Cambridge Assessment International Education

Specimen Paper Answers – Paper 4

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 80 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 4 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)(i)

1 Element **X** can undergo the following physical changes.

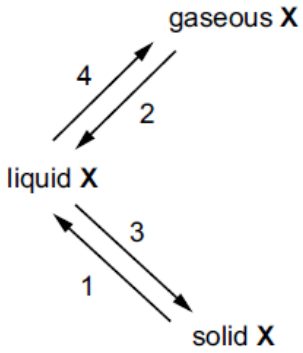


Fig. 1.1

(a) (i) Name each of the numbered physical changes shown in Fig. 1.1.

1 melting

2 condensing

3 freezing

4 evaporating

[4]

Mark awarded = 4 out of 4

Examiner comment

The candidate has been awarded full marks. Boiling was also allowed for process 4.

Common mistakes

Most candidates are familiar with changes of state but occasionally candidates use the correct terms in the wrong order, perhaps rushing their answer.

Question 1(a)(ii)

(ii) One difference between boiling and evaporation is the rate at which the processes occur.

State one **other** difference between boiling and evaporation.

Boiling takes place at a specific temperature, whereas evaporation takes place over a range of temperatures. [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has been awarded the mark for stating a very clear difference. They could also have stated that evaporation is a surface process whereas boiling happens throughout the liquid.

Common mistakes

It is important to make it clear which process is being referred to in an answer. 'It' is best avoided, as it doesn't specify which process is being referred to.

Question 1(b)

(b) Describe the separation, arrangement and motion of particles of element **X** in the solid state.

separation ..... *touching* .....

arrangement ..... *regular* .....

motion ..... *particles only vibrate* .....

[3]

Mark awarded = 3 out of 3

Common mistakes

Candidates often use general descriptions rather than ones which accurately describe the separation, arrangement and motion.

Question 1(c)

(c) Element **X** is a Group III metal. It burns in air to form an oxide $\mathbf{X_2O_3}$.

Write a symbol equation for this reaction.

..... $4X + 3O_2 \rightarrow 2X_2O_3$ ..... [2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has been awarded both marks for writing the correct formulae and fully balancing the equation.

Common mistakes

A common error is to write O_2 as O and giving the equation as $2X + 3O \rightarrow X_2O_3$.

Total mark awarded = 10 out of 10

Question 2

Question 2(a)

2 Magnesium, calcium and strontium are Group II elements.

(a) Complete Table 2.1 to show the electronic configuration of a calcium atom.

Table 2.1

shell	1st	2nd	3rd	4th
number of electrons	2	8	8	2

[1]

Mark awarded = 1 out of 1

Examiner comment

Using the Periodic Table, the candidate has determined that calcium has an atomic number of 20 so an electronic configuration of 2,8,8,2.

Common mistakes

Candidates sometimes misread the question and give the electronic configuration of a calcium ion, Ca^{2+}, 2,8,8., rather than a calcium atom.

Question 2(b)(i)

(b) Describe how the electronic configuration of a strontium atom is:

(i) similar to the electronic configuration of a calcium atom

.....

Both have 2 electrons in their outer shell. ..... [1]

Mark awarded = 1 out of 1

Examiner comment

Candidates are not expected to know the electronic configuration of Sr but they should recall that elements in the same group have the same number of electrons in their outer shell.

Question 2(b)(ii)

(ii) different from the electronic configuration of a calcium atom.

.....

...Ca has 4 electron shells, Sr has 5 electron shells..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has successfully recalled that elements in successive periods have one additional electron shell.

Common mistakes

Candidates often confuse the information given by the group number and period number of an element.

Question 2(c)(i)

(c) Calcium reacts with cold water to form two products:

- a colourless gas, **P**, which 'pops' with a lighted splint
- a weakly alkaline solution, **Q**, which turns milky when carbon dioxide is bubbled through it.

(i) Name gas **P**.

...hydrogen..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has understood that the observation 'pops with a lighted splint' indicates hydrogen gas.

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 2(c)(ii)

(ii) Identify the ion responsible for making solution **Q** alkaline.

..... OH^- ..... [1]

Mark awarded = 1 out of 1

Examiner comment

The name 'hydroxide ion' would also have been acceptable in this case.

Common mistakes

If the formula of an ion is given, the charge must always be included.

Question 2(c)(iii)

(iii) Suggest the pH of solution **Q**.

pH 8 ..... [1]

Mark awarded = 1 out of 1

Examiner comment

The stem of the question states that solution Q is weakly alkaline so any value greater than 7, but less than 12, is acceptable.

Question 2(c)(iv)

(iv) Write a symbol equation for the reaction of calcium with cold water.

calcium + water → calcium hydroxide + hydrogen ..... [2]

Mark awarded = 0 out of 2

Examiner comment

The candidate has understood the reaction but they could not be awarded marks because they have not followed the instructions in the question. The symbol equation is:

$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$

Common mistakes

Many candidates confuse symbol equations with word equations. It's important that candidates read questions carefully to ensure they understand exactly what the question is asking for.

Question 2(d)(i)

(d) Magnesium reacts with chlorine to form magnesium chloride, $MgCl_2$.

Magnesium chloride is an ionic compound.

(i) Complete the dot-and-cross diagram in Fig. 2.1 of the ions in magnesium chloride.

Show the charges on the ions.

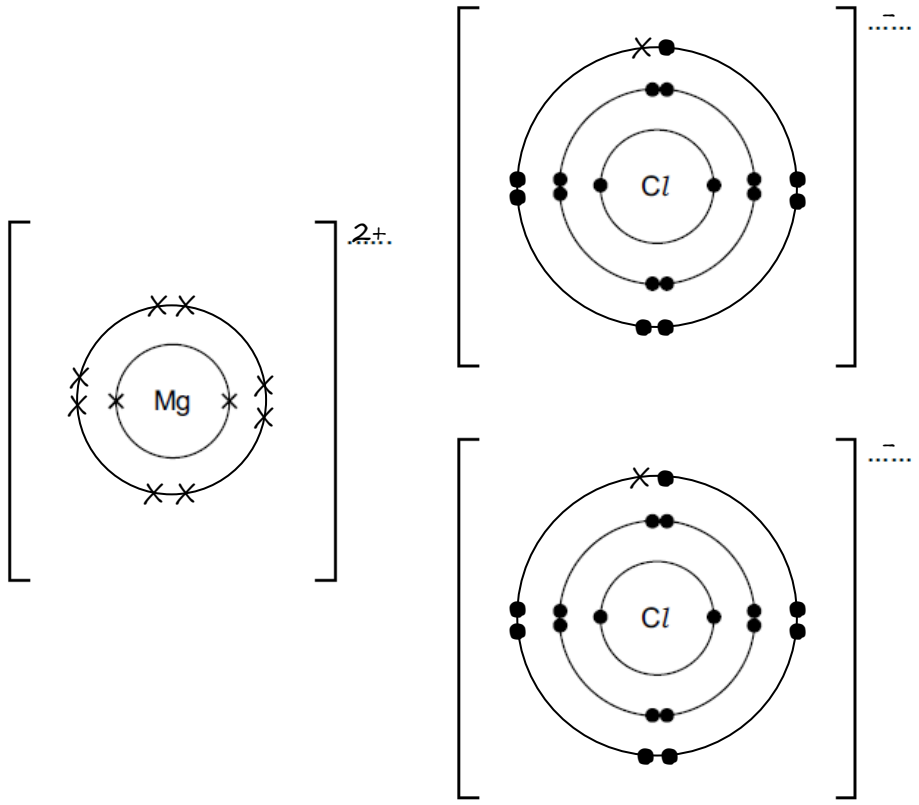


Fig. 2.1 [3]

Mark awarded = 3 out of 3

Examiner comment

The proton number for Mg is 12 so the electronic configuration of the atom is: 2,8,2. To achieve noble gas electronic configuration, a magnesium atom must form a positive ion by losing the outer two electrons. Therefore, the diagram requires 8 electrons to be added to an outer electron shell. It's good practice to draw the electrons as four pairs.

The proton number for Cl is 17 so the electronic configuration of the atom is: 2,8,7. To achieve noble gas electronic configuration, a chlorine atom must form a negative ion by gaining one electron. Therefore, the diagram requires 8 electrons to be added to an outer electron shell with 7 electrons of chlorine being dots and one electron from magnesium being a cross.

Common mistakes

When drawing electrons, candidates should use the format in the question. In this question, electrons are represented by dots, not crosses. It should be remembered that dots and crosses are generally used to represent electrons from different atoms or ions.

Question 2(d)(ii)

(ii) One physical property typical of ionic compounds, such as $MgCl_2$, is that they are soluble in water.

Give two **other** physical properties that are typical of ionic compounds.

1 conduct electricity when molten but not when solid

2 high boiling point

[2]

Mark awarded = 2 out of 2

Common mistakes

Melting point and boiling point are considered the same property so should not be given as two separate properties. Electrical conductivity when molten or aqueous also refers to the same property.

Question 2(e)

(e) Aqueous silver nitrate is added to aqueous magnesium chloride.

A white precipitate forms.

Write an ionic equation for this reaction. Include state symbols.

$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$ [2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has written an ionic equation and added state symbols realising that the precipitate would be a solid.

Common mistakes

State symbols are often overlooked or incorrectly given.

Total mark awarded = 13 out of 15

Question 3

Question 3(a)

3 Copper is a transition element. It has variable oxidation states.

(a) State **two** other chemical properties of transition elements which make them different from Group I elements.

1 *transition elements have variable oxidation states*

2 *transition elements can act as catalysts*

[2]

Mark awarded = 1 out of 2

Examiner comment

The candidate has been awarded one mark for stating that transition elements can act as catalysts. Transition elements do have variable oxidation states but they are stated in the stem of the question and the question itself requires 'two other chemical properties.'. A suitable response would have been that transition elements form coloured compounds or have coloured ions.

Common mistakes

The question asks for chemical properties so candidates must ensure that they do not give physical properties.

The question asks how transition elements are different from Group I elements. It's good practice to make it clear that the response refers to transition elements.

Question 3(b)(i)

(b) When copper(II) oxide is heated at 800 °C it undergoes the reaction shown by the equation.

$$4CuO \rightarrow 2Cu_2O + O_2$$

(i) Identify the changes in oxidation numbers of copper and oxygen in this reaction.

Explain in terms of changes in oxidation numbers why this is a redox reaction.

change in oxidation number of copper: from *+2* to *+1*

change in oxidation number of oxygen: from *-2* to *0*

explanation *A decrease in oxidation number is reduction.*

[3]

Mark awarded = 2 out of 3

Examiner comment

The sum of the oxidation numbers in a compound is zero and the oxidation number of combined oxygen is –2. Therefore, to balance the oxidation numbers in CuO, the Cu must be +2.

In Cu_2O, the Cu must be +1. Therefore, the oxidation number of Cu has changed from +2 to +1.

Uncombined elements, such as O_2, have an oxidation number of 0 so the oxidation number of the oxygen must have changed from –2 to 0.

The candidate has been awarded two marks for deducing the change in oxidation numbers. They have correctly defined reduction but could not be awarded the mark because the question asked for an explanation of why the reaction was a redox reaction. Explaining reduction only explains half of redox. Stating that 'oxidation is an increase in oxidation number' was also required.

Common mistakes

Candidates often give partial answers when describing redox reactions. For full marks to be awarded, redox must be described in terms of oxidation and reduction.

Question 3(b)(ii)

(ii) Calculate the volume of oxygen, measured at r.t.p., which is formed when 1.60 g of CuO reacts as shown in the equation.

$$4CuO \rightarrow 2Cu_2O + O_2$$

M_r CuO = 64 + 16 = 80 g mol^{-1}

moles of CuO = 1.60 g ÷ 80 g mol^{-1} = 0.02 mol

mole ratio CuO : O_2 = 4:1

moles of O_2 = 0.02 ÷ 4 = 0.005 mol

volume of O_2 = 0.005 mol x 24 dm^3 = 0.12 dm^3

..... 0.12 ..... dm^3 [3]

Mark awarded = 3 out of 3

Examiner comment

The candidate has clearly organised their answer, showed all their working and used the correct units throughout.

Common mistakes

Candidates often give just a final answer to numerical questions. However, candidates should be encouraged to show all their working so if an error is made they may receive credit for their method.

Question 3(c)(i)

(c) Copper metal is obtained when scrap iron is added to aqueous copper(II) sulfate.

(i) The reaction between iron and aqueous copper(II) sulfate is a displacement reaction.

State why this displacement reaction takes place.

.....

Iron is more reactive than copper so the iron displaces the copper ions. [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has been awarded the mark for realising that the iron displaces the copper ions because iron is more reactive than copper.

Question 3(c)(ii)

(ii) Write a symbol equation for the reaction between iron and aqueous copper(II) sulfate.

$Fe + CuSO_4 \rightarrow Cu + FeSO_4$ [1]

Mark awarded = 1 out of 1

Examiner comment

All symbol equations should be fully balanced.

Question 3(c)(iii)

(iii) A displacement reaction is one method for obtaining copper metal from aqueous copper(II) sulfate.

Identify **another** method for obtaining copper metal from aqueous copper(II) sulfate.

electrolysis [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has correctly recalled that copper can be obtained by electrolysis.

Total mark awarded = 9 out of 11

Question 4

Question 4(a)(i)

4 Sulfuric acid has many uses.

(a) Sulfuric acid is a strong acid.

(i) Define the term acid.

acids donate protons [1]

Mark awarded = 1 out of 1

Question 4(a)(ii)

(ii) Define the term strong acid.

Strong acids completely dissociate in solution. [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has been awarded the mark as they realised that strong acids completely dissociate in aqueous solution.

Common mistakes

Candidates often confuse the terms strong and weak with concentrated and diluted. A strong acid can still be diluted so it's important that candidates are familiar with the different terms.

Question 4(b)(i)

(b) Dilute sulfuric acid is used to make salts known as sulfates.

A method consisting of three steps is used to make zinc sulfate from zinc carbonate.

step 1 Add an excess of zinc carbonate to 20 cm^3 of 0.4 mol / dm^3 dilute sulfuric acid until the reaction is complete.

step 2 Filter the mixture.

step 3 Heat the filtrate until a saturated solution forms and then allow it to crystallise.

(i) Suggest **two** observations which show that the reaction is complete in **step 1**.

1 *no more fizzing is observed*

2 *no more zinc carbonate dissolves*

[2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has made two clear observations and been awarded two marks.

Common mistakes

Candidates frequently confuse observations with a conclusion. For example, 'carbon dioxide gas is given off' is a conclusion rather than an observation. An observation is something that can be seen. So, the name of a product is not an observation. An appropriate observation would be 'bubbles of gas are no longer seen'.

Question 4(b)(ii)

(ii) State why it is important to add an excess of zinc carbonate in **step 1**.

.....

so that all the acid is used up ..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has realised that excess means that some of the substance will remain after the reaction is complete as the other reactant(s) have been used up.

Question 4(b)(iii)

(iii) Define the term saturated solution.

• *a solution that contains the maximum concentration of a solute dissolved in the solvent*

.....

• *at a specified temperature*

..... [2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has used the description of a saturated solution given in the syllabus and been awarded full marks.

Common mistakes

Candidates are advised to learn the descriptions of terms that are given in the syllabus. Being able to describe terms gives confidence.

Question 4(b)(iv)

(iv) Name **another** zinc compound which can be used to make zinc sulfate from dilute sulfuric acid using this method.

zinc oxide ..... [1]

Mark awarded = 1 out of 1

Examiner comment

Zinc hydroxide would also be a suitable reactant.

Common mistakes

Candidates frequently name zinc. However, the question asks for a compound so zinc would not be appropriate.

Question 4(b)(v)

(v) Suggest why this method would **not** work to make barium sulfate from barium carbonate and dilute sulfuric acid.

barium sulfate is insoluble ..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has correctly applied the general solubility rules and stated that barium sulfate is insoluble.

Question 4(c)(i)

(c) In a titration, a student added 25.0 cm^3 of 0.200 mol / dm^3 aqueous sodium hydroxide to a conical flask. The student then added a few drops of methyl orange to the solution in the conical flask.

Dilute sulfuric acid is then added from a burette to the conical flask. The volume of dilute sulfuric acid needed to neutralise the aqueous sodium hydroxide was 20.0 cm^3.

The reaction is shown by the equation.

$$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$$

(i) State the colour of methyl orange in aqueous sodium hydroxide.

yellow ..... [1]

Mark awarded = 1 out of 1

Examiner comment

Sodium hydroxide is a strong alkali so the candidate has correctly stated yellow as the colour of the indicator.

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 'red' for methyl orange in alkaline conditions.

Question 4(c)(ii)

(ii) Determine the concentration of the dilute sulfuric acid in g / dm^3 using the following steps.

- Calculate the number of moles of aqueous sodium hydroxide added to the conical flask.

moles NaOH = 0.2 mol / dm^3 × 25×10^{-3} dm^3 =

0.005 ..... mol

- Calculate the number of moles of dilute sulfuric acid added from the burette.

mole ratio NaOH:H_2SO_4 = 2:1

moles of H_2SO_4 = 0.005 mol ÷ 2 =

0.0025 ..... mol

- Calculate the concentration of the dilute sulfuric acid in mol / dm^3.

conc. of H_2SO_4 = 0.0025 mol ÷ 20×10^{-3} dm^3 =

0.125 ..... mol / dm^3

- Calculate the concentration of the dilute sulfuric acid in g / dm^3.

conc. of H_2SO_4 in g / dm^3 = 0.125 × M_r H_2SO_4 =

0.125 mol / dm^3 × 98 = 12.25 g / dm^3 =

12.3 ..... g / dm^3

[4]

Mark awarded = 4 out of 4

Examiner comment

The candidate has been awarded full marks for four correct calculations. Each calculation was clearly presented, showing all working and appropriate units.

In the question, the least accurate data value was given to three significant figures. The candidate has correctly expressed their final answer to three significant figures.

Common mistakes

Candidates would benefit from taking care with units. When giving numerical answers, candidates should check the question to ensure they are using the correct units. This is particularly important in questions that require units to be converted, for example cm^3 to dm^3.

Total mark awarded = 14 out of 14

Question 5

Question 5(a)(i)

5 A student investigates the progress of the reaction between dilute hydrochloric acid, HC*l*, and an excess of large pieces of marble, $CaCO_3$, using the apparatus shown in Fig. 5.1.

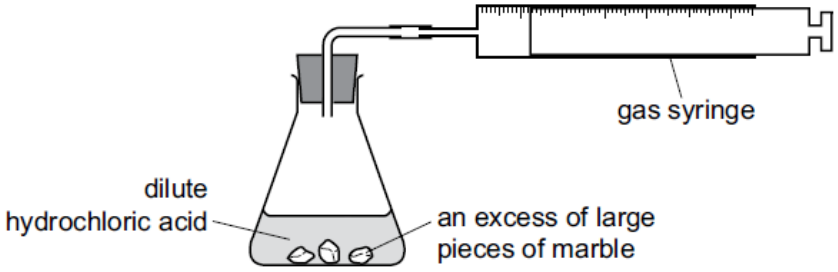


Fig. 5.1

(a) A graph of the volume of gas produced against time is shown in Fig. 5.2.

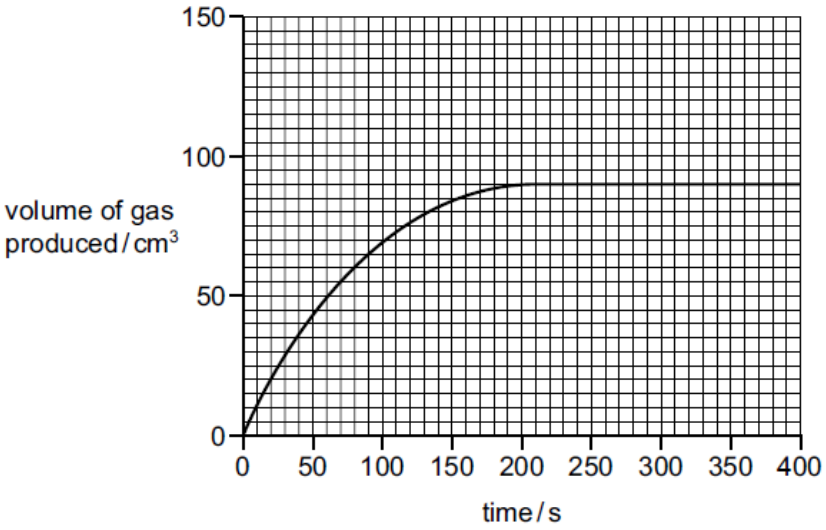


Fig. 5.2

(i) State how the shape of the graph shows that the rate of reaction decreases as the reaction progresses.

.....

The gradient of the slope gets less steep. [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has correctly stated that the gradient gets less as the reaction proceeds.

Question 5(a)(ii)

(ii) Suggest why the rate of reaction decreases as the reaction progresses.

.....

The hydrochloric acid is being used up. ..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has read the question carefully and identified that the calcium carbonate is in excess. Therefore, the rate of reaction must be decreasing because the hydrochloric acid is being used up.

Common mistakes

A common incorrect answer is that 'all of the reactants are being used up'. If a reactant is in excess, 'all' reactants cannot be used up.

Question 5(a)(iii)

(iii) Deduce the time at which the reaction finishes.

.....*200*..... s [1]

Mark awarded = 1 out of 1

Examiner comment

When the reaction is complete, no more gas will be produced. The candidate has identified that at 200 s the line on the graph first becomes flat.

Common mistakes

When using a graph to determine when a reaction is complete, candidates should be sure to choose the point at which the graph first becomes flat.

Question 5(b)

5 A student investigates the progress of the reaction between dilute hydrochloric acid, HC*l*, and an excess of large pieces of marble, $CaCO_3$, using the apparatus shown in Fig. 5.1.

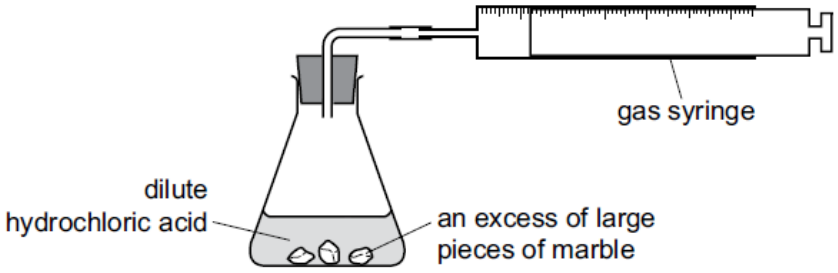


Fig. 5.1

(a) A graph of the volume of gas produced against time is shown in Fig. 5.2.

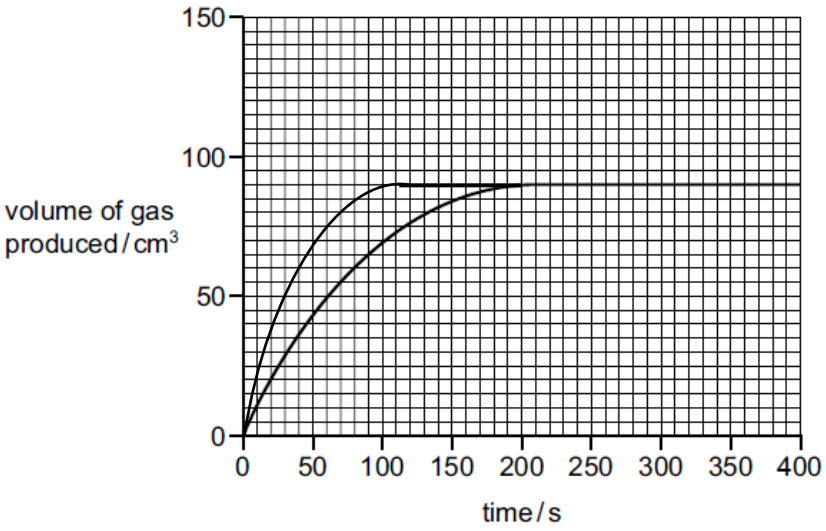


Fig. 5.2

(b) The experiment is repeated using the same mass of smaller pieces of marble.

All other conditions are kept the same.

Draw a line **on the grid** in Fig. 5.2 to show the progress of the reaction using the smaller pieces of marble. [2]

Mark awarded = 2 out of 2

Examiner comment

As the only change to the conditions is a higher temperature, the same final volume of carbon dioxide gas will be collected. However, the initial gradient of the slope will be greater as the reaction takes place at a faster rate. Therefore, the graph is awarded both marks.

Common mistakes

Candidates often realise that the gradient will be steeper but level their line off at a higher volume of carbon dioxide. If the concentration of reactants hasn't changed, the final volume of carbon dioxide cannot change.

Question 5(c)(i)

(c) The original experiment is repeated at a higher temperature. All other conditions are kept the same. The resulting increase in rate of reaction can be explained in terms of activation energy and collisions between particles.

(i) Define the term activation energy.

Activation energy is the minimum energy that particles must have in order to react. [2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has been awarded both marks. A stronger response would have referred to colliding particles, rather than just particles.

Common mistakes

Candidates often omit the fact that activation energy is the **minimum** energy needed to react and not the energy needed to react.

Question 5(c)(ii)

(ii) Explain why the rate of a reaction increases when temperature increases, in terms of activation energy and collisions between particles.

- *particles have more energy so they move faster*
- *there are more frequent collisions between particles*
- *more particles have energy greater than the activation energy*

[3]

Mark awarded = 3 out of 3

Examiner comment

The candidate has been awarded full marks because they explained the increase in reaction rate in terms of both activation energy and collisions between particles.

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.

Common mistakes

The question specifies that responses must refer to activation energy and collisions. Therefore, it's important to specify that at a higher temperature, the particles have a higher kinetic energy and a greater proportion of the particles have energy greater than the activation energy. Therefore, collisions occur more frequently and the collisions are more likely to result in a successful reaction.

Total mark awarded = 10 out of 10

Question 6

Question 6(a)

6 Alkynes and alkenes are homologous series of unsaturated hydrocarbons.

All alkynes contain a C≡C triple bond.

(a) Complete Table 6.1 showing information about the first **three** alkynes.

Table 6.1

formula	C_2H_2	C_3H_4	C_4H_6
structure	H–C≡C–H	H–C≡C–CH_3	H–C≡C–CH_2–CH_3
names	ethyne	*propyne*	but-1-yne

[2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has been awarded both marks for applying knowledge of naming conventions to the information in the question. For the name, carbon compounds with three carbon atoms have the prefix prop- and the alkynes have the suffix -yne, hence the name is propyne. The formula is determined by counting the number of each atom in the structure provided.

Common mistakes

Candidates are not expected to know about alkynes. However, they should be able to use the information in the question to determine the required formula and name. It's important to apply knowledge of naming conventions to the information in the question.

Candidates should remember that the number of each atom should be subscript. For example, C3H6O3 is not an acceptable format.

Question 6(b)(i)

(b) Compounds in the same homologous series have the same general formula.

(i) Give two **other** characteristics of members of a homologous series.

1 *same functional group* .....

2 *similar chemical properties* .....

[2]

Mark awarded = 2 out of 2

Examiner comment

The same general formula has already been given in the question, so two other characteristics have correctly been stated. The candidate could also have stated that members of a homologous series differ from successive members by a $–CH_2–$ unit, or display a trend in physical properties.

Common mistakes

Candidates often state that members of a homologous series have 'the same chemical properties' or 'the same physical properties'. In this case, the use of 'same' is incorrect. It is correct to say that 'they have similar chemical properties' and 'display a trend in physical properties'.

Question 6(b)(ii)

(ii) Deduce the general formula of alkynes.

Use the information from Table 6.1 to help you.

C_nH_{2n-2} ..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has correctly determined the general formula and been awarded the mark.

For ethyne, C_2H_2:

There are 2 carbons so n = 2.

To get 2H atoms, $2n - 2 = (2 \times 2) - 2 = 2$

Common mistakes

Candidates are advised to double check their answer using another formula from the table.

For propyne, C_3H_4:

C: n = 3

H: $2n - 2 = (2 \times 3) - 2 = 4$

Question 6(b)(iii)

(iii) Alkynes are unsaturated.

Describe a test for unsaturation.

test add aqueous bromine .....

result from orange to colourless .....

[2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has been awarded both marks for specifying the correct reagent and the appropriate colour change. For this test, it is also appropriate to state that 'aqueous bromine is decolorised'.

Common mistakes

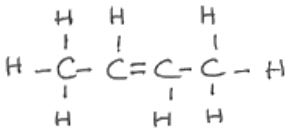
When describing chemical tests, candidates should always describe the colour change, not just the final colour. In this question, the result should be stated as 'aqueous bromine turns from orange to colourless'.

It's common for candidates to state 'turns clear' instead of 'turns colourless', when describing chemical tests. Clear is not specific enough as a coloured liquid can also be clear.

Question 6(c)(i)

(c) Ethene and but-2-ene are alkenes.

(i) Draw the displayed formula of but-2-ene.



[2]

Mark awarded = 2 out of 2

Examiner comment

An organic compound with 2-ene in the name indicates that the C–C double bond is between the 2nd and 3rd carbon. Also, a compound with but- in the name indicates that the compound has 4 carbon atoms.

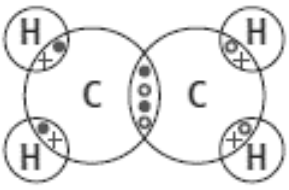
Common mistakes

Candidates often show carbons as having 2 hydrogens bonded to the C2 and C3 atoms. This is incorrect as the carbons would be pentavalent. Each carbon atom should only have 4 covalent bonds with a C–C double bond counting as 2.

Question 6(c)(ii)

(ii) Draw a dot-and-cross diagram to show a molecule of ethene, $CH_2=CH_2$.

Show outer shell electrons only.



[2]

Mark awarded = 2 out of 2

Examiner comment

A dot-and-cross diagram has been asked for so it is good practice to use both dots and crosses. The candidate has made a good attempt at specifying the origin of the electrons in each bond. Crosses represent the electrons from hydrogen, shaded dots represent electrons from one carbon and circled dots represent electrons from the other carbon. Both marks have been awarded.

Common mistakes

Candidates sometimes forget that a single covalent bond involves 2 electrons (a shared pair) and a C–C double bond involves 4 electrons (two shared pairs).

Question 6(d)(i)

(d) Ethene can be converted to ethanoic acid by a two-stage process.

In stage one, ethene is converted to ethanol by catalytic addition.

$$C_2H_4 + H_2O \rightarrow C_2H_5OH$$

(i) Suggest why stage one is called an addition reaction.

only one product is formed ..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has correctly stated that during addition reactions, two reactants combine to form one product.

Common mistakes

Candidate soften state that during addition reactions, one chemical is added to another, but omit the fact that only one product is formed.

Question 6(d)(ii)

(ii) A catalyst is used in stage one.

State one **other** condition that must be used.

A temperature of 300° C. ..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has been awarded the mark for recalling an appropriate temperature. A pressure of 60 atm or the fact that steam is used would also have been correct.

Common mistakes

Candidates often become confused with the different conditions required for different reactions. Candidates would benefit from learning the conditions stated in the syllabus.

Question 6(d)(iii)

(iii) State what must be reacted with ethanol to form ethanoic acid.

potassium manganate(VII) ..... [2]

Mark awarded = 1 out of 2

Examiner comment

The candidate has been awarded one mark for naming potassium manganate(VII) but omitted the fact that it should be acidified and aqueous.

Common mistakes

Candidates often try to state the name and formula for potassium manganate(VII), but in this question, it is not required, and providing a formula with an error can contradict a correct name.

Total mark awarded = 14 out of 15

Question 7

Question 7(a)(i)

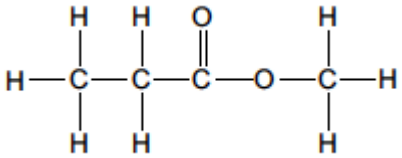
7 Carboxylic acids can be converted into esters.

(a) Propanoic acid and methanol react to form an ester that has the molecular formula $C_4H_8O_2$.

(i) Name this ester and draw its displayed formula.

name of ester *methyl propanoate*

displayed formula



[2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has been awarded both marks for correctly naming the ester and drawing a displayed formula showing all atoms and bonds.

Common mistakes

When naming esters, the alcohol provides the -yl part of the name and the carboxylic acid provides the -oate part. Candidates frequently reverse the name of esters. In this question, the incorrect, reversed name would be propyl methanoate.

Candidates often forget to show all the atoms and all of the bonds in displayed formula.

Question 7(a)(ii)

(ii) Name **another** ester with the molecular formula $C_4H_8O_2$.

ethyl ethanoate [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has been awarded the mark for naming a correct ester. If an ester has four carbon atoms it could be formed from a two-carbon alcohol and a two-carbon carboxylic acid so would be named ethyl ethanoate. Other four carbon esters are also acceptable.

Common mistakes

Candidates should be encouraged to draw the structural or displayed formula of their suggested ester to ensure that it has the correct molecular formula.

Question 7(b)(i)

(b) Polyesters are polymers made from dicarboxylic acids.

(i) Name the **other** type of organic compound used in the formation of polyesters.

diol ..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has correctly recalled that a diol is required in the formation of polyesters.

Question 7(b)(ii)

(ii) Name the type of polymerisation used in the manufacture of polyesters.

condensation ..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate correctly identified the type of polymerisation as condensation because water is formed during the reaction.

Common mistakes

Candidates often confuse condensation and addition polymerisation.

Total mark awarded = 5 out of 5

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