| 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
Higher Tier
June 2012

# Science A
**Unit Chemistry C1**

**CH1HP**

**H**

# Chemistry
**Unit Chemistry C1**

**Friday 15 June 2012 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(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.

**There are no questions printed on this page**

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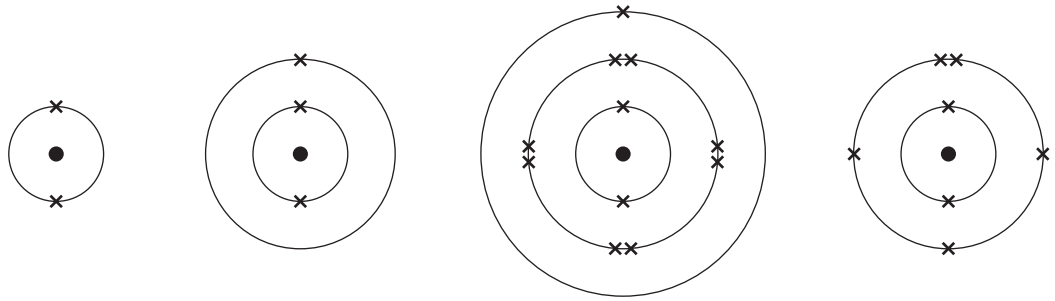
**ANSWER IN THE SPACES PROVIDED**

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

**1** The diagrams show the electronic structure of four different atoms.



**Atom A** **Atom B** **Atom C** **Atom D**

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

**1 (a)** Name the two sub-atomic particles in the nucleus of an atom.

.....

*(1 mark)*

**1 (b)** Why is there no overall electrical charge on each atom?

.....

.....

*(1 mark)*

**1 (c)** Why is **Atom A** unreactive?

.....

*(1 mark)*

**1 (d)** Which **two** of these atoms have similar chemical properties?
Give a reason for your answer.

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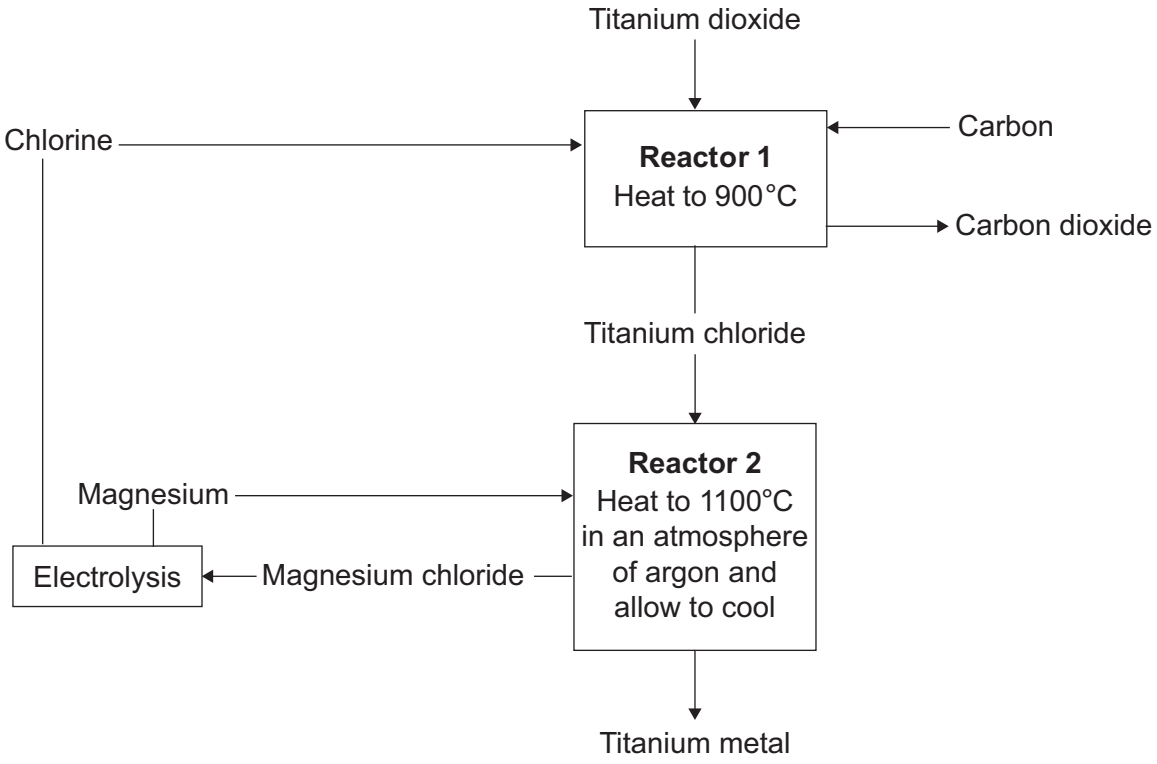
*(2 marks)*

5

**2** Rutile is an ore of titanium. Rutile contains titanium dioxide.
The flow chart shows how titanium metal is extracted from titanium dioxide.




**2 (a)** Titanium is much more expensive than iron.

Give **one** reason why.

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*(1 mark)*

**2 (b)** Name the only waste product shown on the flow chart.

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*(1 mark)*

**2 (c)** Describe the example of recycling shown on the flow chart.

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*(2 marks)*

**2 (d)** The air is removed from **Reactor 2**. An atmosphere of argon is used for the reaction between titanium chloride and magnesium metal.

Explain why.

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*(2 marks)*

**Question 2 continues on the next page**

**2 (e)** Titanium metal is produced by reacting titanium chloride with magnesium.

950 kg of titanium chloride was mixed with 240 kg of magnesium metal. The mixture was heated and produced 950 kg of magnesium chloride.

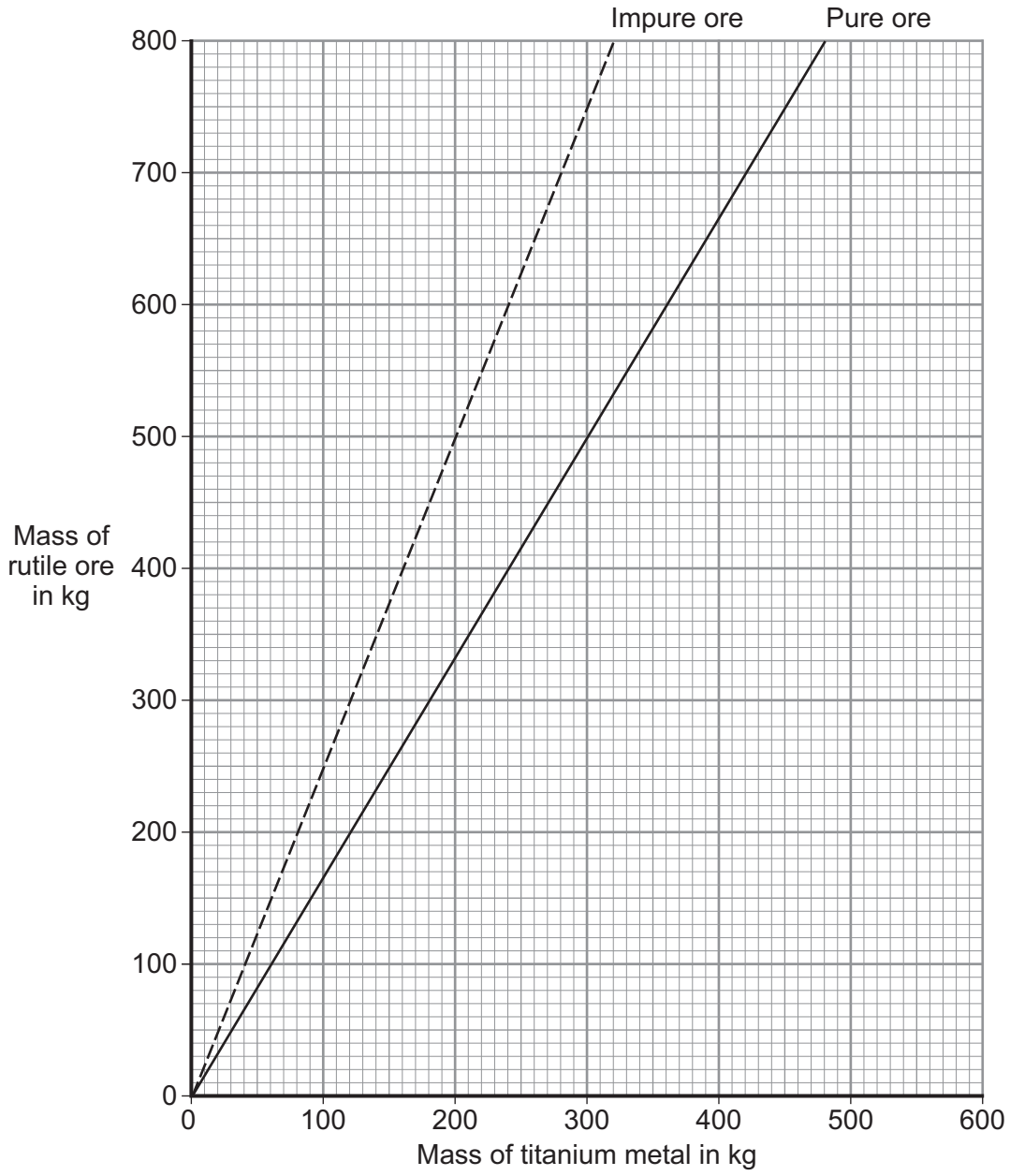
Calculate the mass of titanium metal produced.

.....

Mass = ..... kg

*(1 mark)*

**2 (f)** The graph shows the mass of titanium metal produced from a pure rutile ore and from an impure rutile ore.




The difference between the two lines represents the amount of waste rock in the impure ore.

300 kg of titanium metal was produced from the impure ore.

Calculate the mass of waste rock in the impure ore.

.....

Mass = ..... kg

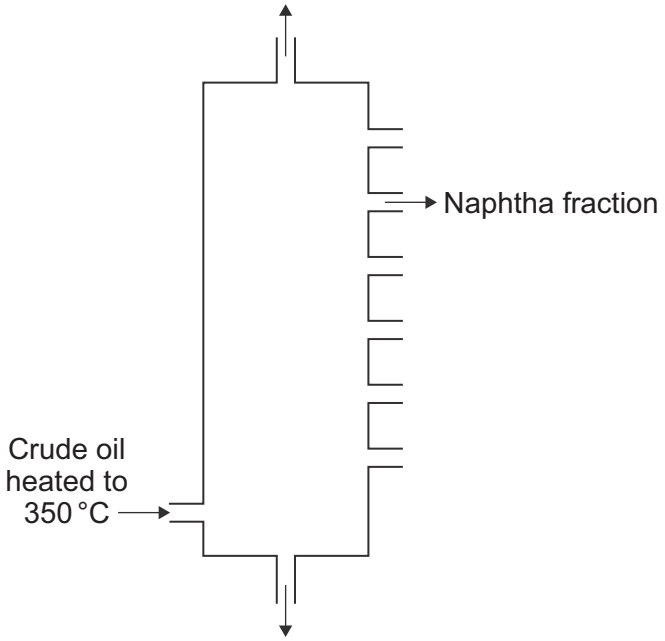
*(1 mark)*

8

**Turn over ▶**

**3** Crude oil is used to produce poly(ethene).

**3 (a)** Fractional distillation is used to separate crude oil into fractions.




**3 (a) (i)** Write a number, **2**, **3**, **4** or **5**, next to each stage so that the description of fractional distillation is in the correct order. Numbers **1** and **6** have been done for you.

| Number | Stage |
|---|---|
| **1** | The crude oil is heated to 350 °C. |
| | When a fraction in the vapours cools to its boiling point, the fraction condenses. |
| | Any liquids flow down to the bottom of the column and the hot vapours rise up the column. |
| **6** | The condensed fraction is separated and flows out through a pipe. |
| | When the hot vapours rise up the column, the vapours cool. |
| | Most of the compounds in the crude oil evaporate. |

*(2 marks)*

**3 (a) (ii)** The naphtha fraction is cracked to produce ethene ($C_2H_4$).
Ethene is used to make the polymer called poly(ethene).

Name **two** substances produced when poly(ethene) burns in air.

1 .....

2 .....

*(2 marks)*

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

Each year in the UK, billions of plastic bags are given free to shoppers. These bags are made from poly(ethene) and are often used only once.
After being used many of these plastic bags are either thrown away as litter or buried in landfill sites.

In 2006 over 10 billion of these plastic bags were given free to shoppers.
In 2009 the number of plastic bags given to shoppers had decreased to 6.1 billion.
One reason for the decrease was because some supermarkets made people pay for their plastic bags.

From 2011 a new type of plastic shopping bag made mainly from poly(ethene) had a use-by date of only one year printed on the bag.

Use the information above and your knowledge and understanding to describe advantages and disadvantages of using plastic shopping bags made from poly(ethene).

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*(6 marks)*

10

**4** Venus is often compared to the Earth. The Earth's early atmosphere was mainly carbon dioxide like the atmosphere of Venus today.

| Atmosphere of Earth today | | Atmosphere of Venus today | |
|---|---|---|---|
| **Gas** | **Percentage (%)** | **Gas** | **Percentage (%)** |
| Nitrogen | 78 | Nitrogen | 3.5 |
| Oxygen | 21 | Oxygen | A trace |
| Carbon dioxide | 0.04 | Carbon dioxide | 96 |

**4 (a)** Give **two** reasons why the percentage of carbon dioxide decreased in the Earth's early atmosphere.

.....

.....

.....

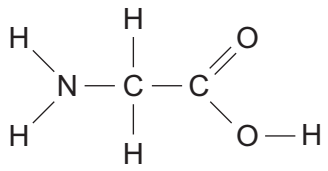
.....

*(2 marks)*

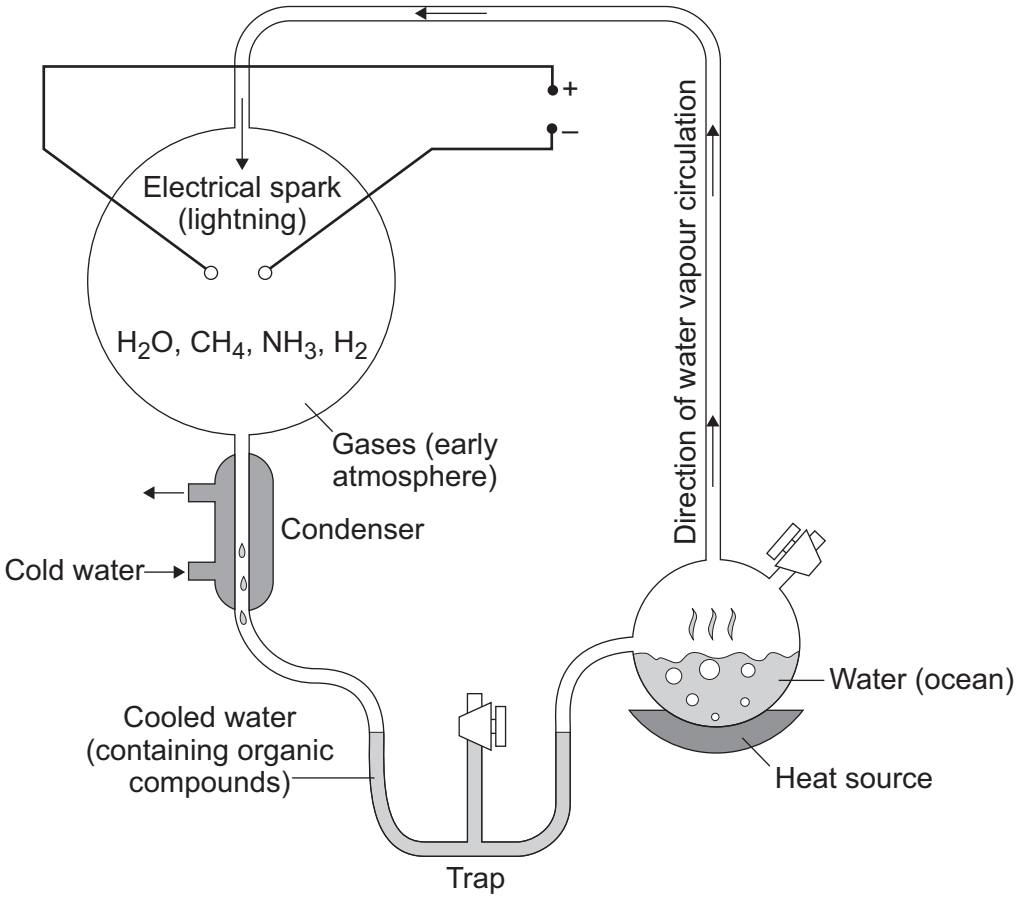
**4 (b)** In the 1950s two scientists, Miller and Urey, investigated the origin of life on Earth.
Miller and Urey used the gases that they believed were in the Earth's early atmosphere and used water to represent the oceans.
The gases they used were methane ($CH_4$), ammonia ($NH_3$) and hydrogen ($H_2$).
A continuous electrical spark was used to simulate lightning storms.

After one week the Miller-Urey experiment had produced amino acids.
Amino acids are essential to life.

The simplest amino acid is glycine (aminoethanoic acid).



The apparatus used in the Miller-Urey experiment is shown in the diagram.




Use the information in the diagram and on page 10 to answer these questions.

**4 (b) (i)** Miller and Urey used methane, ammonia and hydrogen for the Earth's early atmosphere.

Suggest why.

.....

.....

*(1 mark)*

**4 (b) (ii)** The experiment provides only weak evidence of how amino acids formed on Earth.

Suggest **two** reasons why.

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*(2 marks)*

5

**Turn over ▶**

**5** Calcium carbonate is found in limestone.
Limestone is used as a building material.
Limestone is also used to make calcium oxide and calcium hydroxide.

**5 (a)** Limestone is heated to make calcium oxide.

**5 (a) (i)** Calcium oxide reacts with a substance to produce calcium hydroxide.
Name the substance.

.....

*(1 mark)*

**5 (a) (ii)** Calcium hydroxide reacts with a substance to produce calcium carbonate.
Name the substance.

.....

*(1 mark)*

**5 (b)** Limestone reacts with acids.

**5 (b) (i)** Balance the chemical equation for the reaction of calcium carbonate with hydrochloric acid.

$$CaCO_3 + HCl \longrightarrow CaCl_2 + CO_2 + H_2O$$

*(1 mark)*

**5 (b) (ii)** Buildings made from limestone are affected by the products from burning fossil fuels containing sulfur.

Explain why.

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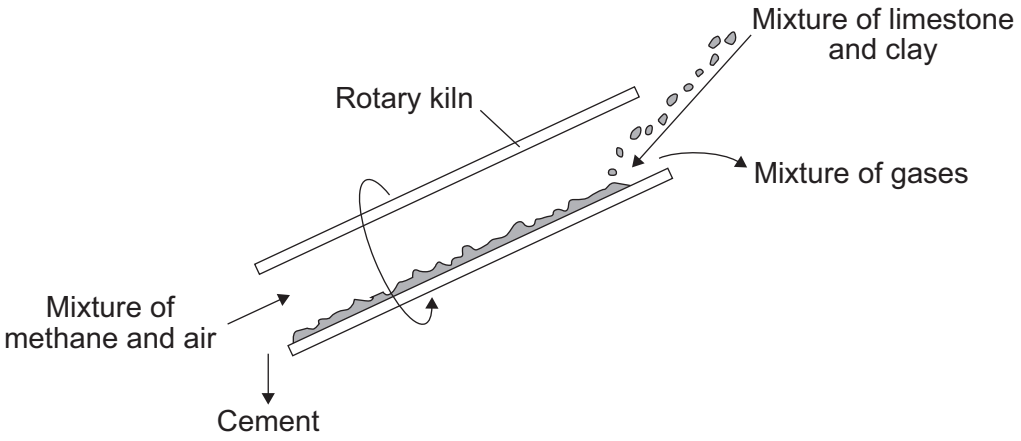
*(2 marks)*

**5 (c)** When a mixture of limestone and clay is heated in a rotary kiln cement is produced.
Burning a mixture of methane and air heats the kiln.
Clay does not decompose in the kiln.




**5 (c) (i)** Carbon dioxide is one of the main gases in the mixture of gases coming out of the kiln.

Give **two** reasons why.

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*(2 marks)*

**5 (c) (ii)** Name the other main gas in the mixture of gases coming out of the kiln.

Give a reason why there is a high percentage of this gas in the mixture of gases coming out of the kiln.

Name of gas .....

Reason .....

.....

.....

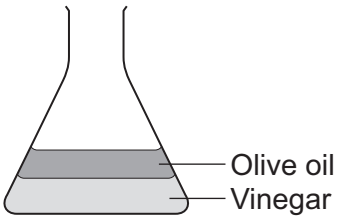
*(2 marks)*

9

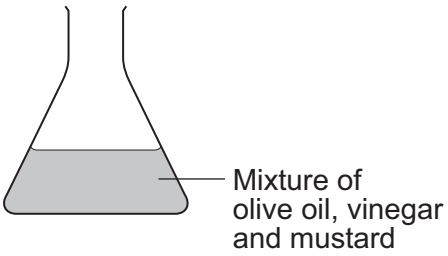
**6** Olive oil is used to make salad dressings and margarine.

**6 (a)** Vinegar is often used to make salad dressings.
Vinegar contains 95% water and 5% ethanoic acid.

**Simple salad dressing**




**French salad dressing**




To make a simple salad dressing add olive oil to vinegar and shake. After a few minutes the mixture separates.
To make a French salad dressing add mustard to the olive oil and vinegar and shake. After several minutes the mixture does **not** separate.

**6 (a) (i)** Why does the mixture in the simple salad dressing separate?

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*(1 mark)*

**6 (a) (ii)** Mustard in the French salad dressing has molecules with hydrophilic properties and hydrophobic properties.

Explain why the French salad dressing does **not** separate.
You may include a diagram to help you to answer this question.

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*(3 marks)*

**6 (b)** Olive oil contains 89 % unsaturated fats and 11 % saturated fats.

What is the test and the result for unsaturated fats?

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*(2 marks)*

**6 (c)** Olive oil is hardened to make margarine.

Describe the reaction and conditions needed to harden a vegetable oil.

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*(3 marks)*

9

**Turn over for the next question**

**7** Ethanol ($C_2H_5OH$) is produced from ethene or from sugar cane.

The two different methods to produce ethanol are summarised in the table.

| **Ethanol from sugar cane is a batch process** | **Ethanol from crude oil is a continuous process** |
|---|---|
| Sugar cane plants are crushed and soaked in water for one day. | Crude oil is distilled to separate the naphtha fraction. |
| The sugar solution is separated by filtration. | The naphtha fraction is cracked when the vaporised hydrocarbons are passed over a hot catalyst. |
| Yeast is added to the sugar solution and fermented for three days. | The ethene produced is separated by distillation. |
| The solution of water and ethanol produced is separated by filtration. | Ethene is reacted with steam in the presence of a catalyst. |
| Distillation of this solution produces a 50 % solution of ethanol. | This hydration reaction produces 100 % ethanol. |

**7 (a)** Complete and balance an equation for the cracking of the hydrocarbon $C_6H_{14}$ to produce ethene.

$C_6H_{14}$ ⟶ ..... + .....

*(2 marks)*

**7 (b)** What is **seen** when the sugar solution and yeast are fermented?

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*(1 mark)*

**7 (c)** Evaluate the issues involved with the production of ethanol from sugar cane compared with the production of ethanol from crude oil.
You should explain why each issue you describe is important.

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*(5 marks)*

8

**Turn over for the next question**

**8** The table shows some properties of gases in dry air.

| Gas in dry air | Density in kg/m$^3$ | Melting point in °C | Boiling point in °C | Percentage (%) in air |
|---|---|---|---|---|
| Nitrogen | 1.2506 | –210 | –196 | 78.08 |
| Oxygen | 1.4290 | –219 | –183 | 20.95 |
| Carbon dioxide | 1.977 | –57 | –57 | 0.033 |
| Helium | 0.1785 | –272 | –269 | 0.00052 |
| Neon | 0.8999 | –249 | –246 | 0.0019 |
| Argon | 1.7837 | –189 | –186 | 0.934 |
| Krypton | 3.74 | –157 | –153 | 0.00011 |
| Xenon | 5.86 | –112 | –108 | 0.0000087 |

**8 (a)** In 1895, Lord Rayleigh isolated nitrogen from dry air by removing the other known gases, oxygen and carbon dioxide.
He then discovered that nitrogen from dry air had a different density to pure nitrogen produced from chemical reactions.
He concluded that nitrogen extracted from dry air was mixed with another gas.
The density of nitrogen extracted from dry air was higher than the density of pure nitrogen.

Use the information above to explain why.

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*(2 marks)*

**8 (b)** Gases from the air are separated to provide raw materials used in many different industrial processes.

Steps in dry air separation:

**Step 1:** Filter to remove solid particles

**Step 2:** Remove carbon dioxide

**Step 3:** Cool the remaining air to –200 °C

**Step 4:** Separate by allowing the liquefied gases to warm up.

**8 (b) (i)** Carbon dioxide is removed before the air is cooled to –200 °C.

Suggest **one** reason why.

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*(1 mark)*

**8 (b) (ii)** Which two gases do **not** condense when the remaining air is cooled to –200 °C?

..... and .....

*(1 mark)*

**8 (b) (iii)** Two gases in air do **not** separate completely when the liquefied gases are allowed to warm up.

Name these **two** gases and give a reason for your answer.

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*(2 marks)*

**6**

**END OF QUESTIONS**

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