

Chemistry
PAPER 2
Foundation Tier

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|-------------|
| Total Marks |
|-------------|

Tuesday 11 June 2024 – Morning

Time: 1 hour 45 minutes

In the boxes below, write your name, centre number and candidate number.

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|-------------------------|--|--|--|--|--|
| Surname | | | | | |
| Other names | | | | | |
| Centre Number | | | | | |
| Candidate Number | | | | | |

YOU MUST HAVE

Calculator, ruler, Periodic table (enclosed)

YOU WILL BE GIVEN

Diagram Booklet

INSTRUCTIONS

Answer ALL questions.

Answer the questions in the spaces provided in this Question Paper or in the separate Diagram Booklet – there may be more space than you need.

Calculators may be used.

Any diagrams may NOT be accurately drawn, unless otherwise indicated.

You must show all your working out with your answer clearly identified at the end of your solution.

INFORMATION

The total mark for this paper is 100.

The marks for EACH question are shown in brackets – use this as a guide as to how much time to spend on each question.

In questions marked with an ASTERISK (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

There may be spare copies of some diagrams.

ADVICE

Read each question carefully before you start to answer it.

Try to answer every question.

Check your answers if you have time at the end.

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

- 1 (a) Look at Figure 1 for Question 1(a) in the Diagram Booklet. It shows a metal spoon.**

This spoon is made of silver.

- (i) Give a reason why silver is a suitable material to use for making a spoon.
(1 mark)**

(continued on the next page)

1(a) continued.

- (ii) Some spoons are made of wood or plastic, not metal.**

The raw material for wooden spoons is trees and the raw material for plastic spoons is crude oil.

**Explain an advantage, other than cost, of using wood rather than plastic.
(2 marks)**

(continued on the next page)

1 continued.

(b) Some people wear spectacles so that they can see more clearly.

(i) Which property of glass makes it suitable for use in spectacles?

(1 mark)

- ☐ **A glass does not conduct electricity**
- ☐ **B glass is a poor conductor of heat**
- ☐ **C glass is transparent**
- ☐ **D glass shatters when dropped**

(continued on the next page)

1(b) continued.

(ii) Some spectacles have a coating made of nanoparticles on the glass.

**Which statement describes nanoparticles?
(1 mark)**

- ☐ **A nanoparticles are larger than small molecules**
- ☐ **B nanoparticles are a type of atom**
- ☐ **C nanoparticles are very small molecules**
- ☐ **D nanoparticles are the monomers in DNA**

(continued on the next page)

1 continued.

- (c) Look at Figure 2 for Question 1(c) in the Diagram Booklet. One nanoparticle has a cube shape that is shown in Figure 2.**

**Calculate the surface area of this nanoparticle.
(2 marks)**

surface area = area of one face \times number of faces

surface area = _____ nm²

(Total for Question 1 = 7 marks)

2 This question is about the metals and non-metals in period 3 of the periodic table.

(a) Look at Figure 3 for Question 2(a) in the Diagram Booklet. It shows some data about some of the elements in period 3.

Use the periodic table to answer these questions.

**(i) Give the NAME of the element in period 3 that is not shown in Figure 3.
(1 mark)**

**(ii) Give the relative atomic mass of silicon.
(1 mark)**

**(iii) State which metal and which non-metal in Figure 3 have the lowest melting points.
(2 marks)**

metal with lowest melting point

non-metal with lowest melting point

2 continued.

- (b) Alkali metals react with water to produce an alkaline solution and hydrogen gas.**

A test tube of gas can be tested to see if the gas is hydrogen by putting a lighted splint at the top of the test tube.

Look at Figure 4 for Question 2(b) in the Diagram Booklet. A student suggests the following method to show that an alkaline solution and hydrogen gas are produced in this reaction.

step 1 pour 150 cm^3 water into the container shown in Figure 4

step 2 add a small piece of lithium to the water in the container shown in Figure 4

step 3 hold a lighted splint above the container

step 4 hold some damp red litmus paper above the mixture in the container.

- (i) Give the name of the container shown in Figure 4.**
(1 mark)
-

2(b) continued.

- (ii) A teacher says that **step 3** and **step 4** will NOT work to show that hydrogen gas and an alkaline solution are produced in the reaction.

Explain ONE change that could be made in each step to make the method work.

(3 marks)

step 3 _____

step 4 _____

(Total for Question 2 = 8 marks)

Turn over

- 3 Compound **A** contains either aluminium ions or copper ions or iron(II) ions.

Look at Figure 5 for Question 3 in the Diagram Booklet. It is a flow chart of the method for the test to identify the ions in compound **A**.

- (a) The precipitates formed in this test are solids.

Which state symbol is used for precipitates in equations?

(1 mark)

☐ A **aq**

☐ B **g**

☐ C **l**

☐ D **s**

(continued on the next page)

3 continued.

- (b) A student is given a container of solid **A** and a bottle of dilute sodium hydroxide solution.**

Look again at Figure 5 for Question 3 in the Diagram Booklet. Describe how the student should carry out the test in Figure 5.

**Include the names of the apparatus needed.
(3 marks)**

(continued on the next page)

Turn over

3 continued.

(c) Look again at Figure 5 for Question 3 in the Diagram Booklet. Iron(II) chloride is tested using the method in Figure 5.

**(i) State what would be SEEN when iron(II) chloride is tested.
(1 mark)**

**(ii) What is the formula of an iron(II) ion?
(1 mark)**

☐ **A Fe_2**

☐ **B Fe_2^+**

☐ **c 2Fe^+**

☐ **D Fe^{2+}**

(continued on the next page)

3 continued.

(d) Look again at Figure 5 for Question 3 in the Diagram Booklet. A different compound is tested using the method in Figure 5.

(i) When the sodium hydroxide solution is added, no precipitate forms.

**State what can be concluded from this result.
(1 mark)**

(continued on the next page)

3(d) continued.

- (ii) In an experiment, the height of the precipitate formed in a reaction is measured using a 10 cm ruler.**

Look at Figure 6 for Question 3(d)(ii) in the Diagram Booklet. The apparatus is shown in Figure 6.

**Give the height of the precipitate in mm.
(2 marks)**

height = _____ mm

(Total for Question 3 = 9 marks)

- 4 (a) In one reaction the temperature of the reaction mixture decreases.

Which word describes this type of reaction?
(1 mark)

☐ A displacement

☐ B endothermic

☐ C exothermic

☐ D neutralisation

(continued on the next page)

4 continued.

(b) In an experiment, a salt is dissolved in water.

The temperature change is measured.

Look at Figure 7 for Question 4(b) in the Diagram Booklet. It shows the apparatus that is used.

(i) State what is used to measure the temperature change in Figure 7.

(1 mark)

(ii) State ONE reason for using the piece of equipment **A in Figure 7.**

(1 mark)

(continued on the next page)

Turn over

4(b) continued.

(iii) A student suggests putting a lid on piece of equipment B.

**State why this would help to give a more accurate value for the temperature change.
(1 mark)**

(continued on the next page)

4(b) continued.

- (iv) Four different salts, **P**, **Q**, **R** and **S**, are dissolved in water.

Look at Figure 8 for Question 4(b)(iv) in the Diagram Booklet. It shows the starting temperature of the water and the final temperature of the solution after the salt dissolves.

Complete the table

- to show the temperature changes when salt **R** and salt **S** dissolve
- by placing a tick (✓) in the box, on the bottom row, for the salt that **ABSORBS** the most heat energy when it dissolves.
(4 marks)

- (v) One of the salts dissolved is barium chloride, **BaCl₂**

Barium chloride contains the chloride ion, **Cl⁻**

Give the **FORMULA** of the barium ion in barium chloride.

(1 mark)

(Total for Question 4 = 9 marks)

- 5 (a) Look at Figure 9 for Question 5(a) in the Diagram Booklet. It shows the structure of one molecule of three different compounds, **X**, **Y** and **Z**.

The molecules of the compounds shown in Figure 9 all contain the same number of carbon atoms.

- (i) Give the number of carbon atoms in a molecule of compound **X**.
(1 mark)

- (ii) Compound **X** contains carbon and one other element.

Give the **NAME** of the other element in compound **X**.
(1 mark)

(continued on the next page)

5(a) continued.

(iii) Look again at Figure 9 for Question 5(a) in the Diagram Booklet. Which of the compounds in Figure 9 is a hydrocarbon?
(1 mark)

- ☐ A X only
- ☐ B Y only
- ☐ C X and Y only
- ☐ D X, Y and Z

(iv) Which of the compounds in Figure 9 have the same molecular formula?
(1 mark)

- ☐ A none of them
- ☐ B X and Y only
- ☐ C X and Z only
- ☐ D X, Y and Z

(continued on the next page)

5 continued.

- (b) Look at Figure 10 for Question 5(b) in the Diagram Booklet. It shows where fractions are produced in the fractional distillation of crude oil.**

Complete the sentences about fractions obtained from crude oil.

(3 marks)

The fraction with the smallest molecules is called

_____.

Compared to petrol, the boiling point of kerosene is

_____.

When petrol burns, one product is

_____.

(continued on the next page)

5 continued.

- (c) When some impure hydrocarbon fuels are burned, sulfur dioxide is one of the products.**

Some sulfur dioxide gas is dissolved in water to form solution **W.**

When solution **W is added to sodium hydroxide solution of **pH 12****

- the pH changes**
- the temperature increases.**

**Explain how the pH changes and why the temperature increases.
(3 marks)**

Answer space continues on the next page.

Turn over

5(c) continued.

(Total for Question 5 = 10 marks)

6 This question is about bromine.

- (a) Give the colour and physical state of bromine at room temperature.
(2 marks)**

colour

physical state

(continued on the next page)

6 continued.

(b) Bromine reacts with hydrogen to form hydrogen bromide.

**(i) Look at the diagram for Question 6(b)(i) in the Diagram Booklet. Write the word equation for this reaction.
(2 marks)**

(ii) Hydrogen bromide dissolves in water to form a solution.

This solution of hydrogen bromide reacts with alkalis.

**State the type of reaction that occurs when a solution of hydrogen bromide reacts with an alkali.
(1 mark)**

(continued on the next page)

6 continued.

- (c) Bromine and the other halogens react with hot iron wool.**

Look at Figure 11 for Question 6(c) in the Diagram Booklet. It shows the relative speed of some of these reactions.

Fluorine also reacts with hot iron wool.

Use Figure 11 to predict the relative speed of this reaction.

(1 mark)

(continued on the next page)

6 continued.

- (d) Potassium bromide contains **32.8%** potassium by mass.

Calculate the mass of potassium and the mass of bromine in **500 g** potassium bromide.
(3 marks)

mass of potassium = _____ g

mass of bromine = _____ g

(Total for Question 6 = 9 marks)

7 (a) Look at Figure 12 for Question 7(a) in the Diagram Booklet. The structure of one molecule of compound L is shown in Figure 12.

**(i) State what the lines between the atom symbols represent in Figure 12.
(1 mark)**

**(ii) Explain why compound L is an alkene.
(2 marks)**

(continued on the next page)

7(a) continued.

(iii) 1 molecule of compound **L** has a mass
of 9.302×10^{-23} g

82,500 molecules of compound **L** combine to
form 1 polymer molecule.

Calculate the mass of this polymer molecule.
(2 marks)

mass = _____ g

(continued on the next page)

7 continued.

(b) Some naturally occurring molecules are polymers.

**Look at the diagram for Question 7(b) in the
Diagram Booklet. Draw ONE straight line from
each natural polymer to its monomer.**

(2 marks)

(continued on the next page)

7 continued.

***(c) Look at Figure 13 for Question 7(c) in the Diagram Booklet. It shows information about four compounds, **E**, **F**, **G** and **H**.**

The compounds are in no particular order

- **butane**
- **carbon dioxide**
- **ethane**
- **ethene.**

Use all of the information in Figure 13 to identify which of the four compounds, **E, **F**, **G** and **H**, is**

- **butane**
- **carbon dioxide**
- **ethane**
- **ethene.**

**You must give reasons for your choices.
(6 marks)**

Answer space continues on the next 4 pages.

Turn over

7(c) continued.

[illegible]

Turn over

7(c) continued.

[illegible]

Turn over

7(c) continued.

[illegible]

Turn over

7(c) continued.

(Total for Question 7 = 13 marks)

- 8 A student investigates the reaction between marble chips and dilute hydrochloric acid.**

The student measures the total volume of carbon dioxide gas produced each minute, for 10 minutes.

- (a) Look at Figure 14 for Question 8(a) in the Diagram Booklet. It shows part of the apparatus used in the experiment.**

**Complete Figure 14 by drawing and labelling apparatus that could be used to collect and measure the volume of the carbon dioxide gas.
(2 marks)**

(continued on the next page)

8 continued.

- (b) Look at Figure 15 for Question 8(b) in the Diagram Booklet. It shows a graph of the results of the experiment.**

A tangent has been drawn on the curve at a time of 3·5 minutes.

- (i) State the total volume of carbon dioxide produced in the first 3·5 minutes.
(1 mark)**

volume = _____ cm³

(continued on the next page)

8(b) continued.

- (ii) Using the tangent, calculate the rate of reaction at 3.5 minutes in cm^3 per minute. (3 marks)

$$\text{rate of reaction} = \frac{\text{change in gas volume}}{\text{change in time}}$$

rate = _____ cm^3 per minute

(continued on the next page)

8 continued.

- (c) The student repeats the experiment using the same mass of smaller marble chips.**

All other conditions remain the same.

Explain the effect on the rate of reaction of using smaller marble chips.

(2 marks)

(continued on the next page)

8 continued.

(d) Which change would make the rate of reaction slower?

(1 mark)

- ☐ **A using the same acid at a higher temperature**
- ☐ **B using acid of a lower concentration**
- ☐ **C using a larger flask**
- ☐ **D adding a catalyst**

(continued on the next page)

8 continued.

(e) In this experiment the volume of carbon dioxide gas produced is measured.

**Give a different way that the amount of carbon dioxide produced can be measured.
(1 mark)**

(continued on the next page)

8 continued.

- (f) In this experiment there is an excess of dilute hydrochloric acid.**

State what you would SEE in the conical flask at the end of the experiment.

(1 mark)

(Total for Question 8 = 11 marks)

9 This question is about the atmosphere.

**(a) Describe the test to show that a gas is oxygen.
(2 marks)**

(continued on the next page)

9 continued.

(b) Copper reacts with oxygen to form copper oxide.

2·100 g of copper will react completely with
0·529 g of oxygen.

In an experiment, **4·200 g** of copper is heated
with **50·000 g** of oxygen until the reaction
is complete.

Calculate the mass of oxygen remaining at the end
of the experiment.
(2 marks)

mass of oxygen = _____ g

(continued on the next page)

9 continued.

(c) Helium, neon and argon are all inert.

**(i) Explain, in terms of electrons, why these gases are inert.
(2 marks)**

(continued on the next page)

9(c) continued.

- (ii) Two pieces of steel can be joined by heating the metal pieces with a very hot flame.**

This process is often carried out in an argon atmosphere rather than in air.

Which property makes argon gas suitable for this use?

(1 mark)

- ☐ **A argon has a low density**
- ☐ **B argon has a low melting point**
- ☐ **C argon is colourless**
- ☐ **D argon is unreactive**

(continued on the next page)

9 continued.

- *(d) Look at Figure 16 for Question 9(d) in the Diagram Booklet. It shows how plant life and the atmosphere of Earth have changed over time.**

Explain the effect that plant life has had on the Earth's atmosphere and the temperature of the Earth.

You should refer to the information in Figure 16 including

- the plant life**
- the amounts of carbon dioxide**
- the amounts of oxygen**

(6 marks)

Answer space continues on the next 4 pages.

Turn over

9(d) continued.

[illegible]

Turn over

9(d) continued.

[illegible]

Turn over

9(d) continued.

[illegible]

Turn over

9(d) continued.

(Total for Question 9 = 13 marks)

10 (a) Look at Figure 17 for Question 10(a) in the Diagram Booklet. It shows a poly(ethene) bottle containing substance **K with one of its hazard symbols showing.**

(i) Explain a safety precaution that should be taken when using a substance with the hazard symbol shown in Figure 17.

(2 marks)

(ii) Substance **K has the formula **AgNO₃****

Give the name of substance **K.**

(1 mark)

(continued on the next page)

Turn over

10(a) continued.

(iii) State ONE property of poly(ethene) that makes it a suitable material to make a container for storing substances.

(1 mark)

(continued on the next page)

10(a) continued.

(iv) A student tests a solid for chloride ions.

The student uses the following method.

step 1 dissolve a small amount of the solid
in water

step 2 add some dilute hydrochloric acid

step 3 add a few drops of a solution of **K**

step 4 observe whether or not a white
precipitate forms.

This method to show whether the solid
contains chloride ions will not work.

Explain a change that needs to be made to

step 2 to allow this method to work.

(2 marks)

Answer space continues on the next page.

Turn over

10(a)(iv) continued.

- (b) In the test for carbonate ions, the carbonate ions react with an acid.

Sodium carbonate, Na_2CO_3 , is reacted with dilute hydrochloric acid.

Look at the diagram for Question 10(b) in the Diagram Booklet. Complete and balance the equation for this reaction.
(3 marks)

(continued on the next page)

10 continued.

- (c) The carbonate of element **X** has the formula **X₂CO₃**

The relative formula mass of this carbonate is 230

Using this information, calculate the relative atomic mass of **X**.

(2 marks)

(relative atomic masses: **C = 12**, **O = 16**)

relative atomic mass of **X** = _____

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 MARKS

END OF PAPER