

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.**

**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.**

**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.**

**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 2 000 °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)**

**Turn over**



**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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**Turn over**

**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)**

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

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**(continued on the next page)**

**Turn over**

**2 continued.**

**(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**

**(continued on the next page)**

**Turn over**

**2 continued.**

- (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)**

**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)**

**Turn over**

**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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**(continued on the next page)**



**3 continued.**

- (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)**

**Turn over**

**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)**

**Turn over**

**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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**Turn over**

**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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**(continued on the next page)**

**4 continued.**

**(ii) Give the name of the piece of apparatus B shown in Figure 5.  
(1 mark)**

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**(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)**

**Turn over**



**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)**

**Turn over**

**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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**Turn over**

**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)**

**Turn over**

**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)**

**Turn over**

**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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**Turn over**

**5 continued.**

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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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**(continued on the next page)**

**Turn over**

**6 continued.**

- (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)**

**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)**

**Turn over**

**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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**Turn over**

**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)**

**Turn over**

**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)**

**Turn over**



**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)**

**Turn over**

**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)**

**(begin your answer on the next page)**

**Turn over**

7 continued.

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**7 continued.**

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**Turn over**

7 continued.

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7 continued.

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# 7 continued.

[illegible]

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

# Turn over

- 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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**(continued on the next page)**

**Turn over**

8 continued.

reason

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(continued on the next page)

**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)**

**Turn over**

**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)**

**Turn over**

**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)**

**Turn over**

**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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**Turn over**

**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)**

**Turn over**

**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)**

**Turn over**

**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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**(continued on the next page)**

**Turn over**

**9 continued.**

**(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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**(continued on the next page)**

**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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**Turn over**

9 continued.

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9 continued.

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9 continued.

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## 9 continued.

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

**Turn over**

**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.**

**(continued on the next page)**

**10 continued.**

- (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)**

**Turn over**

**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)**

**Turn over**

**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**

**(continued on the next page)**

**Turn over**

**10 continued.**

**(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)**

**Turn over**



**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  $219\text{ g}$  of hydrogen chloride.**

**Calculate the mass of hydrogen chloride in the acid used to test 20 samples.  
(2 marks)**

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**(continued on the next page)**

**Turn over**

**10 continued.**

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

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

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