Titan. The average surface temperature on Titan is -179°C .

Which of the substances in the table would form oceans on Titan?

Explain your answer.

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(2 marks)



8 (b) Amino acids are essential to life.

In the 1950s the Miller-Urey experiment showed that simple amino acids, such as glycine ($\text{NH}_2\text{CH}_2\text{COOH}$), could have been produced from the Earth's early atmosphere.

The Miller-Urey experiment showed that simple amino acids could be produced by reactions between hydrocarbons, ammonia and water.

Explain how the Miller-Urey experiment suggests that reactions between the substances in Titan's atmosphere could also produce simple amino acids.

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(4 marks)

6

END OF QUESTIONS



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