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Examiners' report

GATEWAY SCIENCE CHEMISTRY A

J248

For first teaching in 2016

J248/02 Summer 2022 series

Version 1

ocr.org.uk/science

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate answers are also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

Advance Information for Summer 2022 assessments

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our website.

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Paper 2 series overview

J248/02 is the second of two foundation tier papers for the revised specification for Chemistry A (Gateway Science). It assesses Topics C4-C7, and assumes some knowledge of Topics C1-C3.

The overall standard was similar to that in the 2019 examination and there was no evidence that candidates were short of time. However, unlike previous years there were far more parts than normal which were left totally unanswered, suggesting that some candidates were losing confidence in their abilities. This was especially marked with lower scoring candidates.

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• identified the key words in each question part. The examination is a time of considerable stress, and it is easy to misunderstand precisely what the question is asking. It is always a good strategy to underline key words in the command line(s) of the question • realised that information which they recalled might not always quite fit the demands of the question, and so were prepared to modify their answer in the light of this • could decide which information might be significant and which not, especially in tables • in calculation questions, showed their working. The majority of candidates got the answers to calculations wrong, and their working is their only way of gaining marks. Candidates are not penalised for incorrect working.	• left questions blank, guaranteeing a mark of zero. Examiners look for ways in which to give candidates marks, not for reasons to deduct marks. It is always better to write something than nothing • had difficulty in basic mathematical manipulations • gave explanations which, while relevant to the question, lacked sufficient detail, e.g. "pollution", or "harmful".

Section A overview

Section A is made up of objective questions, and candidates very sensibly attempted all of them.

Question 1

1 Chlorine and iodine are Group 7 elements.

	Chlorine	Iodine
A	green gas	purple gas
B	pale yellow gas	grey-black solid
C	green gas	grey-black solid
D	pale yellow gas	purple gas

Which row in the table describes these elements **at room temperature**?

Your answer ☐ **[1]**

This question showed up considerable confusion in the minds of candidates, and answers were evenly spread across all four alternatives.

Question 2

2 What is the test for oxygen gas?

A Ignites with a squeaky pop.

B Limewater turns milky.

C Relights a glowing splint.

D Turns damp blue litmus paper white.

Your answer ☐ **[1]**

Almost all candidates knew the test for oxygen, with A being the most common incorrect response.

Question 3

3 What is an enzyme?

A A catalyst found in living organisms.

B A man-made catalyst.

C A non-biological catalyst.

D A substance which makes a catalyst more efficient.

Your answer ☐ **[1]**

Most candidates recognised that an enzyme is a catalyst found in living systems.

Question 4

4 Bromine water is used to test between ethane and ethene.

	Ethane	Ethene
A	bromine water is decolourised	no colour change
B	bromine water goes cloudy	bromine water is decolourised
C	bromine water goes clear	no colour change
D	no colour change	bromine water is decolourised

Which row in the table gives the correct test results?

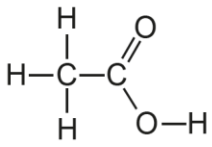
Your answer ☐ **[1]**

A few candidates knew the chemical test for ethene, while most went for options B or C.

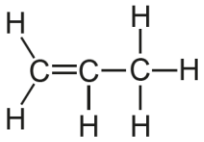
Question 5

5 What is the displayed formula of **propanoic acid**?

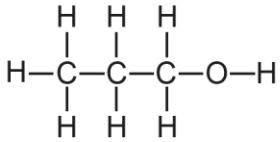
A



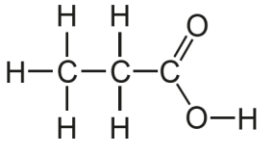
B



C



D



Your answer ☐ **[1]**

Higher scoring candidates often recognised D as the formula of propanoic acid, with options B & C being the most common alternatives.

Question 6

6 DNA molecules are polymers made from monomers.

What are the monomers called?

A Alkenes

B Amino acids

C Carbohydrates

D Nucleotides

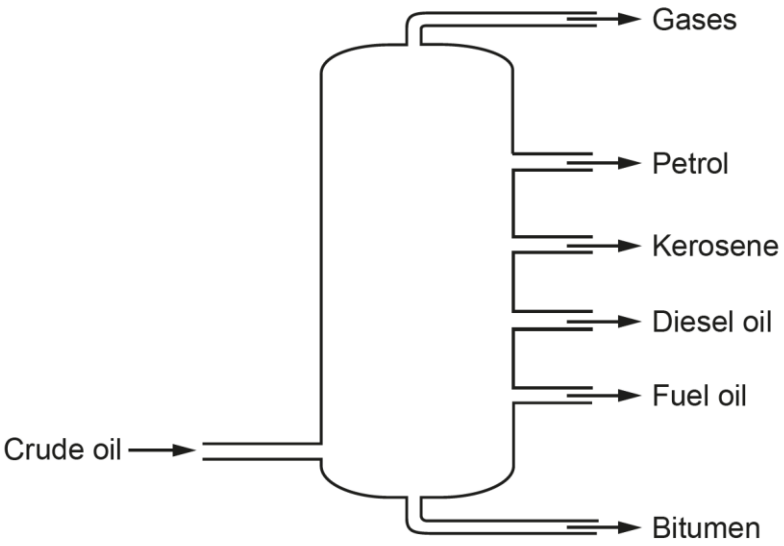
Your answer ☐ **[1]**

Higher scoring candidates often knew that the monomers in DNA are nucleotides.

Question 7

7 Crude oil is separated into useful chemicals by fractional distillation.

The diagram shows the useful chemicals made in fractional distillation.



Which of these chemicals has the **largest** molecules?

A Bitumen

B Diesel oil

C Gases

D Petrol

Your answer ☐ **[1]**

Most candidates were clearly familiar with the fractionation of crude oil, and all but the lowest scoring answered this confidently and correctly. This familiarity was confirmed by their answers to Question 16.

Question 8

8 Which statement describes dynamic equilibrium?

A Occurs in a closed system and the backward reaction is faster than the forward reaction.

B Occurs in a closed system and the forward reaction is faster than the backward reaction.

C Occurs in a closed system and the rates of the forward and backward reactions are equal.

D Occurs in an open system and the rates of the forward and backward reactions are equal.

Your answer ☐ **[1]**

The concept of a dynamic equilibrium was familiar to most, and while higher scoring candidates excelled, many with more modest achievements were also able to choose the correct answer. Those who were uncertain tended to choose between the other options fairly equally.

Question 9

9 The rate of the reaction between marble chips and dilute hydrochloric acid is increased by breaking the marble chips into smaller pieces.

Why does this increase the rate of reaction?

A The marble chips act as a catalyst.

B The marble chips have a greater concentration.

C The marble chips have a larger surface area.

D The marble chips move faster.

Your answer ☐ **[1]**

This was well answered by high scoring candidates, with others tending to go for options A or B.

Question 10

10 Copper carbonate, $CuCO_3$, decomposes when heated.

Copper oxide, CuO, is made. Carbon dioxide is a waste product.

$CuCO_3 \rightarrow CuO + CO_2$

What is the **atom economy** of the reaction?

Relative molecular mass (A_r): $CuCO_3$ = 123.5 CuO = 79.5 CO_2 = 44.0

A 28.7%

B 35.6%

C 64.4%

D 155.3%

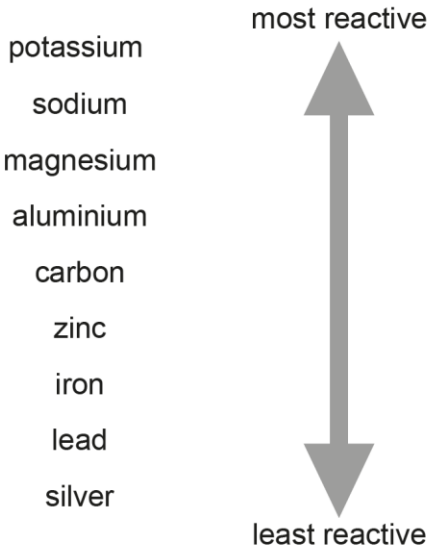
Your answer ☐ **[1]**

Atom economy as a concept is poorly understood, although it was pleasing to see that almost all candidates intuitively realised that it could not go above 100%, so option D was rarely chosen.

Question 11

11 The list shows the reactivity series of some metals.

The non-metal element carbon is also included.



	Extracted from its ore by electrolysis	Extracted from its ore by heating with carbon
A	magnesium	silver
B	silver	potassium
C	sodium	aluminium
D	zinc	aluminium

Which row in the table is correct?

Your answer ☐ **[1]**

It is possible that candidates treated this as a memory task rather than one that requires an understanding of the reactivity series, and did not link the information in the introduction to the options in the table.

Question 12

12 Why is magnesium more reactive with dilute acids than zinc?

A Magnesium forms positive ions more easily than zinc.

B Magnesium forms negative ions more easily than zinc.

C Magnesium gains electrons more easily than zinc.

D Magnesium gains hydrogen more easily than zinc.

Your answer ☐ **[1]**

Answers B and C were most often chosen, suggesting candidates find it much easier to think in terms of electrons rather than ion formation.

Question 13

13 What is the test for halide ions?

A Add a few drops of dilute nitric acid then a few drops of silver nitrate solution.

B Add a few drops of hydrochloric acid then a few drops of barium chloride solution.

C Add a few drops of hydrochloric acid then a few drops of silver nitrate solution.

D Add a few drops of sodium hydroxide solution.

Your answer ☐ **[1]**

The response to this question was similar to that for Question 1, suggesting that chemical tests in general are not well known.

Question 14

14 Large molecules produced by fractional distillation are cracked to make smaller molecules.

Octane, C_8H_{18}, is cracked to form ethene, C_2H_4, and one other product.

What is the formula of the other product?

A C_3H_6

B C_6H_{12}

C C_6H_{14}

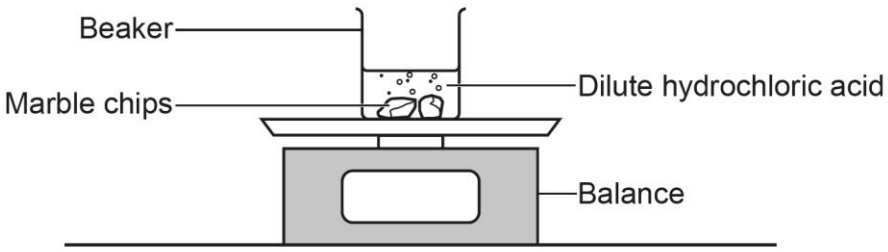
D C_8H_{16}

Your answer ☐ **[1]**

High scoring candidates realised that the other product must be C_6H_{14}, with many others showing partial understanding by suggesting C_6H_{12}.

Question 15

15 Dilute hydrochloric acid reacts with marble chips.



Which statement about the reaction is correct?

A The reaction is faster after 10 seconds than it is after 3 seconds.

B The reaction slows down with time.

C The reaction proceeds at a constant rate.

D The mass of the beaker and its contents stay the same.

Your answer ☐ **[1]**

While low scoring candidates struggled with this, higher scoring candidates successfully recognised that the reaction slows with time.

Section B overview

Section B contains a mixture of objective style questions and those requiring a longer response.

Question 16 (a)

16 The table shows information about some compounds of carbon.

Compound	Formula
A	CH_4
B	C_2H_4
C	C_2H_6
D	C_3H_6
E	C_3H_8

(a) Some of the compounds belong to the homologous series called the **alkanes**.

Which hydrocarbons are alkanes?

Tick (✓) **three** boxes.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐ **[3]**

All the compounds were chosen almost equally, although A less than the others.

Question 16 (b)

(b) Which homologous series do the compounds which are **not** alkanes belong to?

Tick (✓) **one** box.

Alcohols ☐

Alkenes ☐

Carboxylic acids ☐

Esters ☐

[1]

While many candidates recognised that the other compounds were alkenes, those who didn't appeared not to recognise the any names given and seemed to choose fairly randomly.

Question 16 (c)

(c) Compound **B**, C_2H_4, burns completely in oxygen.

State the names of the **two products** of this reaction.

..... and ..... **[2]**

Carbon dioxide was far better known as a product than water, and hydrogen was often given as the second product.

Exemplar 1

Carbon ..... and hydrogen. ..... **[2]**

A large minority of candidates gave this response, suggesting that even though they didn't know the response, they were interacting intelligently with the context of the question.

Question 16 (d)

(d) Compound **A** is obtained from crude oil by fractional distillation.

Complete the sentences about fractional distillation. Use words from the list.

cracked	**colder**	**condense**	**evaporate**
fractions	**heated**	**hotter**	**polymers**

Crude oil is ..... as it enters a fractionating column. The vapours get ..... as they rise. The vapours ..... to a liquid at different points. The separated parts of crude oil are called ..... .

[4]

Candidates showed a clear understanding of which terms might apply to which gaps, even if they did not choose the correct one from each pair. For example, the main alternative to 'condense' was 'evaporate', and for 'fractions' was 'polymers'.

The most frequent error was to suggest that the vapours get hotter as they rise up the column.

Question 16 (e)

(e) Crude oil is a finite resource.

Explain what is meant by a **finite resource**.

.....

..... **[1]**

Most candidates clearly understood that it is a resource that will run out. The main error was to suggest exactly the opposite, that it can be re-used.

Question 17 (a)

17 A student neutralises 6.00 g of nitric acid, HNO_3, with ammonia, NH_3, to make ammonium nitrate, NH_4NO_3.

The equation shows this reaction.

$HNO_3 + NH_3 \rightarrow NH_4NO_3$

(a) Calculate the **theoretical yield** of ammonium nitrate, NH_4NO_3.

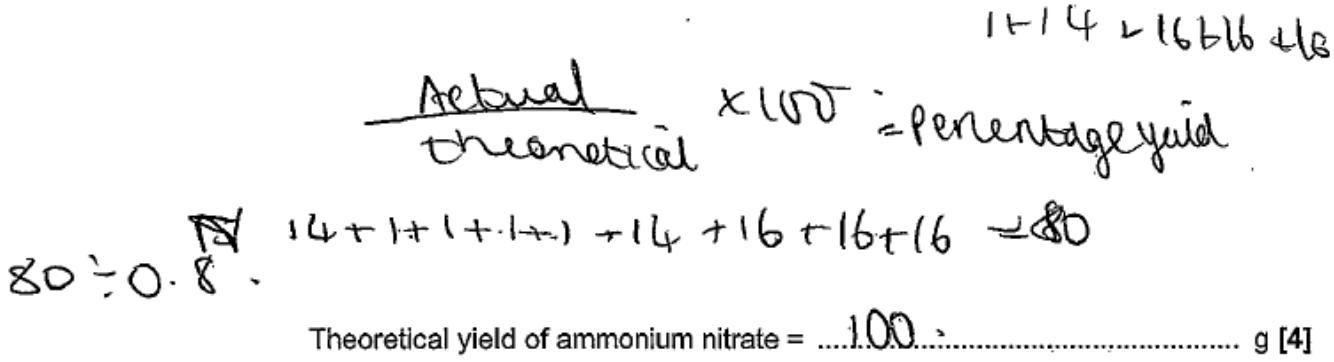
Give your answer to **3** significant figures.

Relative atomic mass (A_r): H = 1.0 N = 14.0 O = 16.0.

Theoretical yield of ammonium nitrate = ... g **[4]**

Few candidates knew how to work out a theoretical yield, but were frequently able to gain intermediate marks for calculating the molar mass of ammonium nitrate.

Exemplar 2



The candidate gets a mark for calculating the molar mass of ammonium nitrate and a second mark, even though the calculation is incorrect, as the incorrect final response has been rounded to a number with 3 significant figures.

Question 17 (b)

(b) The **atom economy** for the reaction between nitric acid and ammonia is 100%.

$HNO_3 + NH_3 \rightarrow NH_4NO_3$

Use the balanced symbol equation to explain why the atom economy is 100%.

.....

..... **[1]**

Atom economy as a term was understood by very few. Most candidates thought it meant that there were equal numbers of atoms on each side of the equation. Some calculated the total masses on each side of the equation to show that it was 100%.

This difficulty also showed up in Question 10

Misconception

Atom economy is NOT the same as a balanced equation.

Atom economy is NOT the same as conservation of mass.

Question 17 (c)

(c) In another reaction, the student makes 4.0 g of ammonium sulfate.

They predicted that they should have made 6.6 g.

Calculate their **percentage yield**.

Give your answer to **2** significant figures.

Percentage yield = ... % **[3]**

Candidates found this question challenging. They either knew what to do, and at most lost a mark for giving the incorrect number of significant figures, or they didn't know where to start at all. Very few intermediate marks were given.

Question 17 (d) (i)

(d) Ammonium sulfate, $(NH_4)_2SO_4$, is used as a fertiliser.

(i) Ammonium sulfate contains the element nitrogen, N, which is essential for plant growth.

State the names of the **two** other essential elements for plant growth.

..... and ..... **[2]**

There are two aspects evident from the answers to this question. Firstly, it was asking about the very specific use of the term 'essential elements' as applied to fertiliser, so in that context the other two have to be phosphorus and potassium. However, many candidates suggested carbon dioxide and water, or sunlight and water, suggesting that because they had shifted to a horticultural context they had moved to a more everyday use of the term 'element'.

Assessment for learning

'Essential elements' in this context are nitrogen, phosphorus and potassium only.

Question 17 (d) (ii)

(ii) Ammonium sulfate can be produced in a laboratory or by industry.

The table gives some information about these two ways of producing ammonium sulfate.

Laboratory	Industry
titration of sulfuric acid and ammonia solution	uses raw materials to make sulfuric acid and ammonia in several stages
batch process	continuous process
small scale	large scale
slow process	quick process
atom economy is 100%	atom economy is 100%
	ammonium sulfate can be made from by-products of other processes

Describe the **advantages** and **disadvantages** of producing ammonium sulfate in the laboratory and in industry.

.....

.....

.....

.....

.....

..... **[4]**

In general, this question was well answered. However, some candidates did not make it obvious which parts of their answer were advantages and which were disadvantages. As examiners were seeing the same points being put into opposite camps by different candidates, we had no way of knowing what was meant if it was not clearly indicated, which unfortunately meant we could not award marks.

Assessment for learning

Advantages and disadvantages should always be clearly labelled.

Question 18 (a)

18 A car manufacturer is concerned about the carbon dioxide, CO_2, emissions of different cars during their lifetime.

The car manufacturer does a life-cycle assessment for three types of car they are developing:
- a petrol car
- a diesel car
- an electric car.

(a) What is the car manufacturer working out in these life-cycle assessments?

Tick (✓) **one** box.

The potential amount of fuel used by the car. ☐

The potential cost of each stage of the life of the car. ☐

The potential environmental impact at each stage of the life of the car. ☐

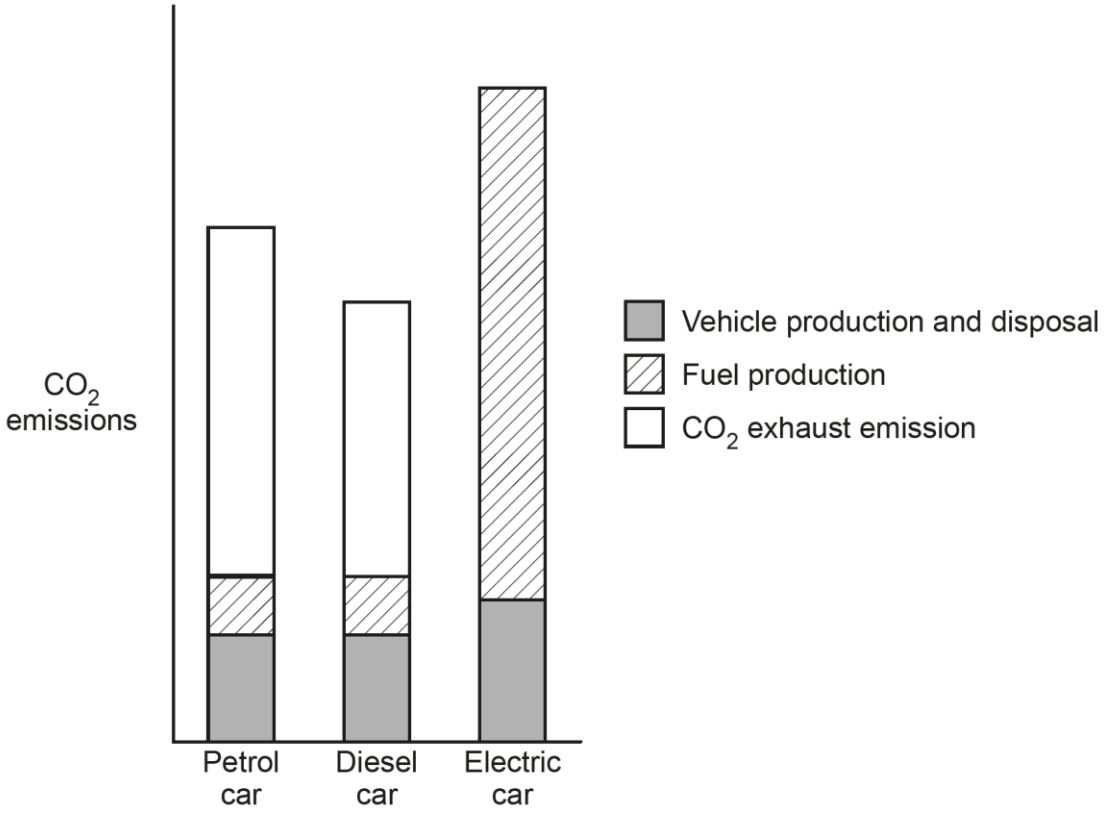
The potential health and safety issues at each stage of the life of the car. ☐

[1]

Most candidates correctly chose the last option. The most common mistake as to go for the first option.

Question 18 (b) (i)

(b) The graph shows the life-cycle assessment for the three types of car.



(i) Which type of car produces the most carbon dioxide exhaust emissions?

Tick (✓) **one** box.

Petrol car ☐

Diesel car ☐

Electric car ☐

[1]

Most candidates correctly chose the petrol car.

Question 18 (b) (ii)

(ii) Which type of car produces the most carbon dioxide over its lifetime?

Tick (✓) **one** box.

Petrol car ☐

Diesel car ☐

Electric car ☐

[1]

This caused more confusion, many candidates going with expectation. However, a significant majority correctly identified that this particular graph shows the electric car as responsible for more carbon dioxide over its lifetime.

Question 18 (c)

(c) Describe **two** potential problems of increased levels of carbon dioxide in the Earth's atmosphere.

1 .....

.....

2 .....

.....

[2]

Higher scoring candidates cited detail such as melting ice caps as well as an overall term such as 'global warming'. Damage to the ozone layer was often quoted as the second problem, along with general statements such as 'air pollution'.

Exemplar 3

1 rising sea level

2 increased temperature of the earth, with more extreme weather conditions

Examiners allowed one general response such as global warming but the second mark had to be for a more specific response, in this case the reference to rising sea levels.

Question 18 (d)

(d) The electricity used to charge the electric car can be produced by burning coal which produces a large amount of carbon dioxide.

The amount of carbon dioxide produced is reduced by 95% if the electricity is generated in a different way.

Suggest how the electricity used to charge the car can be generated, other than by burning coal.

.....

..... **[1]**

Most candidates had an excellent understanding of other ways of charging the car, with solar panels being by far and away the most frequent answer. Less successful candidates sometimes missed the point of the question, although nevertheless engaged with the context, by suggested plugging the car into an electrical socket.

Question 19 (a)

19 The table shows information about three metals.

Metal	Corrosion in moist air	Density (g/cm^3)	Electrical conductivity	Melting point (°C)
aluminium	no obvious corrosion	2.7	good	660
copper	corrodes slowly	9.0	excellent	1084
iron	corrodes quickly	7.9	good	1538

(a) A student thinks that **aluminium** would be the best metal to use to make a model helicopter.

Explain why the student is correct. Use information from the table.

.....

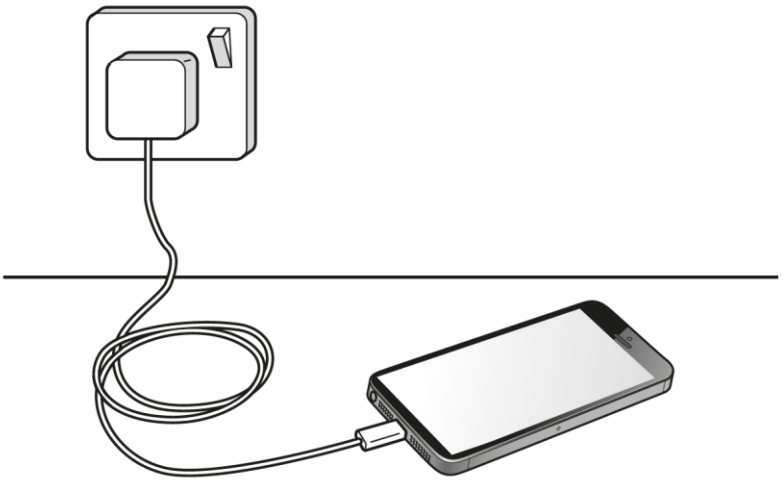
.....

..... **[2]**

This question was answered well. However, a number of candidates chose electrical conductivity as a significant factor.

Question 19 (b)

(b) The wire inside the cable used to charge a mobile phone is made of a metal.



Which of the three metals would you choose to make the wire inside the cable used to charge a mobile phone?

Explain your answer.

Metal .....

Explanation .....

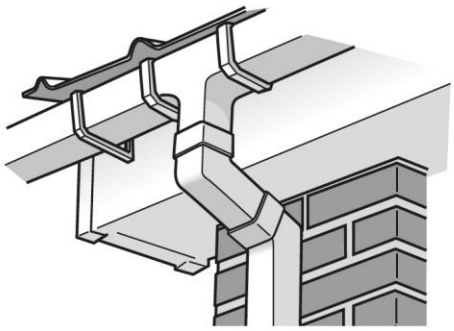
.....

..... **[3]**

This question was well answered

Question 19 (c)

(c) Poly(chloroethene) is a polymer used to make gutters.



Poly(chloroethene) has a melting point of 165 °C.

The melting point of aluminium is 660 °C.

Calculate the ratio of the melting point of poly(chloroethene) to the melting point of aluminium.

Ratio = ... **[2]**

Most candidates had a good understanding of ratio and were able to simplify the two numbers involved.

Question 19 (d)

(d) In the past gutters were made from iron.

Suggest why poly(chloroethene) is a better material than iron for making gutters.

.....

.....

..... **[2]**

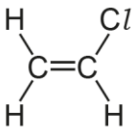
The answer was often given in terms of the disadvantage of iron rather than the advantage of poly(chloroethene) and this was, of course, completely acceptable. Corrosion resistance and weight were the two most common suitable factors given, and while justification could be made for all manner of properties, these were the answers most likely to gain marks.

Melting point was the most frequent response that was not given marks.

Question 19 (e) (i)

(e) Poly(chloroethene) is a polymer made from the monomer chloroethene.

This is the structure of chloroethene.



(i) Explain why chloroethene is **not** a hydrocarbon.

.....

..... **[1]**

The answer 'because it has three hydrogens and not four' was frequently seen, and while it gets part of the way there, it wasn't enough to gain a mark.

Another frequent answer was 'because it has a double bond', showing that candidates had looked at the formula but unfortunately chosen the wrong feature.

Question 19 (e) (ii)

(ii) Complete the diagram to show the displayed formula of the polymer poly(chloroethene).

H Cl

C C

H H

[2]

Almost all candidates drew in a double bond, not realising that it breaks to form the polymer.

Question 20 (a)

20 Atmospheric pollution can be caused by
- carbon monoxide
- oxides of nitrogen
- sulfur dioxide.

(a) Explain why **carbon monoxide** in the atmosphere is a problem.

.....

.....

..... **[2]**

The question stem has already told candidates that carbon monoxide is an atmospheric pollutant and a problem, so this was an invitation to candidates to demonstrate their more detailed knowledge. More general references to it being dangerous, or to killing people, were not enough.

The most successful candidates discussed the fact that it is toxic, and that it has an effect on the respiratory system. Others went for the usual culprit and wrote that it would damage the ozone layer.

Question 20 (b)

(b) Sulfur dioxide causes acid rain.

Why is acid rain a problem?

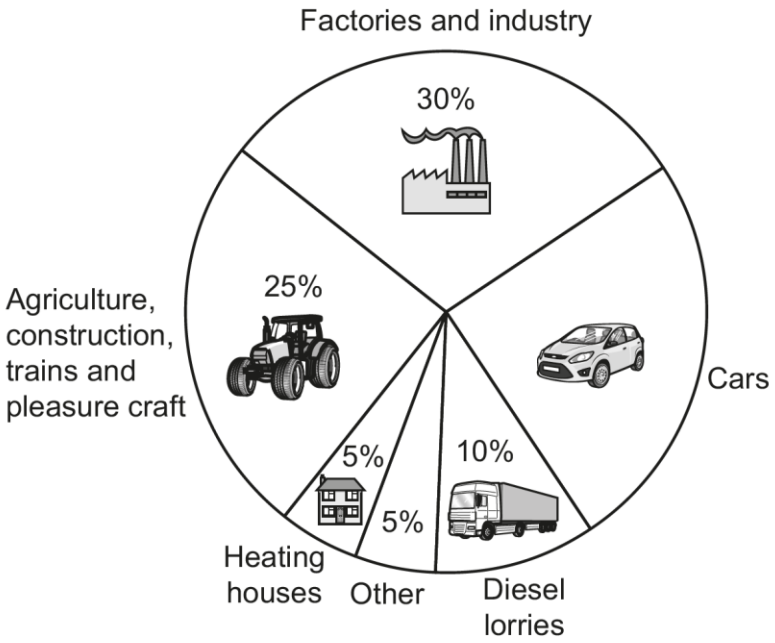
..... **[1]**

As in the previous part, there were many answers stating that it is harmful, which is not going any further than what is given in the question.

'Acid rain burns the skin' was seen quite frequently, but was not allowed.

Question 20 (c) (i)

(c) The pie chart shows different sources of emissions of oxides of nitrogen.



(i) Calculate the percentage emissions of oxides of nitrogen from cars.

Percentage emissions of oxides of nitrogen from cars = ... % **[1]**

A few candidates appeared to double think themselves and went in for complex calculations, but in general this question was very well answered.

Question 20 (c) (ii)

(ii) What is the **largest** source of emissions of oxides of nitrogen?

..... **[1]**

This was very well answered.

Question 20 (d)

(d) A catalytic converter on a car removes nitrogen monoxide and carbon monoxide from exhaust gases.

Nitrogen gas and carbon dioxide gas are made.

This is the equation for the reaction that takes place.

$2CO + 2NO \longrightarrow N_2 + CO_2$

On a car journey 1.4 tonnes of nitrogen is made.

Calculate the **mass of nitrogen monoxide** removed from the exhaust gases.

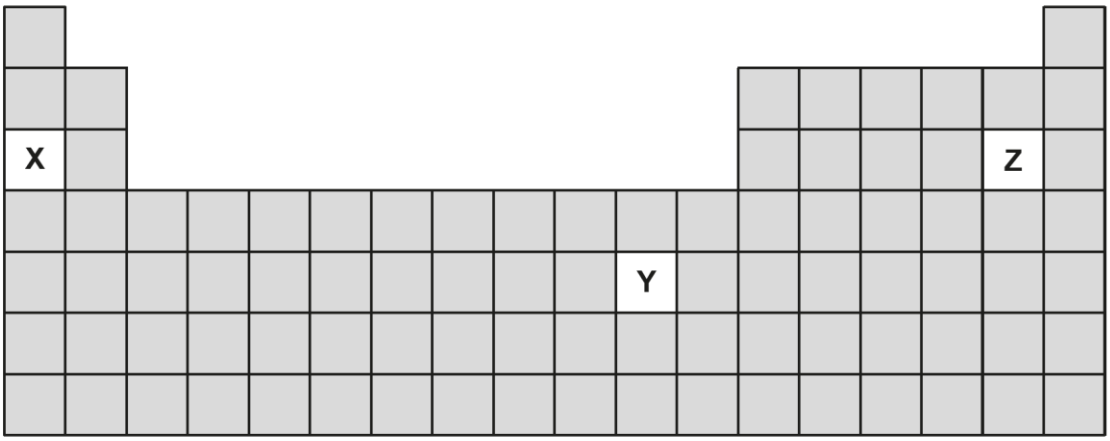
Relative atomic mass (A_r): N = 14.0 O = 16.0.

Mass of nitrogen monoxide = ... tonnes **[3]**

While very few candidates could work out how to calculate the mass of the nitrogen monoxide, those who attempted this question often picked up some marks for calculating relevant molar masses.

Question 21*

21* The diagram shows a simplified version of the Periodic Table.



The letters **X**, **Y** and **Z** are elements in the Periodic Table. These letters are **not** the symbols of the elements.

Describe and explain the **properties** and **reactivity** of elements **X**, **Y** and **Z**.

.....

.....

.....

.....

.....

..... **[6]**

Most candidates were clearly familiar with the Periodic Table and discussed reactivity trends down Groups 1 and 7, and also electron configurations. They often tied electron shells in to ideas of how tightly electrons are held, and discussed electron loss and gain. In this respect the seemed to do better than in Question 12, which looked at metal ion formation and reactivity.

That the Group 1 elements are less reactive at the top of the group had gone in really strongly, but unfortunately it led to many candidates stating that sodium must be unreactive.

There were others who remembered the trends the wrong way round, but it was clear that the underlying ideas had definitely gone in.

They were less certain about properties, and frequently did not mention any, or assumed that their statement about electron configuration would be enough.

Question 22 (a)

22 Hydrogen peroxide, H_2O_2, is used as a source of oxygen gas.

Hydrogen peroxide decomposes to make oxygen gas, O_2, and water.

(a) Write the **balanced symbol** equation for this reaction.

..... **[2]**

There were many worthwhile attempts to answer this question.

Question 22 (b)

(b) The decomposition of hydrogen peroxide is very slow at room temperature. The reaction can be speeded up by adding a catalyst.

- A student investigates the decomposition of hydrogen peroxide using two different catalysts, **A** and **B**.
- The student uses 50 cm^3 of hydrogen peroxide and 0.5 g of the catalyst in each experiment.

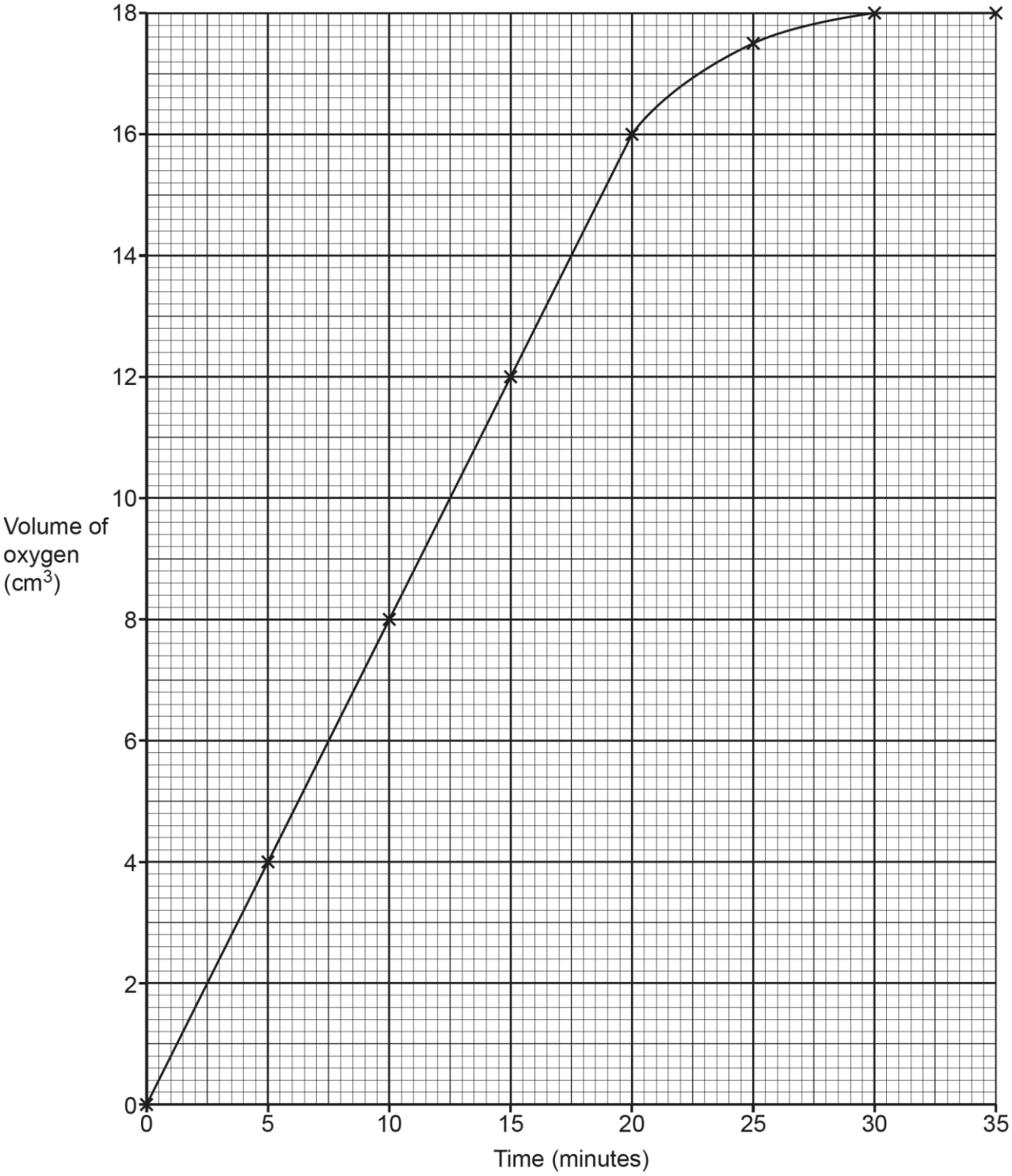
The table shows the student's results.

	Volume of oxygen (cm^3)	
Time (minutes)	Catalyst **A**	Catalyst **B**
0	0.0	0.0
5	4.0	5.0
10	8.0	10.0
15	12.0	15.0
20	16.0	16.5
25	17.5	18.0
30	18.0	18.0
35	18.0	18.0

The results for catalyst **A** are shown on **Fig. 22.1**.

Plot the results for catalyst **B** on **Fig. 22.1** and draw a line of best fit. **[2]**

Fig. 22.1



This question and the next both overlap with the higher tier paper.

Most candidates plotted the points accurately, but either went on to join the dots or to draw a straight line which ignored the last four points.

Question 22 (c)

(c) The student thinks catalyst **B** is the better catalyst.

Explain why the student is correct. Use data from the graph.

.....

.....

..... **[2]**

Many candidates could state that more gas was produced in a given time, and some took this further and made reference to rate of reaction or to the slope of the graph.

Question 22 (d)

(d) The volume of oxygen made in each experiment is 18 cm^3.

Explain why it is the same value.

.....

..... **[1]**

Almost all candidates realised that something had been kept constant, and higher scoring candidates realised that it was the volume of hydrogen peroxide. The majority of candidates stated that the amount of catalyst was significant.

While candidates can often state that catalysts do not affect the outcome of a reaction, this question showed that their understanding of this concept was much less secure.

Question 22 (e)

(e) The student repeats the experiment with **1.0 g** of catalyst **A** instead of 0.5 g.

What is the volume of oxygen gas made at the end of the experiment?

Volume of oxygen gas = ... cm^3 **[1]**

Candidates seemed to treat this question as a much more challenging task than it was intended to be. The most common answers were probably 36 or 18.5, but other quite complex calculations were seen.

Question 22 (f)

(f) The student thinks the decomposition of hydrogen peroxide will be faster at 30 °C than at room temperature.

Describe an experiment the student could do, and its results, to show the reaction is faster at 30 °C.

.....

.....

.....

.....

..... **[3]**

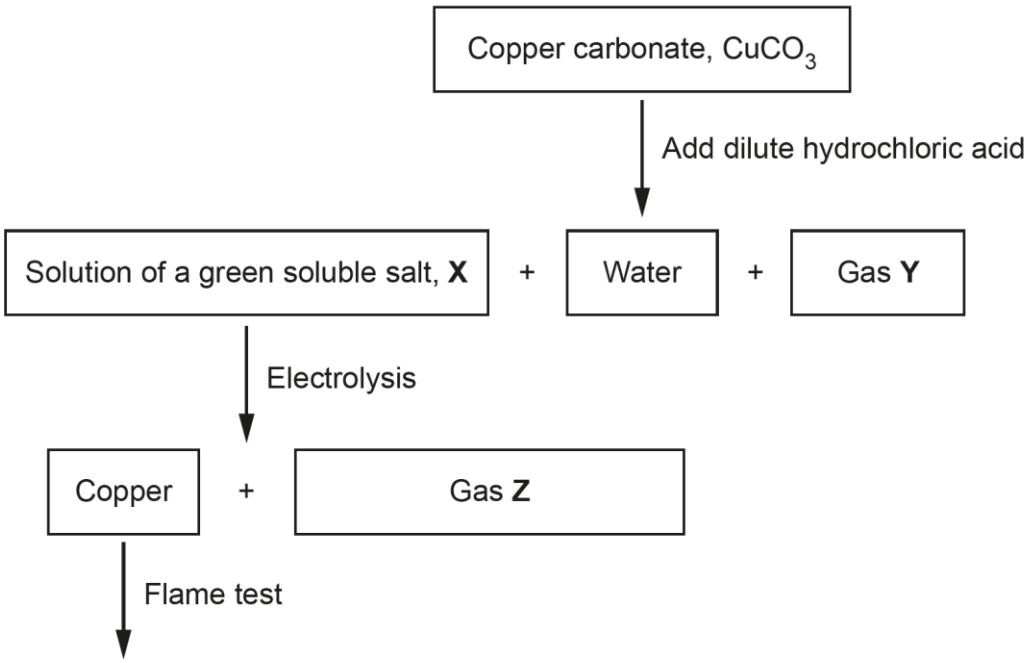
This question has three components, the experiment, the results, and how the results would show the reaction is faster.

The basic idea of repeating the experiment was understood by many. A lot of candidates then gained marks for stating that the new experiment should be conducted at 30°, although stopped there. More successful candidates indicated what measurements should be taken and how the results would show that the reaction is faster.

Question 23 (a)

23 A teacher investigates the reactions of copper carbonate, $CuCO_3$.

The diagram shows the reactions the teacher does.



(a) State the name of the soluble salt, **X**.

..... **[1]**

This was the second of the questions to overlap with the higher tier.

There was a wide range of suggestions, with chlorine, sodium chloride, and copper possibly being the most frequent.

Question 23 (b)

(b) State the name of gas **Y**.

..... **[1]**

Several candidates correctly suggested carbon dioxide, with hydrogen or oxygen being the most popular alternatives.

Question 23 (c)

(c) Gas **Z** turns damp blue litmus paper white.

State the name of gas **Z**.

..... **[1]**

High scoring candidates quite often realised that the gas would be chlorine, with other candidates suggesting not only a range of gases but also substances which are clearly solids.

Question 23 (d)

(d) The teacher performs a flame test of the copper made by the electrolysis of **X**.

What colour flame does the teacher observe?

..... **[1]**

Candidates seemed to split into two schools of thought, those that suggested red/yellow/orange and those that suggested variations on green-blue.

Question 23 (e)

(e) Copper metal is extracted from copper oxide by heating with carbon as shown in the equation.

copper oxide + carbon $\rightarrow$ copper + carbon dioxide

Explain why copper is extracted.

Use ideas about the reactivity series.

.....

..... **[1]**

High scoring candidates successfully pointed to the relative reactivities of carbon and copper.

Question 23 (f)

(f) Copper is used to make useful alloys.

The table gives information about some copper alloys.

Alloy	Main metals	Uses
duralumin	copper and	aircraft parts
brass	copper and	musical instruments
bronze	copper and tin	.....

Complete the table. **[2]**

Aluminium was well recognised, whereas most candidates suggested the other component of brass is iron. Medals and coinage were the most common suggestions for bronze, although some candidates suggested drinks cans.

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