



General Certificate of Secondary Education
2018–2019

Centre Number

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Candidate Number

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Single Award Science: Chemistry

Unit 2

Higher Tier

MV24

[GSA22]

THURSDAY 16 MAY 2019, MORNING

Time

1 hour, 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.

You must answer the questions in the spaces provided.

Do not write on blank pages.

Complete in black ink only.

Answer **all seven** questions.

Information for Candidates

The total mark for this paper is 60.

Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.

Quality of written communication will be assessed in Question 3.

A Data Leaflet, which includes a Periodic Table of the Elements, is included for your use.

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(Questions start overleaf)

1 The diagram opposite represents the Periodic Table.

(a) What name is given to the elements in:

(i) Group 1? [1 mark]

(ii) Group 0? [1 mark]



(b) Group 7 elements are called the halogens. The table below shows information about the first four halogens.

Halogen	Density/ g/cm³	Melting point/°C	Boiling point/°C
Fluorine	0.0017	−220	−188
Chlorine	0.0032	−102	−34
Bromine	3.1028	−7	59
Iodine	4.9330	114	184

(i) State the trend in density shown in the table. [1 mark]

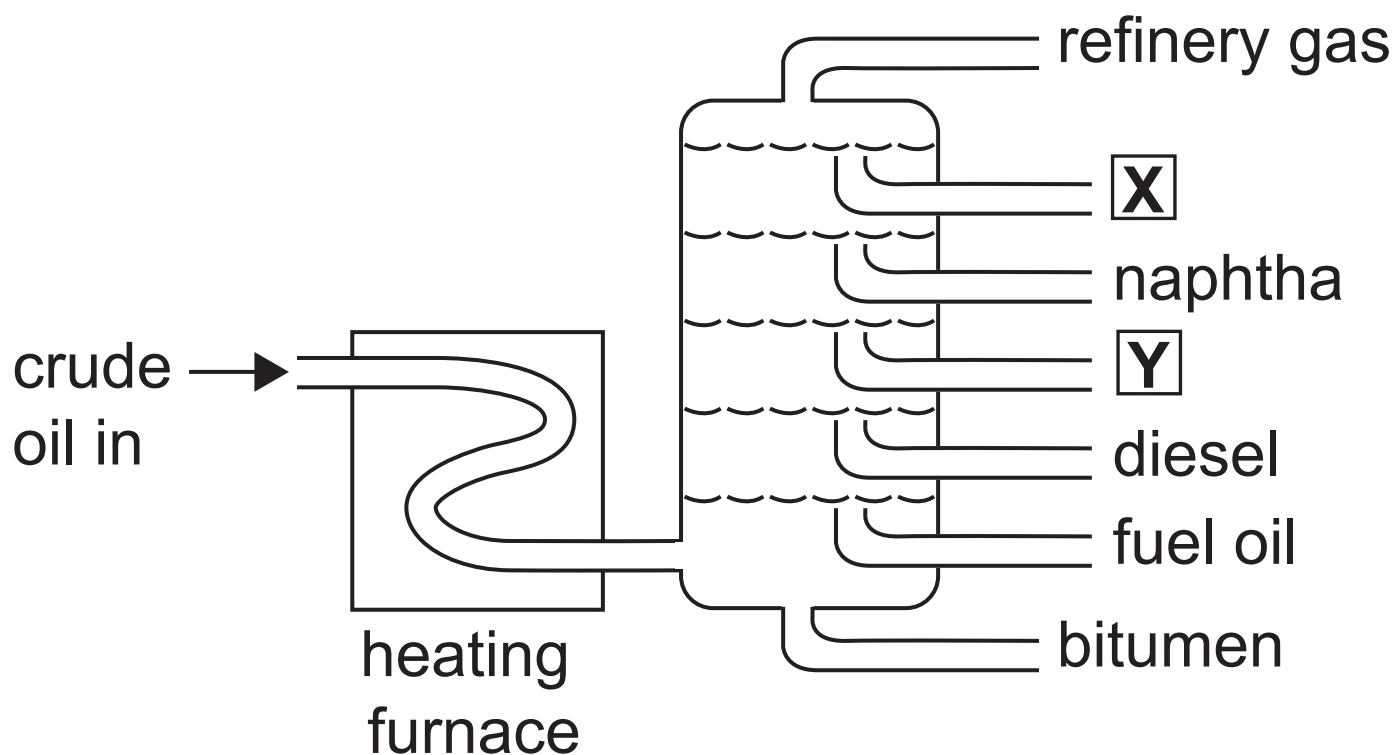
(ii) Astatine is below Iodine in Group 7 of the Periodic Table. Predict the melting point of astatine. [1 mark]

_____ °C

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(Questions continue overleaf)

2 (a) Describe how crude oil is formed.
[3 marks]

(b) The diagram below shows part of the process used to separate crude oil into useful products (fractions).



(i) Name the process that is used to separate crude oil as shown in the diagram above. [1 mark]

(ii) Name the fractions **X** and **Y**.

[2 marks]

X _____

Y _____

(iii) Why is the crude oil heated?

[1 mark]

(c) The table below gives information about some of the fractions obtained from crude oil.

Fraction	Boiling point range/°C	Number of carbon atoms in the alkane chain
refinery gas	−160 to 20	1–4
naphtha	70 to 120	5–10
diesel	170 to 230	14–20
fuel oil	230 to 350	20–50

Use information in the table to answer the following questions.

(i) Which fraction has the largest boiling point range? [1 mark]

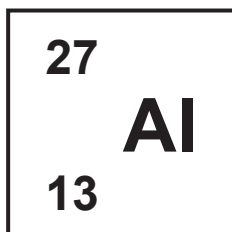
(ii) Which fraction would the alkanes methane and ethane belong to? [1 mark]

(iii) Complete the sentence about the trend shown in the table. [1 mark]

As the number of carbon atoms in the alkane chain _____

(iv) An alkane has a boiling point of 175 °C. Which fraction does it belong to? [1 mark]

3 In the Periodic Table aluminium is shown using the following symbol:



Describe the structure of an aluminium atom. [6 marks]

Your answer should include:

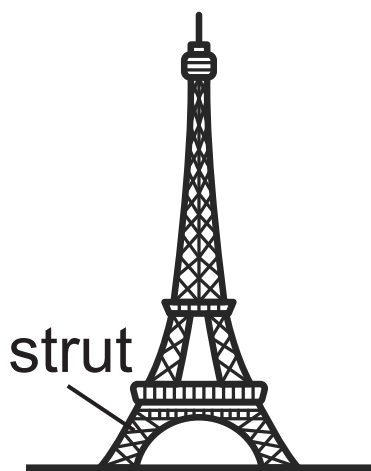
- the numbers of protons, neutrons and electrons in an aluminium atom
- the location of the protons, neutrons and electrons in the atom
- the electronic configuration (structure) of an aluminium atom
- how aluminium's electronic configuration relates to its position (Group and Period) in the Periodic Table.

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

- 4 Below is part of an article from a science magazine.

A super-strong and lightweight new material.

Nanostructured ceramics could be used to build lighter, stronger airplanes and batteries.



Traditional ceramics are strong but also heavy, so they can't be used as building materials. When traditional ceramics break, they shatter like glass.

A new type of ceramic material, made up of nano-sized tubes crisscrossed like the struts of a tiny Eiffel Tower, is one of the strongest and lightest substances ever made.

Experiments showed that by changing the thickness of the tube walls, it is possible to control how the material breaks.

When the walls are thick, the ceramic shatters under pressure as expected. But tubes with thinner walls, just 10 nanometres thick, fold when compressed and then recover their shape.

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

_____ m

(b) Use information from the article to answer the following questions.

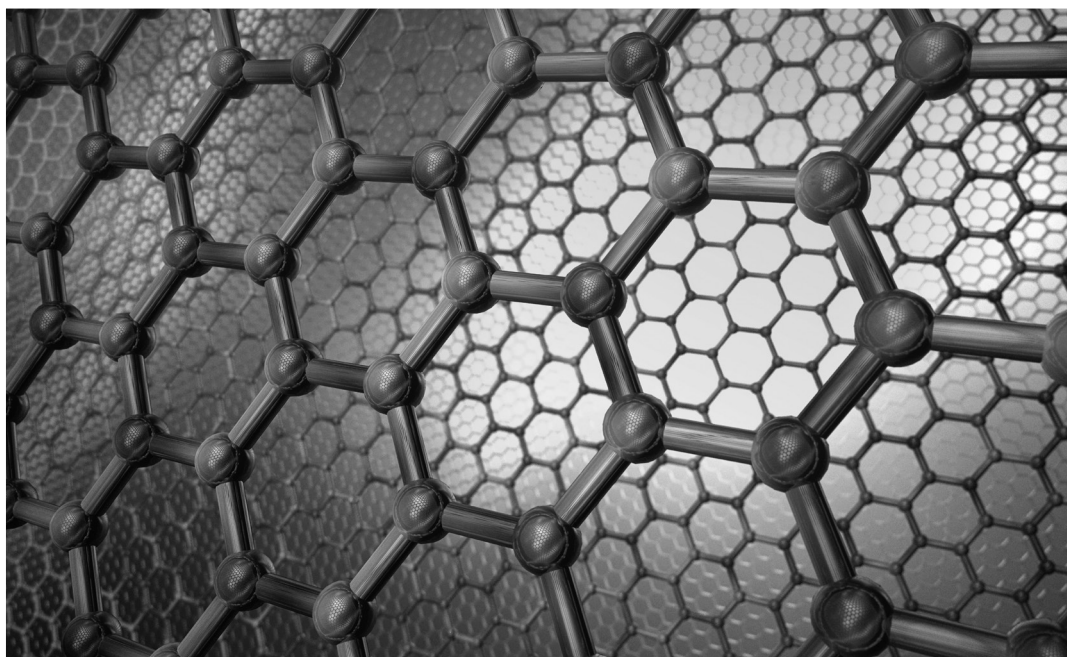
(i) Give **two** properties of the new thinner walled ceramic nano-material described above. [2 marks]

1. _____

2. _____

(ii) Which property of the new ceramic nano-material means it can be described as a smart material? [1 mark]

(c) Graphene is another new material that is made from carbon.



(i) Describe the structure of graphene.
[1 mark]

(ii) Give **one** use of graphene and state the property that makes it suitable for this use. [2 marks]

Use: _____

Property: _____

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(Questions continue overleaf)

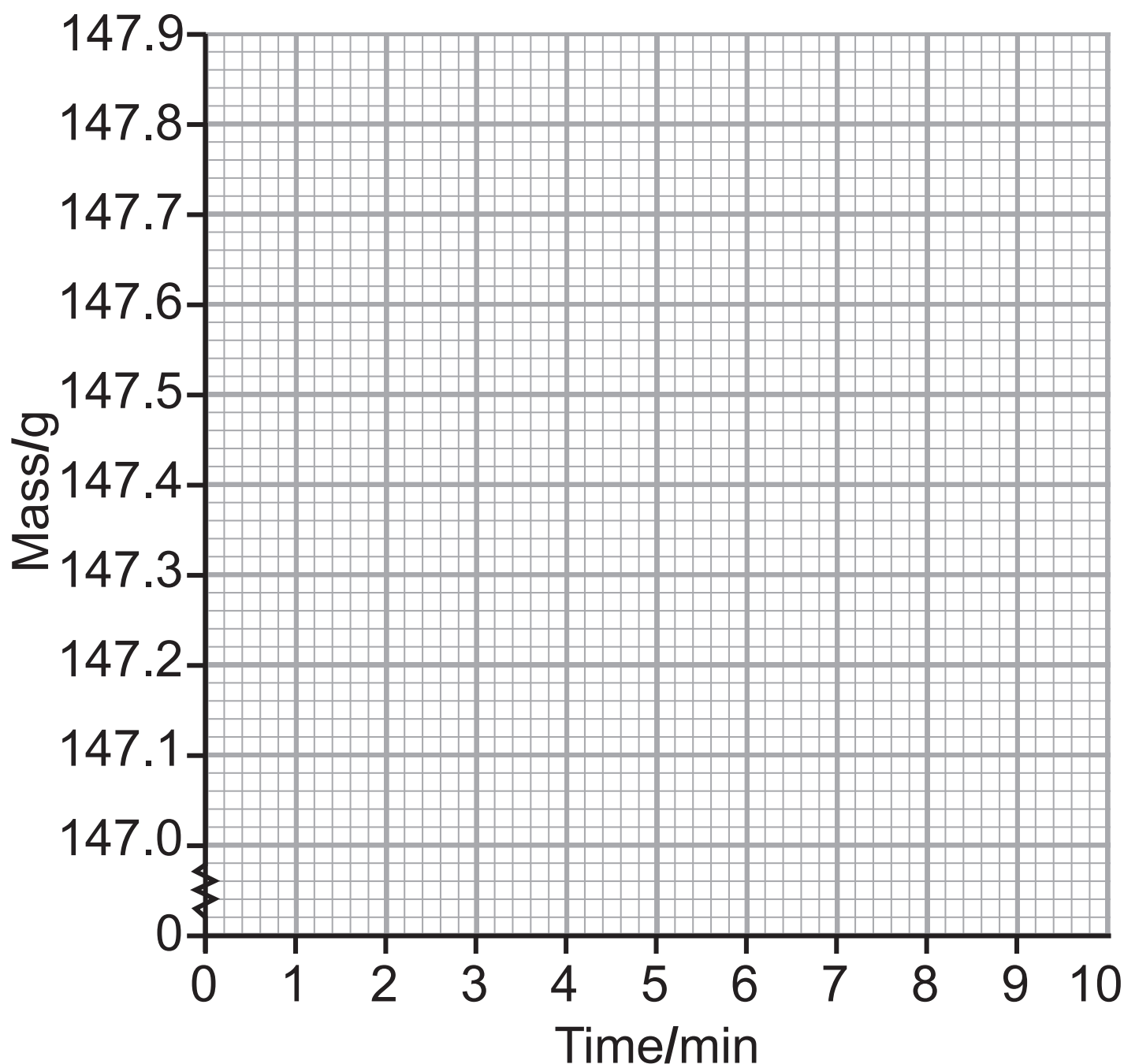
- 5 (a)** The apparatus shown below was set up to measure the rate of reaction between 2.5 g of marble chips (calcium carbonate) and 50 cm³ of hydrochloric acid. The acid was in excess.



The mass of the flask and its contents were recorded every 2 minutes for ten minutes. The results are shown below.

Time/min	0	2	4	6	8	10
Mass of flask and contents/g	147.90	147.40	147.20	147.10	147.05	147.02

- (i) Use the grid below to plot and draw a line graph of these results.
[3 marks]



(ii) Calculate the total loss of mass during this experiment. [1 mark]

_____ g

(iii) During which time period was the rate of this reaction faster: **0 – 2 minutes** or **8 – 10 minutes**? Use your graph to explain your answer. [1 mark]

(b) Explain why the mass of the flask and contents decreased during this experiment. [1 mark]

(c) If this experiment was repeated at a **higher** temperature, with all other factors remaining the same. What change, if any, would you expect to happen to:

(i) the rate of the reaction? [1 mark]

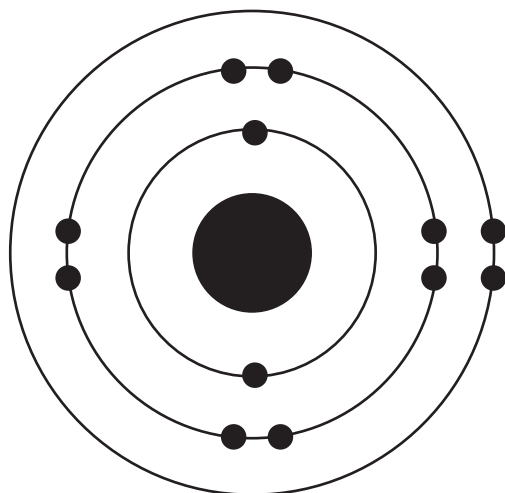
(ii) the total mass lost during the experiment? [1 mark]

(d) The experiment was repeated with **less** concentrated acid and all other factors remained the same. What effect, if any, will this have on the rate of the reaction? Explain your answer in terms of particles. [3 marks]

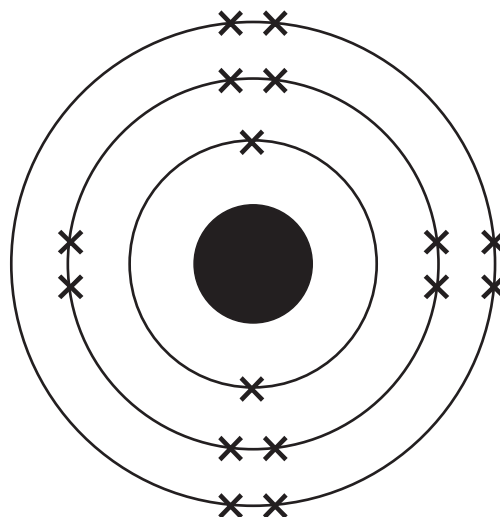
(e) Complete the balanced symbol equation below for this reaction by adding the state symbols for the products.
[2 marks]



- 6 (a) The diagrams below show the electronic configuration of a magnesium atom and a sulfur atom.

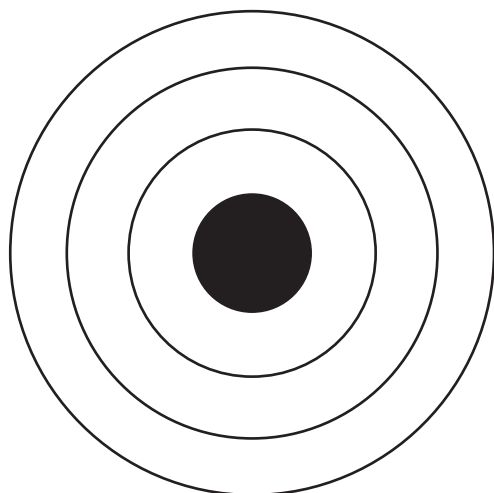


magnesium

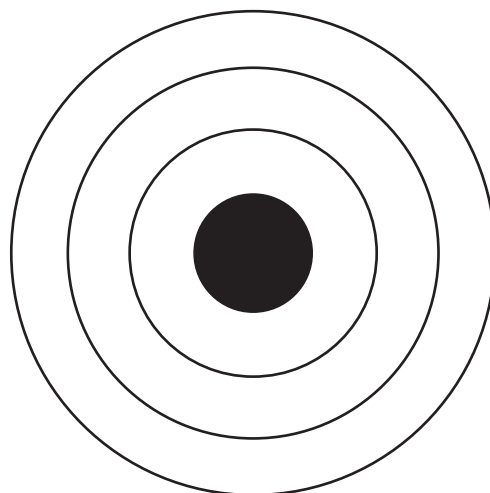


sulfur

- (i) Complete the dot and cross diagrams below for the ions of magnesium and sulfur. [2 marks]



magnesium ion

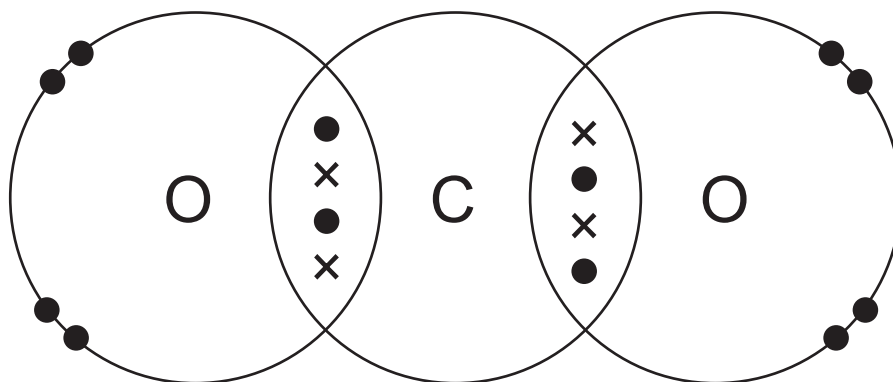


sulfur ion

(ii) Give the formula of a magnesium ion.
[1 mark]

(iii) Name the compound formed when
magnesium and sulfur react.
[1 mark]

(b) Carbon reacts with oxygen to form carbon dioxide. The dot and cross diagram below shows the outer electrons in a molecule of carbon dioxide.



(i) Name the **type** of bonding shown in carbon dioxide. [1 mark]

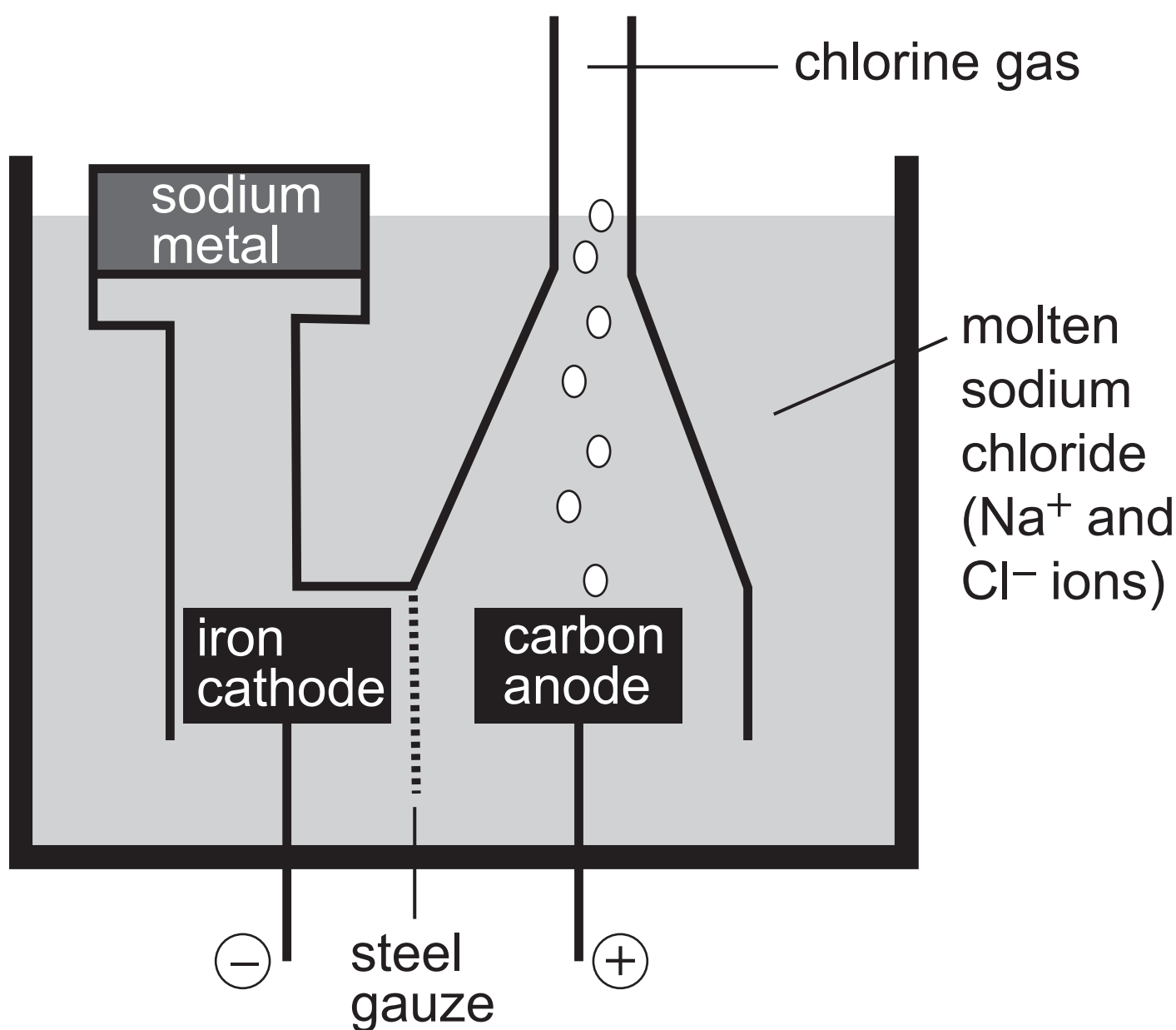
(ii) How many lone pairs of electrons are shown in the diagram? [1 mark]

(iii) Name another compound that has the same type of bonding as carbon dioxide. [1 mark]

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

(d) Increasing levels of carbon dioxide in the atmosphere can lead to climate change. State **one** effect on the Earth of climate change. [1 mark]

- 7 Both aluminium and sodium can be extracted using electrolysis. Sodium can be extracted from molten sodium chloride. In this process a carbon anode and an iron cathode are used. Molten sodium forms at the cathode and floats to the surface. Chlorine gas is formed at the anode.



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

(b) State **two** properties that carbon and iron must have to be useful as electrodes in this electrolysis. [2 marks]

1. _____

2. _____

During the electrolysis of molten aluminium oxide, aluminium is formed at the cathode when the aluminium ions gain three electrons.

(c) Suggest how **sodium** is formed at the cathode during the electrolysis of molten sodium chloride. [2 marks]

(d) Sodium can react with water to produce hydrogen gas.

(i) Describe the test for hydrogen gas. [2 marks]

(ii) Complete the balanced symbol equation for the hydrogen gas test. [2 marks]



**This is the end of the
question paper**

SOURCES

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Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
Total Marks	

Examiner Number

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SYMBOLS OF SELECTED IONS

Positive ions

Name	Symbol
Ammonium	NH_4^+
Chromium(III)	Cr^{3+}
Copper(II)	Cu^{2+}
Iron(II)	Fe^{2+}
Iron(III)	Fe^{3+}
Lead(II)	Pb^{2+}
Silver	Ag^+
Zinc	Zn^{2+}

Negative ions

Name	Symbol
Butanoate	$\text{C}_3\text{H}_7\text{COO}^-$
Carbonate	CO_3^{2-}
Dichromate	$\text{Cr}_2\text{O}_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogencarbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	HCOO^-
Nitrate	NO_3^-
Propanoate	$\text{C}_2\text{H}_5\text{COO}^-$
Sulfate	SO_4^{2-}
Sulfite	SO_3^{2-}

Data Leaflet

Including the Periodic Table of the Elements

For the use of candidates taking
Science: Chemistry,
Science: Double Award
or Science: Single Award

Copies must be free from notes or additions of any
kind. No other type of data booklet or information
sheet is authorised for use in the examinations

SOLUBILITY IN COLD WATER OF COMMON SALTS, HYDROXIDES AND OXIDES

Soluble
All sodium, potassium and ammonium salts
All nitrates
Most chlorides, bromides and iodides EXCEPT silver and lead chlorides, bromides and iodides
Most sulfates EXCEPT lead and barium sulfates Calcium sulfate is slightly soluble
Insoluble
Most carbonates EXCEPT sodium, potassium and ammonium carbonates
Most hydroxides EXCEPT sodium, potassium and ammonium hydroxides
Most oxides EXCEPT sodium, potassium and calcium oxides which react with water

gcse examinations chemistry

Group

1	H	Hydrogen	1
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† 90 – 103 Actinium series

A square with side length 'a' and 'b' (labeled on the left side). Inside the square is a large 'X'.

x = atomic symbol

b = atomic number

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	145 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	231 Pa Protactinium 91	238 U Uranium 92	237 Np Neptunium 93	242 Pu Plutonium 94	243 Am Americium 95	247 Cm Curium 96	245 Bk Berkelium 97	251 Cf Californium 98	254 Es Einsteinium 99	253 Fm Fermium 100	256 Md Mendelevium 101	254 No Nobelium 102	257 Lr Lawrencium 103