

Specimen Paper Answers – Paper 2  
**Cambridge IGCSE™ / IGCSE (9–1)**  
**Chemistry 0620 / 0971**

For examination from 2023



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## Introduction

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

In this booklet, we have provided answers for all questions with examiner comments. This paper requires candidates to answer multiple choice questions. Candidates are awarded a maximum of 40 marks for this paper and the mark scheme provides the answers required to gain the marks.

Each question and answer is followed by an examiner comment on how each answer should be determined. 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 avoid errors.

The mark schemes for the Specimen Papers are available to download from the School Support Hub at [www.cambridgeinternational.org/support](http://www.cambridgeinternational.org/support)

### 2023 Specimen Paper 2 Mark Scheme

Past exam resources and other teaching and learning resources are available on the School Support Hub [www.cambridgeinternational.org/support](http://www.cambridgeinternational.org/support)

## Assessment at a glance

The syllabus for Cambridge IGCSE Chemistry 0620 is available at [www.cambridgeinternational.org](http://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 of the syllabus |     |
| Externally assessed   |     |

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

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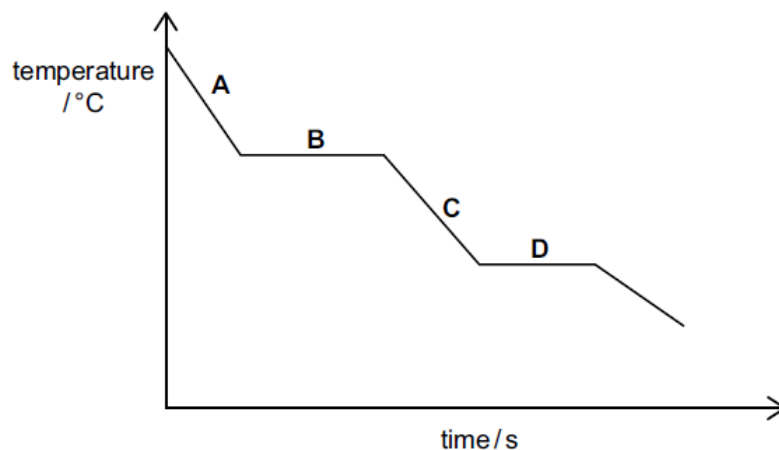
## Specimen answers

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### Question 1

- 1 A gaseous substance is slowly cooled and the temperature recorded every second.

The results are shown on the graph.



At which point is the substance a solid?

**Candidate answer: D**

**Mark awarded = 1**

#### Examiner comment

The parts of the graph where no change in temperature takes place indicate a change in state. The change of state at the lower temperature must represent the substance changing from a liquid to a solid so option D is correct.

#### Common mistakes

Many candidates recall that the substance would be a solid on the part of the graph after region D, as the graph slopes down. However, region D also contains the substance as a solid.

## Question 2

2 A gas is released at point Q, in the apparatus shown.



Which gas changes the colour of the damp universal indicator paper most quickly?

|   | gas            | relative molecular mass |
|---|----------------|-------------------------|
| A | ammonia        | 17                      |
| B | carbon dioxide | 44                      |
| C | chlorine       | 71                      |
| D | hydrogen       | 2                       |

**Candidate answer: A**

**Mark awarded = 1**

## Examiner comment

Ammonia gas is strongly alkaline so it will turn damp universal indicator paper dark blue. Chlorine gas bleaches damp indicator paper so both options A and C could be correct. The rate of diffusion is inversely proportional to the relative molecular mass of the gas so the gas with the lowest RMM will diffuse the fastest. Ammonia has the lowest RMM so option A is correct.

## Common mistakes

Many candidates recall the relationship between relative molecular mass and the rate of diffusion and select option D because hydrogen has the lowest RMM. However, hydrogen gas will not change the colour of damp universal indicator paper.

## Question 3

3 Which statement describes the bonding in sodium chloride?

- A A shared pair of electrons between two atoms leading to a noble gas configuration.
- B A strong force of attraction between oppositely charged ions.
- C A strong force of attraction between two molecules.
- D A weak force of attraction between oppositely charged ions.

**Candidate answer: B**

**Mark awarded = 1**

## Examiner comment

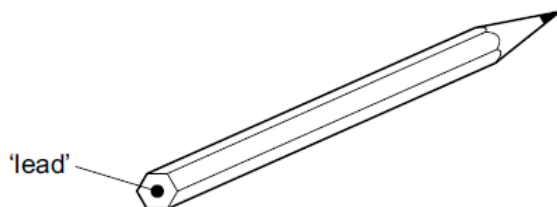
Sodium is a metal and chlorine is a non-metal so the bonding in sodium chloride will be ionic. Ionic bonding is the strong force of attraction between ions so option B is correct.

### Common mistakes

Some candidates recall that ionic bonding is a strong force of attraction but confuse attraction between ions and molecules and select option C.

### Question 4

- 4 The 'lead' in a pencil is made of a mixture of graphite and clay.



When the percentage of graphite is increased, the pencil moves across the paper more easily.

Which statement explains this observation?

- A Graphite has a high melting point.
- B Graphite is a form of carbon.
- C Graphite is a lubricant.
- D Graphite is a non-metal.

**Candidate answer: C**

**Mark awarded = 1**

### Examiner comment

All the statements about graphite are correct, but only C explains the observations in the question.

### Common mistakes

Candidates often recognise a statement as being true and automatically think that it must be the correct answer. All four options are correct but only option C answers the specific question being asked.

### Question 5

- 5 Which statement about metals is **not** correct?
- A They conduct electricity because delocalised electrons can move throughout the metal.
  - B They consist of layers of atoms that can slide over each other.
  - C They have a giant lattice of oppositely charged ions in a 'sea' of delocalised electrons.
  - D They have a giant lattice of positive ions in a 'sea' of delocalised electrons.

**Candidate answer: C**

**Mark awarded = 1**

### Examiner comment

The question has **not** in bold which highlights its importance. All metal ions are positive so option C must be incorrect as it states that metals have a giant lattice of oppositely charged ions.



### Common mistakes

Candidates often confuse metallic bonding with ionic bonding. In ionic bonding, oppositely charged ions attract each other but in metallic bonding positively charged metal ions are surrounded by a 'sea' of negatively charged electrons.

### Question 6

- 6 Aqueous iron(III) sulfate and aqueous sodium hydroxide react to give a precipitate of iron(III) hydroxide and a solution of sodium sulfate.

What is the balanced symbol equation for this reaction?

- A  $\text{Fe}_2(\text{SO}_4)_3(\text{aq}) + 2\text{NaOH}(\text{aq}) \rightarrow \text{Fe}(\text{OH})_3(\text{s}) + \text{Na}_2\text{SO}_4(\text{aq})$   
 B  $\text{Fe}_2(\text{SO}_4)_3(\text{aq}) + 3\text{NaOH}(\text{aq}) \rightarrow \text{Fe}(\text{OH})_3(\text{s}) + 3\text{Na}_2\text{SO}_4(\text{aq})$   
 C  $\text{Fe}_2(\text{SO}_4)_3(\text{aq}) + 6\text{NaOH}(\text{aq}) \rightarrow 2\text{Fe}(\text{OH})_3(\text{s}) + 3\text{Na}_2\text{SO}_4(\text{aq})$   
 D  $2\text{Fe}_2(\text{SO}_4)_3(\text{aq}) + 6\text{NaOH}(\text{aq}) \rightarrow 4\text{Fe}(\text{OH})_3(\text{s}) + 6\text{Na}_2\text{SO}_4(\text{aq})$

**Candidate answer: C**

**Mark awarded = 1**

### Examiner comment

The formulae of the species are all correct so the balancing needs to be checked. Options A and B can be eliminated because the number of Fe atoms does not balance. D is incorrect because the number of Na atoms does not balance.

### Common mistakes

Candidates are often confused by unfamiliar equations. However, the question only requires candidates to check that each atom balances.

### Question 7

- 7 Which information is needed to calculate the relative atomic mass of an element?

- A The total number of protons and neutrons in the most abundant isotope.  
 B The nucleon numbers and the total number of isotopes.  
 C The mass number and abundance of each of its isotopes.  
 D The atomic number and abundance of each of its isotopes.

**Candidate answer: C**

**Mark awarded = 1**

### Examiner comment

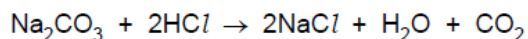
Most candidates recall that relative atomic mass is based on the mass of atoms of each isotope and the abundance of each isotope.

### Common mistakes

Many candidates select option D because it contains abundance but miss the fact that it states atomic number, rather than mass number.

### Question 8

- 8 The equation for the reaction between sodium carbonate and excess dilute hydrochloric acid is shown.



When 26.5 g of sodium carbonate reacts with excess dilute hydrochloric acid, what is the maximum volume of carbon dioxide produced?

- A 6 dm<sup>3</sup>      B 12 dm<sup>3</sup>      C 18 dm<sup>3</sup>      D 24 dm<sup>3</sup>

**Candidate answer: A**

**Mark awarded = 1**

#### Examiner comment

$M_r$  of  $\text{Na}_2\text{CO}_3 = 106 \text{ g mol}^{-1}$

moles of  $\text{Na}_2\text{CO}_3 = 26.5 \text{ g} \div 106 \text{ g mol}^{-1} = 0.25 \text{ mol}$

mole ratio  $\text{Na}_2\text{CO}_3 : \text{CO}_2 = 1:1$ , so moles of  $\text{CO}_2 = 0.25 \text{ mol}$

volume  $\text{CO}_2 = 24 \text{ dm}^3 \times 0.25 \text{ mol} = 6 \text{ dm}^3$

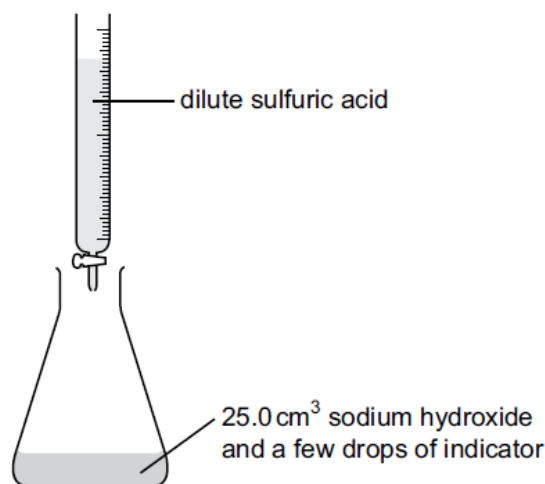
#### Common mistakes

Some candidates incorrectly calculate the  $M_r$  of  $\text{Na}_2\text{CO}_3$  as  $52 \text{ g mol}^{-1}$  because they use the atomic number rather than the mass number. This would give a final answer of  $12.2 \text{ dm}^3$  so candidates select option B.

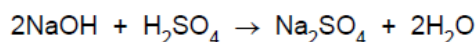
## Question 9

- 9 A volumetric pipette is used to measure  $25.0 \text{ cm}^3$  of  $2.0 \text{ mol/dm}^3$  aqueous sodium hydroxide into a conical flask.

A burette is filled with dilute sulfuric acid.



The equation for the reaction is shown.



The reaction requires  $50.0 \text{ cm}^3$  of dilute sulfuric acid to reach the end-point.

What is the concentration of the dilute sulfuric acid in  $\text{mol/dm}^3$ ?

- A  $0.50 \text{ mol/dm}^3$
- B  $1.0 \text{ mol/dm}^3$
- C  $2.0 \text{ mol/dm}^3$
- D  $4.0 \text{ mol/dm}^3$

**Candidate answer: A**

**Mark awarded = 1**

### Examiner comment

moles of NaOH =  $2.0 \text{ mol/dm}^3 \times 25 \times 10^{-3} \text{ dm}^3 = 0.05 \text{ mol}$

mole ratio NaOH:  $\text{H}_2\text{SO}_4 = 2:1$

so moles of  $\text{H}_2\text{SO}_4 = 0.05 \text{ mol} \div 2 = 0.025 \text{ mol}$

concentration of  $\text{H}_2\text{SO}_4 = 0.025 \text{ mol} \div 50 \times 10^{-3} \text{ dm}^3 = 0.50 \text{ mol/dm}^3$

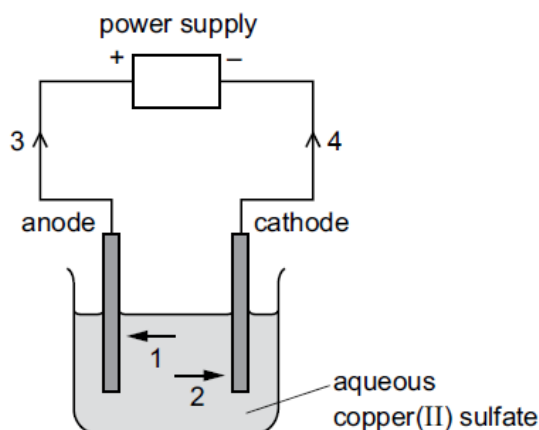
### Common mistakes

Candidates commonly forget to convert  $\text{cm}^3$  into  $\text{dm}^3$ . This can be done by either using  $\times 10^{-3}$  or dividing the volume in  $\text{cm}^3$  by 1000.

Another common mistake is to forget that the mole ratio is 2:1 and thereby obtaining option B as the correct answer.

## Question 10

10 The diagram shows a circuit used to electrolyse aqueous copper(II) sulfate.



Which arrows indicate the movement of the copper ions in the electrolyte and of the electrons in the external circuit?

|          | copper ions | electrons |
|----------|-------------|-----------|
| <b>A</b> | 1           | 3         |
| <b>B</b> | 1           | 4         |
| <b>C</b> | 2           | 3         |
| <b>D</b> | 2           | 4         |

**Candidate answer: C**

**Mark awarded = 1**

## Examiner comment

The positively charged copper ions,  $\text{Cu}^{2+}$ , are attracted to the negative charge of the cathode so only options C and D can be correct. Electrons always travel from the anode to the cathode so option C is correct.

## Common mistakes

Candidates often confuse the direction of electron flow in the external circuit. A useful sentence to help remember is that 'electrons flow alphabetically from the Anode to the Cathode'.

## Question 11

11 Which row shows the waste products released from the exhaust of a vehicle powered using a hydrogen–oxygen fuel cell?

|          | carbon dioxide | oxides of nitrogen | water |
|----------|----------------|--------------------|-------|
| <b>A</b> | ✓              | ✓                  | ✓     |
| <b>B</b> | x              | ✓                  | ✓     |
| <b>C</b> | ✓              | x                  | x     |
| <b>D</b> | x              | x                  | ✓     |

**Candidate answer: D**

**Mark awarded = 1**

**Examiner comment**

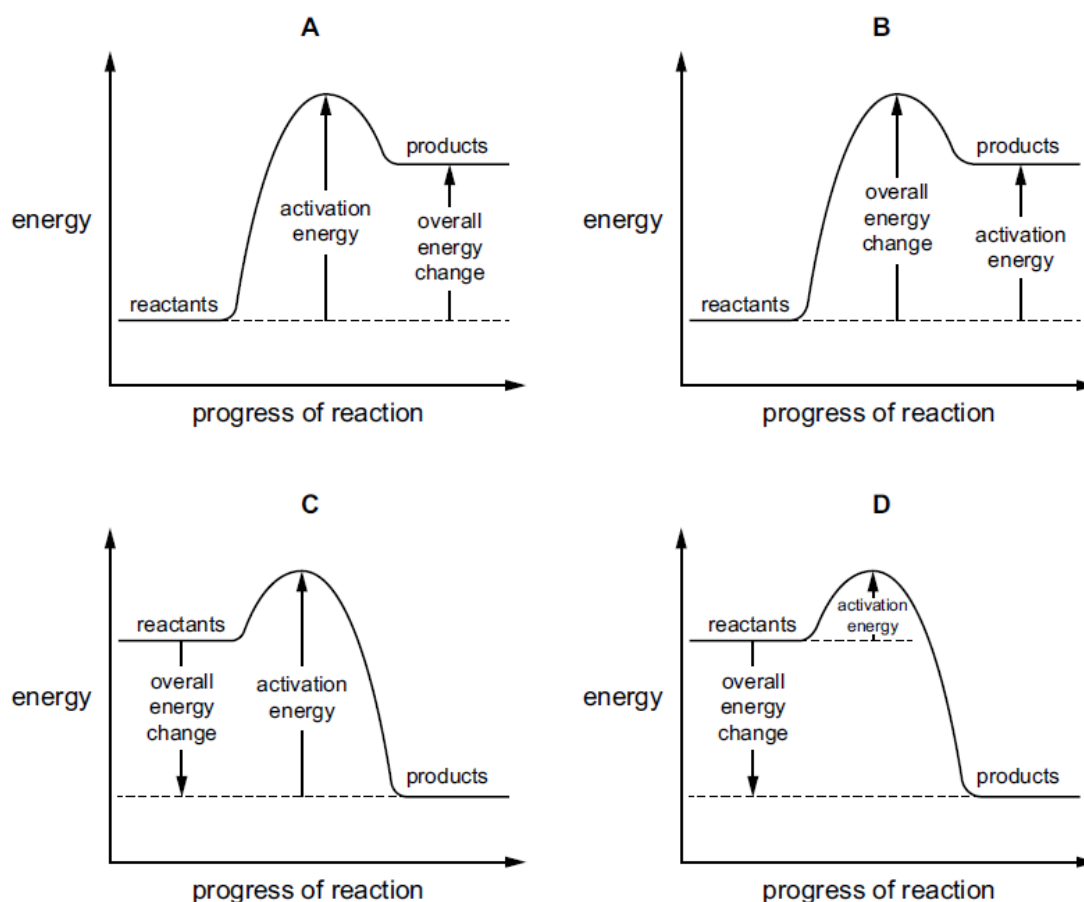
One of the main advantages of hydrogen-oxygen fuel cells is that they do not release carbon dioxide or oxides of nitrogen. The only waste product from hydrogen-oxygen fuel cells is water.

**Common mistakes**

Many candidates spot the word 'fuel' and recall the fact that the combustion of many fuels produces carbon dioxide. Therefore, they select option C.

**Question 12**

12 Which diagram is a correctly labelled reaction pathway diagram for an endothermic reaction?



**Candidate answer: A**

**Mark awarded = 1**

**Examiner comment**

The products in endothermic reactions have more energy than the reactants so only options A and B can be correct. The overall energy change is the difference in energy between the reactants and the products so option A is correct.

**Common mistakes**

Many candidates confuse endothermic and exothermic reactions. Endothermic reactions have products with more energy than the reactants because they take in energy from their surroundings. Exothermic reactions have products with less energy than the reactants and they give out energy to their surroundings.

### Question 13

13 Which changes are physical changes?

- 1 melting ice to form water
- 2 burning hydrogen to form water
- 3 adding sodium to water
- 4 boiling water to form steam

A 1 and 2      B 1 and 4      C 2 and 3      D 3 and 4

**Candidate answer: B**

**Mark awarded = 1**

### Examiner comment

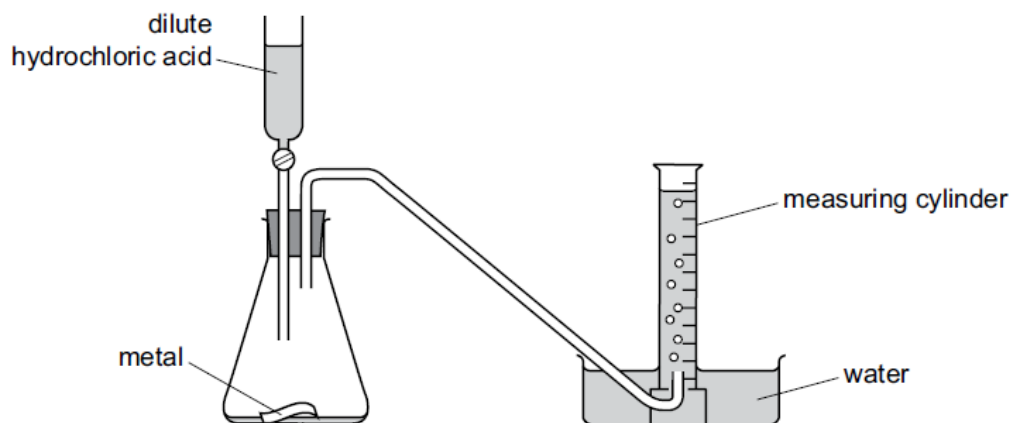
Physical changes can be reversed, whereas chemical changes cannot. Melting ice and boiling water are both reversible processes, so are physical changes. Therefore, option B is correct.

### Common mistakes

Candidates sometimes confuse physical and chemical changes. If a change can be reversed it will be a physical change.

### Question 14

14 The diagram shows an experiment to measure the rate of a chemical reaction.



Which change decreases the rate of reaction?

- A adding water to the flask
- B heating the flask during the reaction
- C using more concentrated acid
- D using powdered metal

**Candidate answer: A**

**Mark awarded = 1**

**Examiner comment**

Adding water to the flask results in a lower concentration of hydrochloric acid, which decreases the rate of the reaction.

**Common mistakes**

Candidates are familiar with questions about increasing the rate of reaction so quickly select option B, C or D. This question asks about decreasing the rate of reaction – highlighting the importance of reading the question carefully.

**Question 15**

- 15 Which row describes the effect of increasing concentration and increasing temperature on the collisions between reacting particles?

|          | increasing concentration   | increasing temperature   |
|----------|--|--|
| <b>A</b> | more collisions per second only  | more collisions per second only  |
| <b>B</b> | more collisions per second only  | more collisions per second and more collisions with sufficient energy to react |
| <b>C</b> | more collisions per second and more collisions with sufficient energy to react | more collisions per second only  |
| <b>D</b> | more collisions per second and more collisions with sufficient energy to react | more collisions per second and more collisions with sufficient energy to react |

**Candidate answer: B**

**Mark awarded = 1**

**Examiner comment**

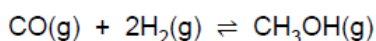
Increasing the concentration causes more collisions per second but it doesn't affect the energy of the particles so options C and D cannot be correct. Increasing the temperature increases the energy of the particles so option B is correct.

**Common mistakes**

Candidates often confuse the difference between the frequency of collisions and the frequency of successful collisions. A collision will only be successful, and a reaction occur, if the reacting particles have sufficient energy to react.

## Question 16

16 Methanol is prepared by the reversible reaction shown.



The forward reaction is exothermic.

Which conditions produce the highest equilibrium yield of methanol?

|          | temperature | pressure |
|----------|-------------|----------|
| <b>A</b> | high        | high     |
| <b>B</b> | high        | low      |
| <b>C</b> | low         | high     |
| <b>D</b> | low         | low      |

Candidate answer: **C**

Mark awarded = 1

## Examiner comment

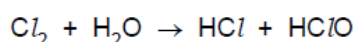
As the forward reaction is exothermic, a decrease in temperature will shift the position of equilibrium to the right (increasing the yield of methanol). For gases, a higher pressure shifts the equilibrium position to the side with the least number of moles, in this case, the right-hand side, which also increases the yield of methanol.

## Common mistakes

Candidates often confuse the effect of temperature on reversible reactions. For exothermic reactions, the left-hand side (reactants) is favoured by an increase in temperature. For endothermic reactions, the right-hand side (products) is favoured by an increase in temperature.

## Question 17

17 When chlorine gas dissolves in water a reaction occurs.



Which row of the table identifies the oxidation number for chlorine in the chlorine-containing species?

|          | $\text{Cl}_2$ | $\text{HCl}$ | $\text{HClO}$ |
|----------|---------------|--------------|---------------|
| <b>A</b> | -1            | -1           | -1            |
| <b>B</b> | 0             | -1           | -1            |
| <b>C</b> | -1            | +1           | +1            |
| <b>D</b> | 0             | -1           | +1            |

Candidate answer: **D**

Mark awarded = 1



**Examiner comment**

Uncombined elements, such as  $\text{Cl}_2$ , have an oxidation number of 0 so options B and D could be correct.

The sum of oxidation numbers in a compound is zero and hydrogen has an oxidation number of +1. Therefore, in  $\text{HCl}$ , the  $\text{Cl}$  must be  $-1$ .

The oxidation number of O is  $-2$ , H is  $+1$ , therefore to achieve a zero overall charge in  $\text{HClO}$ , the  $\text{Cl}$  must be  $+1$ .

**Common mistakes**

Candidates often work methodically through the question and then doubt their answer because they are familiar with  $\text{Cl}$  in compounds having an oxidation number of  $-1$ .

**Question 18**

18 Four different solutions, J, K, L and M, are tested with universal indicator.

| solution                        | J     | K   | L      | M      |
|---------------------------------|-------|-----|--------|--------|
| colour with universal indicator | green | red | purple | orange |

Which solutions are acidic?

- A** J and M      **B** K and M      **C** K only      **D** L only

**Candidate answer: B**

**Mark awarded = 1**

**Examiner comment**

Most candidates recall that acidic solutions turn universal indicator red so solution K must be acidic. Therefore, only options B and C can be correct. Acids with a lower hydrogen ion concentration turn universal indicator orange so solution M must also be acidic. Option B must therefore be correct.

**Question 19**

19 Which solution has the lowest pH?

- A**  $0.1 \text{ mol/dm}^3$  ammonia solution  
**B**  $0.1 \text{ mol/dm}^3$  ethanoic acid  
**C**  $0.1 \text{ mol/dm}^3$  hydrochloric acid  
**D**  $0.1 \text{ mol/dm}^3$  lithium hydroxide

**Candidate answer: C**

**Mark awarded = 1**

**Examiner comment**

Acids have a low pH whereas alkalis have a high pH. The two acids are ethanoic and hydrochloric acid, options B and C respectively. Hydrochloric acid is a strong acid so it fully dissociates and has a higher hydrogen ion concentration than ethanoic acid, which is a weak acid and only partially dissociates. The solution with the highest hydrogen ion concentration will have the lowest pH.

### Common mistakes

Candidates often confuse low and high pH. Acids have a low pH which means they have a pH value lower than pH 7, which is neutral. Alkalis have a high pH which means they have a pH value higher than pH 7.

Acids and alkalis can also be described as strong and weak. This refers to the extent of their dissociation in aqueous solutions, not their concentration.

### Question 20

20 Magnesium, calcium, strontium and barium are Group II elements.

Group II elements follow the same trends in reactivity as Group I elements.

Which statements about Group II elements are correct?

- 1 Calcium reacts faster than magnesium with water.
- 2 Barium reacts less vigorously than magnesium with dilute acid.
- 3 Strontium oxidises in air more slowly than barium.

**A** 1, 2 and 3    **B** 1 and 2 only    **C** 1 and 3 only    **D** 2 and 3 only

**Candidate answer: C**

**Mark awarded = 1**

### Examiner comment

Candidates are not required to know the trends in reactivity of Group II elements but they are required to know the trends of Group I metals and therefore can apply their knowledge to Group II. Candidates can use their Periodic Table to see that the order down the group is Mg, Ca, Sr, Ba, so magnesium is the least reactive and barium is the most reactive.

Statement 1 is correct because Ca is below Mg in the group.

Statement 2 is incorrect because Ba is below Mg in the group.

Statement 3 is correct because Sr is above Ba in the group.

Therefore, option C is correct.

### Common mistakes

Some candidates lose confidence when they have face unfamiliar contexts. In this question, the only fact that must be recalled is that the reactivity increases down Group I. The question tells candidates that the same trend will apply to Group II.

### Question 21

21 Chlorine, bromine and iodine are elements in Group VII of the Periodic Table.

Which statement about these elements is correct?

- A The colour gets lighter down the group.
- B The density decreases down the group.
- C They are all gases at room temperature and pressure.
- D They are all non-metals.

**Candidate answer: D**

**Mark awarded = 1**

#### Examiner comment

Most candidates recall that Group VII are all non-metals.

#### Common mistakes

Chlorine is perhaps the best-known Group VII element and most candidates know that it is a pale yellow-green gas. Many also know that iodine is a solid. These basic facts allow options A, B and C to be eliminated.

### Question 22

22 Which row describes the properties of a typical transition element?

|          | melting point | variable oxidation number | can act as a catalyst |
|----------|---------------|---------------------------|-----------------------|
| <b>A</b> | high          | no                        | no                    |
| <b>B</b> | high          | yes                       | yes                   |
| <b>C</b> | low           | no                        | yes                   |
| <b>D</b> | low           | yes                       | no                    |

**Candidate answer: B**

**Mark awarded = 1**

#### Examiner comment

Transition elements have high melting points so options C and D must be incorrect. A key characteristic of transition elements is that they often act as catalysts so option B must be correct.

#### Common mistakes

If the answer cannot be recalled, candidates should use all the columns in a table as they may be able to use one column to eliminate an option or even answer the question.

### Question 23

- 23 Which statement about the noble gases is correct?
- A Noble gases are diatomic molecules.
  - B Noble gases are reactive gases.
  - C Noble gases have full outer electron shells.
  - D The noble gases are found on the left-hand side of the Periodic Table.

**Candidate answer: C**

**Mark awarded = 1**

#### Examiner comment

Most candidates recall that noble gases have full outer electron shells which explains their lack of reactivity.

### Question 24

- 24 What is a property of **all** metals?
- A conducts electricity
  - B hard
  - C low melting point
  - D reacts with water

**Candidate answer: A**

**Mark awarded = 1**

#### Examiner comment

The question has **all** in bold which highlights its importance. Only option A is a characteristic of **all** metals.

#### Common mistakes

Candidates are often familiar with the characteristics of metals but forget that these are general characteristics of metals and there are exceptions. Candidates should remember that mercury and Group I metals show exceptions to these general characteristics.

### Question 25

- 25 Which statement explains why aluminium is used in the manufacture of aircraft?
- A It conducts heat well.
  - B It has a low density.
  - C It is a good insulator.
  - D It is easy to recycle.

**Candidate answer: B**

**Mark awarded = 1**

#### Examiner comment

Most candidates recall that aluminium has a low density which is why it is used in the manufacture of aircraft.

## Question 26

26 The section of the reactivity series shown includes a newly discovered metal, symbol X.

Ca  
Mg  
Fe  
X  
H  
Cu

The only oxide of X has the formula XO.

Which equation shows a reaction which occurs?

- A  $\text{Cu(s)} + \text{X}^{2+}(\text{aq}) \rightarrow \text{Cu}^{2+}(\text{aq}) + \text{X(s)}$   
 B  $2\text{X(s)} + \text{Cu}^{2+}(\text{aq}) \rightarrow 2\text{X}^+(\text{aq}) + \text{Cu(s)}$   
 C  $\text{X(s)} + \text{Fe}_2\text{O}_3(\text{s}) \rightarrow 2\text{Fe(s)} + 3\text{XO(s)}$   
 D  $\text{X(s)} + 2\text{HCl(aq)} \rightarrow \text{XCl}_2(\text{aq}) + \text{H}_2(\text{g})$

**Candidate answer: D**

**Mark awarded = 1**

## Examiner comment

The reactivity series shows that X is more reactive than Cu, so option A must be incorrect as copper cannot displace  $\text{X}^{2+}(\text{aq})$  ions.

X is more reactive than Cu so X can displace  $\text{Cu}^{2+}(\text{aq})$  ions. However, as the formula of the oxide is XO, then X ions must be  $\text{X}^{2+}$  rather than  $\text{X}^+$ . Therefore, option B is incorrect.

Option C must be incorrect because the atoms of X do not balance in the equation.

## Common mistakes

Candidates should always try to eliminate options that are known to be incorrect then work through the question and apply their knowledge and understanding to the question. In this question, option C can be eliminated easily because the equation does not balance. Applying knowledge of displacement also allows options A and B to be eliminated, leaving option D as the correct answer.

## Question 27

27 Which metal compound produces a gas that turns limewater milky when it is heated with a Bunsen burner?

- A copper(II) carbonate  
 B magnesium nitrate  
 C sodium sulfate  
 D zinc nitrate

**Candidate answer: A**

**Mark awarded = 1**

### Examiner comment

Carbon dioxide turns limewater milky so candidates need to identify which metal compound will produce carbon dioxide when heated with a Bunsen burner. Many candidates recall that carbonates thermally decompose to produce carbon dioxide so option A is the correct choice.

### Common mistakes

If a candidate cannot recall that carbonates thermally decompose, this question could be challenging. However, only copper(II) carbonate contains carbon atoms so it is the only compound that could release carbon dioxide.

### Question 28

**28** Which statement about the extraction of iron in a blast furnace is correct?

- A** Calcium oxide reacts with basic impurities.
- B** Carbon is burnt to provide heat.
- C** Iron(III) oxide is reduced to iron by carbon dioxide.
- D** The raw materials are bauxite, limestone and coke.

**Candidate answer: B**

**Mark awarded = 1**

### Examiner comment

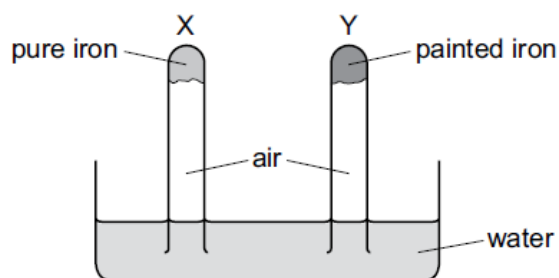
The impurities in the blast furnace are acidic, not basic, so option A is incorrect. Option C is incorrect because carbon and carbon monoxide, not carbon dioxide, reduce the iron(III) oxide. The raw materials for the extraction of iron do not include bauxite so option D is incorrect.

### Common mistakes

Many candidates recall that limestone and coke are needed to extract iron and therefore select option D. However, bauxite is used to extract aluminium, not iron.

## Question 29

29 An experiment to investigate the effect of painting iron is shown.



The experiment is left for seven days.

What happens to the water level in test-tubes X and Y?

|          | test-tube X | test-tube Y |
|----------|-------------|-------------|
| <b>A</b> | falls       | rises       |
| <b>B</b> | no change   | no change   |
| <b>C</b> | rises       | falls       |
| <b>D</b> | rises       | no change   |

Candidate answer: D

Mark awarded = 1

## Examiner comment

In test-tube X, pure iron reacts with moisture and oxygen in the air to form rust, this causes the water level in the test-tube to rise. In test-tube Y, the coat of paint protects the iron from the moisture and the oxygen so no rusting occurs and the water level remains the same. Therefore, option D is correct.

## Common mistakes

Most candidates realise that painting iron prevents it from rusting so no reaction will occur in test-tube Y. Candidates also realise that the iron in test-tube X will rust but they don't understand that the reaction uses up oxygen and this causes water to move up the test-tube to replace the oxygen.

## Question 30

30 Bauxite contains aluminium oxide.

Aluminium is extracted from aluminium oxide by electrolysis.

Which statement is a reason for why cryolite is added to the electrolytic cell used to extract aluminium?

- A** Cryolite decreases the rate at which aluminium ions are discharged.
- B** Cryolite lowers the melting point of the electrolyte mixture.
- C** Cryolite prevents the carbon anodes being burned away.
- D** Cryolite removes impurities from the bauxite.

**Candidate answer: B**

**Mark awarded = 1**

**Examiner comment**

Many candidates recall that cryolite lowers the melting point of the electrolyte mixture.

**Question 31**

**31** Which statement is correct?

- A Atmospheric carbon dioxide is not a cause of climate change.
- B Atmospheric methane is produced by respiration.
- C Burning natural gas decreases the level of carbon dioxide in the atmosphere.
- D Decomposition of vegetation causes an increase in atmospheric methane.

**Candidate answer: D**

**Mark awarded = 1**

**Examiner comment**

Many candidates recall that the decomposition of vegetation causes an increase in atmospheric methane and therefore option D is correct. If the pertinent fact cannot be recalled, some incorrect options can be eliminated. Carbon dioxide is a well-known atmospheric pollutant so option A is incorrect. Carbon dioxide, not carbon monoxide, is produced by complete combustion so option B is incorrect. Burning natural gas increases, not decreases, the level of carbon dioxide in the atmosphere so option C is incorrect.

**Common mistakes**

Climate change is an area of confusion because the causes are extremely complex, it involves a multitude of gases and has terminology that is commonly used incorrectly.

**Question 32**

**32** A plastic combusts to form sulfur dioxide,  $\text{SO}_2$ , and hydrogen chloride,  $\text{HCl}$ .

How could both gases be removed from the air?

- A pass the gases over solid anhydrous cobalt(II) chloride
- B pass the gases over solid damp calcium oxide
- C pass the gases through a catalytic converter
- D pass the gases through filter paper

**Candidate answer: B**

**Mark awarded = 1**

**Examiner comment**

Sulfur dioxide and hydrogen chloride are both acidic and will therefore react with a base such as calcium oxide, option B.

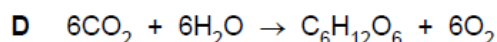
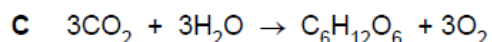
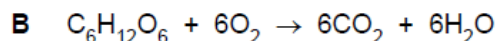
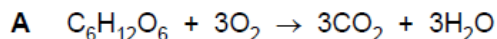


### Common mistakes

Candidates often select option C because they are aware that catalytic converters reduce atmospheric pollutants. However, they will not remove these two pollutants.

### Question 33

33 Which equation represents photosynthesis?



**Candidate answer: D**

**Mark awarded = 1**

### Examiner comment

Most candidates are familiar with the equation for photosynthesis and select option D. If the equation cannot be recalled, most candidates know that photosynthesis uses carbon dioxide so only options C and D can be correct. The equation in option C is not balanced so option D is the correct choice.

### Question 34

34 Which statement defines structural isomers?

A They are compounds with the same displayed formula but a different molecular formula.

B They are compounds with the same molecular and displayed formulae but a different structural formula.

C They are compounds with the same molecular formula but a different structural formula.

D They are compounds with the same structural formula but a different displayed formula.

**Candidate answer: C**

**Mark awarded = 1**

### Examiner comment

The molecular formula indicates the number of atoms for each element in a molecule. The structural formula is an unambiguous representation of the way the atoms in a molecule are arranged. The displayed formula is a diagram that shows all atoms and bonds in a molecule. Applying these definitions gives option C as the correct choice.

### Common mistakes

Molecular, structural and displayed formulae can be confusing to candidates. At this level, candidates might find it useful to remember that the molecular formula allows a displayed formula to be written which then allows a displayed formula to be drawn.

### Question 35

35 Petroleum is a mixture of different hydrocarbons.

Which process is used to separate the petroleum into groups of similar hydrocarbons?

- A combustion
- B cracking
- C fractional distillation
- D reduction

**Candidate answer: C**

**Mark awarded = 1**

#### Examiner comment

Most candidates recall that petroleum is separated into fractions using fractional distillation.

#### Common mistakes

Some candidates select option B because they recall a link between cracking and hydrocarbons. Cracking is used to make useful hydrocarbons, not to separate petroleum.

### Question 36

36 Which equation representing a reaction of methane is correct?

- A  $\text{CH}_4 + \text{Cl}_2 \rightarrow \text{CH}_3\text{Cl} + \text{HCl}$
- B  $\text{CH}_4 + \text{Cl}_2 \rightarrow \text{CH}_4\text{Cl}_2$
- C  $\text{CH}_4 + \text{Cl}_2 \rightarrow \text{CH}_2\text{Cl}_2 + \text{H}_2$
- D  $2\text{CH}_4 + 2\text{Cl}_2 \rightarrow 2\text{CH}_3\text{Cl} + \text{Cl}_2 + \text{H}_2$

**Candidate answer: A**

**Mark awarded = 1**

#### Examiner comment

Candidates should recall that alkanes undergo substitution reaction with chlorine in the presence of ultraviolet light. The correct equation, option A, shows methane reacting with  $\text{Cl}_2$  to form chloromethane and hydrogen chloride.

## Question 37

37 Ethanol can be produced by fermentation or by the catalytic addition of steam to ethene.

Which row shows an advantage and a disadvantage for each process?

|          | fermentation           |                       | catalytic addition of steam to ethene |                        |
|----------|------------------------|-----------------------|---------------------------------------|------------------------|
|          | advantage              | disadvantage          | advantage                             | disadvantage           |
| <b>A</b> | batch process          | slow reaction         | continuous process                    | fast reaction          |
| <b>B</b> | fast reaction          | continuous process    | pure ethanol formed                   | renewable raw material |
| <b>C</b> | renewable raw material | batch process         | pure ethanol formed                   | slow reaction          |
| <b>D</b> | renewable raw material | impure ethanol formed | fast reaction                         | finite raw material    |

Candidate answer: D

Mark awarded = 1

## Examiner comment

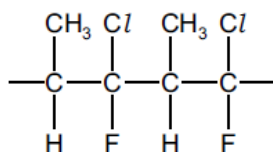
Option A can be eliminated because being a batch process is not an advantage of fermentation. Option B can be eliminated because fermentation is slow. Option C can also be eliminated because the catalytic addition of steam is a fast process.

## Common mistakes

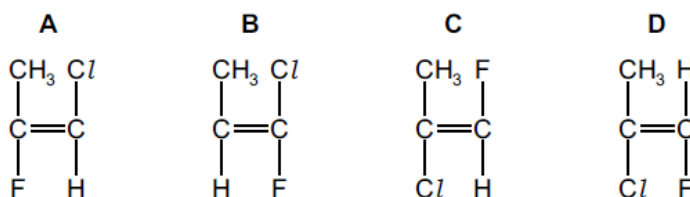
Even if candidates can't recall all the advantages and disadvantages of each process, they can still work methodically through the question using the facts they do know. Eliminating incorrect options allows a better chance of success when choosing the final answer.

## Question 38

38 Part of the structure of a polymer is shown.



Which monomer is used to make this polymer?



**Candidate answer: B**

**Mark awarded = 1**

### Examiner comment

The polymer shows that the monomer has the F atom and Cl atom bonded to the same carbon atom so only option B can be correct.

### Common mistakes

When asked to identify monomers or repeat units, some candidates may find it useful to draw the polymerisation reaction as this may allow them to visualise the reaction and check their answer.

## Question 39

**39** Five steps in an acid–base titration are shown.

- 1 Slowly add the acid from a burette into a conical flask until the indicator becomes colourless.
- 2 Add thymolphthalein.
- 3 Use a volumetric pipette to add a fixed volume of alkali to a conical flask.
- 4 Read and record the initial volume of acid in the burette.
- 5 Read and record the final volume of acid in the burette.

What is the correct order of these steps to complete an acid–base titration?

- A** 2 → 4 → 1 → 5 → 3  
**B** 3 → 2 → 4 → 1 → 5  
**C** 3 → 4 → 1 → 5 → 2  
**D** 4 → 3 → 1 → 2 → 5

**Candidate answer: B**

**Mark awarded = 1**

### Examiner comment

Candidates that have performed titrations will be able to apply this experience to determine that option B lists the correct order of steps for an acid-base titration.

### Common mistakes

Some candidates realise that the last step must be number 5, to record the final volume, and therefore only options B and D can be correct. Option D must be incorrect because the indicator, thymolphthalein, is added after step 1.

**Question 40**

40 A student does paper chromatography on a mixture of amino acids.

The student sprays the dried chromatogram with a locating agent.

What is the function of the locating agent?

- A to dissolve the amino acids
- B to form coloured spots with the amino acids
- C to preserve the amino acids
- D to stop the amino acids reacting

**Candidate answer: B**

**Mark awarded = 1**

**Examiner comment**

In chromatography, locating agents are used to show the position of colourless substances that otherwise wouldn't be visible. In this question, the locating agent shows the colourless amino acids as coloured spots.

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