

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS  
GCSE**

**A172/02**

**TWENTY FIRST CENTURY SCIENCE  
CHEMISTRY A**

**Modules C4 C5 C6 (Higher Tier)**

**TUESDAY 22 JANUARY 2013: Morning**

**DURATION: 1 hour**

**plus your additional time allowance**

**MODIFIED ENLARGED 24pt**

<b>Candidate forename</b>		<b>Candidate surname</b>	
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<b>Centre number</b>						<b>Candidate number</b>				
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**Candidates answer on the Question Paper.  
A calculator may be used for this paper.**

**OCR SUPPLIED MATERIALS:**

**Periodic Table (inserted)**

**Data Sheet appears on a separate sheet**

**OTHER MATERIALS REQUIRED:**

**Pencil**


**Ruler (cm/mm)**

**READ INSTRUCTIONS OVERLEAF**

## **INSTRUCTIONS TO CANDIDATES**

- **Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.**
- **Use black ink. HB pencil may be used for graphs and diagrams only.**
- **Answer ALL the questions.**
- **Read each question carefully. Make sure you know what you have to do before starting your answer.**
- **Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).**

## **INFORMATION FOR CANDIDATES**

- **Your quality of written communication is assessed in questions marked with a pencil ().**
- **The number of marks is given in brackets [ ] at the end of each question or part question.**
- **The total number of marks for this paper is 60.**
- **An enlarged copy of the Periodic Table is inserted.**
- **A list of qualitative tests for ions is printed on a separate sheet.**

**Answer ALL the questions.**

- 1 Jack writes down data about some elements in Group 7.**

**Jack has made a mistake. One of the boiling points is wrong.**

- (a) Which boiling point in the table is wrong?**

**Explain how you made your choice.**

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**[2]**

<b>Element</b>	<b>Formula of molecule</b>	<b>Normal physical state (room temperature 20 °C)</b>	<b>Melting point in °C</b>	<b>Boiling point in °C</b>
<b>fluorine</b>	<b>F<sub>2</sub></b>	<b>gas</b>	<b>-220</b>	<b>-188</b>
<b>chlorine</b>	<b>Cl<sub>2</sub></b>	<b>gas</b>	<b>-101</b>	<b>-35</b>
<b>bromine</b>	<b>Br<sub>2</sub></b>	<b>liquid</b>	<b>-7</b>	<b>-59</b>
<b>iodine</b>	<b>I<sub>2</sub></b>	<b>solid</b>	<b>114</b>	<b>184</b>

**(b) Estimate the correct value for the boiling point.**

\_\_\_\_\_ °C [1]

**(c) Astatine is another element in Group 7 of the Periodic Table.**

**What is the formula for a MOLECULE of astatine?**

\_\_\_\_\_ [1]

**[TOTAL: 4]**

## 2 The table shows some information about the element hydrogen.

Properties of hydrogen	
State at room temperature	gas
Type of element	non-metal
Atomic number	1
Number of electrons in outer shell of an atom	1
Maximum number of electrons the outer shell can hold	2
Ion	$\text{H}^+$
Formula of chloride	$\text{HCl}$
Reactivity	Very flammable. Reacts with both metals and non-metals. Does not react with water.

**(a) Fay and Guy are discussing where hydrogen fits in the Periodic Table.**

**FAY**

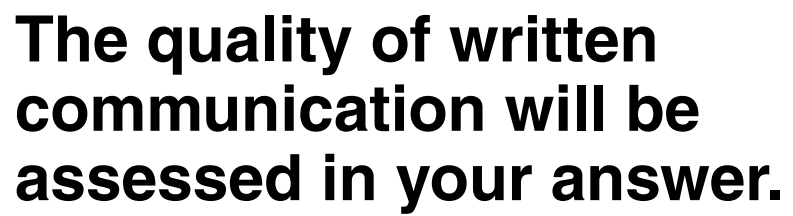
**Hydrogen is similar to  
Group 1 elements.  
It should be placed in Group 1.**

**GUY**

**I don't think it fits in Group 1.  
It should be on its own.**

**Use information in the table  
and your knowledge of Group 1  
elements to evaluate the ideas of  
Fay and Guy.**





**[6]**

**(b) Hydrogen gas reacts with lithium at high temperatures to make lithium hydride.**

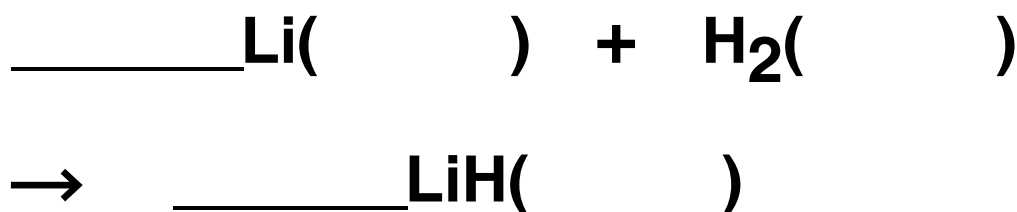
**(i) At the high temperatures of the reaction, lithium is a liquid and lithium hydride is a solid.**

**The equation shows the reaction of lithium with hydrogen.**

**Fill in the missing STATE SYMBOLS and BALANCE the equation for the reaction.**

**The state symbols should match the state of the chemicals at the high temperatures of the reaction.**

**lithium + hydrogen  
→ lithium hydride**



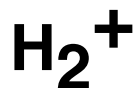
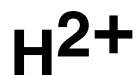
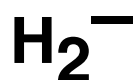
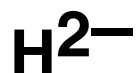
**[2]**

(ii) The formula for lithium hydride is LiH.

Lithium ions have a charge of +1.

What is the formula of a hydride ion?

Put a ring around the correct answer.



[1]

**(iii) Another compound has the formula  $\text{CaH}_2$ .**

**What is the name of this compound?**

\_\_\_\_\_ **[1]**

**[TOTAL: 10]**

### **3 Arsenic can be used to treat some cancers.**

**Ben wants to analyse a mineral to see if it contains arsenic.**

**He looks at a table of flame colours for some elements.**

<b>Element</b>	<b>Flame colour</b>
<b>arsenic</b>	<b>blue</b>
<b>barium</b>	<b>green</b>
<b>calcium</b>	<b>red</b>
<b>copper</b>	<b>blue</b>
<b>potassium</b>	<b>purple</b>
<b>sodium</b>	<b>yellow</b>

**(a) Ben talks about what a flame test could show.**

**BEN**

**I can use these flame colours to show that there is no calcium or sodium in the mineral.**

**The flame colour will not prove that the mineral contains arsenic.**

**Explain why what Ben says is true.**

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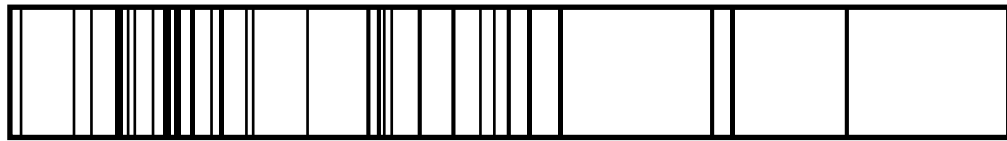
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**[3]**

**(b) Ben finds an image of the line spectrum of arsenic.**

**LINE SPECTRUM OF ARSENIC**



**BEN**

**I will take a line spectrum from the mineral.**

**I expect it to show that the mineral contains arsenic and other elements.**

**How can Ben use a line spectrum to show that the mineral contains arsenic AND other elements?**

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**[2]**

**(c) Ben finds out that arsenic is in Group 5 of the Periodic Table.**

**Some arsenic atoms have different atomic structures to other arsenic atoms.**

**The table shows information about two different arsenic atoms.**

**How does the table show that the two atoms are the same element?**

**Put a tick (✓) in the box next to the correct answer.**

**Both atoms have similar relative atomic masses.**

☐

**Arsenic-75 has two more neutrons than arsenic-73.**

☐

**Both atoms have the same number of protons.**

☐

**The number of electron shells is the same.**

☐

**[1]**

**[TOTAL: 6]**



	Relative atomic mass	Number of protons	Number of neutrons	Number of electron shells
arsenic-75	75	33	42	4
arsenic-73	73	33	40	4

**4 Sam does some research about the properties of diamond and graphite.**

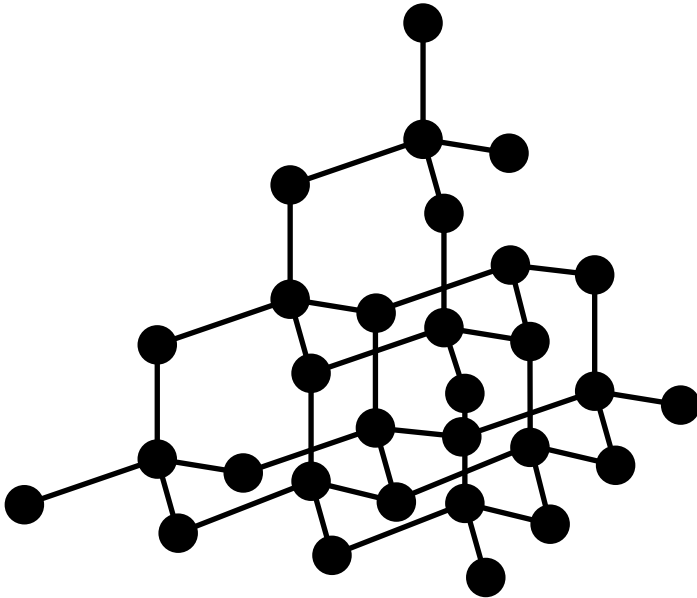
**The table shows what he finds out.**

	<b>Diamond</b>	<b>Graphite</b>
<b>Melting point in °C</b>	<b>3560</b>	<b>3650</b>
<b>Boiling point in °C</b>	<b>4830</b>	<b>4830</b>
<b>Solubility in water</b>	<b>insoluble</b>	<b>insoluble</b>
<b>Electrical conductivity</b>	<b>does not conduct</b>	<b>good conductor</b>
<b>Hardness</b>	<b>very hard</b>	<b>soft, flakes easily</b>

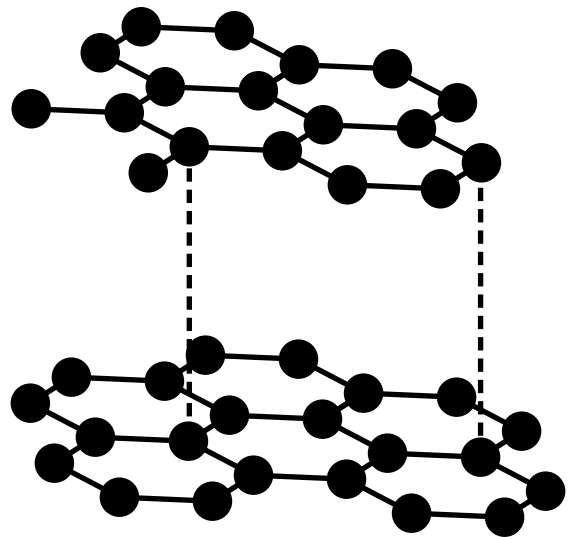
**Sam notices that some of the properties are similar and some are different.**

**He finds diagrams that show the structures of diamond and graphite.**

**DIAMOND**

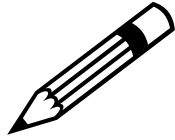


**GRAPHITE**



**The table shows some similarities and differences in the PROPERTIES of diamond and graphite.**

**Use ideas about their STRUCTURES to explain these similarities and differences.**



**The quality of written communication will be assessed in your answer.**

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**[6]**

**[TOTAL: 6]**

- 5 Zoe works for a mining company. The company extracts copper from two different minerals.**

**They use the minerals cuprite,  $\text{Cu}_2\text{O}$ , and chalcocite  $\text{Cu}_2\text{S}$ .**

**Zoe works out the percentage mass of copper in cuprite. It is 88.8%.  
She uses this formula:**

$$\begin{aligned} &\text{percentage mass of copper} \\ &= \frac{\text{total mass of copper in gram formula mass (g)}}{\text{gram formula mass of compound (g)}} \\ &\times 100\% \end{aligned}$$

- (a) (i) Calculate the percentage mass of copper in chalcocite,  $\text{Cu}_2\text{S}$ .**

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

\_\_\_\_\_ % [3]

- (ii) Use your answer to (i) to work out how much copper can be extracted from 1 kg of pure chalcocite.**

\_\_\_\_\_ kg [1]

**(b) The minerals are transported from the mine to be processed to make copper.**

**Zoe thinks about the environmental harm caused by transporting each mineral.**

**I think that we should use minerals with higher percentages of copper. Transporting these minerals causes less environmental harm.**

**Do you agree with Zoe?**

**Explain your answer.**

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**[2]**

**[TOTAL: 6]**

## **6 Read the information about the atmosphere of some planets.**

### **PLANET ATMOSPHERES**

**Other planets do not have the same atmosphere as Earth. Venus has an atmosphere that is mainly CARBON DIOXIDE with about 4% NITROGEN. The atmosphere on Jupiter is mainly HYDROGEN, with about 10% HELIUM. The atmospheres on both planets contain very small amounts of other gases.**



**(a) Using the gases named in the information, complete the table below.**

<b>Description</b>	<b>Name of gas</b>
<b>A gas whose molecules have a relative formula mass of 2</b>	
<b>A gas that is a compound.</b>	
<b>A gas that consists of single atoms.</b>	

**[3]**

**(b) The atmospheres contain molecular substances.**

**What are the properties of molecular substances?**

**Put ticks (✓) in the boxes next to the TWO correct answers.**

**They do not conduct electricity.** ☐

**They all have boiling points above room temperature.** ☐

**They form crystals at room temperature.** ☐

**They have low melting points.** ☐

**They are hard and strong.** ☐

**[2]**

- (c) The atoms in a hydrogen molecule are held together by a covalent bond.**

**Which statements are TRUE for the hydrogen molecule?**

**Put ticks (✓) in the boxes next to the TWO correct answers.**

**The nuclei of the two atoms are attracted together.** ☐

**Electrons are attracted together to form a bond.** ☐

**The nuclei of the two atoms repel each other.** ☐

**The nucleus of each atom attracts the shared electrons.** ☐

**The electrons repel the nuclei away from each other.** ☐

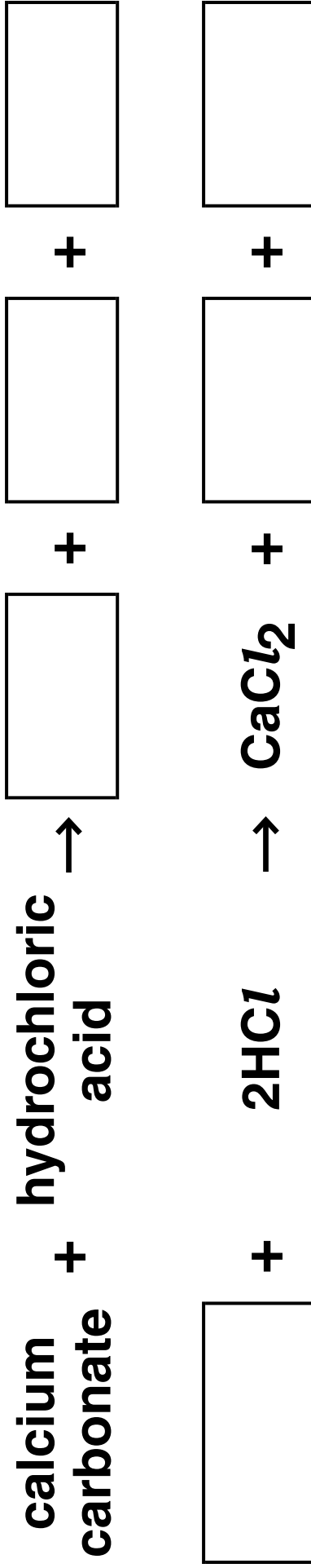
**[2]**

**[TOTAL: 7]**

**7 Alex adds dilute hydrochloric acid to solid calcium carbonate.**

**He sees that the reaction makes bubbles of gas.**

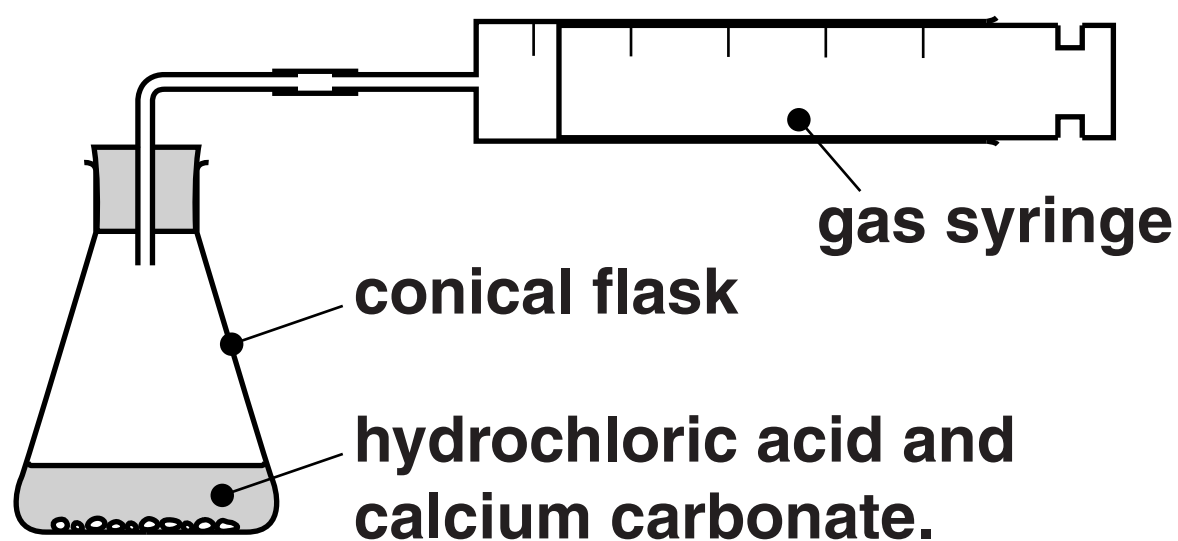
**(a) Complete the word and symbol equations for the reaction by filling in the boxes.**



**(b) Alex predicts that the more concentrated the acid, the faster the reaction.**

**He plans some experiments to find out if his prediction is right.**

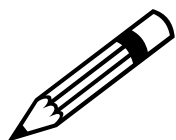
**He has this equipment.**



**He has three different concentrations of hydrochloric acid.**

<b>Acid</b>	<b>Concentration</b>
<b>1</b>	<b>20 g/dm<sup>3</sup></b>
<b>2</b>	<b>10 g/dm<sup>3</sup></b>
<b>3</b>	<b>5 g/dm<sup>3</sup></b>

**Describe how Alex could use the equipment and his results to show that the more concentrated the acid, the faster the reaction.**



**The quality of written communication will be assessed in your answer.**

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[6]



**(c) The results of the experiments in part (b) confirm that the reaction is faster with more concentrated acid.**

**Why does this happen?**

**Put ticks (✓) in the boxes next to the TWO correct answers.**

**More concentrated acids have larger acid particles.**

☐

**At higher concentrations there are more particles in the same volume.**

☐

**Collision rate increases when particles are closer together.**

☐

**Higher concentrations of acid split the calcium carbonate to give a bigger surface area.**

☐

**Reactions are faster when particles have less energy.**

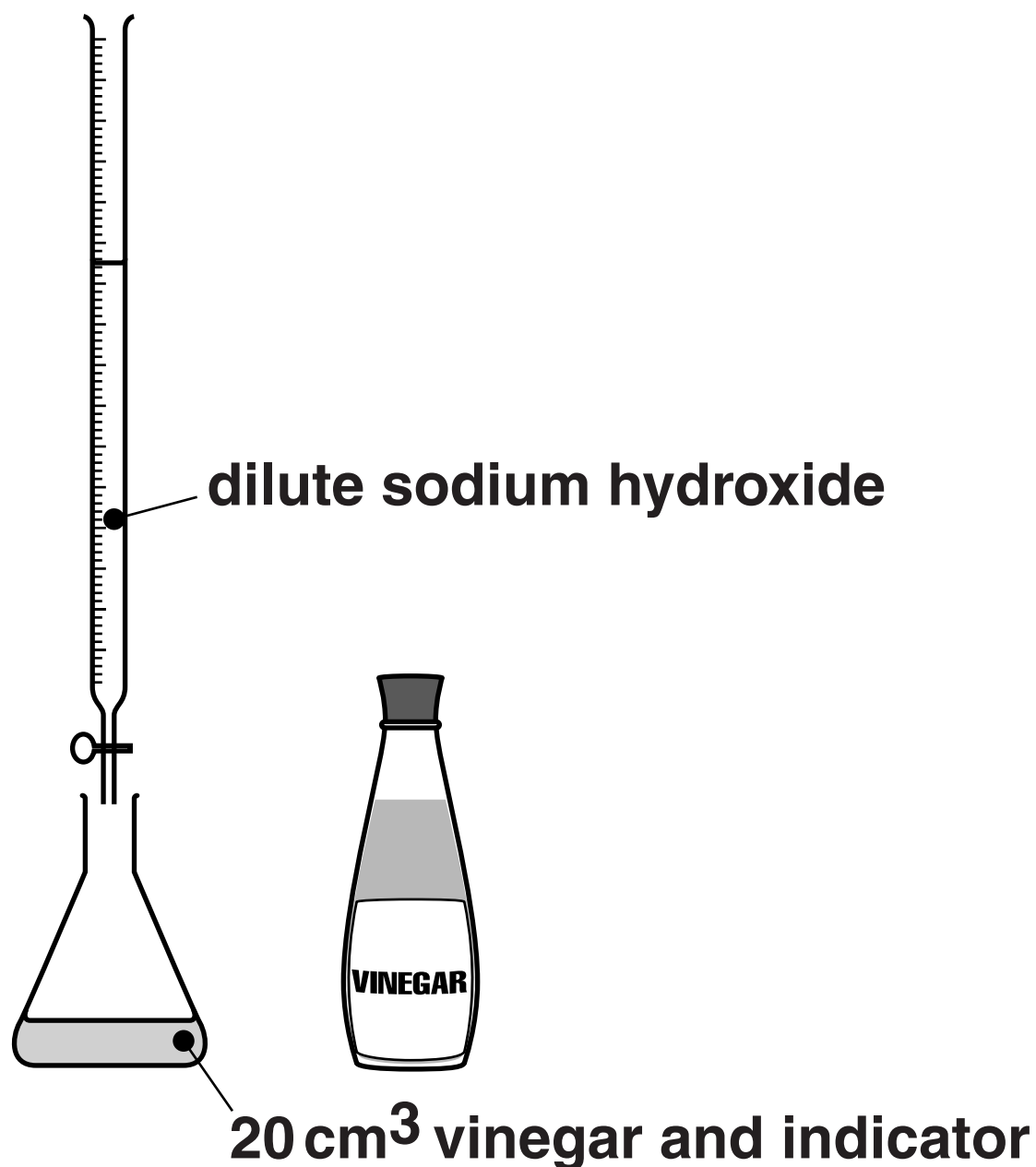
☐

**[2]**

**[TOTAL: 11]**

- 8 Some students do titrations to find out the concentration of acid in vinegar.**

**The diagram shows the equipment they use.**



**Each student does a first titration then repeats the titration several times.**

- (a) Each student calculates an average result from their repeats.**

**The first titration result is NOT used to calculate the average.**

**Which statement best explains why?**

**Put a tick (✓) in the box next to the BEST answer.**

**The first result is usually lower than the others.**

☐

**The first titration is done without an indicator.**

☐

**The students do not follow the method carefully the first time.**

☐

**The first result is used to give a rough idea of the volume needed.**

☐

**[1]**

**(b) All students test vinegar from the same bottle and use the same concentration of sodium hydroxide.**

**The students record their average results in a table.**

<b>Name of student</b>	<b>Average volume of sodium hydroxide used in cm<sup>3</sup></b>
<b>Amy</b>	<b>23.4</b>
<b>Ben</b>	<b>24.1</b>
<b>Carl</b>	<b>23.8</b>
<b>Dee</b>	<b>18.2</b>

**The students notice that Dee's result is very different from the others.**

**They suggest explanations for this.**

**AMY**

**I think she must have gone past the end point.**

**BEN**

**The vinegar she tested is more concentrated than the others.**

**CARL**

**She made mistakes when she measured the volume of the vinegar.**

**Which student has the best explanation for Dee's result?**

**Explain why you AGREE or DISAGREE with the ideas suggested by each student.**

**Best explanation** \_\_\_\_\_

**Reasoning** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

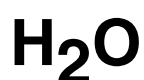
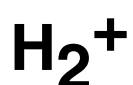
**[3]**

**(c) The acid in the vinegar reacts with the sodium hydroxide.**

**In the reaction, HYDROGEN IONS react with HYDROXIDE IONS.**

**Complete the equation for this reaction by filling in the boxes.**

**Choose formulae from the list.**

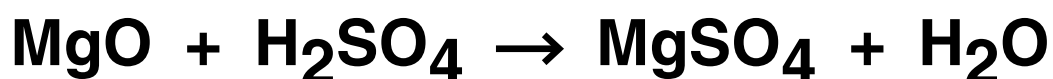


**[2]**

**[TOTAL: 6]**

**9 Magnesium sulfate is used in some medicines.**

**Magnesium sulfate can be made by reacting magnesium oxide with sulfuric acid.**



**The table shows the relative formula masses of some of the compounds involved in the reaction.**

<b>Compound</b>	<b>Relative formula mass</b>
<b>MgO</b>	<b>40</b>
<b>H<sub>2</sub>SO<sub>4</sub></b>	
<b>MgSO<sub>4</sub></b>	<b>120</b>
<b>H<sub>2</sub>O</b>	<b>18</b>



**(a) Calculate the mass of sulfuric acid that reacts exactly with 5 g of magnesium oxide.**

\_\_\_\_\_ g [2]

**(b) Elly works out a formula for calculating the maximum mass of magnesium sulfate that can be made from different amounts of magnesium oxide.**

**Elly's formula is:**

$$\text{mass of magnesium sulfate in grams} = 3 \times \text{mass of magnesium oxide in grams}$$

**Use the equation and information from the table to explain why Elly's formula works.**

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**[2]**

**[TOTAL: 4]**

**END OF QUESTION PAPER**

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