Cambridge Assessment International Education

Specimen Paper Answers – Paper 3

Cambridge IGCSE™ / IGCSE (9–1)

Chemistry 0620 / 0971

For examination from 2023

Version 1

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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 3 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 Fig. 1.1 shows the electronic configurations of five atoms, **A**, **B**, **C**, **D** and **E**.

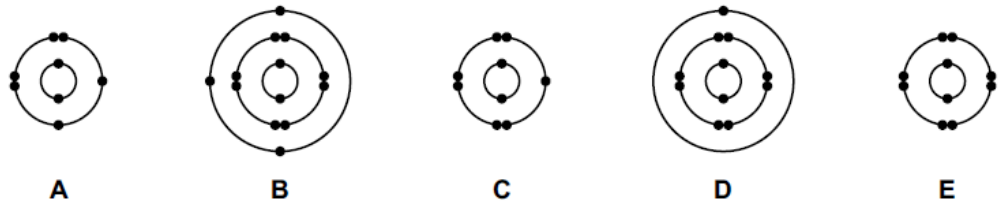

Fig. 1.1

(a) Answer the following questions.

Each letter may be used once, more than once or not at all.

Give the letter of the atom, **A**, **B**, **C**, **D** or **E**, that:

(i) is in Group III of the Periodic Table

B ..... [1]

Mark awarded = 1 out of 1

Examiner comment

Atoms in Group III have three electrons in their outer shell, therefore atom B is the correct choice.

Common mistakes

Candidates often confuse the number of electrons in the outer shell with the number of electron shells and therefore select atom D.

Question 1(a)(ii)

(ii) has 13 protons

B ..... [1]

Mark awarded = 1 out of 1

Examiner comment

If an atom has 13 protons it must have 13 electrons, therefore atom B is the correct choice.

Common mistakes

Some candidates are reluctant to select option B in two consecutive questions. The question states that 'Each letter may be used once, more than once, or not at all.' so they should select the letter that matches the information.

Question 1(a)(iii)

(iii) is a noble gas

E ..... [1]

Mark awarded = 1 out of 1

Examiner comment

Noble gases have a full outer electron shell. Only atom E has a full outer shell.

Question 1(a)(iv)

(iv) forms a stable ion with a single negative charge.

C ..... [1]

Mark awarded = 1 out of 1

Examiner comment

To form a stable negative ion, an atom must achieve a full outer electron shell by gaining electrons. If an ion is to have a single negative charge it must gain only one electron. Atom C has 7 electrons in its outer shell so when it gains one electron the ion will have a full outer electron shell and have a 1– charge.

Common mistakes

Candidates often select atom D because they know that electrons have a negative charge and atom D has a single electron in its outer shell.

Question 1(b)

(b) Complete Table 1.1 to show the number of electrons, neutrons and protons in the sulfur atom and oxide ion.

Table 1.1

	number of electrons	number of neutrons	number of protons
$^{34}_{16}S$	16	18	16
$^{18}_{8}O^{2-}$	10	10	8

[3]

Mark awarded = 3 out of 3

Examiner comment

The number of neutrons is calculated by subtracting the proton number from the mass number. In S, = 34 – 16 = 18.

The number of protons is given by the proton number. In S, this is 16.

The number of electrons in an atom is given by the proton number. The number of electrons in an ion has to be calculated using the proton number and the charge on the ion. In O^{2-}, the atom has a proton number of 8 but an overall charge of 2–, meaning there are 8 + 2 = 10 electrons.

The number of protons in an atom or an ion is given by the proton number. In O^{2-}, this is 8.

Common mistakes

Candidates are often confident working out the numbers of particles in atoms but they find ions more challenging. It is important to remember that electrons have a negative charge, so if an atom gains electrons, the ion will have a negative charge. If an atom loses electrons, the ion will have a positive charge.

Total mark awarded = 7 out of 7

Question 2

Question 2(a)(i)

2 (a) Table 2.1 shows the mass of ions present in a 100 cm^3 sample of milk.

Table 2.1

ion	formula of ion	mass of ion in 100 cm^3 milk / mg
calcium	Ca^{2+}	125
chloride	Cl^-	120
magnesium	Mg^{2+}	12
negative ions of organic acids		160
phosphate	PO_4^{3-}	95
potassium	K^+	140
sodium	Na^+	58
sulfate	SO_4^{2-}	30

(i) Calculate the mass of calcium ions present in a 20 cm^3 sample of this milk.

mass of calcium ions = ... 25 ..... mg [1]

Mark awarded = 1 out of 1

Examiner comment

In 100 cm^3 of milk there is 125 mg of Ca^{2+}.

In 20 cm^3 = 125 mg × (20/100)

= 25 mg

Question 2(a)(ii)

(ii) Identify the positive ion present in the highest concentration in the 100 cm^3 sample of milk.

..... K^+ ..... [1]

Mark awarded = 1 out of 1

Examiner comment

K^+ has the greatest mass in 100 cm^3 so it must have the highest concentration.

Common mistakes

Candidates may be distracted by the mass of organic acids. However, organic acids are negative ions and the question asks about positive ions.

Question 2(a)(iii)

(iii) Complete Fig. 2.1 to show the electronic configuration of a potassium ion.

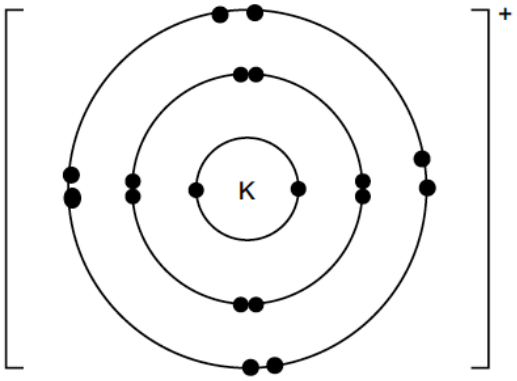

Fig. 2.1 [1]

Mark awarded = 1 out of 1

Examiner comment

The proton number for K is 19 so the electronic configuration is: 2,8,8,1. The formation of a single positive ion requires one electron to be lost. Therefore, the diagram requires 8 electrons to be added to the outer electron shell. It's good practice to draw the electrons as four pairs.

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(a)(iv)

(iv) Describe a test for chloride ions.

test ..... *add silver nitrate* .....

positive result ..... *white ppt.* .....

[2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has been awarded the mark for the test but a stronger answer would have stated 'add acidified silver nitrate'. The candidate was awarded the mark for 'white ppt' but abbreviations should be avoided to ensure clarity.

Common mistakes

Some candidates describe the result as a 'white solid'. This is acceptable but 'white precipitate' is preferred.

Question 2(a)(v)

(v) Explain why the solutions used in qualitative chemical tests are made using distilled water and **not** tap water.

.....

Distilled water contains fewer impurities. ..... [1]

Mark awarded = 1 out of 1

Common mistakes

Candidates must make it clear whether they are referring to tap or distilled water. For example, a response that reads 'it contains ions' does not make it clear whether the 'it' refers to distilled or tap water.

Question 2(b)

(b) Which one of these salts is soluble in water?

Tick **one** box.

barium sulfate	
calcium carbonate	
ammonium sulfate	√
iron(II) hydroxide	

[1]

Mark awarded = 1 out of 1

Examiner comment

The general solubility rules state that:

- ammonium salts are soluble
- barium sulfate is insoluble
- hydroxides and carbonates are insoluble

Common mistakes

Candidates often select iron(II) hydroxide because they recall that Group I hydroxides are soluble but forget that hydroxides generally have a low solubility.

Question 2(c)(i)

(c) One of the organic acids present in milk is lactic acid.
The displayed formula of lactic acid is shown in Fig. 2.2.

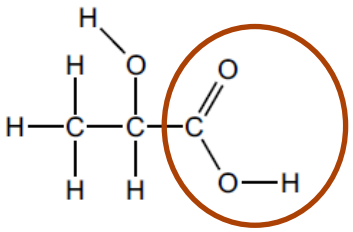

Fig. 2.2

(i) Draw a circle around the carboxylic acid functional group on the structure. [1]

Mark awarded = 1 out of 1

Common mistakes

It's important to circle the functional group carefully so atoms not included in the functional group, for example another C, are avoided.

Question 2(c)(ii)

(ii) Deduce the molecular formula of lactic acid.

$C_3H_6O_3$ [1]

Mark awarded = 1 out of 1

Examiner comment

The molecular formula is the number and type of different atoms in one molecule. In lactic acid, there are 3C atoms, 6H atoms and 3O atoms. The candidate has correctly given $C_3H_6O_3$.

Common mistakes

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

Total mark awarded = 9 out of 9

Question 3

Question 3(a)

3 A coloured crystal of cobalt(II) chloride is placed at the bottom of a beaker containing water.

Colour spreads throughout the water over time. Fig 3.1 shows the spread of colour after two days.

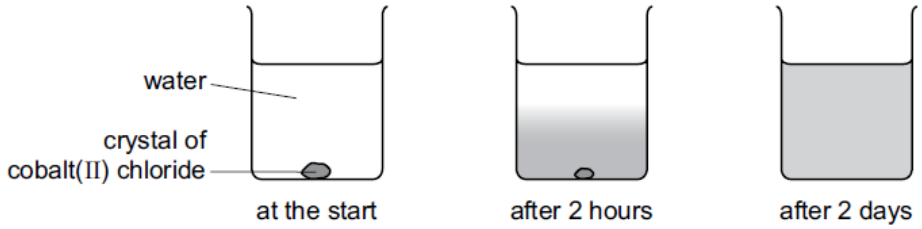

Fig. 3.1

(a) Explain these observations.

- *the cobalt chloride crystal(II) dissolves in the water*
- *the cobalt chloride particles diffuse and spread out*
- *the particles move in all directions and collide with each other*

[3]

Mark awarded = 3 out of 3

Examiner comment

The candidate provided a full explanation including details of how the particles move throughout the solution. Specific scientific vocabulary (dissolves, particles, diffusion and collide) has been used correctly showing understanding of the process. The response could also have included the random nature of particle movement.

Common mistakes

Candidates often describe diffusion but forget to state that the crystal must first dissolve before the particles can diffuse.

Question 3(b)(i)

(b) Cobalt(II) chloride can be used to test for the presence of water.

$$CoCl_2 + 6H_2O \rightleftharpoons CoCl_2 \cdot 6H_2O$$

anhydrous cobalt(II) chloride — hydrated cobalt(II) chloride

(i) State the meaning of the symbol ⇌.

It shows the reaction is reversible [1]

Mark awarded = 1 out of 1

Examiner comment

It would also be correct to say the symbol shows the reaction is in equilibrium.

Common mistakes

Some candidates have a general understanding of the meaning of the arrow and state 'it shows the reaction goes both ways', but they cannot recall the correct terminology.

Question 3(b)(ii)

(ii) State the colour change when water is added to anhydrous cobalt(II) chloride.

from ……blue…… to ……pink…… [2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has correctly recalled that blue is the colour of anhydrous cobalt(II) chloride and pink is the colour of the hydrated form.

Common mistakes

If response prompts are not given, candidates should make it clear what the starting and final colours are. Candidates often confuse the colours of cobalt(II) chloride and copper(II) sulfate so give from white to blue.

Question 3(c)(i)

(c) (i) Table 3.1 compares the reactivity of cobalt with that of three other metals.

Table 3.1

metal	reactivity with cold water	reactivity with steam
barium	reacts rapidly	
cobalt	no reaction	reacts slowly when heated
magnesium	reacts very slowly	reacts rapidly
zinc	no reaction	reacts easily when heated

Use this information to put the four metals in order of their reactivity. Put the least reactive metal first.

least reactive ⟶ most reactive

cobalt	zinc	magnesium	barium

[2]

Mark awarded = 2 out of 2

Examiner comment

The reactivity with cold water shows the order is:

cobalt or zinc → magnesium → barium.

The reactivity with steam shows that cobalt is less reactive than zinc.

Common mistakes

It's common for candidates to reverse the order which highlights the importance of reading the question carefully. In this question, the order of reactivity must be from least to most reactive.

Question 3(c)(ii)

(ii) State the boiling point of pure water at room temperature and pressure.

.....100..... °C [1]

Mark awarded = 1 out of 1

Common mistakes

Candidates may rush the question and confuse boiling and melting point and state 0°C.

Question 3(d)

(d) Cobalt is a transition element. Lithium is a Group I element.

Describe **two** ways in which the properties of cobalt differ from those of lithium.

1 Cobalt is harder

2 Cobalt has a higher melting point

[2]

Mark awarded = 2 out of 2

Examiner comment

Cobalt is a transition element and lithium is a Group I metal. Both are metals but the question asks how they are different. Therefore, the answer needs to focus on the differences between transition and Group I metals. The candidate has named two differences and been awarded two marks. The question does not specify physical or chemical properties, so either are acceptable in this question.

Common mistakes

The question is asking for how the properties of cobalt are different from lithium, so the answer should clearly refer to cobalt and not lithium. Melting point and boiling point are considered the same type of property so should not be given as two separate properties.

Question 3(e)

(e) When cobalt(II) oxide, CoO, is heated in air an oxide with the formula Co_3O_4 is formed.

Balance the equation for this reaction.

.....6.. $CoO + O_2 \rightarrow 2Co_3O_4$ [1]

Mark awarded = 1 out of 1

Examiner comment

There are (2 × 3) = 6 atoms of Co on the right-hand side so there must be 6 on the left-hand side.

There are (2 × 4) = 8 atoms of oxygen on the right-hand side, so there must be 8 on the left-hand side.

Common mistakes

Candidates often miss the subscript 3 and therefore think that there are 2 atoms of Co on the right-hand side.

Question 3(f)

(f) When the oxide Co_3O_4 is heated in hydrogen, cobalt metal is formed.

$$Co_3O_4 + 4H_2 \rightarrow 3Co + 4H_2O$$

Explain how this equation shows that Co_3O_4 is reduced.

.....

Oxygen has been lost from Co_3O_4. ..... [1]

Mark awarded = 1 out of 1

Examiner comment

At Core, reduction is defined as the loss of oxygen. Reduction can also be defined in terms of hydrogen and electrons but that is not required knowledge for Core candidates.

Common mistakes

Candidates often confuse oxidation and reduction. For Core candidates, oxidation is the gain of oxygen and reduction is the loss of oxygen.

Total mark awarded = 13 out of 13

Question 4

Question 4(a)(i)

4 A student investigates the reaction of small pieces of zinc with dilute sulfuric acid at 20 °C. The zinc is in excess.

(a) Fig. 4.1 shows the volume of hydrogen gas released as the reaction proceeds.

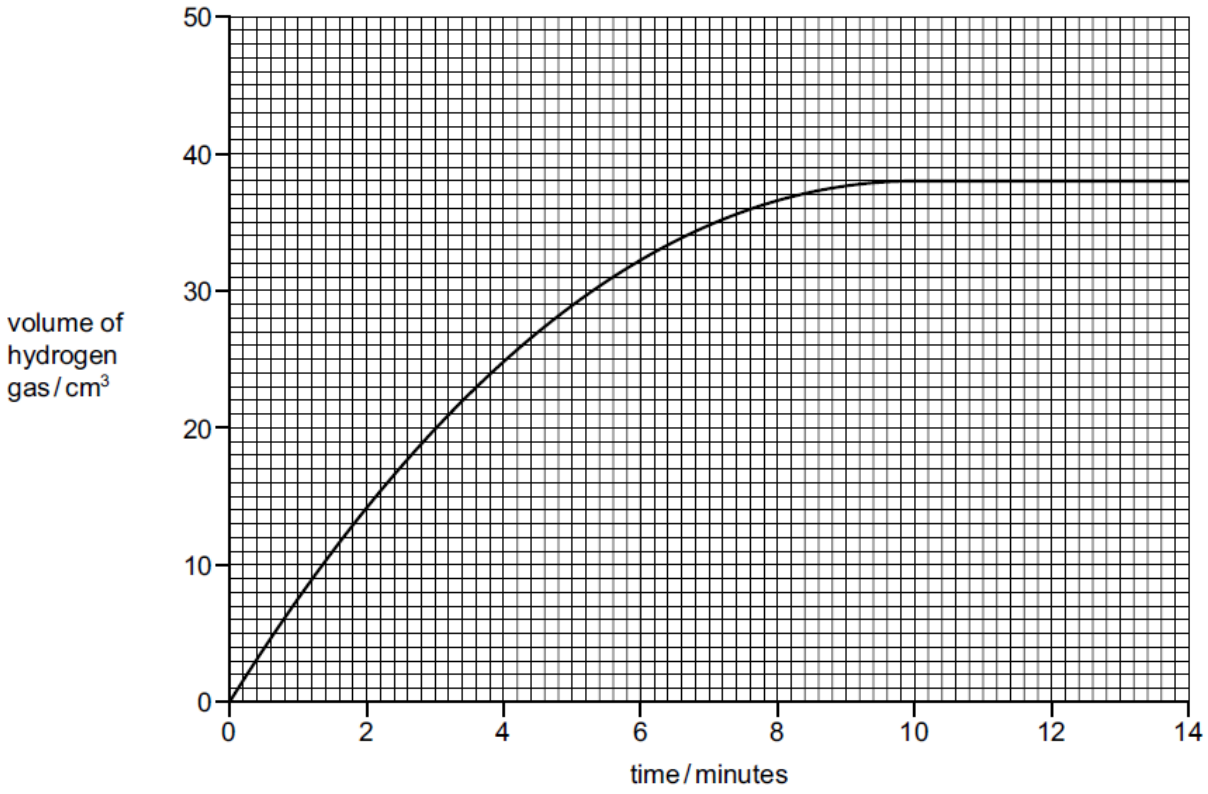

Fig. 4.1

(i) Suggest why the volume of hydrogen gas stays the same after 10 minutes.

.....

Because the reaction has finished. ..... [1]

Mark awarded = 1 out of 1

Examiner comment

The response was awarded the mark but a stronger response would have stated that 'the reaction had finished because the sulfuric acid was used up'.

Common mistakes

Candidates often make general statements, such as 'all the reactants are used up'. As the zinc is in excess, this would be incorrect.

Question 4(a)(ii)

(ii) Deduce the time taken from the start of the experiment to collect 20 cm^3 of hydrogen gas.

35 ..... [1]

Mark awarded = 0 out of 1

Examiner comment

There was no unit given on the response line, so candidates must include the unit in their answer. The mark has not been awarded because the candidate stated the incorrect unit.

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.

Question 4(a)(iii)

4 A student investigates the reaction of small pieces of zinc with dilute sulfuric acid at 20 °C. The zinc is in excess.

(a) Fig. 4.1 shows the volume of hydrogen gas released as the reaction proceeds.

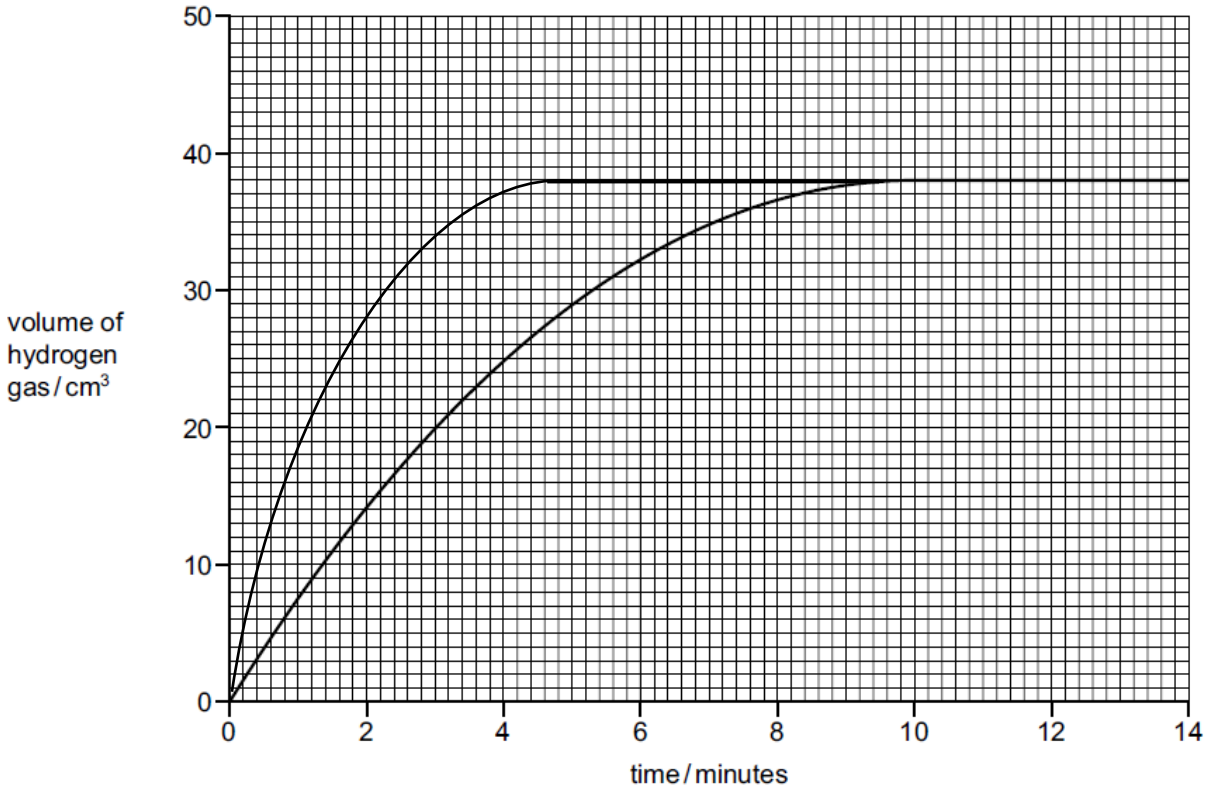

Fig. 4.1

(iii) The student repeats the experiment at 30 °C.

All other conditions stay the same.

Draw a line **on the grid** in Fig. 4.1 to show how the volume of hydrogen gas changes with time when the reaction is carried out at 30 °C. [2]

Mark awarded = 2 out of 2

Examiner comment

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

The graph line was acceptable but could have been improved by making the curve more gradual before levelling off, to match the shape of the original line.

Common mistakes

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

Question 4(b)

(b) The student repeats the experiment using zinc powder instead of small pieces of zinc.

Describe how the rate of reaction differs when zinc powder is used.

Give a reason for your answer.

.....

The rate of reaction increases because a powder has a larger surface area than

small pieces of zinc. [2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has clearly described how the rate of reaction changes and given an appropriate reason for the change.

Common mistakes

The question has two parts – describe and give a reason. Some candidates give a clear description but omit to state a reason.

Question 4(c)(i)

(c) Sulfuric acid is a compound.

(i) Define the term compound.

A compound has two or more different atoms that are chemically combined.

..... [1]

Mark awarded = 1 out of 1

Common mistakes

Candidates often recall that a compound involves two or more atoms but omit to state that they are chemically bonded, or chemically joined, together.

Question 4(c)(ii)

(ii) State the formula of the ion that is present in an aqueous solution of all acids.

H^+ ..... [1]

Mark awarded = 1 out of 1

Common mistakes

Some candidates state 'hydrogen' but the question specifically asks for the formula of the ion. As this is an ion, the charge on the ion must also be shown, H^+.

Question 4(c)(iii)

(iii) A few drops of the indicator methyl orange are added to aqueous dilute sulfuric acid.

State the colour change observed.

from orange to red ..... [1]

Mark awarded = 1 out of 1

Examiner comment

Sulfuric acid is a strong acid so the candidate has correctly stated red 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 of methyl orange indicator in acidic and alkaline conditions. In acid, it is red and in alkali it is yellow.

Question 4(c)(iv)

(iv) The formula of sulfuric acid is H_2SO_4.

Complete Table 4.1 to calculate the relative molecular mass of sulfuric acid.

Table 4.1

atom	number of atoms	relative atomic mass	
hydrogen	2	1	2 × 1 = 2
sulfur	1	32	1x32=32
oxygen	4	16	4x16=64

2 + 32 + 64 =

relative molecular mass = ...98..... [2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has applied the formula of H_2SO_4 to correctly work out the RMM.

Common mistakes

The most common mistake is to forget to multiply the relative atomic mass of oxygen by 4.

Total mark awarded = 10 out of 11

Question 5

Question 5(a)

5 Table 5.1 shows the properties of four substances.

Table 5.1

substance	boiling point	electrical conductivity of solid	electrical conductivity when molten	density in g / cm^3
aluminium	high	conducts	conducts	2.70
diamond		*does not conduct*		3.51
potassium bromide	high	does not conduct	conducts	2.75
sulfur	low	does not conduct	*does not conduct*	2.07

(a) Complete Table 5.1 to show the electrical conductivity of solid diamond and molten sulfur. [2]

Mark awarded = 2 out of 2

Common mistakes

Candidates often confuse the electrical conductivity of diamond with that of graphite and state that diamond does conduct electricity.

Question 5(b)

(b) State **one** piece of evidence from Table 5.1 that shows that sulfur is a simple molecular substance.

Sulfur has a low boiling point ..... [1]

Mark awarded = 1 out of 1

Common mistakes

Candidates should only use the information in the table. Other information about sulfur cannot be given credit because the question specifically states that the evidence must come from Table 5.1.

Question 5(c)(i)

(c) (i) State the meaning of the term ionic bonding.

.....

An ionic bond is a strong force of attraction between charged ions. ..... [2]

Mark awarded = 1 out of 2

Examiner comment

The candidate clearly stated that ionic bonding is a strong force of attraction between ions. However, they did not specify that the ions are oppositely charged, or positive and negative.

Common mistakes

It is advised to use the syllabus definitions where these have been given. The syllabus states that an ionic bond is a strong electrostatic attraction between oppositely charged ions.

Question 5(c)(ii)

(ii) Identify which information in Table 5.1 shows that potassium bromide is an ionic compound.

.....

- potassium bromide conducts electricity when molten
- but does not conduct when solid. [2]

Mark awarded = 2 out of 2

Examiner comment

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

Question 5(d)

(d) State the property of aluminium given in Table 5.1 which makes it suitable for the manufacture of aircraft.

Aluminium has a low density. [1]

Mark awarded = 1 out of 1

Question 5(e)

(e) Molten potassium bromide can be electrolysed.

Predict the products of this electrolysis at:

the anode ..... bromide .....

the cathode. .. potassium .....

[2]

Mark awarded = 1 out of 2

Examiner comment

The anode is positive, so the Br- ions move towards the anode and are discharged as bromine gas. The candidate stated ‘bromide’ rather than ‘bromine’ so cannot be awarded the mark. The cathode is negative, so it will attract positive ions. As this is molten potassium bromide, the only positive ion present is K^+.

Common mistakes

It is incorrect to state bromide, as the ion is not formed (discharged) at the anode. To avoid ambiguity candidates should not write Br as it is bromine (Br_2) that is discharged.

Total mark awarded = 8 out of 10

Question 6

Question 6(a)

6 Aqueous sodium hydroxide is a base.

(a) Complete this sentence about the different types of bases.

Bases are metal hydroxides or metal ..oxides..... [1]

Mark awarded = 1 out of 1

Question 6(b)

(b) Describe the reaction of aqueous sodium hydroxide with:

- a named acid

.....

sodium hydroxide + hydrochloric acid → sodium chloride + water

This is a neutralisation reaction.

- an ammonium salt.

.....

sodium hydroxide + ammonium sulfate → sodium sulfate + ammonia + water

The ammonia gas formed turns damp red litmus blue.

[4]

Mark awarded = 4 out of 4

Examiner comment

Reaction with an acid:

A word equation is not asked for but this clearly identifies the acid, which must be named, the salt formed and the other product, water. As a description is required, the type of reaction should be identified.

Reaction with an ammonium salt:

Again, a word equation is not asked for but this clearly identifies the ammonium salt, the salt formed from this salt and the other products, ammonia and water. As a description is required, it is sensible to include the test and observation if the ammonia gas is tested.

Common mistakes

Before starting to answer, candidates should plan their answer to make sure they are making sufficient points to be awarded full marks. Writing word or symbol equations provides lots of information that is often difficult to express in words.

Question 6(c)

(c) Ammonia is a soluble base.

Draw a circle around the pH value of aqueous ammonia.

pH 1 **pH 5** **pH 7** **pH 10** [1]

Mark awarded = 1 out of 1

Common mistakes

Only one pH value should be circled. If a mistake is made, the candidate must clearly cross out the incorrect response.

Question 6(d)

(d) Ammonia is used in the manufacture of nitrogen-containing fertilisers.

Which two of these compounds are present in fertilisers?

Tick **two** boxes.

copper(II) oxide	
potassium chloride	√
sodium phosphate	√
strontium fluoride	
sulfur dioxide	

[2]

Mark awarded = 2 out of 2

Question 6(e)(i)

(e) Bacteria in the soil convert ammonium compounds to oxides of nitrogen.
The oxides of nitrogen escape into the atmosphere.

(i) State one **other** source of oxides of nitrogen in the atmosphere.

car engines ..... [1]

Mark awarded = 1 out of 1

Question 6(e)(ii)

(ii) Oxides of nitrogen contribute to photochemical smog.

Describe one **other** adverse effect of oxides of nitrogen on the environment.

they cause acid rain ..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has been awarded the mark for naming a specific environmental effect.

Common mistakes

Candidates often give vague answers to questions about environmental effects. Candidates should be able to recall the sources and adverse effects of the air pollutants stated in the syllabus.

Total mark awarded = 10 out of 10

Question 7

Question 7(a)

7 (a) Table 7.1 shows some properties of some of the halogens.

Table 7.1

halogen	melting point / °C	boiling point / °C	colour
chlorine	−101	−35	yellow-green
bromine	−7		red-brown
iodine	+114	+184	grey-black
astatine	+302	+337	

Use the information in Table 7.1 to suggest:

- the colour of astatine ..... black .....
- the boiling point of bromine ..... 60°C .....
- the state of iodine at 190 °C. ..... gas .....

[3]

Mark awarded = 3 out of 3

Examiner comment

Table 7.1 shows that the trend down Group VII is for a darker colour so a prediction must indicate that astatine is darker than grey-black.

It is known that bromine is a liquid at room temperature so the boiling point must be higher than 25°C (room temperature). As iodine has a boiling point of +184°C the value must be less than this.

As iodine has a boiling point of +184°C, at temperatures greater than this it must be a gas.

Common mistakes

Candidates are not expected to know the answers, but they are expected to use their knowledge and the information in the table to suggest an appropriate answer. A methodical approach allows questions to be broken down into simple parts so recalled knowledge can be applied to the information in the question.

Question 7(b)(i)

(b) Aqueous chlorine reacts with aqueous potassium bromide as shown.

$$Cl_2 + 2KBr \rightarrow Br_2 + 2KCl$$

(i) Name the salt formed in this reaction.

..... potassium chloride ..... [1]

Mark awarded = 1 out of 1

Examiner comment

When asked to 'name' a substance, candidates often write a formula and cannot be awarded the mark.

Question 7(b)(ii)

(ii) Explain why aqueous bromine does **not** react with aqueous potassium chloride.

..Bromine.is.below.chlorine.in.Group.VII.and.so.bromine.is.less.reactive.....
than chlorine. ..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has been awarded the mark because they have clearly referred to the relative reactivity of the two halogens.

Common mistakes

A weaker response may have stated 'it is less reactive'. Candidates should avoid using 'it' as this doesn't specify if 'it' refers to chlorine or bromine.

Question 7(b)(iii)

(iii) Complete the dot-and-cross diagram in Fig. 7.1 of a molecule of chlorine.

Show outer shell electrons only.

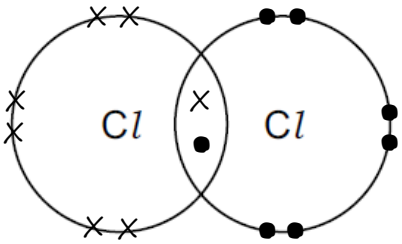

Fig. 7.1 [2]

Mark awarded = 2 out of 2

Examiner comment

As chlorine is in Group VII, there must be a total of 7 electrons in the outer shell of each individual chlorine atom. When combined as a molecule, each chlorine atom shares one electron to form a noble gas configuration.

Total mark awarded = 7 out of 7

Question 8

Question 8(a)(i)

8 Hydrogen is a fuel which can be obtained from water by electrolysis.

Refinery gas and petrol are fuels obtained by the fractional distillation of petroleum.

(a) (i) Complete the equation for the burning of hydrogen.

.....2..$H_2(g)$ + $O_2(g)$ → .....2..$H_2O(l)$ [1]

Mark awarded = 1 out of 1

Common mistakes

Candidates often forget that oxygen gas is diatomic and therefore consists of two atoms.

Question 8(a)(ii)

(ii) State the meaning of (g) and (l).

(g) .....gas.....

(l) .....liquid.....

[2]

Mark awarded = 2 out of 2

Question 8(a)(iii)

(iii) Thermal energy is released to the surroundings when hydrogen is burnt.

State the name of the type of reaction which transfers heat to the surroundings.

.....exothermic..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has correctly identified exothermic reactions as those that release energy to their surroundings.

Common mistakes

Candidates often confuse exothermic and endothermic. When writing their answer, candidates should ensure that the ‘exo’ part of the answer is clear to read and unambiguously not endothermic.

Question 8(b)

(b) Some cars use hydrogen–oxygen fuel cells as a source of energy.

Explain **one** advantage to the environment of using a hydrogen–oxygen fuel cell instead of a petrol engine.

.....

No carbon dioxide is formed so it doesn't contribute to global warming.

..... [2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has been awarded both marks because they stated one advantage and explained why it is an advantage.

Common mistakes

Questions often include a command word such as describe, explain and calculate. These command words indicate how a candidate should respond to a question and it's important that candidates understand the requirements of each command word.

Question 8(c)

(c) Refinery gas contains methane.

Methane is a gas which is responsible for climate change.

State **two** strategies to reduce the amount of methane entering the atmosphere.

1 *...decrease the demand for meat as cattle produce methane*.....

2 *...switch to renewable energy resources*.....

[2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has been awarded both marks. A stronger response to strategy 2 would have been 'switch to renewable energy resources because that will decrease the use of fossil fuels'.

Question 8(d)

(d) Petrol is a mixture of alkanes.

One of the alkanes in petrol is octane, C_8H_{18}.

Name the **two** products formed when octane is burnt in excess air.

Carbon dioxide and *water* [2]

Mark awarded = 2 out of 2

Examiner comment

As the octane is burnt in excess air, complete combustion must take place. The candidate has correctly named the products of complete combustion.

Common mistakes

Candidates are often confused by complete and incomplete combustion. Complete combustion forms carbon dioxide whereas incomplete combustion forms carbon monoxide.

Question 8(e)(i)

(e) More petrol can be made by cracking less useful petroleum fractions.

(i) Define the term cracking.

- *breaking up of larger alkanes*
- *into smaller alkanes, alkenes and hydrogen* [2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has given a very detailed definition of cracking by clearly stating what is happening and what is formed.

Common mistakes

Candidates often recall that cracking is the breaking up of large molecules but forget to name these large molecules as alkanes, or to name the products as alkanes, alkenes and hydrogen.

Question 8(e)(ii)

(ii) Complete the equation for the cracking of dodecane, $C_{12}H_{26}$, to form ethene and one other hydrocarbon.

$$C_{12}H_{26} \rightarrow C_2H_4 + C_{10}H_{22} \quad [1]$$

Mark awarded = 1 out of 1

Examiner comment

There are 12C atoms and 26H atoms in $C_{12}H_{26}$, and 2C atoms and 4H atoms in C_2H_4, so 12 – 2 = 10 carbon atoms and 26 – 4 = 22 hydrogen atoms in the other product.

Common mistakes

Some candidates balance the equation using two other hydrocarbons. However, the question states that only one other hydrocarbon is formed so $C_{10}H_{22}$ has to be the correct choice.

Total mark awarded = 13 out of 13

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