Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2017–2018

Science: Single Award

Unit 2 (Chemistry)
Higher Tier

MV18

[GSS22]

THURSDAY 9 NOVEMBER 2017, MORNING

Time

1 hour 15 minutes, plus your additional time allowance.

Instructions to Candidates

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all eleven** questions.

Information for Candidates

The total mark for this paper is 75.
Quality of written communication will be assessed in Questions **3** and **10**.
Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.
A Data Leaflet, which includes a Periodic Table of the Elements, is included for your use.

1 The hydrocarbons in crude oil are separated into different fractions by fractional distillation. The table below shows some of the properties of these fractions.

Fraction	**Number of carbon atoms in chain**	**Boiling point range /°C**	**State at room temperature**	**Ease of catching fire**
refinery gas	1 – 4	–160 to 20	gas	
petrol	5 – 9	20 to 70	liquid	
naphtha	6 – 11	70 to 120	liquid	
paraffin	11 – 18	120 to 170	liquid	
diesel oil	16 – 20	170 to 230	liquid	
fuel oil	21 – 70	230 to 350	liquid	
bitumen	more than 70	above 350	solid	

(a) State **one** trend shown by this information. [1 mark]

_____

_____

(b) Using information from the table, explain why petrol is suitable for use as a fuel. [2 marks]

_____

_____

_____

(c) Explain how the fractions in crude oil are separated by fractional distillation. [2 marks]

2 **(a)** The table below shows some information about the elements found in Period 2 of the Periodic Table.

Name of element	Lithium	Beryllium	Boron	Carbon	Nitrogen	Oxygen	Fluorine	Neon
Symbol	Li	Be	B	C	N	O	F	Ne
Atomic number	3	4	5	6	7	8	9	10
Mass number	7	9	11	12	14	16	19	20
Melting point/°C	180	1287	2076	3500	−210	−219	−220	−249
Boiling point/°C	1342	2970	3927	4827	−196	−183	−188	−246
Metallic character	Metal	Metal	Semi-Metal	Non-Metal	Non-Metal	Non-Metal	Non-Metal	Non-Metal

Use this information and your knowledge to answer the following questions.

(i) Name the element which is a halogen. [1 mark]

_____

(ii) Name the element which has three electrons in its outer shell. [1 mark]

_____

(iii) Name the **metal** with the lowest boiling point. [1 mark]

_____

(iv) Describe the trend in metallic character across Period 2. [1 mark]

_____

_____

(b) Lithium is a reactive metal.

(i) Lithium reacts with fluorine to form the compound lithium fluoride.
What is the formula of lithium fluoride?

Circle the correct answer. [1 mark]

Li_2F **LiF_2** **LiF**

(ii) Lithium also reacts with water. Complete the word equation for this reaction. [1 mark]

lithium + water → ☐ + hydrogen

(iii) Apart from seeing bubbles of hydrogen gas, give **one** other observation you would make when lithium reacts with water. [1 mark]

_____

_____

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(Questions continue overleaf)

3 To help solve crimes forensic scientists take and analyse fingerprints found at the scene of a crime.

Explain fully why fingerprints are so important in crime scene investigations. [6 marks]

Your answer should include:

- the name of one type of fingerprint
- how fingerprints are obtained from different coloured surfaces
- why fingerprints are useful in solving crime

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

4 The photograph below was taken on a tour of the Marble Arch Caves in County Fermanagh which is a hard water area.

(a) Give **two** advantages of drinking the water in a hard water area. [2 marks]

1. _____

2. _____

(b) A student investigated the hardness of different water samples.
The results are shown below.

Sample	Volume of soap solution needed to form a lather before boiling/cm^3	Volume of soap solution needed to form a lather after boiling/cm^3
A	2	2
B	16	7
C	18	2
D	24	2
E	22	22

(i) Which two samples (**A**, **B**, **C**, **D** or **E**) contained **only** temporary hardness? [1 mark]

_____ and _____

(ii) Which sample of water (**A**, **B**, **C**, **D** or **E**) was the hardest? [1 mark]

_____

(iii) Which sample (**A**, **B**, **C**, **D** or **E**) contained both temporary and permanent hardness? [1 mark]

_____

(c) Temporary hard water undergoes thermal decomposition to form 'fur' in kettles.

(i) What is meant by the term thermal decomposition? [2 marks]

_____

_____

(ii) Give the chemical name for 'fur' in kettles. [1 mark]

_____

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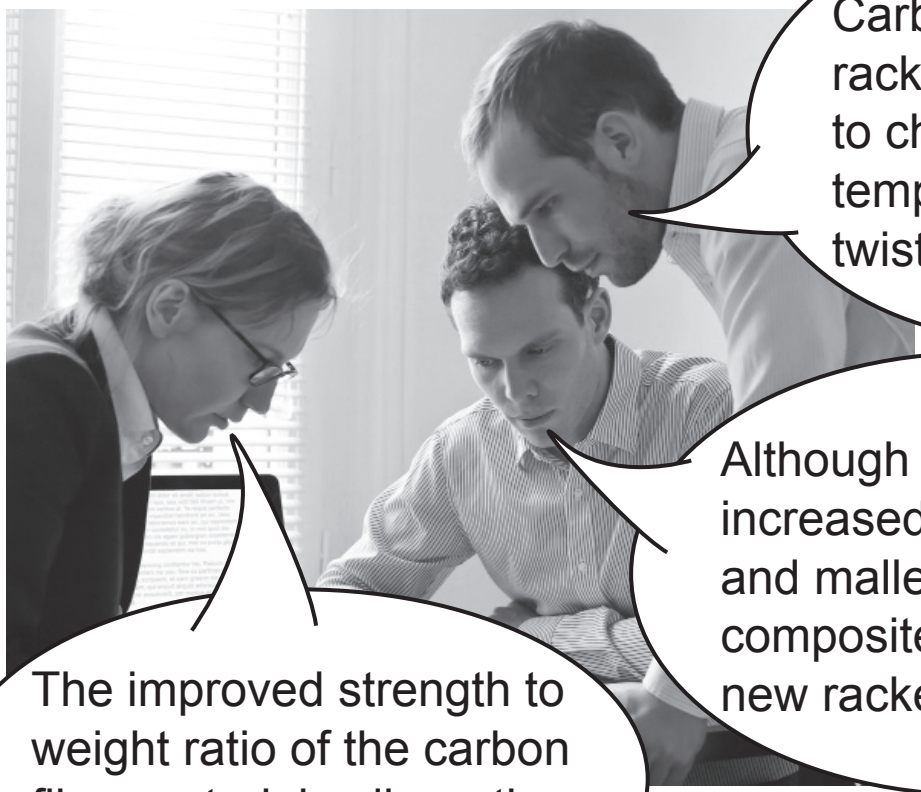
(Questions continue overleaf)

5 Anne, Robert and Jack have a very successful business producing top of the range tennis rackets. Shown below is their discussion as they prepare to launch a new carbon composite racket. Rackets have traditionally been made from wood.



(a) Use this information to explain why many professional tennis players use carbon composite rackets.
[2 marks]

(b) Suggest **one** reason why parents might still buy a wooden racket for their child. [1 mark]

6 **(a)** Sodium hydrogencarbonate is used in the baking of cakes.

(i) Sodium hydrogencarbonate releases carbon dioxide during the baking of cakes.
Balance the symbol equation below for this reaction.
[1 mark]

$$NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$$

(ii) Give **one** reason why it is important that carbon dioxide is produced during the baking of cakes.
[1 mark]

_____

(b) Sodium hydrogencarbonate also combines with citric acid and sugar in the production of sherbet in sweets.

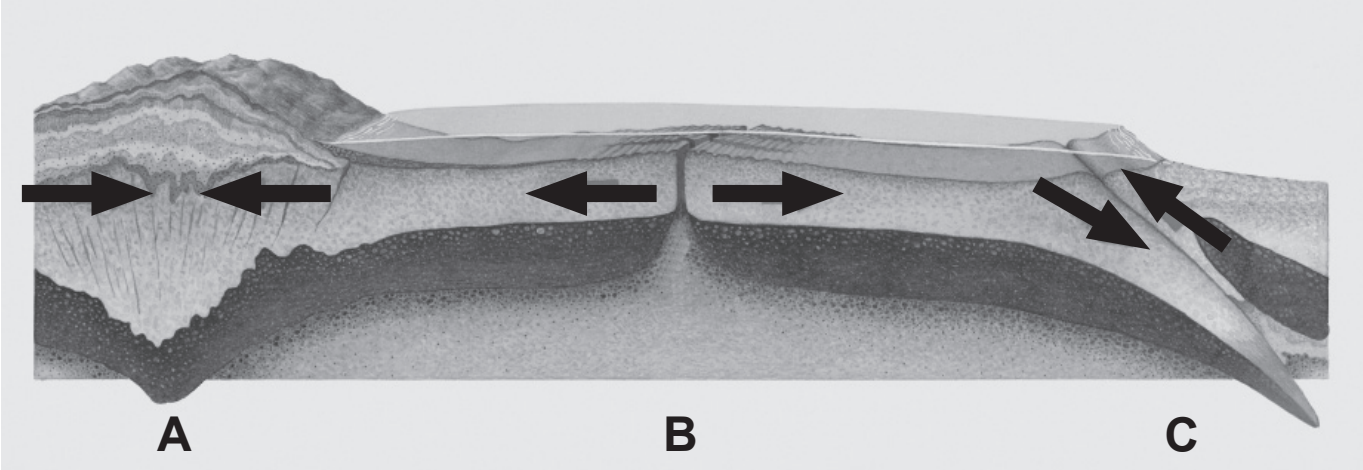
(i) Complete the word equation for the reaction between citric acid and sodium hydrogencarbonate.
[2 marks]

sodium hydrogencarbonate + citric acid → ☐ + ☐ + carbon dioxide

(ii) Name the solution that is used to test for carbon dioxide. [1 mark]

_____

7 **(a)** The diagram below shows a section of the Earth's crust. The arrows represent the movement of tectonic plates.



The movement of tectonic plates is responsible for many of the Earth's features.

(i) Complete the table below by naming the features produced by tectonic plate movement at areas **A** and **B** in the diagram above. [2 marks]

Area	**Feature**
A	
B	
C	Earthquakes

(ii) Explain fully how an earthquake occurs. [2 marks]

(b) There are different ideas on the age of the Earth. One was proposed by a local man from Armagh based on the Book of Genesis.

(i) Name the person who worked out the age of the Earth based on the Book of Genesis. [1 mark]

(ii) What age did he calculate the Earth to be? [1 mark]

(iii) Describe how he used the Book of Genesis to calculate this age. [1 mark]

8 The table below shows some information about different metals.

Metal	Relative Strength	Melting point/°C	Density/ g/cm^3	Relative electrical conductivity	Relative cost
Iron	very high	1535	7.9	1.0	low
Gold	low	1065	19.3	4.3	very high
Aluminium	medium	659	2.7	3.7	medium
Copper	medium	1083	8.9	5.8	high
Lead	very low	327	11.3	0.5	low
Silver	low	961	10.5	6.1	very high

Use the information in the table to answer the questions below.

(a) Overhead cables are used to carry electricity all over the country.
Which metal would be most suitable to use for this purpose?
Explain fully your choice. [3 marks]

(b) Iron is often used in the building of bridges.
State one property that is **not** important when using iron for this purpose. Explain your choice. [2 marks]

(c) Nano-sized particles of titanium dioxide and zinc oxide are used in the latest sun-protection creams. Unlike previous sun creams they provide protection from the sun while appearing invisible on the skin.

(i) What size is a nanoparticle? [1 mark]

_____

(ii) Explain the advantage in using nano-sized particles in sun creams. [1 mark]

_____

(iii) Give **one** use for nano-sized particles of silver. [1 mark]

_____

(d) Another group of newly developed materials are described as smart materials.

(i) Explain fully what is meant by the term 'smart material'. [2 marks]

_____

_____

_____

(ii) Name one **type** of smart material that changes colour. [1 mark]

_____

9 Table salt (sodium chloride) is a compound used in cooking.

(a) Explain the meaning of the term compound.
[2 marks]

_____

_____

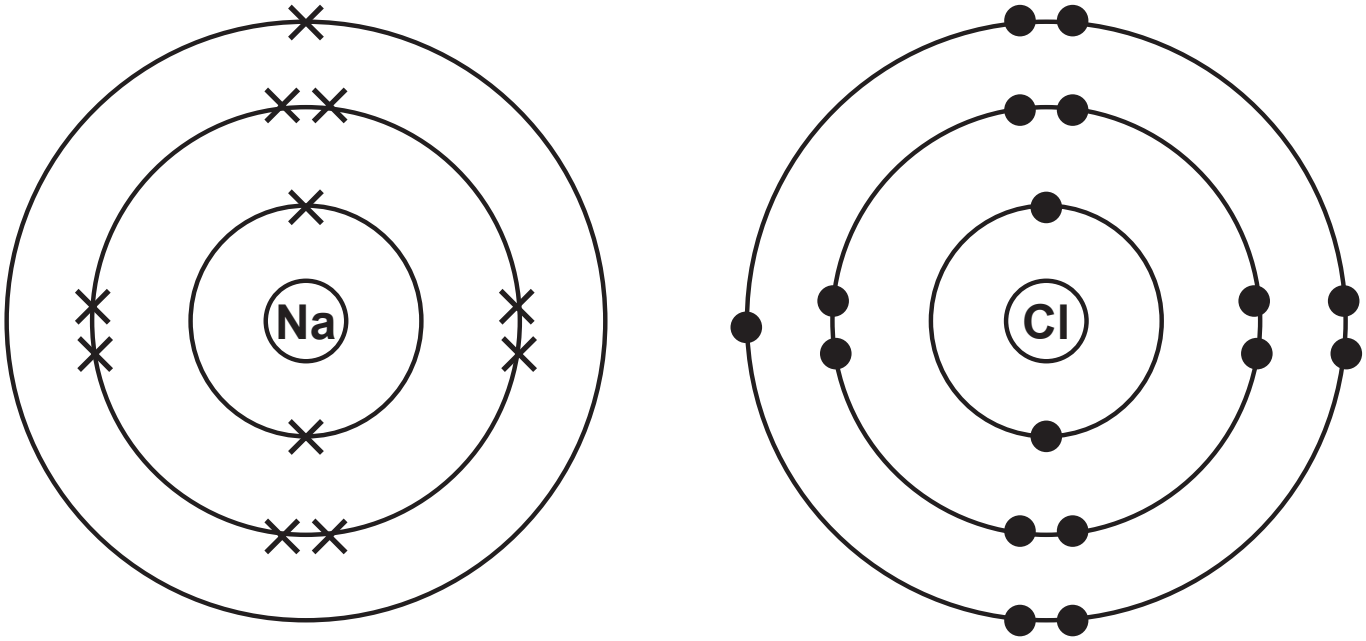
_____

(b) Complete the sentences below. [1 mark for each]
You may find your Data Leaflet helpful.

(i) Sodium is in Group _____ of the Periodic Table.

(ii) Chlorine is in Period _____ of the Periodic Table.

(c) Given below are the electronic structures for sodium and chlorine.



Explain fully, in terms of electrons, how sodium and chlorine will form a compound. [3 marks]

Sodium can also react with fluorine to produce sodium fluoride (NaF).

- sodium can be represented as $^{23}_{11}Na$
- fluorine can be represented as $^{19}_{9}F$

(d) Calculate the **total** number of protons, electrons and neutrons represented by the formula NaF. [3 marks]

Protons _____

Electrons _____

Neutrons _____

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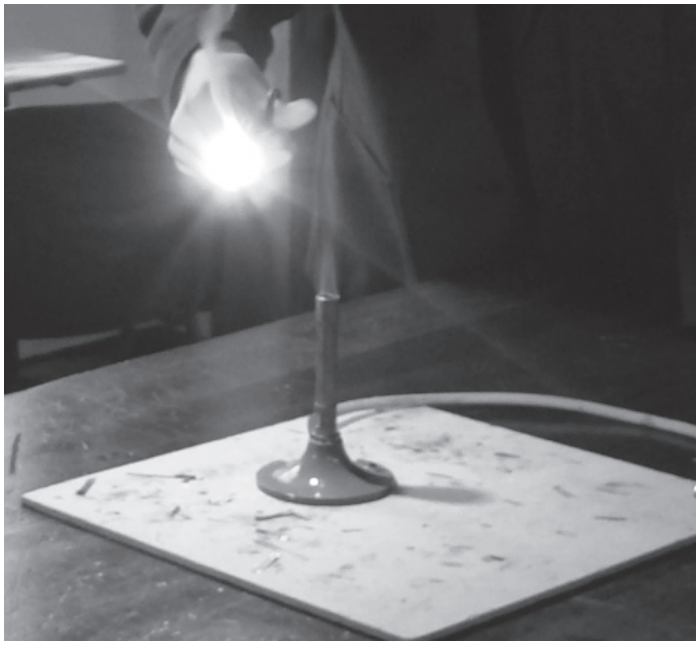
(Questions continue overleaf)

10 The photograph below shows a teacher demonstrating the burning of magnesium.



Describe what the students will observe, naming the type of reaction and the product formed. Apart from wearing safety glasses, state **two** safety precautions that should be taken. [6 marks]

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

11 Crude oil is a mixture of hydrocarbons.

(a) What is meant by the term hydrocarbon? [2 marks]

(b) Draw the structural formula of propane (C_3H_8) showing all the chemical bonds. [1 mark]

(c) Name the family (homologous series) of hydrocarbons that propane belongs to. [1 mark]

(d) Write the **balanced symbol** equation for the burning of propane. [3 marks]

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Question Number	**Marks**
1	
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