

Chemistry  
PAPER 2:  
Foundation Tier

Total Marks
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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**

## **YOU WILL BE GIVEN**

**Diagram Booklet**

**Periodic Table**

## **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.**

**A periodic table is provided as a separate insert.**

**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.**

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**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 Some toothbrushes are placed in a container on a bathroom shelf.**

**(a) The toothbrush handles are made of plastic (polymer).**

**(i) Give a reason why plastic is a suitable material to make a toothbrush handle.  
(1 mark)**

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**(continued on the next page)**

**1 continued.**

- (ii) Some toothbrush handles are made of wood, not plastic.**

**Explain a disadvantage of using plastics.  
(2 marks)**

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**(continued on the next page)**

**1 continued.**

**(b) The container is made of a ceramic material.**

**Which is a property of the ceramic that makes it suitable for the container?**

**(1 mark)**

- ☐ **A it will break if dropped**
- ☐ **B it does not react with water**
- ☐ **C it melts at over 2000 °C**
- ☐ **D it is a good conductor of heat**

**(continued on the next page)**

**1 continued.**

**(c) In some countries, toothpastes contain nanoparticles of silver.**

**Which statement describes the size of a nanoparticle?**

**(1 mark)**

- ☐ **A the size of an electron**
- ☐ **B the size of an atom**
- ☐ **C the size of a few hundred atoms**
- ☐ **D the size of 1 million molecules**

**(continued on the next page)**

**1 continued.**

- (d) Toothpastes contain abrasives and other substances to make them effective.**

**Look at FIGURE 1 for Question 1(d) in the Diagram Booklet. It shows the percentage composition by volume of one toothpaste.**

**Calculate the volume of water in  $150\text{ cm}^3$  of this toothpaste.  
(2 marks)**

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**volume of water = \_\_\_\_\_  $\text{cm}^3$**

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

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**2 This question is about elements in group 1 of the periodic table.**

**(a) Look at FIGURE 2 for Question 2(a) in the Diagram Booklet. It shows the symbols of the first three elements in group 1 of the periodic table and their melting points.**

**Use the periodic table to answer these questions.**

**(i) Give the symbol of ANOTHER element in group 1.  
(1 mark)**

\_\_\_\_\_

**(ii) Give the atomic number of lithium.  
(1 mark)**

\_\_\_\_\_

**(iii) Describe the trend in the melting points of the elements in Figure 3.  
(2 marks)**

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**(continued on the next page)**

**Turn over**

**2 continued.**

**(b) The elements in group 1 react very vigorously with water.**

**A student suggests this method to see what happens when sodium reacts with water.**

**STEP 1 put on safety glasses and a laboratory coat**

**STEP 2 cut a 2 cm × 2 cm × 2 cm cube of sodium**

**STEP 3 Look at FIGURE 3 for Question 2(b) in the Diagram Booklet. Put a few drops of water in the container shown in Figure 3**

**STEP 4 add the sodium to the water in the container and observe the reaction**

**(i) Figure 3 shows a diagram of the container the student suggested for step 3.**

**Give the name of the container shown in Figure 3.  
(1 mark)**

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**(continued on the next page)**

**Turn over**

**2 continued.**

- (ii) A teacher says that the method is not safe because the reaction is too vigorous.**

**Explain changes that could be made to step 2 and to step 3 that would make the method safer.**

**(3 marks)**

**step 2: change and explanation**

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**(continued on the next page)**

**2 continued.**

**step 3: change and explanation**

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

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- 3 Compounds are tested to see if they contain chloride, bromide or iodide ions.**

**Look at FIGURE 4 for Question 3 in the Diagram Booklet. It shows a flow chart of this test.**

- (a) (i) Describe how to make a solution from a solid in a test tube.  
(2 marks)**

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- (ii) Give the name of the apparatus that should be used to add a few drops of silver nitrate solution to the test tube.  
(1 mark)**

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**(continued on the next page)**

**3 continued.**

**(iii) When an equation is written for this reaction, which state symbol is used for the silver nitrate solution?  
(1 mark)**

☐ **A    aq**

☐ **B    g**

☐ **C    l**

☐ **D    s**

**(continued on the next page)**

**3 continued.**

- (b) (i) When one compound is tested, a precipitate is seen.**

**State what you SEE when a precipitate forms.  
(1 mark)**

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- (ii) Using Figure 4, name the ion in the compound that causes a cream precipitate.  
(1 mark)**

**ion \_\_\_\_\_**

**(continued on the next page)**

**3 continued.**

**(c) A compound of potassium is tested.  
It forms a white precipitate.**

**(i) Using Figure 4, name the compound.  
(1 mark)**

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**(continued on the next page)**



**3 continued.**

**(ii) 10.0 g of the solution of the compound of potassium are tested.**

**1.0 g of dilute nitric acid is added.**

**4 drops of silver nitrate solution are added, each with a mass of 0.2 g.**

**Calculate the mass of the mixture at the end of the test.**

**(2 marks)**

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

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

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**4 Some reactions are exothermic and some reactions are endothermic.**

**(a) What does an exothermic reaction always give out?  
(1 mark)**

☐ **A heat energy**

☐ **B light**

☐ **C a gas**

☐ **D sound**

**(continued on the next page)**

**4 continued.**

- (b) In an experiment, a solid is mixed with a liquid. The temperature change of the mixture is measured.**

**Look at FIGURE 5 for Question 4(b) in the Diagram Booklet. It shows the apparatus that is used.**

- (i) Give the letter of the piece of apparatus, A, B, C or D, in Figure 5 that is used to measure the temperature.  
(1 mark)**
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- (ii) Give the name of the piece of apparatus B shown in Figure 5.  
(1 mark)**
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**(continued on the next page)**

**4 continued.**

**(iii) The piece of apparatus labelled C is made from polystyrene.**

**State why polystyrene is a better material than glass for this piece of apparatus.**

**(1 mark)**

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**(continued on the next page)**

**4 continued.**

**(iv) Look at FIGURE 6 for Question 4(b)(iv) in the Diagram Booklet. The results of the experiment are given.**

**Calculate the change in temperature.**

**Give a sign and a unit in your answer.  
(3 marks)**

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**temperature change = \_\_\_\_\_**

**(continued on the next page)**

**4 continued.**

- (v) The solid used in this experiment contained only  $\text{NH}_4^+$  ions and  $\text{NO}_3^-$  ions.**

**Give the formula and the name of the solid.  
(2 marks)**

**formula**

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**name**

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

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**5 (a) Look at FIGURE 7 for Question 5(a) in the Diagram Booklet. It shows one molecule of a compound obtained from crude oil.**

**(i) Give the names of the TWO elements in this molecule.  
(2 marks)**

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**(ii) What is the molecule in Figure 7?  
(1 mark)**

- ☐ **A an oxide**
- ☐ **B a chain molecule**
- ☐ **C a fullerene**
- ☐ **D a ring molecule**

**(continued on the next page)**

**5 continued.**

**(iii) What is the relative formula mass of the compound in Figure 7?**

**(relative atomic masses: H = 1.0, C = 12)  
(1 mark)**

☐ **A    13**

☐ **B    42**

☐ **C    44**

☐ **D    96**

**(continued on the next page)**



**5 continued.**

**(b) Crude oil can be separated into different fractions.**

**Look at the diagram for Question 5(b) in the Diagram Booklet. Draw ONE straight line from each fraction to a use of that fraction.**

**(3 marks)**

**(continued on the next page)**

**5 continued.**

- (c) Hydrogen chloride gas and sulfur dioxide gas are dissolved in separate test tubes of water. Blue litmus paper is dipped into each test tube.**

**State and explain the colour change you would observe in each test tube.  
(3 marks)**

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

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**6 This question is about elements in group 7, the halogens.**

**(a) Which halogen is a green gas at room temperature and pressure?  
(1 mark)**

☐ **A bromine**

☐ **B chlorine**

☐ **C fluorine**

☐ **D iodine**

**(continued on the next page)**

**6 continued.**

**(b) Bromine, chlorine and iodine all react with heated iron wool.**

**Look at FIGURE 8 for Question 6(b) in the Diagram Booklet. It shows the speed of these reactions.**

**(i) When iron wool is heated with chlorine, iron chloride is formed.**

**Write the word equation for this reaction.  
(2 marks)**

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**(ii) Give the name of the halogen in Figure 8 that is the most reactive with iron.  
(1 mark)**

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**(continued on the next page)**

**Turn over**

**6 continued.**

**(iii) 34.4 % of the mass of iron chloride is iron.**

**Calculate the mass of iron and the mass of chlorine in 125 g of iron chloride.  
(3 marks)**

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**mass of iron = \_\_\_\_\_ g**

**mass of chlorine = \_\_\_\_\_ g**

**(continued on the next page)**

**6 continued.**

**(c) Alkenes react with halogens.**

**When iron chloride is added to the reaction mixture, the reaction is much faster but the products are the same.**

**Look at the list for Question 6(c) in the Diagram Booklet. Use words from the list to complete the sentences.**

**(2 marks)**

**The iron chloride speeds up the reaction because**

**it is \_\_\_\_\_**

**After the reaction, the mass of iron chloride is**

**\_\_\_\_\_**

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

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**7 Look at FIGURE 9 for Question 7 in the Diagram Booklet. The structure of one molecule of a compound is shown.**

**(a) What is the molecular formula of the compound in Figure 9?  
(1 mark)**

☐ **A CH**

☐ **B CH<sub>2</sub>**

☐ **C 3C6H**

☐ **D C<sub>3</sub>H<sub>6</sub>**

**(continued on the next page)**

**7 continued.**

**(b) The compound in Figure 9 is an unsaturated hydrocarbon.**

**State why the compound is described as an unsaturated hydrocarbon.**  
**(3 marks)**

**unsaturated**

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**(continued on the next page)**



**7 continued.**

**hydrocarbon**

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**(continued on the next page)**

**7 continued.**

**(c) Many molecules of the compound in Figure 9 combine to form substance Y.**

**Look at FIGURE 10 for Question 7(c) in the Diagram Booklet. It shows part of a molecule of substance Y.**

**(i) What type of substance is Y?  
(1 mark)**

- ☐ **A a composite**
- ☐ **B a nanoparticle**
- ☐ **C a polymer**
- ☐ **D a protein**

**(continued on the next page)**

**7 continued.**

- (ii) One molecule of the compound in Figure 9 has a mass of  $6.98 \times 10^{-23}$  g.**

**64 800 of these molecules combine to form one molecule of Y.**

**Calculate the mass of this molecule of Y in g.  
(2 marks)**

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**mass of one molecule of Y = \_\_\_\_\_ g**

**(continued on the next page)**

**7 continued.**

- \*(d) Alkanes can be burned in air.  
Different products can be formed as  
the combustion of alkanes can be  
complete or incomplete.**

**An investigation was carried out to compare the  
energy released when the first four alkanes in the  
homologous series were burned.**

**Equal amounts of these alkanes were burned to  
heat  $100\text{ cm}^3$  of water.**

**Look at FIGURE 11 for Question 7(d) in the  
Diagram Booklet. The temperature change for each  
alkane is shown.**

**Discuss the complete and incomplete combustion  
of these alkanes and the trend in the energy  
changes they produced.**

**You should give word equations in your answer.  
(6 marks)**

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**7 continued.**

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

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- 8 Look at FIGURE 12 for Question 8 in the Diagram Booklet. A student used the apparatus in Figure 12 to investigate the rate of the reaction between a metal and dilute hydrochloric acid.**

**Pieces of the metal were placed in dilute hydrochloric acid in the flask, and the total volume of gas produced was measured every minute.**

**(continued on the next page)**

**8 continued.**

**(a) Look at FIGURE 13 for Question 8(a) in the Diagram Booklet. It shows a graph of the student's results.**

**(i) Name a piece of apparatus that would be better to measure the volume of gas produced, instead of the 250 cm<sup>3</sup> measuring cylinder.**

**Give a reason for your answer.  
(2 marks)**

**name of apparatus**

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**reason**

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**(continued on the next page)**

**Turn over**

**8 continued.**

- (ii) Calculate the mean rate of production of hydrogen over the first 90 seconds, in  $\text{cm}^3$  per second.  
(3 marks)**

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

**(continued on the next page)**

**8 continued.**

**(iii) The student measured the volume of gas for 10 minutes.**

**State why the measurements could have been stopped at 9 minutes.**

**(1 mark)**

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**(continued on the next page)**

**8 continued.**

**(b) The experiment was repeated, but with acid of a higher concentration.**

**The rate of reaction was faster.**

**(i) Explain why the rate of reaction increases when the concentration of acid is increased.  
(2 marks)**

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**(continued on the next page)**

**8 continued.**

**(ii) Another student suggests four other ways of increasing the rate of this reaction.**

**Which one is correct?  
(1 mark)**

- ☐ **A use the same acid but at a lower temperature**
- ☐ **B use a larger trough**
- ☐ **C use a smaller flask**
- ☐ **D use the same metal but in a powdered form**

**(continued on the next page)**

**8 continued.**

- (c) The apparatus in Figure 12 can be used to measure the rate of the reaction between marble chips and hydrochloric acid.**

**The student needs different sized marble chips.**

**Describe how the student can make small and medium sized marble chips from large chips.  
(2 marks)**

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

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**9 This question is about gases.**

**(a) When sodium is added to water, hydrogen gas is produced.**

**Which observation shows that a gas has been produced?**

**(1 mark)**

- ☐ **A a white precipitate forms**
- ☐ **B effervescence is seen**
- ☐ **C the sodium sinks in the water**
- ☐ **D the water changes to a pink colour**

**(continued on the next page)**



**9 continued.**

**(b) Some damp litmus paper is placed in a gas.  
The litmus paper is bleached.**

**Which gas bleaches damp litmus paper?  
(1 mark)**

☐ **A carbon dioxide**

☐ **B chlorine**

☐ **C hydrogen**

☐ **D oxygen**

**(continued on the next page)**

9 continued.

(c) When calcium carbonate is heated it decomposes.



When 5.000 g of calcium carbonate is heated, the mass of solid remaining is 2.800 g.

Calculate the mass of carbon dioxide that has been released.

Give your answer to three significant figures.  
(2 marks)

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mass of carbon dioxide = \_\_\_\_\_ g

(continued on the next page)

**9 continued.**

**(d) Look at FIGURE 14 for Question 9(d) in the Diagram Booklet. It shows a diagram of an atom of helium.**

**(i) Explain, using Figure 14, why helium is inert.  
(2 marks)**

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**(ii) Helium is used to fill balloons.**

**State one property of helium, apart from it being inert, that makes it suitable for filling balloons.**

**(1 mark)**

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**Turn over**

**9 continued.**

- \*(e) Look at FIGURE 15 for Question 9(e) in the Diagram Booklet. It shows the relative amounts of three gases in the early atmosphere compared to the composition of today's atmosphere.**

**Natural processes and human activities have altered the relative amounts of these gases in the atmosphere.**

**Explain how the relative amount of each of the gases in Figure 15 has increased or decreased over time.**

**(6 marks)**

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**9 continued.**

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

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**10 (a) Some acids are used in tests for ions.**

**Look at FIGURE 16 for Question 10(a) in the Diagram Booklet. A bottle of one acid is shown.**

**(i) The acid in Figure 16 can be used in the test for carbonate ions.**

**Explain, giving the name of the hazard symbol shown, what safety precautions should be taken when using this acid.**

**(2 marks)**

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**(continued on the next page)**

**10 continued.**

- (ii) Give the name of the acid shown in Figure 16.  
(1 mark)**

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- (iii) State a property of glass that makes it a  
suitable material to make the container for  
an acid.  
(1 mark)**

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**(continued on the next page)**

**10 continued.**

**(b) A teacher conducts a flame test to identify the metal ions in some unknown solids.**

**STEP 1 dip a flame test wire into hydrochloric acid**

**STEP 2 dip the flame test wire into the unknown solid**

**STEP 3 hold the flame test wire above a Bunsen burner flame**

**(i) This method did not work well.**

**Explain an improvement that needs to be made to STEP 3 to enable a bright flame colour to be produced.  
(2 marks)**

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**(continued on the next page)**

**Turn over**

**10 continued.**

- (ii) Look at FIGURE 17 for Question 10(b)(ii) in the Diagram Booklet. It shows the results of the flame tests on three compounds, P, Q and R.**

**Use Figure 17 to identify the metal ions in compounds P, Q and R.  
(3 marks)**

**P** \_\_\_\_\_

**Q** \_\_\_\_\_

**R** \_\_\_\_\_

**(continued on the next page)**

10 continued.

(c) A flame photometer was used to analyse samples of a solution of metal ions.

Each sample was treated with  $5.00\text{ cm}^3$  of dilute hydrochloric acid.

$1.00\text{ dm}^3$  of the acid contained 219 g of hydrogen chloride.

Calculate the mass of hydrogen chloride in the acid used to test 20 samples.

(2 marks)

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

(Total for Question 10 = 11 marks)

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