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GCSE (9-1)

Examiners' report

GATEWAY SCIENCE CHEMISTRY A

J248
For first teaching in 2016

J248/02 Summer 2019 series

Version 1

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. 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 can be downloaded from OCR.

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

Candidates who did 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 identify the command line(s) of the question and to underline key words.
- 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. Most candidates got the answers to calculations wrong, and their working is their only way of gaining credit. Candidates are not penalised for incorrect working.

Candidates who did less well on this paper displayed the following tendencies:

- Under the stress of sitting an examination, candidates sometimes misinterpreted question's instructions. The instruction to 'write about what the candidate would observe' was frequently interpreted as 'what the candidate ***should*** observe', which unfortunately meant the candidate did not gain any credit for that question.
- Gave explanations which, while relevant to the question, lacked sufficient detail, eg 'bad for the environment'
- Had difficulty in basic mathematical manipulations.
- Left questions blank.. Examiners look for ways in which to give candidates credit. It is ***always*** better to write something than nothing.

There was no evidence that any time constraints had led to a candidate not completing the paper.

Section A overview

Most candidates did reasonably well on Questions 1, 2, 3, 7, 9 and 15 but found Questions 4,6,8,10,11,12,13 and14 challenging with only higher ability candidates gaining credit.

Question 1

1 Which type of water is **potable** water?

A Groundwater

B Seawater

C Tap water

D Waste water

Your answer ☐ **[1]**

Many candidates knew that 'potable water' means safe to drink and chose tap water as the best of the alternatives given.

Question 2

2 Which of these elements is a **transition metal**?

A Calcium

B Caesium

C Carbon

D Cobalt

Your answer ☐ **[1]**

Most candidates realised that cobalt is a transition metal, with a sizeable minority opting for carbon

Question 3

3 Lithium, sodium and potassium all react with water.

In all three reactions the same gas is produced.

What is the name of the gas?

A Carbon dioxide

B Chlorine

C Hydrogen

D Oxygen

Your answer ☐ **[1]**

Most candidates realised that the gas was hydrogen, with carbon dioxide being the most common alternative.

Question 4

4 The rate of a reaction can be changed by adding a catalyst to the reaction mixture.

Which line of the table shows how the **rate of reaction** and the **mass of the catalyst** change as the reaction takes place?

	Change in rate of reaction	**Change in mass of catalyst**
A	decreases	no change
B	no change	decreases
C	increases	no change
D	increases	decreases

Your answer ☐ **[1]**

Almost all candidates chose 'the rate increases'. However, only the higher ability candidates knew that there would be no change in mass, with the others thinking that mass would decrease.

Question 5

5 How was the Earth's early atmosphere formed?

A Animals breathing

B Global warming

C Plants growing

D Volcanic activity

Your answer ☐ **[1]**

While most of the higher ability candidates knew that the early atmosphere was formed by volcanic activity, many lower ability candidates were also quite familiar with this.

Question 6

6 Crude oil is a mixture of hydrocarbons.

Crude oil is separated into useful fractions.

Which of these mixtures of substances could be in a fraction from crude oil?

A C_2H_4, C_4H_{10}, $C_4H_{10}O$

B C_2H_4, C_2H_3Br, C_4H_{10}

C C_2H_6, C_3H_8, C_4H_{10}

D C_2H_6, C_2H_3Br, $C_4H_{10}O$

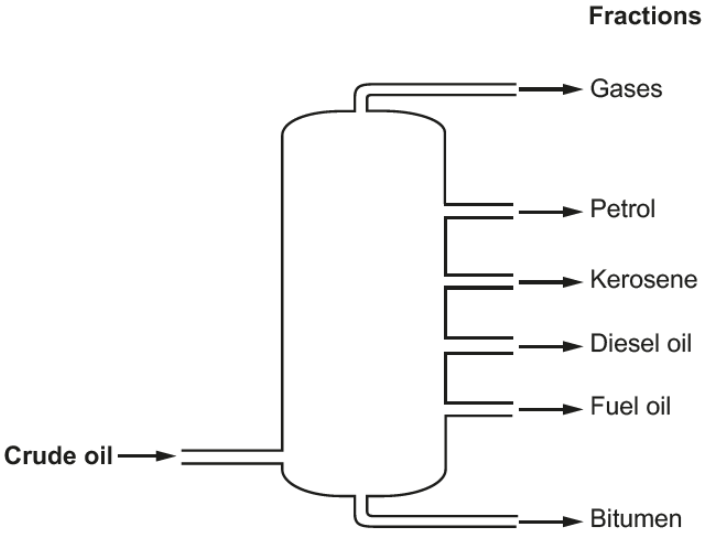
Your answer ☐ **[1]**

Higher ability candidates tended to recognise that option C was the only option to consist solely of hydrocarbons. For the others, choices were fairly evenly split between options A, B and D although, interestingly, far fewer went for option D.

Question 7

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

The diagram shows the useful fractions made in fractional distillation.



Which of these fractions has the **weakest** intermolecular forces?

A Bitumen

B Diesel oil

C Gases

D Petrol

Your answer ☐ **[1]**

Higher ability candidates realised that gases would have the weakest intermolecular forces, with the most popular alternative being bitumen.

Question 8

8 What type of reaction takes place between an alkene and hydrogen?

A Addition

B Dehydration

C Neutralisation

D Thermal decomposition

Your answer ☐ **[1]**

Addition reactions were not well known. Most candidates assumed that the reaction would be a neutralisation.

Question 9

9 The table shows the main stages in the life-cycle assessment of a manufactured product.

Stage	Process
1	Manufacturing the product
2	Obtaining raw materials
3	Disposing of the product
4	Using the product

What is the correct order for the stages?

A 1, 2, 3, 4

B 1, 2, 4, 3

C 2, 1, 4, 3

D 2, 4, 1, 3

Your answer ☐ **[1]**

Most candidates successfully identified the correct order for the stages in a life cycle.

Question 10

10 The Haber process is used to make ammonia, NH_3.

$N_2 + 3H_2 \rightleftharpoons 2NH_3$

What is the raw material for the **nitrogen**?

A Air

B Hydrochloric acid

C Natural gas

D Seawater

Your answer ☐ **[1]**

While higher ability candidates often knew that air is the raw material for nitrogen, the majority chose natural gas.

Question 11

11 Which statement describes the test for **chlorine gas**?

A A lighted splint makes a squeaky pop.

B Limewater turns milky.

C A glowing splint re-lights.

D Damp litmus paper is bleached.

Your answer ☐ **[1]**

The test for chlorine gas was well known and tended to be ability related. However, many candidates of all abilities opted either for a squeaky pop with a lighted splint or for limewater turning milky.

Question 12

12 Which statement describes the **atom economy** of a reaction?

A A measure of how many atoms in the reactants form the waste products.

B A measure of how many atoms in the reactants form the desired product.

C A measure of the actual yield of product compared to the predicted yield of product.

D A measure of how many atoms form waste products compared to desired products.

Your answer ☐ **[1]**

By contrast, atom economy was much less well understood. Candidates clearly realised that it is a measure of the desired products and so almost no-one chose option A with its heavy emphasis on the waste products. However, the choices between options B, C and D were fairly evenly spread at all ability ranges.

Question 13

13 Which statement describes the properties of **transition metals**?

A High melting point, shiny when freshly cut and brittle.

B Good conductors of electricity, low density and low melting point.

C Good conductors of electricity, strong and malleable.

D Strong, malleable and low density.

Your answer ☐ **[1]**

Most candidates chose electrical conductivity as a key property of a transition metal. Many of the higher ability candidates tended to realise that option C gave the better description, others opted for option B.

Question 14

14 Which statement describes the **advantages** of instrumental methods of analysis?

A Instruments can analyse very small amounts and carry out the analyses slowly.

B Instruments are very accurate and use large amounts of substances.

C Instruments are very accurate and carry out the analyses slowly.

D Instruments are very accurate and can run all the time.

Your answer ☐ **[1]**

Many candidates realised that option D best described the advantages of instrumental methods, with the remaining choices being fairly evenly split between the others.

Question 15

15 The table shows the composition of the Earth's early atmosphere compared with the atmosphere today.

	Nitrogen	**Oxygen**	**Argon**	**Carbon dioxide**
Percentage of gas in the early atmosphere	4	0.5	0.5	95
Percentage of gas in the atmosphere today	78	21	0.9	0.04

Which gas has **changed by the largest percentage** from the early atmosphere to the atmosphere today?

A Nitrogen

B Oxygen

C Argon

D Carbon dioxide

Your answer ☐ **[1]**

Almost all candidates realised that carbon dioxide shows the largest percentage change. Some went for the largest percentage **increase** rather than percentage change, choosing option A.

Section B

Question 16 (a)

16 This question is about the corrosion of metals.

(a) A student investigates the rusting of iron.

Fig. 16.1 shows the experiments she sets up.

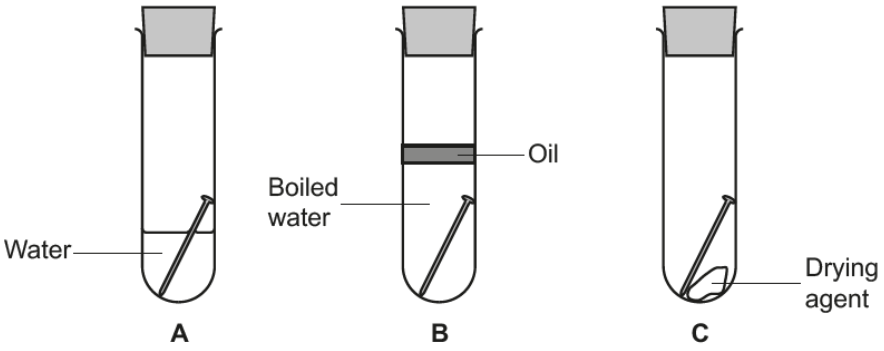


Fig. 16.1

Write about what the student would observe in each tube after one week.

Explain the observations.

Tube **A** .....

.....

Tube **B** .....

.....

Tube **C** .....

.....

[3]

Many candidates knew what would happen in the first and last tubes, and the higher ability remembered to explain their observations and so gained credit. The function of the oil above the boiled water was least well understood 'The oil can't get to the iron.'

Some candidates misread the question and described what **should** be observed rather than what **would** be observed.

Question 16 (b)

(b) Another student buys a new bicycle. The bicycle chain is made of iron.

The student decides to oil the chain to prevent it from rusting, as shown in **Fig. 16.2**.

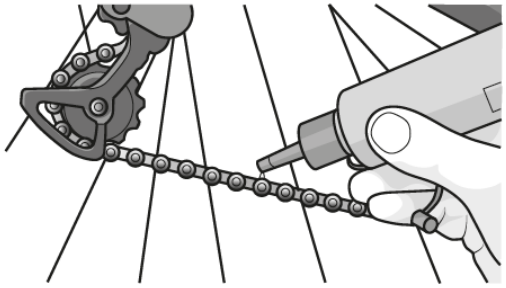


Fig. 16.2

Explain why oiling the chain will prevent the iron from rusting.

.....

.....

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

Most candidates knew that the oil acted as a barrier, although often didn't say against what, as in **exemplar 1,** which was not creditworthy. Higher ability candidates did state that this barrier was against both oxygen and water.

It was interesting to see a language change on going from the laboratory example of rusting to a real-life application. 'Water' often became 'moisture' or 'rain', and 'oxygen' often became 'air'.

For some, this practical application became totally dissociated from the preceding part, and their answers focused on the lubricating properties of oil with minimal mention of corrosion prevention. 'It loosens the chain and makes it more flexible which prevents it from rusting'.

Exemplar 1

Because it is like a protection layer due to being slippy and thick.

Question 16 (c)

(c) A galvanised iron bucket is made of iron coated with a layer of zinc.

After years of use, the zinc coating has become scratched.

The iron below the zinc has been exposed but the iron has not rusted.

Explain why the iron has not rusted.

.....

.....

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

Almost all candidates knew and understood that the zinc plays an active role, and many recognised that it was the continuing presence of zinc that was responsible. 'There are still bits of zinc on the iron stopping it from rusting'. However, even the higher ability candidates had difficulty explaining this in terms of reactivity and sacrificial metals.

A common misunderstanding was to state that zinc acts as a barrier, either without appreciating that the iron was no longer completely coated or accepting that the iron wasn't completely coated but not dealing with it as an issue, as in **exemplar 2** which was not creditworthy.

Some suggested that the zinc was no longer needed because it had permanently altered the iron in some way, for example 'the zinc has covered the iron for so long that the iron isn't vulnerable anymore'. This was sometimes explicitly explained as the zinc continuing to have an effect even though it was no longer there, for example 'because the agents of the zinc are still with the iron, even if the physical zinc isn't'.

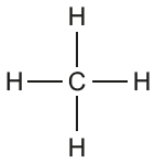
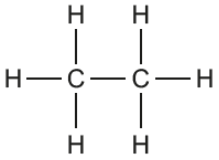
Exemplar 2

Because no moisture can get to the iron So the reaction for rust can't happen. Most of the iron is still covered. **[2]**

Question 17 (a)

17 This question is about hydrocarbons.

The table shows some information about alkanes.

Name of alkane	Molecular formula	Structure
Methane	CH_4	
Ethane	.....	
.....	C_4H_{10}	.....

(a) Complete the table. **[3]**

Molecular formula and structure were both exceptionally well done, with the most common mistake being to write the structure as an incorrect version of cyclobutane.

Naming was much more problematic. Most candidates assumed that alkane would be propane. A few realised that it would start with 'b' but wrote bromine. There was the usual crop of minor misspellings.

Question 17 (b)

(b) Ethane is a **saturated hydrocarbon**.

Explain why ethane is called both a hydrocarbon **and** saturated.

.....

.....

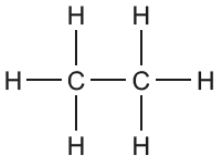
..... **[2]**

Almost all candidates saw that there were two parts to this question and tried to answer both. Hydrogen and carbon were quoted by many, and a small minority went on to say 'only' and so gained credit.

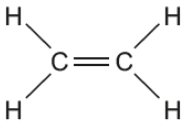
Very, very few could explain what 'saturated' meant. Sometimes candidates got part way there with 'it contains single bonds' but again did not add the word 'only' which would have made it complete. 'Because it only contains two carbons' was not an uncommon incorrect response.

Question 17 (c)

(c) A student has two test tubes. One contains **ethane** and one contains **ethene**.



Ethane



Ethene

The student added **bromine water** to each test tube.

Describe what she observes.

Ethane .....

Ethene .....

[2]

Very few candidates knew what happens when bromine water is added. 'Water fizzes and bubbles with ethene' was a common incorrect response

Question 17 (d)

(d) Ethane belongs to the **homologous series** called the alkanes.

What is the name of the homologous series that **ethene** belongs to?

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

The term alkenes was well known.

Question 17 (e)

(e) Pentane, C_5H_{12}, is an alkane found in petrol.

Pentane undergoes **complete combustion** in excess oxygen, O_2.

Carbon dioxide and water are made.

Write the **balanced symbol** equation for the complete combustion of pentane.

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

Many candidates wrote out the formulae correctly and so gained the first marking point, although some candidates used lower case letters. Many stopped at the formula stage without attempting the more difficult problem of balancing the equation. higher ability candidates went on to do the balancing, often with careful working showing lists of the different atoms on each side. See **exemplar 3**.

Exemplar 3

$C_5H_{12} + 8O_2 \longrightarrow 5CO_2 + 6H_2O$ [2]

Question 18 (a) (i)

18 This question is about the extraction of metals.

(a) When iron oxide is heated with carbon, iron is made.

(i) Complete the **word equation** for this reaction.

iron oxide + carbon → ..... + ... **[1]**

The word equation was well known. Even candidates who were confused still suggested answers such as 'iron and water' or 'iron and oxygen'.

Question 18 (a) (ii)

(ii) Iron oxide is **reduced** during this reaction.

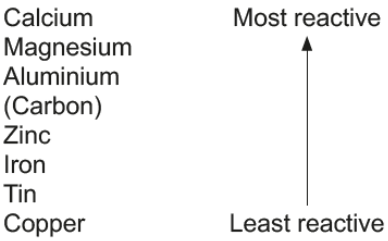
Explain how you can tell that iron oxide is reduced.

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

All candidates found it difficult to explain how they could tell that the iron oxide had been reduced.

Question 18 (b) (i)

(b) Look at the reactivity series of some metals. Carbon is also included.



(i) Zinc is usually extracted from zinc oxide by **heating zinc oxide with carbon**.

Explain why. Use the reactivity series to help you.

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

The reactivity of carbon compared to zinc was well understood.

Question 18 (b) (ii)

(ii) Aluminium is extracted from aluminium oxide by **electrolysis**.

Explain why. Use the reactivity series to help you.

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

The link between reactivity and the need for electrolysis was less well known than the previous part. Some candidates discussed other elements from the reactivity series rather than aluminium, giving answers such as 'because copper is less reactive' or 'magnesium is very reactive'.

Question 18 (c)

(c) The table shows some information about aluminium and zinc.

Metal	Cost of 1 kg (£)	Amount in Earth's crust (%)
Aluminium	1.31	8.1
Zinc	2.51	0.0078

Suggest **two** reasons why it could be more important to recycle zinc than aluminium.

Use information from the table to help you.

1 .....

.....

2 .....

.....

[2]

This question was very well attempted

Question 18 (d)

(d) Aluminium alloys are often used to build aircraft.

A sample of an aluminium alloy contains 1.28 g of magnesium and 43.70 g of aluminium only.

Calculate the **percentage of magnesium** in this alloy.

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

Percentage of magnesium = ... % **[4]**

This question was well attempted. Most candidates had a good basic grasp of how to solve the problem, even if they made mistakes.

Many candidates gained at least partial credit because they had shown their working. A common mistake was to divide 1.28 by 43.70 instead of 44.98. In such cases, the candidate could still gain three of the marks. Often marks were lost due to miscopying of numbers eg 43.70+1.24 instead of 1.28.

Another problem occurred when candidates did not convert the number on their calculator screens from 2.8457 to 2.85. Again, these candidates could still gain the remaining three marks.

Question 19 (a) (i)

19 The Haber process is used to make ammonia, NH_3.

$N_2 + 3H_2 \rightleftharpoons 2NH_3$

(a) The reaction reaches a **dynamic equilibrium**.

(i) What happens to the **rate** of the forward and backward reactions at dynamic equilibrium?

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

That the rates become equal was well understood by higher ability candidates. Others often showed a partial understanding, suggesting 'the rates stayed the same' which is not correct. The lower ability candidates limited themselves to 'the rate increased (or decreased)'.

Question 19 (a) (ii)

(ii) What happens to the **concentrations** of the reacting substances at equilibrium?

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

This was less well understood, with many candidates saying that the concentrations became the same.

Question 19 (b)

(b) Ammonia is used to make fertilisers.

Fertilisers usually contain nitrogen.

Name the **two** other elements that fertilisers usually contain.

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

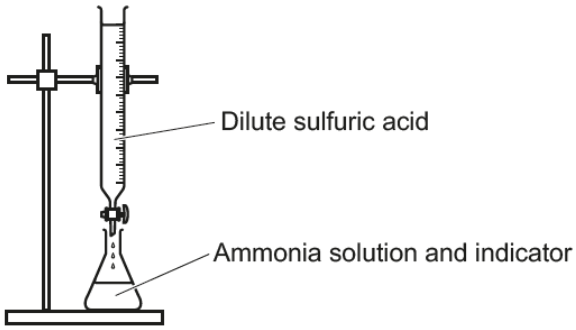
The most popular acceptable response was 'sulfur'. Incorrect responses of water, ammonia, carbon and hydrogen were also common.

Question 19 (c)

(c) Ammonium sulfate is a salt used as a fertiliser.

Ammonium sulfate can be made in a laboratory in a batch process.

Ammonia solution is titrated with dilute sulfuric acid to make a solution of ammonium sulfate, as shown in the diagram.



Describe how you would make **dry crystals** of ammonium sulfate from ammonium sulfate solution.

.....

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

Many candidates got a mark for heating the solution.

Question 19 (d)

(d) Calcium sulfate is another salt.

A student made some calcium sulfate.

Look at the method he used:

- pour 100 cm^3 of calcium nitrate solution into a beaker
- add drops of sodium sulfate solution until a precipitate appears
- allow the precipitate to settle to the bottom of the beaker
- pour off the liquid
- use a spatula to transfer the solid calcium sulfate onto a piece of filter paper.

Describe and explain **two** ways that the student could improve his method to **increase** the amount of **pure**, **dry** calcium sulfate made.

1 .....

.....

.....

2 .....

.....

.....

[4]

Candidates experienced great difficulty in applying their experience to this practical application. Few realised that the calcium nitrate was in excess. Tasks such as filtration were mentioned but lacked clarity of expression. Washing the precipitate was not mentioned at all and at the drying stage many wanted to evaporate the initial solution rather than the wash liquid.

Question 20 (a)

20 Crude oil is separated into useful fractions using fractional distillation.

The table shows the percentages of crude oil fractions from different oil wells.

Fraction	Percentage of fraction in crude oil		
	Oil well X	Oil well Y	Oil well Z
LPG	2	7	10
Petrol	3	10	25
Paraffin	6	15	20
Diesel	7	11	15
Fuel oil	26	29	28
Bitumen	56	28	2

(a) Which oil well contains the highest percentage of low boiling point fractions?

Tick (✓) **one** box.

X ☐

Y ☐

Z ☐

[1]

Higher ability candidates often realised that well Z had the lowest boiling point fraction but most candidates saw the largest number in the table and went for X.

Question 20 (b)

(b) A barrel of crude oil from oil well **Y** has a mass of 139 kg.

Calculate the mass of **fuel oil** in this barrel.

Mass = ... kg **[2]**

Marks gained tended to be 2 or 0. Higher ability candidates answered correctly, many others added all the figures in the 'Oil Y' column to get, unsurprisingly, 100, then either calculated 139/100 or 139-100.

Question 20 (c)

(c) Fractions from crude oil contain alkanes.

Alkanes have the general formula C_nH_{2n+2}.

Write the **formula** of hexadecane, the alkane with 16 carbon atoms.

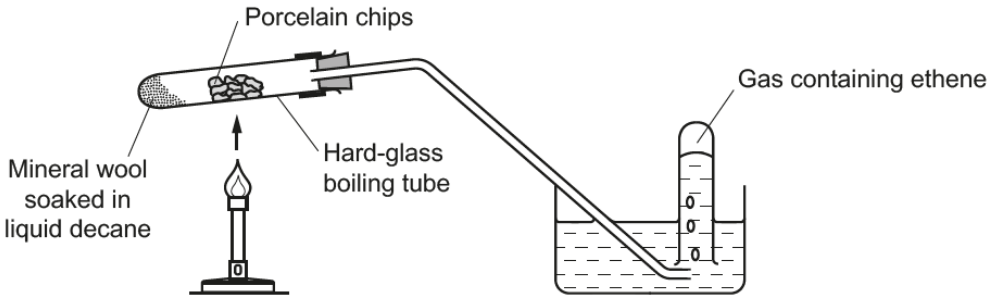
..... **[1]**

Higher ability candidates handled the formula with ease. Other candidates showed clear partial understanding with answers such as $C_{16}H_{2n+2}$ or $C_{16}H_{32+2}$.

Question 20 (d) (i)

(d) A sample of decane was cracked.

Look at the diagram of the apparatus used.



(i) Describe how this apparatus is used to produce ethene from decane.

.....

.....

.....

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

This is another question where candidates were expected to explain a practical application, and few appeared comfortable with the task. The most common incorrect responses included 'decane reacts with the water and makes ethene', 'the porcelain turns into ethene', and 'the chips melt / give off a gas'.

Question 20 (d) (ii)

(ii) One molecule of decane, $C_{10}H_{22}$, produced two molecules of ethene, C_2H_4, and one molecule of product **Z**.

$C_{10}H_{22} \rightarrow 2C_2H_4$ + product **Z**

Write the **formula** for product **Z**.

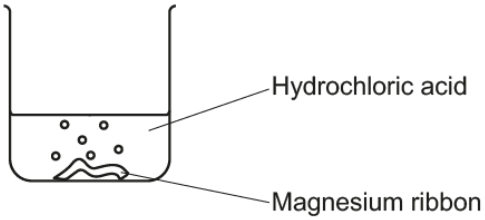
..... **[1]**

Again, higher ability candidates handled this formula with ease. Others got most of the way there and gave answers such as C_6H_{18} or C_8H_{18}.

Question 21 (a)

21 A student investigates the reaction between magnesium and dilute hydrochloric acid, HCl.

The student adds magnesium ribbon to hydrochloric acid in a beaker, as shown in the diagram.



Magnesium chloride, $MgCl_2$, and hydrogen gas are made.

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

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

The task of writing an equation has two main components: writing the correct formulae, most of which were given, and then doing the balancing. In this case, higher ability candidates showed mastery of the formulae and went on to gain both marks. Most other candidates were uncertain of the formulae of hydrogen gas and used 'H' or '2H'. Some did not see the formula of the hydrochloric acid in the stem and wrote HCl_2.

Question 21 (b)

(b)* The student measures the time it takes for all the magnesium to react. This is the reaction time.

The student does five experiments.

This is the student's prediction:

"The smaller the volume of acid and the smaller the mass of magnesium, the shorter the reaction time."

Look at the student's results.

Experiment	Mass of magnesium used (g)	Volume of acid used (cm^3)	Concentration of acid (mol/dm^3)	Reaction time (s)
1	0.05	25	1.0	30
2	0.05	50	1.0	30
3	0.05	50	2.0	15
4	0.10	25	1.0	30
5	0.10	50	2.0	15

Describe and explain whether the student's results support his prediction.

Include ideas about the reacting particle model in your answer.

.....

.....

.....

.....

.....

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

While candidates often had trouble in describing what the table showed, many of them showed a clear intuitive understanding and pointed out that it was only changes in concentration that produced an effect.

The higher ability candidates responded to both the command prompts and interpreted the table and also included ideas about the reacting particle model. A very large number of candidates did not respond to this second prompt, which limited the number of marks available to them.

Question 21 (c)

(c) The student repeats experiment **1**. This time he uses acid at a **lower** temperature.

Explain, using the reacting particle model, **what happens to the rate of reaction** and **predict the reaction time** for this reaction.

.....

.....

.....

.....

.....

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

Higher ability candidates realised that the particles would move slower or have less energy and suggested a suitable reaction time. Occasionally they even went on to discuss collision frequency or the idea of successful collisions and so scored all three marks.

Others showed much confusion over 'rate of reaction' and 'time for reaction'. Many said that when the rate is less the time is less, to the point where examiners could not give credit for statements such as 'the reaction is slower' because there was so much evidence of misunderstanding in that area.

A significant number of candidates were able to explain what happens when temperature increases but had some difficulty in reversing their argument to explain what happens if temperature falls. Answers such as 'Less chance of more frequent successful collisions' and 'Fewer frequent successful collisions' were common. These candidates were still able to gain full marks, but centres should be aware of this as a potential problem.

Question 21 (d)

(d) During chemical reactions, reactants are used up and the rate of reaction **decreases**.

Explain, in terms of particles, why the rate of reaction decreases.

.....

.....

.....

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

The reasons why reactions slow down as they progress was not well understood by candidates of all abilities. Many answers went no further than a re-wording of the stem, stating that the reactants are used up so the rate decreases. Most candidates who did give some form of explanation did so in terms of energy. 'Once the reactants are used up the particles slow down / have less energy', as in **exemplar 4**. There were also several references to enzymes and denaturing

Exemplar 4

because once the reactants are used up there is no more product to react so particles slow down [2]

Question 22 (a)

22 This question is about properties of materials.

Police bullet-resistant vests could be made from steel or Kevlar®.

The table shows some information about steel and Kevlar®.

	Steel	**Kevlar®**
Density (g/cm^3)	7.85	1.44
Relative strength	1	5
Flexibility	low	high
Resistance to corrosion	low	high

(a) Describe and explain **two** reasons why bullet-resistant vests are made from Kevlar® instead of steel.

1 .....

.....

.....

2 .....

.....

.....

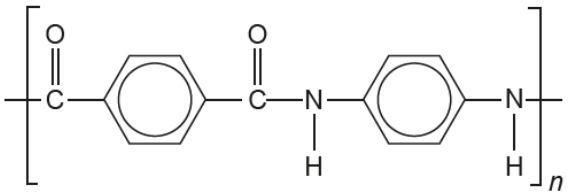
[4]

The whole of this question is common with the Higher Tier paper.

Part (a) was well answered.

Question 22 (b)

(b) Look at the structure of Kevlar®.



What type of molecule is Kevlar®?

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

Candidates found this question challenging with only some of the higher ability candidates appreciating that Kevlar is a polymer molecule. Some others were heading more in the right direction when they suggested that it might be a giant structure. There was a wide variety of incorrect answers to this question with 'nanoparticle' being one of the more commonly seen responses.

Question 22 (c) (i)

(c) Nanoparticles are being used to make a material that is better than Kevlar® at resisting bullets.

Nanoparticles are often made of silicon dioxide.

A silicon dioxide nanoparticle has a diameter of 18 nm.

The diameter of a silicon atom is 0.22 nm.

(i) Estimate how many times larger the silicon dioxide nanoparticle is, compared to a silicon atom.

Give your answer to **1** significant figure.

Number of times larger = ... **[3]**

The many candidates who calculated the exact answer rather than estimating it were still able to gain some credit, but examiners were looking for the ability to estimate as it is one of the mathematical requirements.

A few candidates assumed this was a much more complicated problem than it was and calculated the areas of circles of the two diameters given.

Question 22 (c) (ii)

(ii) Silicon dioxide is used as a **catalyst**.

Suggest why 1 g of silicon dioxide is **more effective** as a catalyst when used as nanoparticles rather than as a powder.

.....

.....

.....

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

A few candidates understood that nanoparticles might be more effective as catalysts because of their surface area, even though they had problems in expressing that relationship, as in **exemplar 5**. Most, but not all, realised that nanoparticles are smaller than the particles of powder, although it was not uncommon to see 'nanoparticles have larger diameter so larger surface area'. It was rare for candidates to explain why surface area affected rate of reaction, and there was no discussion of reaction sites.

Exemplar 5

Because it has more surface area to volume ratio. This means the more surface area it has, the faster the reaction will take place - speeding it up. **[3]**

This response gained two of the three marks available.

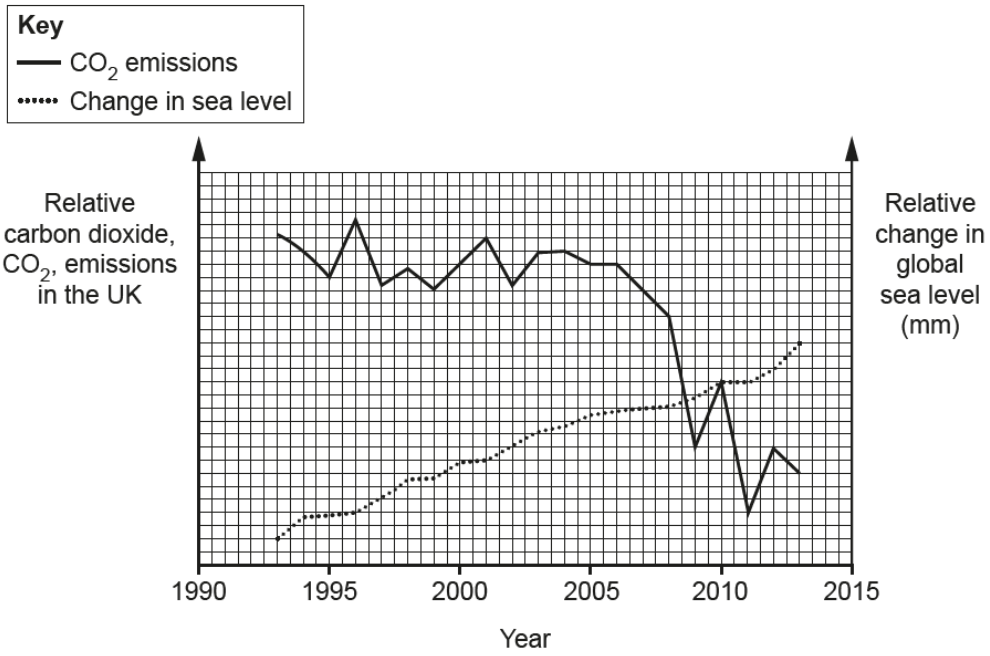
Question 23 (a)

23 Some scientists believe that the increased burning of fossil fuels has contributed to global warming.

The scientists say that global warming is causing ice to melt, which results in sea levels rising.

Other scientists believe that rises in global temperatures are just natural variations.

The graph shows the carbon dioxide, CO_2, emissions by fossil fuels in the UK and the changes in global sea levels between 1993 and 2013.



(a) Evaluate the information shown in the graph.

To what extent does the graph support a link between human activity and global warming?

.....

.....

.....

.....

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

The whole of this question was common with the Higher Tier paper.

Many candidates successfully described the trends of the two lines. However, some assumed that the graph illustrated what they were expecting and made statements such as 'this shows that humans have a massive impact on global warming'. Some lower ability candidates clearly did not understand that the two lines on the chart referred to different Y axes, so discussed sea level and CO_2 emissions being equal in 2008 or 2010.

Question 23 (b)

(b) There are problems with using information about **CO_2 emissions by fossil fuels** to draw conclusions about the effect of carbon dioxide emissions on **global** sea levels.

Suggest what these problems are.

.....

.....

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

Some candidates gained credit for realising that there were other sources of CO_2 but the majority discussed factors other than CO_2 such as methane emissions. These answers could not be given credit because the question was specifically about the link between CO_2 emissions and global sea levels. A significant minority of candidates mentioned difficulty of acquiring data on CO_2.

Question 23 (c) (i)

(c) (i) Describe **one** effect on the Earth's climate of increased carbon dioxide levels, other than rising sea levels.

.....

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

Many candidates went no further than the stem, stating that temperatures would rise. Examiners were looking for a little more detail than this. There were many references to the ozone layer, the greenhouse effect, acid rain and global warming, which were not creditworthy.

Question 23 (c) (ii)

(ii) Suggest how we can lower carbon dioxide levels.

.....

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

This question was very well answered, with suggestions ranging from tree planting to increased use of public transport. This was clearly an issue that candidates have discussed.

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