Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
SCIENCE A
CHEMISTRY

H

Higher Tier Unit Chemistry C1

Thursday 18 May 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 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.

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

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ANSWER IN THE SPACES PROVIDED

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

1 Elements are made of atoms.

1 (a) **Table 1** shows the atomic numbers and mass numbers of three atoms.

Table 1

Atom	Atomic number	Mass number
1	12	24
2	12	25
3	12	26

1 (a) (i) Suggest, in terms of the number of subatomic particles, why the atomic numbers of the three atoms are the same.

[1 mark]

_____

_____

1 (a) (ii) Explain, in terms of the number of subatomic particles, why the mass numbers of the three atoms are different.

[2 marks]

_____

_____

_____

1 (b) When elements react, their atoms join with other atoms to form compounds.

Sulfuric acid, H_2SO_4, is a compound.

1 (b) (i) How many elements are in the formula H_2SO_4?

[1 mark]

_____

1 (b) (ii) How many atoms are in the formula H_2SO_4?

[1 mark]

_____

1 (c) Sulfuric acid reacts with metal oxides.

$$\underset{\text{copper oxide}}{CuO} + \underset{\text{sulfuric acid}}{H_2SO_4} \longrightarrow \underset{\text{copper sulfate}}{CuSO_4} + \underset{\text{water}}{H_2O}$$

In a reaction, 159 g of copper oxide reacts with 196 g of sulfuric acid.

What is the mass of the products?

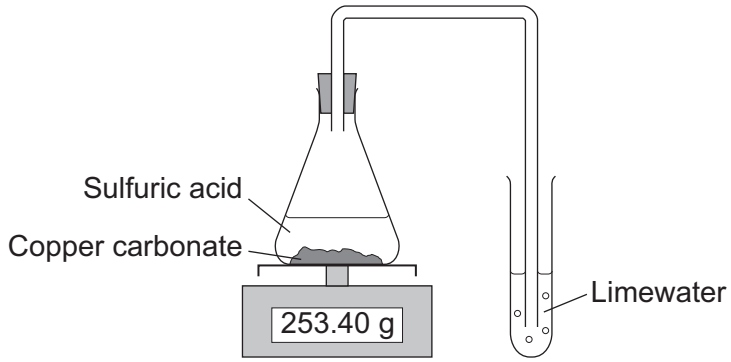
[1 mark]

Tick (✓) **one** box.

Mass of copper sulfate in g	**Mass of water in g**	**Tick (✓)**
30	7	
159	36	
196	18	
319	36	

1 (d) **Figure 1** shows apparatus used to investigate the reaction of sulfuric acid with copper carbonate.

Figure 1



Describe and explain the changes seen during the reaction.

[3 marks]

9

Turn over for the next question

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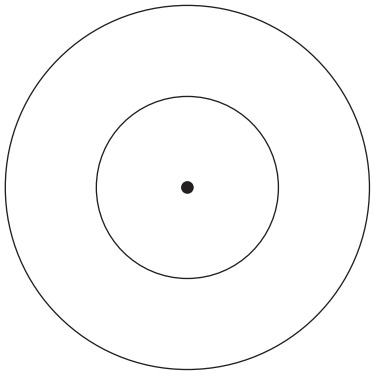
ANSWER IN THE SPACES PROVIDED

2 This question is about compounds of carbon.

2 (a) **Figure 2** shows an atom with two energy levels (shells).

Figure 2



2 (a) (i) A carbon atom has six electrons.

Complete **Figure 2** to show the electronic structure of a carbon atom.

Use **x** to represent an electron.

[1 mark]

2 (a) (ii) Complete the following description about the central part of this carbon atom.

[3 marks]

The central part is made up of six neutrons that have no electrical charge and _____

_____

_____

_____

_____

2 (b) Crude oil is a mixture of compounds. These compounds are mainly hydrocarbons.

What does the term hydrocarbon mean?

[1 mark]

_____

_____

2 (c) Alkanes and alkenes are hydrocarbons.

Table 2 shows the boiling points of some alkanes and alkenes.

Table 2

Alkanes

Name	Formula	Boiling point in °C
Ethane	C_2H_6	–88
Propane	C_3H_8	–42
Butane	C_4H_{10}	0
Pentane	C_5H_{12}	+36
Hexane	C_6H_{14}	+69

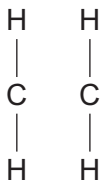
Alkenes

Name	Formula	Boiling point in °C
Ethene	C_2H_4	–104
Propene	C_3H_6	–48
Butene	C_4H_8	–6
Pentene	C_5H_{10}	+30
Hexene	C_6H_{12}	+64

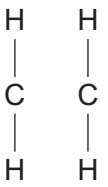
2 (c) (i) Complete the displayed structure of ethane and the displayed structure of ethene.

[2 marks]

Ethane



Ethene



2 (c) (ii) Describe the relationship between the number of carbon atoms in an alkane molecule and the boiling point of the alkane molecule.

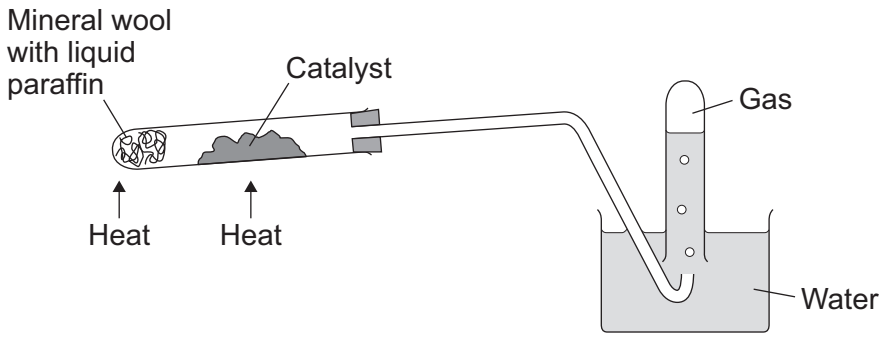
[1 mark]

2 (c) (iii) Use the information in **Table 2** to compare the boiling points of alkanes with the boiling points of alkenes.

[2 marks]

2 (d) A student used the apparatus in **Figure 3** to investigate what happens when liquid paraffin is heated to a high temperature.

Figure 3



Liquid paraffin contains alkanes.

Describe what happens to the alkane molecules in this investigation.

[3 marks]

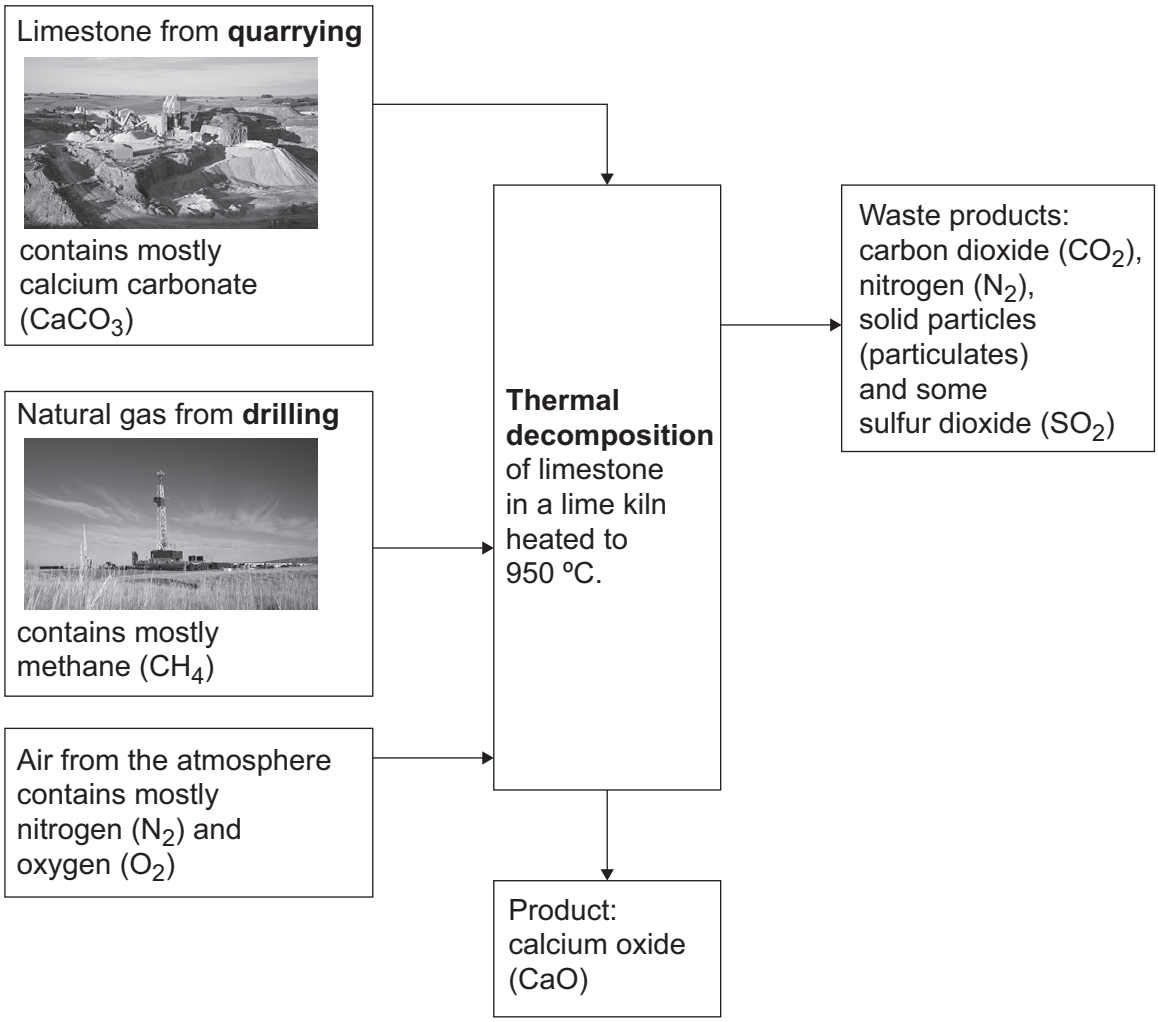
13

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

Limestone is heated in a lime kiln to produce calcium oxide.

Figure 4 shows the reactants used and the products made in a lime kiln.

Figure 4



Use information from **Figure 4** to explain the potential environmental impacts of quarrying, drilling and the thermal decomposition of limestone used in the production of calcium oxide.

[6 marks]

Extra space

6

4 A polymer is used to make supermarket carrier bags.

4 (a) **Table 3** shows data about polymer bags used by customers of UK supermarkets.

Table 3

Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Number of bags used in millions	12 419	11 346	9004	7570	7974	8392	8487	8759	8959
Mass of bags used in thousands of tonnes	109.8	104.7	83.4	65.6	68.3	72.3	70.4	67.3	66.1

4 (a) (i) Describe what happens in a polymerisation reaction.

[1 mark]

4 (a) (ii) Describe the trend in the number of bags used per year between 2006 and 2014.

[2 marks]

4 (a) (iii) The trend in the number of bags used does **not** match the trend of the mass of bags used between 2012 and 2014.

Suggest **two** reasons why.

[2 marks]

4 (b) There has been an increase in the amount of recycled polymer used to make supermarket carrier bags.

This reduces the amount of polymer put into landfill.

4 (b) (i) Give **two** reasons why the amount of polymer put into landfill **should** be reduced.

[2 marks]

4 (b) (ii) Apart from reducing the use of landfill, give **two** reasons why more recycled polymer, instead of newly manufactured polymer, should be used to make supermarket carrier bags.

[2 marks]

9

Turn over for the next question

5 This question is about the Earth's atmosphere.

5 (a) The Earth's early atmosphere was a mixture of gases.

One theory is that the Earth's early atmosphere had the composition shown in **Table 4**.

Table 4

Gas	**Percentage in Earth's early atmosphere (%)**
Carbon dioxide	96
Nitrogen	3.5
Oxygen	a trace
Other gases including methane, ammonia, hydrogen and water vapour	0.5

5 (a) (i) Amino acids are at the basis of all life processes.
The simplest amino acid is glycine, NH_2CH_2COOH

Two scientists, Miller and Urey, showed that they could produce glycine from a mixture of methane, ammonia, hydrogen and water.
Miller and Urey concluded that this is how life was formed on Earth.

Suggest **one** reason why this conclusion may **not** be correct.

[1 mark]

5 (a) (ii) Give **three** reasons why the percentage of carbon dioxide in the Earth's atmosphere today is less than the percentage of carbon dioxide in the Earth's early atmosphere.

[3 marks]

5 (b) **Table 5** shows the boiling points of some gases in the air.

Table 5

Gas	Boiling point in °C
Nitrogen	–196
Oxygen	–183
Carbon dioxide	–79*
Helium	–269
Neon	–246
Argon	–186

*freezes at this temperature

Oxygen from the air is separated by fractional distillation. To do this separation the air is cooled to –200 °C. Most of the gases condense.

5 (b) (i) Name the two gases that would **not** condense at –200 °C.

[1 mark]

_____ and _____

5 (b) (ii) Suggest why carbon dioxide is removed before the air is cooled.

[1 mark]

_____

_____

5 (b) (iii) The liquid at –200 °C is passed into a fractionating column.

Explain why one of the fractions is a mixture of oxygen and one other gas.

[2 marks]

_____

_____

_____

_____

5 (c) Oxygen is used in the production of steel.

Cast iron from a blast furnace contains 96% iron and 4% carbon.

The stages for the production of steel from cast iron are:

Stage 1 pass oxygen into molten cast iron

Stage 2 add small amounts of other metals.

Explain why each stage is needed in the production of steel.

[4 marks]

12

6 Oils from plants are used in the production of fuels and foods.

6 (a) Explain **one** advantage of using biodiesel made from plant oils compared with using fossil diesel made from crude oil.

[2 marks]

6 (b) Plant oils are used in emulsions to give a consistent texture to many foods.

Explain how an emulsion of water and oil is formed.

[4 marks]

6 (c) Bromine water changes colour when shaken with some plant oils.

Describe the colour change.

[2 marks]

Question 6 continues on the next page

6 (d) Describe and explain what happens to plant oils when they react with hydrogen in the presence of a nickel catalyst at about 60 °C.

[3 marks]

11

END OF QUESTIONS

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