Cambridge Assessment International Education

Specimen Paper Answers – Paper 6

Cambridge IGCSE™ / IGCSE (9–1)

Chemistry 0620 / 0971

For examination from 2023

Version 1

Cambridge Pathway

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Contents

Introduction

The main aim of this booklet is to exemplify standards for those teaching Cambridge IGCSE / IGCSE (9-1) Chemistry 0620 / 0971, and to show different examples of answers within an overall good performance.

In this booklet, we have provided answers for all questions with examiner comments where relevant. This paper requires candidates to answer short-answer and structured questions and candidates are awarded maximum of 40 marks for this paper and the mark scheme provides the answers required to gain the marks.

In some cases, the question and answer is followed by an examiner comment on the candidates answer. Additionally, the examiner has set out a number of common mistakes that occur when candidates answer the questions. In this way, it is possible to understand what candidates have done to gain their marks and how they could improve their answers and avoid errors.

The mark schemes for the Specimen Papers are available to download from the School Support Hub at www.cambridgeinternational.org/support

2023 Specimen Paper 6 Mark Scheme

Past exam resources and other teaching and learning resources are available on the School Support Hub www.cambridgeinternational.org/support

Assessment at a glance

The syllabus for Cambridge IGCSE Chemistry 0620 is available at www.cambridgeinternational.org

All candidates take three papers. Candidates who have studied the Core syllabus content, or who are expected to achieve a grade D or below, should be entered for Paper 1, Paper 3 and either Paper 5 or Paper 6. These candidates will be eligible for grades C to G.

Candidates who have studied the Extended syllabus content (Core and Supplement), and who are expected to achieve a grade C or above, should be entered for Paper 2, Paper 4 and either Paper 5 or Paper 6. These candidates will be eligible for grades A* to G.

Core assessment

Core candidates take Paper 1 and Paper 3. The questions are based on the Core subject content only:

Paper 1: Multiple Choice (Core)	
45 minutes	
40 marks	30%
40 four-option multiple-choice questions	
Externally assessed	

Paper 3: Theory (Core)	
1 hour 15 minutes	
80 marks	50%
Short-answer and structured questions	
Externally assessed	

Extended assessment

Extended candidates take Paper 2 and Paper 4. The questions are based on the Core and Supplement subject content:

Paper 2: Multiple Choice (Extended)	
45 minutes	
40 marks	30%
40 four-option multiple-choice questions	
Externally assessed	

Paper 4: Theory (Extended)	
1 hour 15 minutes	
80 marks	50%
Short-answer and structured questions	
Externally assessed	

Practical assessment

All candidates take one practical paper from a choice of two:

Paper 5: Practical Test	
1 hour 15 minutes	
40 marks	20%
Questions will be based on the experimental skills in Section 4	
Externally assessed	

Paper 6: Alternative to Practical	
1 hour	
40 marks	20%
Questions will be based on the experimental skills in Section 4	
Externally assessed	

Question 1

Question 1(a)

1 A student investigates the rate of reaction between magnesium ribbon and excess dilute hydrochloric acid by measuring the volume of gas produced.

The student uses the apparatus in Fig. 1.1 to do two different experiments.

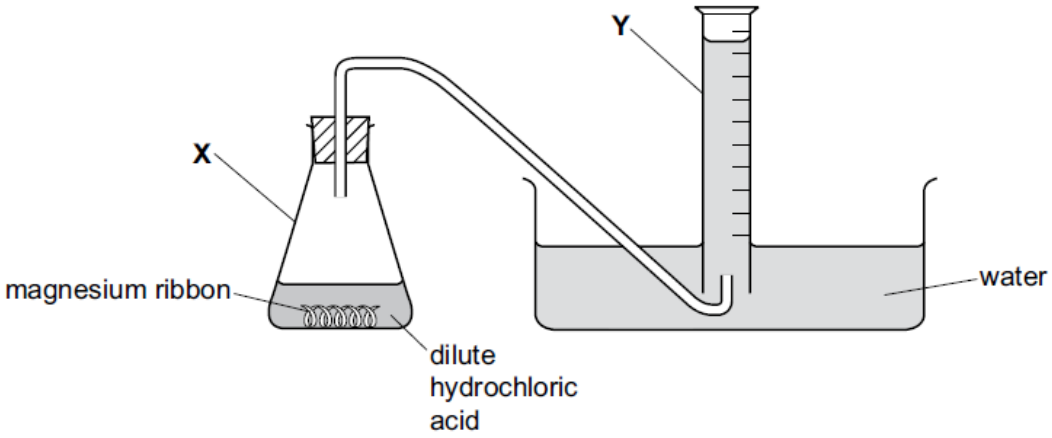


Fig. 1.1

(a) Name the items of apparatus labelled **X** and **Y** in Fig. 1.1.

X conical flask

Y measuring cylinder

[2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has correctly named the apparatus and been awarded two marks.

Common mistakes

To be awarded credit, candidates must state ‘conical flask’, not just ‘flask’.

Candidates often identify **Y** as an inverted burette. **Y** does have graduations but cannot be a burette as it doesn’t have a tap.

Question 1(b)

(b) The gas made in the reaction is hydrogen.

Describe how the student can test that the gas is hydrogen.

Give the expected result of the test.

test ..... *lighted splint* .....

result ..... *squeaky pop* .....

[1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has been awarded the mark for stating the test and the result of a positive test.

Common mistakes

The test for hydrogen is sometimes confused with the test for oxygen as they both involve a splint. Oxygen relights a glowing splint whereas hydrogen causes a lighted splint to ‘pop’.

Question 1(c)(i)

Fig. 1.2 shows the results for each experiment.

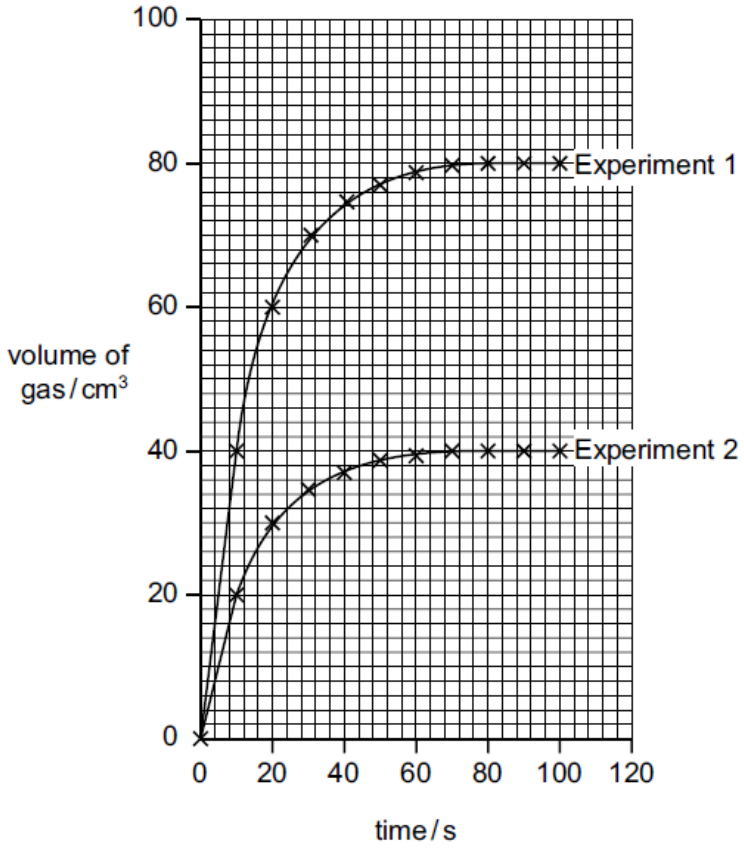


Fig. 1.2

(c) (i) Use Fig. 1.2 to determine the total volume of gas made in each experiment.

total volume in Experiment 1 ..... 80 ..... cm^3

total volume in Experiment 2 ..... 40 ..... cm^3

[1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has been awarded the mark for reading the total volume from the *y*-axis for each experiment.

Common mistakes

Candidates frequently reverse the order for the volumes because they have rushed to answer the question and not carefully read the prompts on the answer lines.

Question 1(c)(ii)

(ii) Use your answers in **(c)(i)** to suggest what the student changed Experiment 2.

.....

Half the mass of magnesium was used in experiment 2.

..... [1]

Mark awarded = 1 out of 1

Examiner comment

Experiment 1 produced double the volume of hydrogen gas as did Experiment 2. The hydrochloric acid was in excess so to halve the volume of hydrogen gas produced, half the mass of magnesium should be used. Therefore, the candidate has been awarded the mark.

Common mistakes

Candidates often state that 'the volume of hydrochloric acid should be halved'. However, this misses the importance of 'excess' in the question. Depending on the amount in excess, halving the volume of hydrochloric acid will decrease the volume of hydrogen gas produced, but it will not halve it.

Question 1(c)(iii)

Fig. 1.2 shows the results for each experiment.

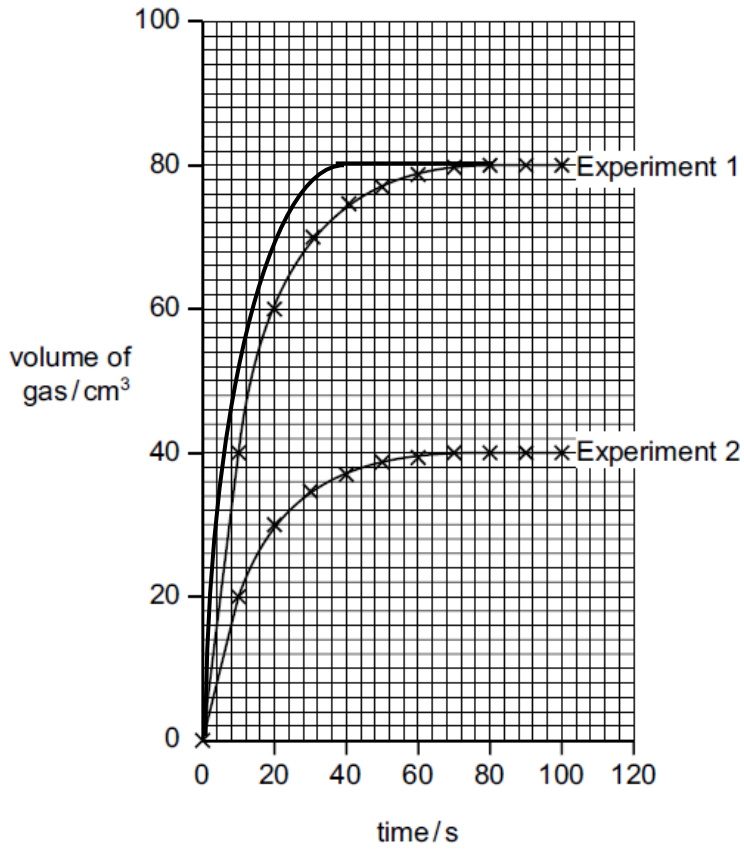


Fig. 1.2

(iii) **On Fig. 1.2**, sketch the curve expected if Experiment 1 is repeated using magnesium powder instead of magnesium ribbon. All other conditions remain the same. [2]

Mark awarded = 2 out of 2

Examiner comment

If the experiment was performed with magnesium powder, the gradient of the slope would initially be steeper than experiment 1 because the initial rate of reaction would be greater. The amount of each reactant has been kept the same so the total volume of hydrogen gas produced must also remain the same. Therefore, the candidate was awarded both marks.

Common mistakes

Candidates should ensure they carefully read the question and draw their expected curve in comparison to Experiment 1, not Experiment 2.

Total mark awarded = 7 out of 7

Question 2

Question 2(a)

2 A student investigates the reaction between dilute hydrochloric acid and two different aqueous solutions of sodium hydroxide labelled solution **A** and solution **B**.

The student does two experiments.

Experiment 1

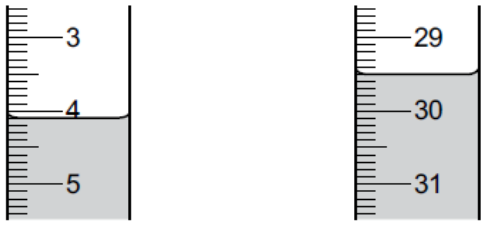
The student:
- rinses a burette with dilute hydrochloric acid
- fills the burette with dilute hydrochloric acid
- runs out some of the acid so that the level of acid is on the burette scale
- uses a measuring cylinder to pour 25 cm^3 of solution **A** into a conical flask
- adds five drops of thymolphthalein indicator to the conical flask
- swirls the flask while adding the acid from the burette to the conical flask until the solution just changes colour.

Experiment 2

The student:
- empties and rinses the conical flask with distilled water
- repeats Experiment 1 using solution **B** instead of solution **A**.

(a) Use Fig. 2.1 and Fig. 2.2 to record the readings for Experiments 1 and 2 in Table 2.1 and complete Table 2.1.

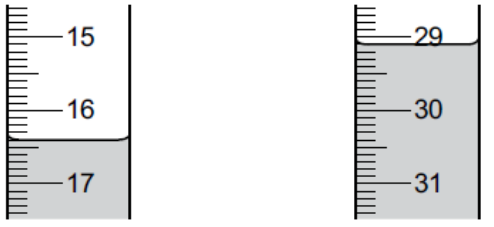
Experiment 1



initial reading final reading

Fig. 2.1

Experiment 2



initial reading final reading

Fig. 2.2

Table 2.1

	Experiment 1	Experiment 2
final burette reading / cm^3	29.6	29.1
initial burette reading / cm^3	19.0	16.3
volume of dilute hydrochloric acid added / cm^3	25.6	12.8

[4]

Mark awarded = 2 out of 4

Examiner comment

The candidate has been awarded two marks. The candidate had misread the initial and final volumes in Experiment 1 and the initial volume in Experiment 2. Therefore, the two marks for collecting and recording data could not be awarded. The marks awarded were for giving all volumes to one decimal place and calculating the volumes added in both experiments, even though their values were incorrect.

Common mistakes

Candidates should be familiar with reading volumes using a variety of apparatus. Values should always be read from the bottom of the meniscus.

A common error is to put the initial volumes in the row for the final volumes. Tables for recording titration results are designed in this way to allow candidates to easily subtract initial from final volumes.

Candidates should always give burette readings to a minimum of one decimal place.

Question 2(b)

(b) State the colour change observed in Experiment 1.

from ..... blue ..... to ..... colourless ..... [1]

Mark awarded = 1 out of 1

Examiner comment

Sodium hydroxide is a strong alkali so the candidate has correctly stated blue as the initial colour of the indicator. At neutralisation, the indicator would be colourless.

Common mistakes

It's important that candidates can recall the colour changes of the indicators stated in the syllabus. Some candidates confuse the colour in acid and alkali and incorrectly state 'colourless' for thymolphthalein in alkaline conditions. In addition, 'colourless' solutions should not be described as 'clear' because a coloured solution can still be clear.

Question 2(c)(i)

(c) (i) State which solution of sodium hydroxide, solution **A** or solution **B**, is the more concentrated.

Explain your answer.

Solution A is more concentrated because a greater volume of acid was used in the titration [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has been awarded the mark for identifying the most concentrated solution and explaining their answer.

Common mistakes

Candidates often misinterpret titration results. In a titration, the greater the volume of known solution (titrant) that is required, the greater the concentration of the unknown solution.

Question 2(c)(ii)

(ii) Deduce the simplest whole number ratio of concentration of solution **A** : concentration of solution **B**.

25.6:12.8 = 2:1 [1]

Mark awarded = 1 out of 1

Examiner comment

Titration of solution **A** required 25.4 cm^3 of acid for neutralisation whereas solution **B** required 12.7 cm^3. Therefore, the ratio of the concentrations in solution **A** and **B** is 25.4:12.7. Expressed as the simplest whole number ratio gives 2:1. The candidate used their incorrect values from **(a)** but simplified the ratio appropriately so was awarded the mark.

Common mistakes

The most common error is to give 25.4:12.7 and not give the simplest whole number ratio. This highlights the importance of reading the question carefully and following all instructions.

Question 2(d)

(d) State the volume of hydrochloric acid needed if Experiment 1 is repeated using 10 cm^3 of solution **A**.

25.6 cm^3 × (10/25) = 10.24 = 10.2 cm^3 [2]

Mark awarded = 2 out of 2

Examiner comment

25 cm^3 of solution **A** required 25.4 cm^3 of hydrochloric acid for neutralisation. If only 10 cm^3 of solution A was used, the required volume can be calculated using 25.4 cm^3 × (10/25).

The candidate used their incorrect values from **(a)** but used the correct method and performed the calculation accurately, so has been awarded the mark for the calculation and the mark for the correct unit.

Common mistakes

The response line does not include units so candidates must include a unit. In this question, the data is given in cm^3 and therefore the appropriate unit is cm^3. If dm^3 is used, the volumes must have been correctly converted.

This candidate received full credit for this question despite using incorrect values from **(a)**. This highlights the importance of showing all working as full marks were awarded for the method and accurately performing the calculation.

Question 2(e)(i)

(e) In Experiment 2 the conical flask is rinsed with distilled water.

(i) Suggest why the conical flask is rinsed with distilled water.

to remove any solution left over from experiment 1 [1]

Mark awarded = 1 out of 1

Question 2(e)(ii)

(ii) The conical flask is **not** dried after it is rinsed with distilled water.

Suggest why the conical flask is **not** dried.

water will dilute solution B [1]

Mark awarded = 0 out of 1

Examiner comment

The candidate has not been awarded the mark. The volume of acid required is dependent on the number of moles of sodium hydroxide. Water will not affect the number of moles of sodium hydroxide so drying is not required.

Common mistakes

Candidates often think, incorrectly, that drying prevents the water from contaminating the experiment.

Question 2(f)

(f) State the effect, if any, on the volume of dilute hydrochloric acid used in Experiment 1 if the solution of sodium hydroxide is warmed before adding the dilute hydrochloric acid.

Give a reason for your answer.

effect on volume *no effect*

reason *because changing the temperature doesn't change the number of moles of sodium hydroxide* [2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has been awarded both marks. They have realised that the volume of hydrochloric acid required is dependent on the number of moles of sodium hydroxide, not on other factors such as temperature.

Common mistakes

Candidates are familiar with rate of reaction experiments in which the rate is dependent on the temperature. Therefore, they incorrectly think that a smaller volume of acid will be required because the reaction occurs faster.

Question 2(g)(i)

(g) (i) Suggest how the reliability of the results from Experiment 1 and Experiment 2 can be confirmed.

Repeat the whole experiment and compare the two sets of results. [1]

Mark awarded = 1 out of 1

Examiner comment

Repeating experiments allows increased reliability provided that the data is compared and anomalous results removed. The candidate has been awarded the mark for stating 'repeat and compare'.

Common mistakes

It is not sufficient to state 'repeat' alone as the result must be compared in order for reliability to be assessed.

Question 2(g)(ii)

(ii) Suggest a more accurate method of measuring the volume of the solution of sodium hydroxide.

use a burette [1]

Mark awarded = 1 out of 1

Examiner comment

In the experiment, the sodium hydroxide was measured with a measuring cylinder. A volumetric pipette or a burette would both be more accurate.

Common mistakes

Candidates often state that a 'pipette' should be used. That is insufficient to be awarded credit as the pipette could be a dropping pipette. When describing pipettes, candidates are advised to state the full name, dropping pipette and volumetric pipette, rather than just pipette.

Question 2(h)

(h) Aqueous sodium hydroxide reacts with aqueous barium chloride to form a white precipitate of barium hydroxide.

Use this information to suggest a different method of finding out which of the solutions of sodium hydroxide, solution **A** or solution **B**, is more concentrated.

In your answer, state how your results show which solution of sodium hydroxide, solution **A** or solution **B**, is more concentrated.

- *add equal volumes of solution A and B separately to the same volume of barium chloride*
- *measure the height of the precipitate formed*
- *the more concentrated solution of sodium hydroxide will form the highest precipitate.* [3]

Mark awarded = 3 out of 3

Examiner comment

The candidate has used bullet points to ensure they made sufficient points to match the mark allocation of the question. This is a sensible approach provided sufficient detail is included in each bullet point.

The candidate has been awarded full marks. They identified the dependent variable (height of precipitate), described how variables would be controlled (same volume of barium chloride) and described how the most concentrated solution would be identified (highest precipitate).

Common mistakes

Candidates often miss the fact that the question is in two parts. To be awarded full credit, candidates must suggest a different method and describe how the results show which solution of sodium hydroxide is more concentrated. This highlights the importance of reading questions carefully and planning an answer to fully address all requirements of the question.

Total mark awarded = 15 out of 18

Question 3

Question 3(a)

3 A student tests two solids, solid **C** and solid **D**.

tests on solid C

Solid **C** is iron(II) sulfate.

Complete the expected observations.

The student dissolves **solid C** in water to form **solution C**.

The student divides **solution C** into three portions.

(a) To the first portion of solution **C**, the student adds 1 cm^3 of dilute nitric acid followed by a few drops of aqueous silver nitrate.

observations ..... *no reaction* ..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has been awarded the mark for stating that no reaction occurred. However, a better observation would have been to state that 'no change was seen'.

Common mistakes

Candidates often give a dashed line '–' to represent 'no reaction'. However, this cannot be credited as it is insufficient to indicate 'no reaction' as it could mean the candidate has left the question blank. If no change is seen, candidates must state this.

Question 3(b)

(b) To the second portion of solution **C**, the student adds 1 cm^3 of dilute nitric acid followed by a few drops of aqueous barium nitrate.

observations ..... *white precipitate* ..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has been awarded the mark for stating an accurate colour and the fact that a precipitate formed.

Common mistakes

The colour of any precipitate formed must be stated. In this case, the precipitate is white but in some cases the precipitate colour will be less distinct. Candidates often state 'blueish' or 'reddish'. This should be avoided and more accurate descriptions given. For example, 'blue-green' or 'red-brown'. Answers which include unrelated colours, such as 'red-blue' cannot be credited as the candidate is essentially giving two answers.

Question 3(c)

(c) To the third portion of solution **C**, the student adds aqueous ammonia dropwise and then in excess.

observations ..... *green precipitate* .....

..... [2]

Mark awarded = 1 out of 2

Examiner comment

The candidate has been awarded one mark for stating an accurate colour and the fact that a precipitate formed. However, they have not described any observations for when excess ammonia was added. In excess ammonia, the precipitate remains.

Question 3(d)

tests on solid D

Table 3.1 shows the tests and the student's observations for solid **D**. For **test 2** and **test 3**, the student dissolves **solid D** in water to form **solution D**. The student divides **solution D** into two portions.

Table 3.1

tests	observations
test 1 Do a flame test.	orange-red colour
test 2 To the first portion of **solution D**, add aqueous sodium hydroxide dropwise and then in excess.	white precipitate, no further change
test 3 To the second portion of **solution D**, add 1 cm^3 dilute nitric acid followed by a few drops of aqueous silver nitrate.	white precipitate

(d) Describe how to do the flame test used in **test 1**.

- *soak a new wooden splint in the solution*
- *use a Bunsen flame*
- *put the splint into the edge of the flame* [3]

Mark awarded = 2 out of 3

Examiner comment

The candidate has been awarded a mark for describing the use of a wooden splint. Clean nichrome wire would also have been appropriate. They were also awarded a mark for stating that the soaked splint is put into the flame. However, they did not specify that the Bunsen flame was blue, or hot, or roaring, so could not be credited the mark. The candidate could also have stated that the flame colour was observed and recorded.

Question 3(e)

(e) Identify solid **D**.

.....

calcium chloride

..... [2]

Mark awarded = 2 out of 2

Examiner comment

The formation of a white precipitate, that is insoluble in excess, with aqueous sodium hydroxide identifies the cation as calcium, Ca^{2+}. The white precipitate with acidified silver nitrate identifies the anion as chloride, Cl^-. Therefore, the candidate has been awarded two marks for identifying the compound as calcium chloride.

Common mistakes

Candidates often confuse the identification of calcium and zinc ions because they both form a white precipitate with aqueous sodium hydroxide. However, the precipitate with calcium is insoluble in excess, whereas the precipitate with zinc is soluble in excess.

Total mark awarded = 7 out of 9

Question 4

4 The label on a bottle of orange drink states 'contains no artificial colours'.

A scientist thinks that the orange colour in the drink is a mixture of two artificial colours:

- Sunset Yellow E110
- Allura Red E129.

Plan an experiment to show that the orange colour in the drink does **not** contain these two artificial colours.

Your plan should describe the use of common laboratory apparatus and samples of E110, E129 and the orange colouring from the drink.

You may draw a diagram to help answer the question.

- use chromatography
- draw a baseline in pencil a short distance from the bottom of the chromatography paper
- put a small spot of the orange drink and small spots of E110 and E129 on the baseline
- put the chromatography paper in a beaker with solvent in, but make sure the solvent touches the paper but is below the baseline
- put the chromatography paper in a beaker with solvent in, but make sure the solvent touches the paper but is below the baseline
- compare the height of E110 and E129 with the orange drink spot to see if they are the same [6]

Mark awarded = 6 out of 6

Examiner comment

The candidate has been awarded full marks for a clear, detailed plan.

The question was worth six marks and therefore six separate points have to be made to be awarded full credit. The candidate has used six separate bullet points, each containing a separate point, to ensure they have made sufficient points to be awarded full credit.

Common mistakes

Some candidates may find it easier to draw a diagram to help them describe the experiment. A diagram will receive credit but it should be clearly labelled and annotated where appropriate.

When planning any experiment or investigation, it is always sensible to plan the answer before starting to write it down. This allows a clear, logical plan to be written that includes all the necessary information.

Total mark awarded = 6 out of 6

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