

Chemistry  
PAPER 2  
Foundation Tier

Total Marks
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Tuesday 11 June 2024 – Morning

Time: 1 hour 45 minutes

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

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.**

**Turn over**

## **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)**

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**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)**

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**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)**

**Turn over**

**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)**

**Turn over**

**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 ×  
number of faces**

**Answer space continues on the next page.**

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**Turn over**



**1(c) continued.**

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**surface area = \_\_\_\_\_ nm<sup>2</sup>**

**(Total for Question 1 = 7 marks)**

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**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)**

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

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**2(a) continued.**

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

**metal with lowest melting point**

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**non-metal with lowest melting point**

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**(continued on the next page)**

**Turn over**

**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.**

**(continued on the next page)**

**2(b) continued.**

**step 1** pour  $150\text{ cm}^3$  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)**

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**(continued on the next page)**

**Turn over**

**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)**

**Answer space continues on the next page.**

**step 3** \_\_\_\_\_

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**Turn over**

**2(b)(ii) continued.**

**step 4** \_\_\_\_\_

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\_\_\_\_\_

**(Total for Question 2 = 8 marks)**

\_\_\_\_\_

- 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)**

**Turn over**



**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)**

**Answer space continues on the next page.**

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**Turn over**

**3(b) continued.**

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**(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)**

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**(continued on the next page)**

**Turn over**

**3(c) continued.**

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

☐ **A Fe<sub>2</sub>**

☐ **B Fe<sub>2</sub><sup>+</sup>**

☐ **c 2Fe<sup>+</sup>**

☐ **D Fe<sup>2+</sup>**

**(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)**

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**(continued on the next page)**

**Turn over**

**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)**

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**height = \_\_\_\_\_ mm**

**(Total for Question 3 = 9 marks)**

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**Turn over**

- 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)**

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**(continued on the next page)**

**4(b) continued.**

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

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**(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)**

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**(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)**

**(continued on the next page)**

**Turn over**

**4(b) continued.**

**(v) One of the salts dissolved is barium chloride,  $\text{BaCl}_2$**

**Barium chloride contains the chloride ion,  $\text{Cl}^-$**

**Give the FORMULA of the barium ion in barium chloride.  
(1 mark)**

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**(Total for Question 4 = 9 marks)**

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

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

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**(continued on the next page)**

**Turn over**

**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**

**(continued on the next page)**

**Turn over**

**5(a) continued.**

**(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)**

**Turn over**

**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.**

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**Turn over**



**5(c) continued.**

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**(Total for Question 5 = 10 marks)**

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**6 This question is about bromine.**

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

**colour**

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**physical state**

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**(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)**

**(continued on the next page)**

**Turn over**

**6(b) continued.**

**(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)**

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**(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)**

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**(continued on the next page)**

**Turn over**

**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)**

**Answer space continues on the next page.**

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**Turn over**

**6(d) continued.**

**mass of  
potassium = \_\_\_\_\_ g**

**mass of  
bromine = \_\_\_\_\_ g**

**(Total for Question 6 = 9 marks)**

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**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)**

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**(continued on the next page)**

**7(a) continued.**

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

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**(continued on the next page)**



**7(a) continued.**

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

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

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

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**mass = \_\_\_\_\_ g**

**(continued on the next page)**

**Turn over**

**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.

**(continued on the next page)**

**Turn over**

**7(c) continued.**

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

**Answer space continues on the next 4 pages.**

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**Turn over**

7(c) continued.

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7(c) continued.

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7(c) continued.

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**7(c) continued.**

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**(Total for Question 7 = 13 marks)**

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- 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 = \_\_\_\_\_ cm<sup>3</sup>**

**(continued on the next page)**

**Turn over**

**8(b) continued.**

- (ii) Using the tangent, calculate the rate of reaction at 3.5 minutes in  $\text{cm}^3$  per minute. (3 marks)**

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

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**rate = \_\_\_\_\_  $\text{cm}^3$  per minute**

**(continued on the next page)**

**Turn over**

**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)**

**Answer space continues on the next page.**

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**Turn over**

**8(c) continued.**

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**(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)**

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**(continued on the next page)**

**Turn over**

**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)**

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**(Total for Question 8 = 11 marks)**

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**Turn over**

**9 This question is about the atmosphere.**

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

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**(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)**

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**mass of oxygen = \_\_\_\_\_ g**

**(continued on the next page)**

**Turn over**

**9 continued.**

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

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

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**(continued on the next page)**

**Turn over**

**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)**

**Turn over**

**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 5 pages.**

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**Turn over**

9(d) continued.

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9(d) continued.

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9(d) continued.

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9(d) continued.

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**9(d) continued.**

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**(Total for Question 9 = 13 marks)**

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**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)**

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**(continued on the next page)**

**Turn over**

**10(a) continued.**

**(ii) Substance K has the formula  $\text{AgNO}_3$ . Give the name of substance K.**  
**(1 mark)**

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

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**(continued on the next page)**

**Turn over**

**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.**

**(continued on the next page)**

**Turn over**

**10(a) continued.**

**Explain a change that needs to  
be made to **step 2** to allow this  
method to work.  
(2 marks)**

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**(continued on the next page)**

**Turn over**

**10 continued.**

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

**Sodium carbonate,  $\text{Na}_2\text{CO}_3$ , 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  $X_2CO_3$**

**The relative formula mass of this carbonate is 230**

**Using this information, calculate the relative atomic mass of  $X$ .  
(2 marks)**

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

**Answer space continues on the next page.**

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**Turn over**

**10(c) continued.**

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**relative atomic  
mass of  $X$  =** \_\_\_\_\_

**(Total for Question 10 = 11 marks)**

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**TOTAL FOR PAPER = 100 MARKS  
END OF PAPER**