



Oxford Cambridge and RSA

**Monday 19 May 2025 – Morning**

**GCSE (9–1) Combined Science A  
(Gateway Science)**

**J250/03 Chemistry (Foundation Tier)**

**Time allowed: 1 hour 10 minutes**

**You must have:**

- a ruler (cm/mm)
- the Data Sheet for GCSE (9–1) Combined Science A (Chemistry) (inside this document)

**You can use:**

- a scientific or graphical calculator
- an HB pencil



Please write clearly in black ink. **Do not write in the barcodes.**

Centre number

|  |  |  |  |  |
|--|--|--|--|--|
|  |  |  |  |  |
|--|--|--|--|--|

Candidate number

|  |  |  |  |
|--|--|--|--|
|  |  |  |  |
|--|--|--|--|

First name(s)

---

Last name

---

### INSTRUCTIONS

- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

### INFORMATION

- The total mark for this paper is **60**.
- The marks for each question are shown in brackets [ ].
- Quality of extended response will be assessed in questions marked with an asterisk (\*).
- This document has **20** pages.

### ADVICE

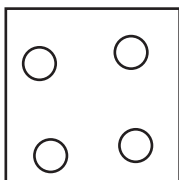
- Read each question carefully before you start your answer.

## Section A

You should spend a **maximum of 20 minutes** on this section.

Write your answer to each question in the box provided.

- 1 Which state of matter is shown in the diagram?



- A A gas
- B A liquid
- C A solid
- D A solution

Your answer

[1]

- 2 24 g of magnesium reacts with oxygen to make 40 g of magnesium oxide.

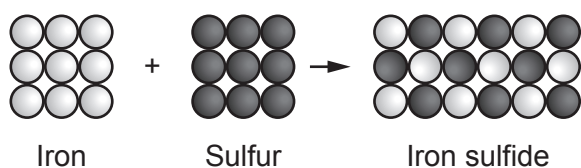
What mass of magnesium oxide is made when 12 g of magnesium reacts?

- A 20 g
- B 24 g
- C 36 g
- D 40 g

Your answer

[1]

3 What type of change is shown in the diagram?

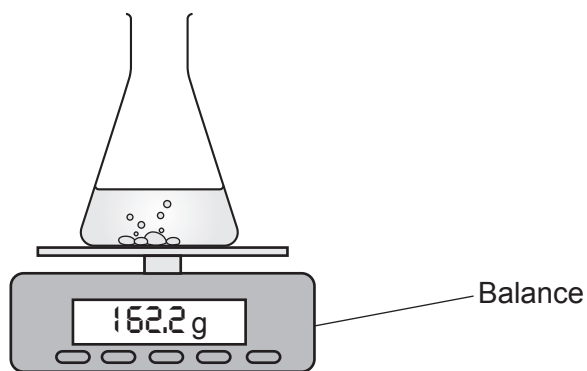


- A A change of state
- B A chemical change
- C A physical change
- D A reversible change

Your answer

[1]

4 The diagram shows a chemical reaction.



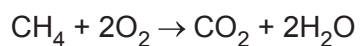
Why does the mass on the balance **decrease** during the reaction?

- A A gas is produced.
- B A liquid is produced.
- C A solid is produced.
- D A solution is produced.

Your answer

[1]

- 5 Methane reacts with oxygen to make carbon dioxide and water.



Which chemical is being **oxidised**?

- A  $\text{CH}_4$
- B  $\text{CO}_2$
- C  $\text{H}_2\text{O}$
- D  $\text{O}_2$

Your answer

☐

[1]

- 6 Which type of mixture can be separated using paper chromatography?

- A A mixture of gases.
- B A mixture of insoluble liquids.
- C A mixture of insoluble solids.
- D A mixture of soluble liquids.

Your answer

☐

[1]

- 7 Which particle in dilute hydrochloric acid,  $\text{HCl}$ , makes it acidic?

- A  $\text{Cl}^-$
- B  $\text{H}^+$
- C  $\text{H}_2\text{O}$
- D  $\text{OH}^-$

Your answer

☐

[1]

- 8 The table shows the boiling points of four substances made from simple molecules.

| Substance | Boiling point (°C) |
|-----------|--------------------|
| A         | −196               |
| B         | −33                |
| C         | 36                 |
| D         | 98                 |

Which substance has the **weakest** intermolecular forces?

Your answer

[1]

- 9 Which statement describes a **pure** substance?

- A A mixture of substances which melts at a single temperature.  
 B A mixture of substances which melts over a range of temperatures.  
 C One substance which melts at a single temperature.  
 D One substance which melts over a range of temperatures.

Your answer

[1]

- 10 Which row describes the **nucleus** of an atom?

|   | Charge   | Mass                                    |
|---|----------|-----------------------------------------|
| A | positive | contains little of the mass of the atom |
| B | positive | contains most of the mass of the atom   |
| C | negative | contains little of the mass of the atom |
| D | neutral  | contains most of the mass of the atom   |

Your answer

[1]

**6**  
**Section B**

**11** This question is about metals.

**(a)** Where are metals found in the Periodic Table?

Use the Periodic Table.

Tick (✓) **one** box.

On the left.

☐

On the left and right.

☐

On the right.

☐

[1]

**(b)** Which metal is found in Group 2 and Period 3 of the Periodic Table?

Use the Periodic Table.

Tick (✓) **one** box.

Aluminium

☐

Copper

☐

Magnesium

☐

[1]

**(c)** The table shows the properties of four elements.

| Element  | Appearance at room temperature | Melting point (°C) | Electrical conductivity |
|----------|--------------------------------|--------------------|-------------------------|
| <b>A</b> | black solid                    | 114                | low                     |
| <b>B</b> | brown solid                    | 2076               | low                     |
| <b>C</b> | orange-red solid               | 1358               | high                    |
| <b>D</b> | yellow solid                   | 388                | low                     |

Which element **A**, **B**, **C** or **D**, is a metal?

..... [1]

(d) The properties of a metal are changed by mixing it with small amounts of another element.

(i) What is a mixture of a metal and small amounts of another element called?

Tick (✓) **one** box.

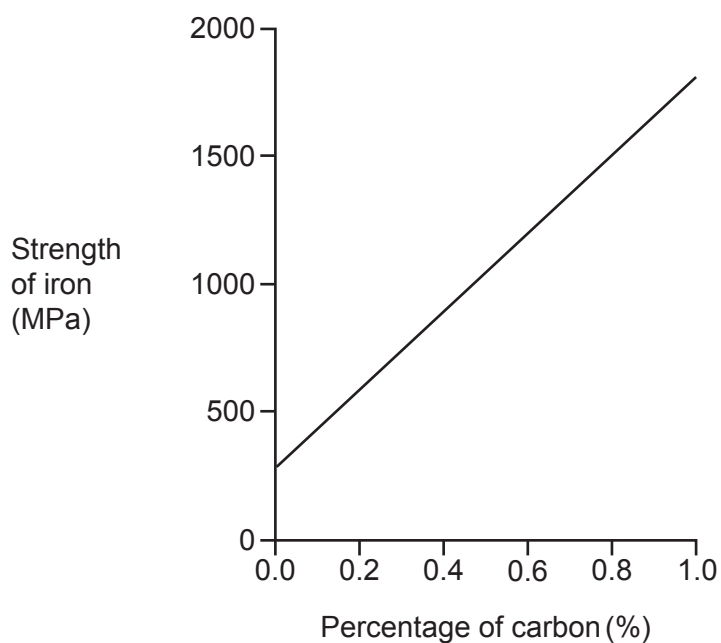
A compound ☐

An alloy ☐

An element ☐

[1]

(ii) The graph shows how the strength of iron changes with the percentage of carbon it contains.



How does the strength of iron change as the percentage of carbon changes?

.....

..... [1]

**12** A student investigates some exothermic and endothermic reactions.

They measure the temperature change in two reactions.

The table shows their results.

| Reaction | Start temperature (°C) | End temperature (°C) | Temperature change (°C) |
|----------|------------------------|----------------------|-------------------------|
| <b>1</b> | .....                  | 12                   | −4                      |
| <b>2</b> | 18                     | 39                   | +21                     |

(a) Complete the table by writing in the start temperature for Reaction 1. [1]

(b) State **and** explain which reaction is exothermic and which is endothermic.

Reaction 1 .....

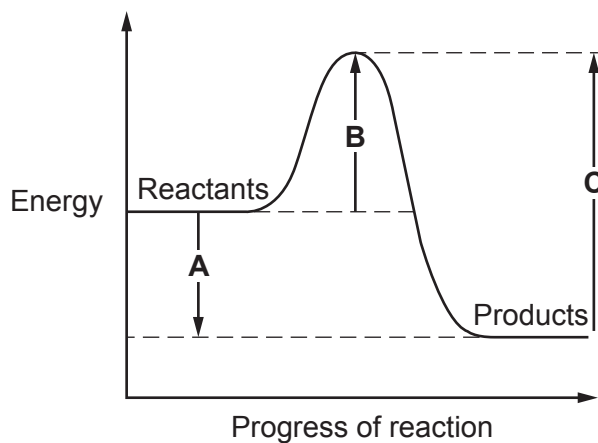
.....

Reaction 2 .....

.....

[2]

(c) The diagram shows a reaction profile for an **exothermic** reaction.



(i) Which energy change, **A**, **B** or **C**, is the activation energy?

..... [1]

(ii) Which energy change, **A**, **B** or **C**, is the energy change for the reaction?

..... [1]

**13** Sodium chloride is an ionic compound.

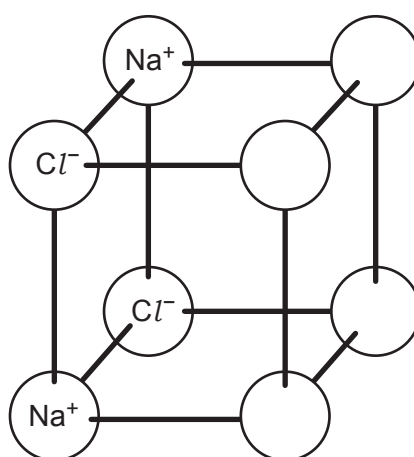
**(a)** Sodium chloride is made from sodium ions,  $\text{Na}^+$ , and chloride ions,  $\text{Cl}^-$ .

**(i)** **Fig. 13.1** shows a model for the ionic lattice of sodium chloride.

Complete **Fig. 13.1** by writing in the missing sodium ions,  $\text{Na}^+$ , and chloride ions,  $\text{Cl}^-$ .

**[1]**

**Fig. 13.1**



**(ii)** What is the formula of sodium chloride?

..... **[1]**

**(b)** Sodium chloride can be split up into its elements using electrolysis.

During electrolysis, sodium chloride must be heated until it is a liquid.

The table shows the melting point and boiling point of sodium chloride.

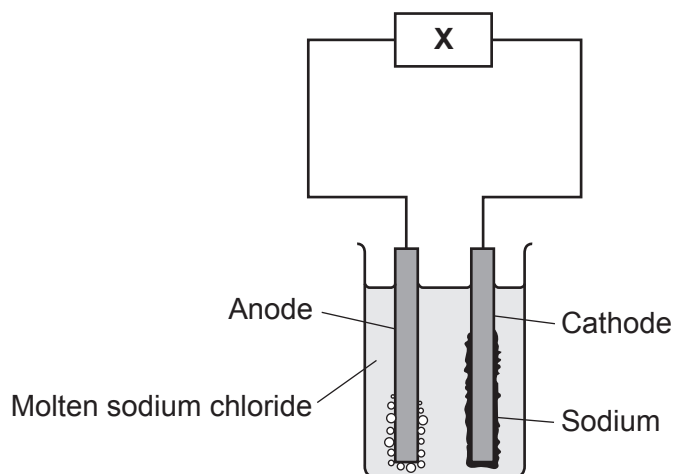
| Melting point ( $^{\circ}\text{C}$ ) | Boiling point ( $^{\circ}\text{C}$ ) |
|--------------------------------------|--------------------------------------|
| 801                                  | 1465                                 |

Suggest a temperature that sodium chloride should be heated to so it is a liquid.

..... **[1]**

(c) Fig. 13.2 shows a diagram for the electrolysis of molten sodium chloride.

Fig. 13.2



(i) What is the name of the piece of equipment, X?

..... [1]

(ii) Name the gas produced at the anode.

..... [1]

(iii) A student thinks that the electrodes (anode and cathode) should be inert and made from graphite.

Complete the sentences to explain why the student is **correct**.

Put a ring around each correct option.

Graphite is **reactive** / **unreactive**. It is an **electrical conductor** / **electrical insulator**. [1]

(d) Sodium chloride contains 39% sodium.

Calculate the mass of sodium that is produced from the electrolysis of 160 kg of sodium chloride.

Give your answer to **2** significant figures.

Mass of sodium = ..... kg [3]

Sodium atom      Chlorine atom      Sodium ion      Chloride ion

Use information:

- from **Fig. 13.3**
- your knowledge of chemical bonding
- ideas about the electron arrangement in the atoms and ions.

[6]

**14** Atoms are made up of protons, neutrons and electrons.

**(a)** The table shows the relative mass and relative charge for a proton and electron.

|                 | Relative mass | Relative charge |
|-----------------|---------------|-----------------|
| <b>Proton</b>   | 1             | +1              |
| <b>Neutron</b>  | .....         | .....           |
| <b>Electron</b> | 0.0005        | −1              |

Complete the table to show the relative mass and relative charge of a neutron.

Use numbers from the list.

|    |        |   |   |    |
|----|--------|---|---|----|
| −1 | 0.0005 | 0 | 1 | +1 |
|----|--------|---|---|----|

**[2]**

**(b)** The mass of a proton is  $1.67 \times 10^{-27}$  kg.

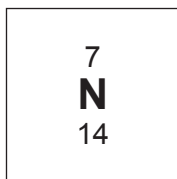
An electron is 0.0005 times lighter than a proton.

Calculate the mass of an electron in kg.

Give your answer in **standard form**.

Mass of an electron = ..... kg **[2]**

(c) The symbol for an atom of nitrogen is:



The table shows the number of protons in this atom of nitrogen.

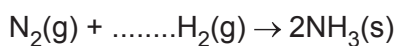
| Number of protons | Number of neutrons | Number of electrons |
|-------------------|--------------------|---------------------|
| 7                 | .....              | .....               |

Complete the table by writing in the number of neutrons and number of electrons.

[2]

(d) Nitrogen reacts with hydrogen to form ammonia,  $\text{NH}_3$ .

(i) This is the equation for the reaction.



What is the missing number that **balances** the equation?

Tick (✓) **one** box.

|   |  |
|---|--|
| 2 |  |
| 3 |  |
| 4 |  |

[1]

(ii) Calculate the relative formula mass,  $M_r$ , of ammonia,  $\text{NH}_3$ .

Relative atomic masses ( $A_r$ ): H = 1    N = 14

Relative formula mass of ammonia = ..... [1]

- (e) A student thinks that the empirical formula of ammonia is  $\text{NH}_3$ .

Explain why the student is **correct**.

Tick (✓) **one** box.

Ammonia contains only two elements.

☐

Ammonia is a compound of nitrogen.

☐

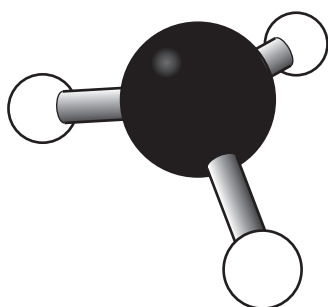
$\text{NH}_3$  gives the simplest ratio of the atoms.

☐

[1]

- (f) Fig. 14.1 shows the ball and stick model for a molecule of ammonia.

Fig. 14.1



Which statements about a ball and stick model are **true**, and which are **false**?

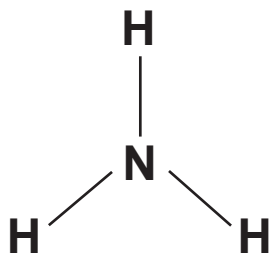
Tick (✓) **one** box in **each** row.

|                                                  | True                     | False                    |
|--------------------------------------------------|--------------------------|--------------------------|
| It shows how the atoms are arranged in space.    | <input type="checkbox"/> | <input type="checkbox"/> |
| It shows the exact length of the covalent bonds. | <input type="checkbox"/> | <input type="checkbox"/> |
| It shows the numbers of atoms of each element.   | <input type="checkbox"/> | <input type="checkbox"/> |

[2]

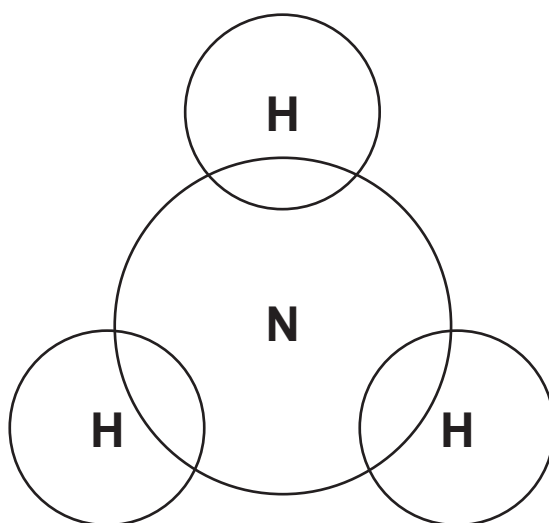
(g) Fig. 14.2 shows the structure of a molecule of ammonia.

Fig. 14.2



Complete the dot and cross diagram for a molecule of ammonia.

Only show the outer shell electrons.



[2]

**15** A student investigates the reaction of magnesium carbonate and dilute sulfuric acid.

**(a)** The student wants to measure the pH of the dilute sulfuric acid.

**(i)** Suggest the pH of dilute sulfuric acid.

..... [1]

**(ii)** Name an indicator that the student could use to measure the pH of dilute sulfuric acid.

State the colour of the indicator after it has been added to the dilute sulfuric acid.

Name of indicator .....

Colour ..... [2]

**(iii)** Name a piece of equipment the student could use to measure the pH more accurately.

..... [1]

**(b)** When magnesium carbonate reacts with dilute sulfuric acid, it forms a salt, water and carbon dioxide.

What is the name of the salt?

..... [1]

**(c)** The student adds an **excess** of magnesium carbonate to dilute sulfuric acid until **no more of it reacts**.

magnesium carbonate(s) + sulfuric acid(aq)  $\rightarrow$  salt(aq) + water(l) + carbon dioxide(g)

Magnesium carbonate is a white powder that is insoluble in water.

A colourless solution of the salt is formed.

Describe **two** observations the student would see as the reaction is happening.

1 .....

.....

2 .....

.....

[2]

- (d) The student separates the salt from the solution formed at the end of the reaction.

**Step 1:** They remove the excess magnesium carbonate.

**Step 2:** They remove the water from the salt solution.

State the names of the separation techniques used in Step 1 and Step 2.

Step 1 .....

Step 2 ..... [2]

- (e) The student measures the mass of the salt obtained when different masses of magnesium carbonate are added to the same volume of dilute sulfuric acid.

The table shows their results.

| Mass of magnesium carbonate (g) | Mass of the salt (g) |
|---------------------------------|----------------------|
| 1.0                             | 1.4                  |
| 2.0                             | 2.9                  |
| 3.0                             | 4.3                  |
| 4.0                             | 5.7                  |
| 5.0                             | 7.1                  |
| 6.0                             | 7.1                  |
| 7.0                             | 7.1                  |

- (i) Describe the relationship between the mass of magnesium carbonate and the mass of the salt.

.....  
 .....  
 ..... [2]

- (ii) A student thinks that when 6.0g of magnesium carbonate has been added it is in excess.

Explain why the student is **correct**.

.....  
 ..... [1]

**END OF QUESTION PAPER**

[illegible]



© OCR 2025