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Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

TWENTY FIRST CENTURY SCIENCE CHEMISTRY B

J258
For first teaching in 2016

J258/02 Summer 2018 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

This paper was designed to assess the depth of chemical knowledge shown by the candidates. It was the second paper of this kind in the new specification. Most candidates were able to attempt most questions, even if they didn't always manage to earn many marks. To do well, candidates needed to make use of the information they had been given but also to bring their own knowledge of chemistry into play. The exam included more mathematical assessment than previous specifications and some candidates did not expect to have the mathematical skills in the specification assessed directly (Question 5 and Question 8). The extended prose required in some questions (Question 7 and Question 9) is a challenge to some candidates, but the question often provides a structure which the best candidates use to good effect. Practical skills are now assessed in the written examination instead of a coursework assessment. Some candidates showed ability to describe laboratory practice (Question 9) but there is scope for improvement here. Questions 10 and 11 were an overlap with the Higher Paper so provided some of the most demanding challenges. It was particularly noticeable that candidates did not recognise the anion tests used in Question 10.

To achieve a good grade, candidates needed to take careful note of the questions as there is often key information in the stem. Some candidates also lost marks by misreading the question or answering a question of their own devising. The language of the examination was inclusive and there was no evidence that any were disadvantaged by this or cultural issues. There was little or no indication of time pressure or other constraints for most candidates.

Question 1 (a) (i)

1 Ali does an experiment to find out how the pH changes when he adds dilute sodium hydroxide to dilute sulfuric acid.

He puts the dilute acid in a beaker and adds dilute sodium hydroxide, 1.0 cm^3 at a time.

He uses a pH meter to measure the pH of the mixture during the reaction, as shown in **Fig. 1.1**.

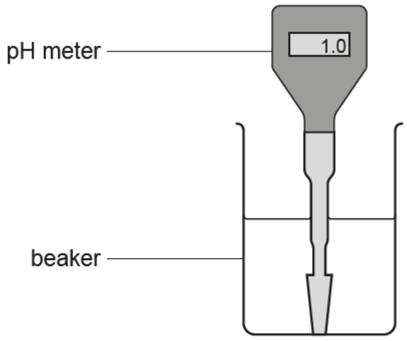


Fig. 1.1

Ali plots a graph of his results, as shown in **Fig. 1.2**.

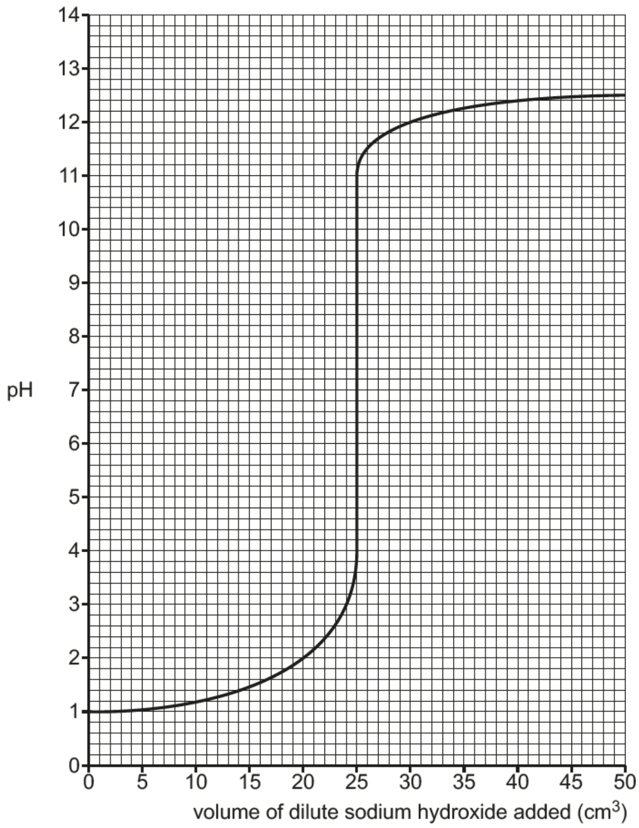


Fig. 1.2

(a) (i) Use values from the graph in **Fig. 1.2** to describe how the pH changes when dilute sodium hydroxide is added to the acid.

....

....

.... **[2]**

It was not sufficient to simply say that the pH has increased – nor even that it increased slowly then rapidly and then slowly again. Candidates need to use values from the graph to gain credit.

Exemplar 1

When 5cm³ of dilute sodium hydroxide is added the pH increases slowly until 25cm³ is added then it increases rapidly to 11pH then slowly increases and becomes constant **[2]**
at 12.5pH.

This candidate has **used values** to describe the graph.

Question 1 (a) (ii)

(ii) Explain why the pH readings at the start, and at the end of the reaction, are different.

....

....

.... **[2]**

The question requires an explanation of **why** the pH is low at the start and high at the end and not just a restatement of the shape of the graph.

Question 1 (b) (i)

(b) Ali writes an equation for the reaction.

(i) Balance the symbol equation by putting numbers on the dotted lines.

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

[1]

This was reassuringly well done by many candidates, although some showed a lot of working to obtain just one mark.

Question 1 (b) (ii)

(ii) Draw lines to connect each **substance** with its correct **formula**.

Substance	**Formula**
water	NaOH
sodium sulfate	H_2SO_4
sulfuric acid	Na_2SO_4
sodium hydroxide	H_2O

[2]

This question was well done with the large majority of candidates clearly able to relate formulae to names.

Question 1 (c) (i)

(c) The reactions of acids with hydroxides can be shown by this general equation.

(i) Complete the word and symbols equations by filling.

hydrogen ions + ... → water

.... + OH^- → ....

[2]

Most candidates were aware of the formula for water but far fewer were able to name hydroxide ions (often simply called oxide ions) or give the formula for a hydrogen ion.

Question 1 (c) (ii)

(ii) What is the name for this type of reaction?

Put a (ring) around the correct answer.

filtration **oxidation** **precipitation** **neutralisation**

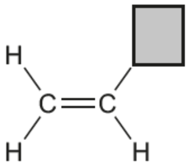
[1]

Neutralisation was the commonest (and correct) answer and oxidation was the frequently given incorrect answer.

Question 2 (a)

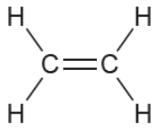
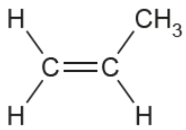
2 Polymers are made when small monomer molecules react together.

The diagram shows a general formula for some monomers that react to make addition polymers.



 represents an atom or group of atoms in the formula.

The table shows the formulae of some monomers.

Name of polymer	**Monomer**	 **represents**
poly(ethene)		H
PVC	....	C*l*
poly(propene)		....

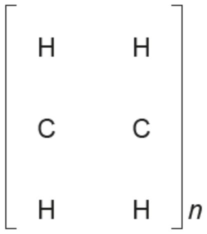
(a) Complete the table by filling in the missing information. **[2]**

This question discriminated effectively. Many good candidates were quick to be credited two marks – but some candidates were unfamiliar with the idea. A few lost the mark for the PVC monomer by using two capital letters for the chlorine symbol.

Question 2 (b)

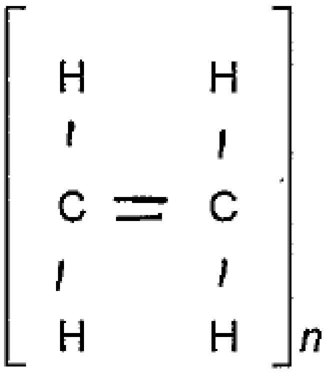
(b) The structure of each polymer can be shown as a repeating unit.

Complete the diagram below by drawing the bonds in the **repeating unit** of poly(ethene).



[2]

Exemplar 2



Few candidates appreciated that the question was asking for the repeating unit and instead gave the formula of the ethene monomer, as in **exemplar 2**.

Question 2 (c) (i)

(c) The formula of the poly(propene) monomer can be shown as $CH_2CH(CH_3)$.

(i) Calculate the relative formula mass of the poly(propene) monomer.

Use the Periodic Table to help you.

Relative formula mass = ... **[2]**

A small number of lower ability candidates used the atomic number rather than the mass for carbon. However, most used relative mass values for carbon and hydrogen from the Periodic Table. Some candidates were more familiar with the use of brackets in mathematics than a chemical formula. A surprisingly large value can be obtained by working out the mass of CH_2CH (27) and then multiplying by the mass of CH_3 (15), which was seen from some candidates.

Question 2 (c) (ii)

(ii) The relative formula mass of an ethene monomer is 28.

A poly(ethene) polymer has an average relative formula mass of 11200.

How many ethene monomers have been joined to make this poly(ethene) polymer?

Number of ethene monomers = ... **[1]**

Most candidates worked this out correctly.

Question 3 (a)

3 Malachite is an ore of copper that contains copper carbonate, $CuCO_3$. It is mined on a large scale all over the world.

The flowchart in **Fig. 3.1** shows how copper can be made from copper carbonate, either in industry, or on a small scale in the laboratory.

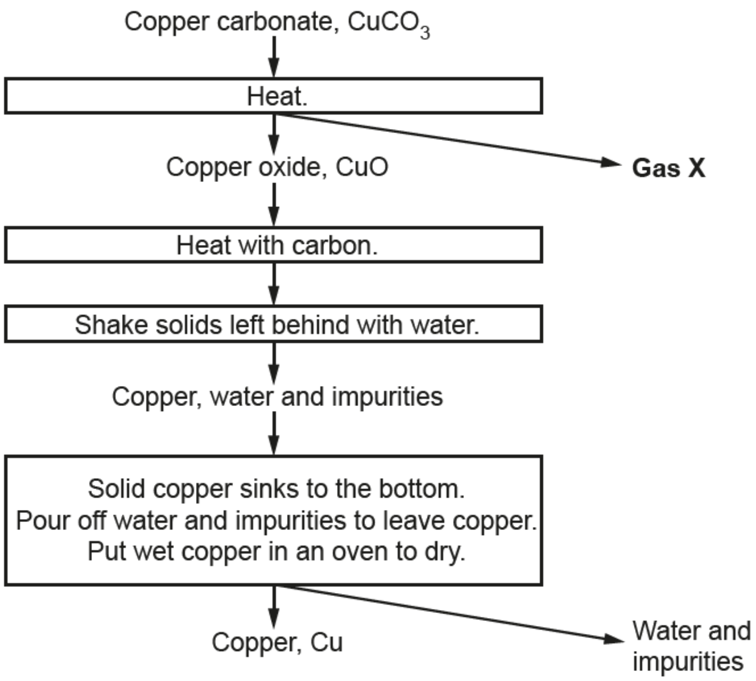


Fig. 3.1

(a) **Gas X** forms when copper carbonate is heated.

What is the name of **gas X**?

Put a ring around the correct answer.

carbon dioxide **chlorine** **hydrogen** **nitrogen**

[1]

The evolution of carbon dioxide from a carbonate was well known.

Question 3 (b)

(b) Which substances in **Fig. 3.1** are **raw materials**, which are **products** and which are **waste**?

Tick (✓) **one** box in each row.

Substance	Raw Material	Product	Waste
copper carbonate			
gas X			
carbon			
water and impurities			
copper			

[2]

The distinction between raw material, product and waste was very well understood by most higher ability candidates.

Question 3 (c) (i)

(c) Jane uses the flowchart in **Fig. 3.1** as a method to make copper in the laboratory.

Jane's teacher gives her **Fig. 3.2** to help her predict the theoretical yield of copper.

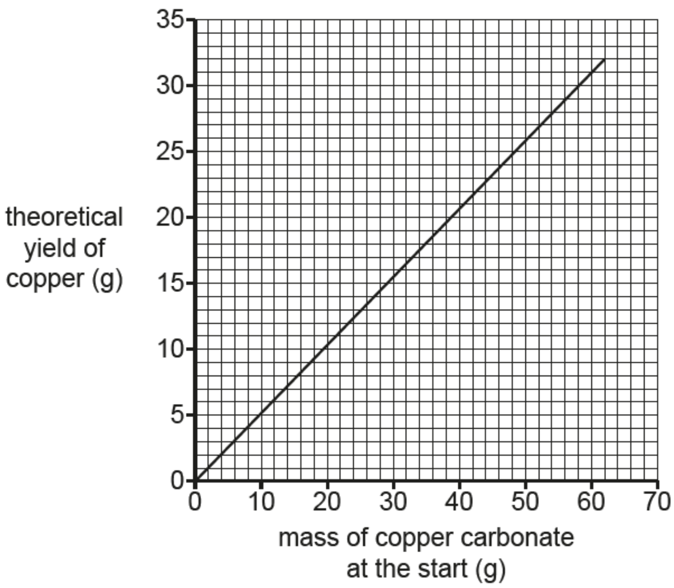


Fig. 3.2

(i) Jane looks at **Fig. 3.2** and thinks that the theoretical yield of copper is directly proportional to the mass of copper carbonate at the start.

Use values from the graph in **Fig. 3.2** to explain why Jane is right.

....

....

.... **[2]**

The concept of direct proportion is often used but was rarely well explained. The idea that both quantities are increasing is a useful start, but two marks required the use of values from the graph to demonstrate more detail.

Question 3 (c) (ii)

(ii) Explain why the line on the graph in **Fig. 3.2** starts at 0 on both axes.

....

.... **[1]**

Only the higher ability candidates gained this mark. If the amount of copper carbonate is zero, then there cannot be a yield. The reverse argument is not true.

Question 3 (c) (iii)

(iii) Jane wants to make a theoretical yield of 15.0 g of copper.

What starting mass of copper carbonate should she use?

Use the graph in **Fig. 3.2** to help you.

Mass of copper carbonate = ... g **[1]**

The tolerance of half a small square (28-30g) was sufficient for most candidates to be credited a mark.

Question 3 (c) (iv)

(iv) Jane does the experiment. She measures the mass of copper she makes (her actual yield).

The mass of copper she makes is higher than she predicts. She knows that she has made mistakes.

Which two mistakes could lead to an incorrectly high yield?

Tick (✓) **two** boxes.

She did not use enough copper carbonate. ☐

She did not dry the copper at the end. ☐

She did not heat the copper oxide for long enough. ☐

Her copper contains solid impurities. ☐

[2]

Most candidates selected one correct response but many assumed that Jane had not heated the sample for long enough for their second response.

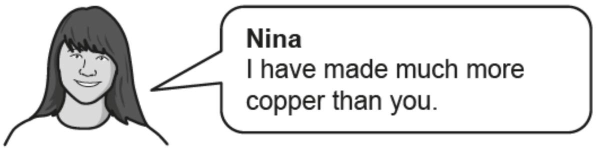
Question 3 (d)

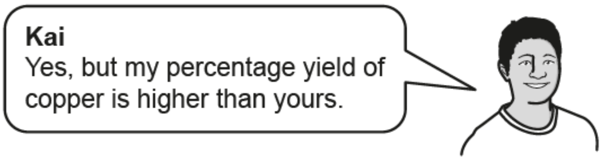
(d) Nina and Kai also follow the flowchart in **Fig. 3.1** to make some copper.

They compare the mass of copper they make at the end (their actual yield) with each other.

Name	Mass of copper carbonate at the start (g)	Theoretical yield of copper (g)	Mass of copper made (actual yield) (g)
Nina	50.0	26.0	18.0
Kai	10.0	5.0	4.8

They make statements about their results.





Are Nina and Kai's statements correct?

Use data from the table to explain your answers.

Nina

....

....

Kai

....

.... **[2]**

As before, the question required that the answer **use data** from the table. Although many saw that Nina had made more copper (13.2g more) the yield calculation was often misunderstood. Many candidates wrongly estimated Kai's yield at 48% and Nina's at 32%.

Exemplar 3

Nina

Nina is correct, but this is because she used a larger mass of ~~CuCO~~ copper carbonate.

Kai

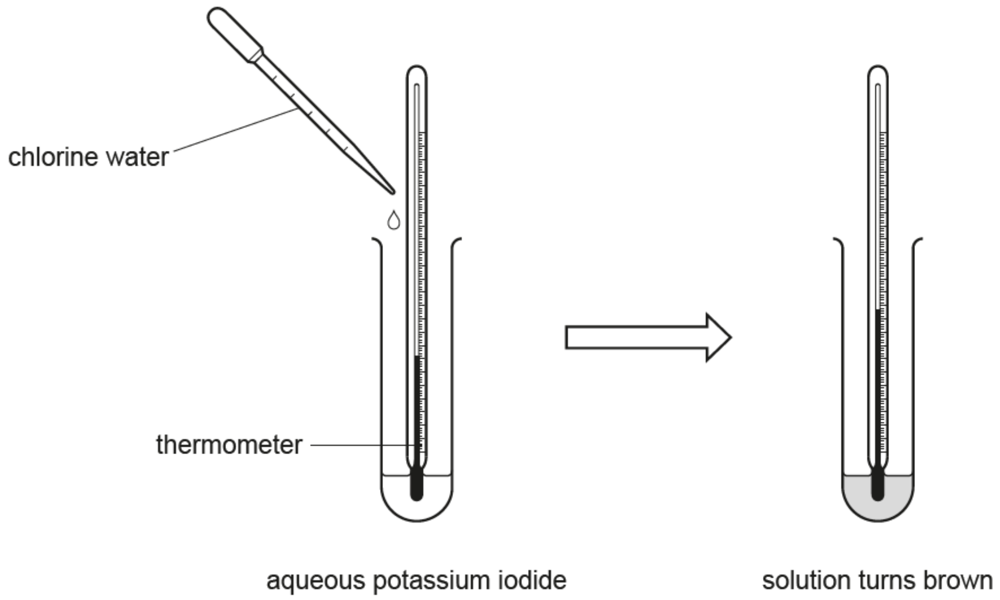
This is correct as the percentage yield of the copper is higher being 96% whereas Nina's is only 69%. **[2]**

This candidate has selected the relevant data to describe Nina's experiment and has correctly calculated the yields for both for the second mark.

Question 4 (a)

4 Eve does an experiment to find out if chlorine is more reactive than iodine.

She adds a few drops of chlorine water to aqueous potassium iodide.



The solution turns brown and there is an increase in temperature.

She writes this equation for the reaction.

$$Cl_2\,(aq) \quad + \quad 2KI(........) \quad \longrightarrow \quad I_2\,(aq) \quad + \quad 2KCl\,(........)$$

(a) Add the missing **state symbols** to the equation. **[1]**

Despite simply requiring (aq) as both missing state symbols, only a minority of candidates obtained this mark.

Question 4 (b)

(b) Write a **word** equation for this reaction.

.... **[1]**

Exemplar 4

chlorine + potassium iodine → iodine + potassium chloride **[1]**

The word equation was attempted by most candidates but many lost credit for mixing up **iodine** with **iodide**, as in **exemplar 4.**

Question 4 (c)

(c) Explain why the solution turns brown.

.... **[1]**

The colour of iodine solution was rarely known.

Question 4 (d)

(d) Complete the sentences about this reaction by putting a (ring) around **one** word in each line.

The temperature increase shows that the reaction is **endothermic** / **exothermic**.

The reaction happens because chlorine is **more** / **less** reactive than iodine.

This type of reaction is called **displacement** / **precipitation**.

The reaction makes iodine and a **metal** / **salt**.

[3]

These terms were well understood with only a minority of candidates gaining less than 2/3.

Question 5 (a)

5 **Table 5.1** shows the melting points of some transition metals.

Metal	Melting point (°C)
mercury	–39
vanadium	1910
copper	1100
chromium	1900
zinc	420

Table 5.1

(a) Complete each sentence.

Use the symbols.

You can use each symbol once, more than once, or not at all.

= **<** **~** **>**

The melting point of mercury ☐ the melting point of vanadium.

The melting point of vanadium ☐ the melting point of chromium.

The melting point of chromium ☐ the melting point of zinc.

[2]

This question was answered well with the meanings of these symbols being understood by the majority of candidates.

Question 5 (b) (i)

(b) The **boiling** point of mercury is 357 °C. Room temperature is 20 °C.

(i) What is the **state** of mercury at room temperature?

Put a (ring) around the correct answer.

aqueous solution **gas** **liquid** **solid**

[1]

Almost half of candidates could work out (or knew) that mercury is a liquid.

Question 5 (b) (ii)

(ii) Explain the reasoning for your answer to **(b)(i)**.

....

.... **[2]**

Many candidates struggled to explain how the melting and boiling point relate to the room temperature in deciding the state of matter.

Question 5 (c)

(c) **Table 5.2** shows more information about **copper**, **zinc** and **mercury**.

Metal	Colour of metal oxide	Acts as a catalyst
copper	black or red	yes
zinc	white	no
mercury	red	yes

Table 5.2

Zinc is **not** a typical transition metal.

Which two statements show that it is **not** a typical transition metal?

Tick (✓) **two** boxes.

All transition metals have red oxides. ☐

Transition metals are good catalysts. ☐

Zinc does not form coloured compounds. ☐

Zinc is in Group 1. ☐

[2]

Many candidates gained credit here with the most common incorrect answer being that 'zinc is in Group 1'.

Question 6 (a)

6 Ammonium sulfate is a fertiliser. It is usually sold to farmers as a solid in large sacks.

Different industrial processes can be used to make ammonium sulfate.

Process	**Equation**	**How the process works**	**Other points**
1	$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$	Reactor kept at 60 °C. Uses concentrated sulfuric acid. A solution of ammonium sulfate is made.	Reaction is exothermic. Atom economy 100%.
2	$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$	Sulfuric acid is sprayed into dry ammonia gas. Dry powdered ammonium sulfate is made.	Reaction is exothermic. Atom economy 100%.
3	$(NH_4)_2CO_3 + CaSO_4 \rightarrow (NH_4)_2SO_4 + CaCO_3$	Calcium carbonate forms as a precipitate in a solution of ammonium sulfate.	Atom economy 57%. Calcium carbonate is a waste product.

Use information from the table to answer these questions.

(a) In **process 1**, the reactor reaches 60 °C without being heated.

Explain why the reactor keeps hot **without** being heated.

....

.... **[2]**

Question 6 is largely assessing the ability of the candidate to apply their knowledge. Many candidates gained a mark for spotting that the exothermic reaction is responsible for this, but the explanation requires that the candidate brings their knowledge to explain how this happens.

Question 6 (b)

(b) Suggest **one** advantage of using **process 2** to make ammonium sulfate, rather than the other two processes.

....

.... **[2]**

Candidates found this question challenging with less than half gaining any marks. Again, the key is the idea of making a solid rather than a solution – but the second mark is for linking this to how the fertiliser is transported.

Question 6 (c)

(c) Use the equations in the table to explain why the atom economies of the processes are different.

....

....

....

.... **[2]**

The Atom Economy values are given in the table, so there is no credit for simply reporting them. A small number of candidates spotted this and explained why process three is so different.

Question 6 (d) (i)

(d) **(i)** The method used in **process 3** can also be done in the laboratory.

Which two techniques are needed to separate solid ammonium sulfate from the final reaction mixture?

Tick (✓) **two** boxes.

Filtration ☐

Distillation ☐

Neutralisation ☐

Evaporation ☐

[2]

Quite a lot of candidates answered this correctly, relating their practical experience to an unfamiliar situation.

Question 6 (d) (ii)

(ii) Ammonium sulfate is made in the laboratory in a **batch** process.

The processes that make ammonium sulfate in industry are **continuous** processes.

Describe the **differences** between batch and continuous processes.

....

....

....

.... **[2]**

Exemplar 5

Batch processes are ~~whe~~ were the substance is made in big groups, seperately; and continuous processes is where the substance is constantly being made to produce larger amounts at a continuous rate. **[2]**

Although most candidates attempted this question, the need to explain two words without using the words themselves proved to be challenging for some.

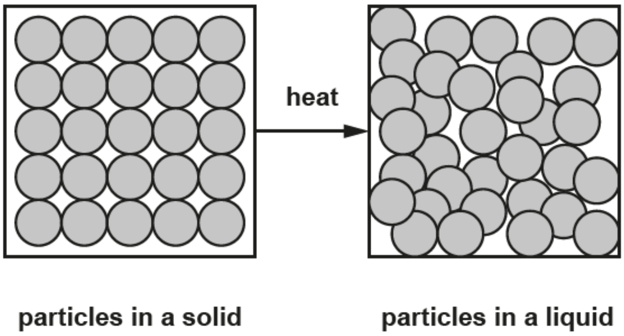
	AfL	A batch process is usually deployed to make a small amount of a product. The process is then stopped and the same space or equipment may be used to make a different product. Continuous processing does not stop and uses the equipment for one specialised purpose only.

Question 7

7* Ice (solid water) and common salt (sodium chloride) are solids with different melting points.

	Melting point (°C)
ice	0
salt	800

The diagrams show what happens when a solid is heated until it melts and becomes a liquid.



Explain why heating causes solids to melt, and why ice and salt have different melting points.

Use the diagrams, and ideas about forces between particles, to support your answer.

....

....

....

....

....

.... **[6]**

Many responses started by describing what happens to particles in a solid during melting. A purely descriptive answer could then be enhanced by the candidate bringing their own knowledge about the forces between particles. Having established that heat was needed to overcome these forces the difference in the melting points can then be explained by considering the relative strength of the intermolecular forces in ice and the ionic attractions in solid sodium chloride. The best responses identified these three steps from the stem of the question and were structured accordingly.
Less successful candidates often answered one part (usually the description) at length and then did not address the remaining requirements of the question.

Exemplar 6

Heating causes solids to melt because it breaks bonds between particles and causes particles to slide over eachother which makes it a liquid.
Salts have a higher melting point than ice because they have stronger intermolecular forces between it's particles so it requires more heat energy to break these bonds and cause it to melt.

Many responses started by describing what happens to particles in a solid during melting as in this exemplar. A purely descriptive answer achieved Level 1. It could then be enhanced by the candidate bringing in their knowledge about the forces between particles. Having established that heat was needed to make these forces insignificant the difference in the melting points can then be explained by considering the relative strength of the intermolecular forces in ice and the ionic attractions in solid sodium chloride. Level 3 responses identified these three steps from the stem of the question and were structured accordingly. **Exemplar 6** is a Level 3, 6-mark answer as they have addressed all parts of the question successfully.

Question 8 (a) (i)

8 Over the last 20 years, there have been a series of agreements between governments to limit the emission of greenhouse gases. These gases include carbon dioxide, methane and nitrous oxides.

(a) **Table 8.1** shows some measurements of the concentrations of these gases in the atmosphere now.

Gas	Concentration in the atmosphere
carbon dioxide	0.04%
methane	1800 ppb
nitrous oxides	1400 ppb

Table 8.1

The units used to measure the concentration of the gases are different.

(i) Calculate the concentration of carbon dioxide, in ppb.

1% = 10 000 000 ppb (parts per billion)

Concentration = ... ppb **[2]**

Many candidates did well here but a wrong answer costs both marks unless working was given.

Question 8 (a) (ii)

(ii) Governments think that reducing emissions of carbon dioxide will have a bigger effect on the environment, than reducing emissions of the other gases.

Use the data in **Table 8.1** to explain why they are right.

....

....

.... **[2]**

Most candidates identified that the carbon dioxide concentration (which they had just calculated) was much higher than the other gases mentioned (although some candidates were confident that the carbon dioxide had the highest atmospheric concentration overall, forgetting nitrogen, oxygen and argon). The second mark was for explaining the effect on the environment of reducing CO_2 emissions. A common error was to ignore this, or simply repeat the stem.

Question 8 (b) (i)

(b) The first major agreement between countries was the 1997 Kyoto Protocol.

The graph in **Fig. 8.1** shows the concentration of some greenhouse gases in the atmosphere before the Kyoto Protocol was introduced.

Item removed due to third party copyright restrictions

Fig. 8.1

(i) Which statements about the data in **Fig. 8.1** are **true** and which are **false**?

Tick (✓) **one** box in each row.

Statement	**True**	**False**
For each gas the concentration remained approximately constant for 1500 years.		
The concentration of methane is usually higher than the concentration of nitrous oxide.		
The concentration of carbon dioxide is measured in ppb.		
The concentration of all three gases has more than doubled since 1500 years ago.		

[3]

The graphic showed concentration of three gases over 2000 years. However, the concentration of CO_2 was in parts per million, the N_2O and CH_4 were both in parts per billion but on separate scales. Very few candidates extracted information to gain full marks. Most candidates could usefully practice extracting data from a complex graphic and comparing this to valid (and invalid) conclusions.

Question 8 (b) (ii)

(ii) Amir makes this comment about the graph.

> **Amir**
> There are general correlations on the graph but annual concentrations do not show close correlations.

Do you agree with Amir?

Yes ☐

No ☐

Use the graph in **Fig. 8.1** to explain your answer.

....

....

.... **[2]**

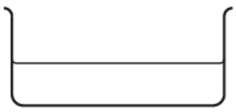
The concept of correlation causes some difficulty. Here, the three gases are perhaps correlated because all follow a broad pattern (varying very little over 1500 years and then increasing abruptly at about the same time). However, because of the varying units and axes, this was not always well explained. The second part of the statement concerned the early stages of the graph. The three lines are not identical with a peak for one gas corresponding to a minimum for another so close correlation is not achieved. Very few candidates managed to explain this adequately.

Question 9

9* Mia is a teacher. She does a demonstration to show the reactions of the metals in Group 1 with water. She wants to show the trend in reactivity for potassium, sodium and lithium.

She wears goggles and takes other steps to make sure that she keeps herself and her students safe.

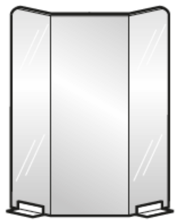
The diagram shows the equipment she uses.



water

small pieces of each metal stored in oil

tongs



safety screen

Describe how Mia should do her demonstration, and what results she should expect to see.

....

....

....

....

....

.... **[6]**

As with Question 7, careful reading of the stem would yield the structure for a complete response. Many candidates started with detailed and clear descriptions of the demonstration with good reference to safety. A more complete response attempted the second part of the stem, describing what results would be observed and the candidate is expected to add their own knowledge to the stimulus material to describe a general reaction of a group 1 metal in cold water. The higher ability candidates also noted that the demonstration was intended to show the trend in reactivity and addressed this point as well.

Exemplar 7

Mia should put the safety screen in front of ~~her~~ the water and tell her students to remain on the side of the screen where the water is not. One by one she should put a single piece of the metal into the water using the tongs. Mia should expect that all the metals will be very reactive and potassium will do the most harm if anyone is stupid and messes around in the demonstration.

As with Question 7, careful reading of the stem would yield the structure for a complete response. Most candidates gave clear descriptions of the demonstration with good reference to safety, but many stopped there, achieving only Level 1 (2 marks). **Exemplar 7** demonstrates this.

Exemplar 8

Mia, in her experiment, should follow some steps. She must put goggles and gloves on to ensure no accidents happen. Then she must put up the safety screen and ask her students to step away from the experiment for safety precautions. Now, using the tongs she must pick up a piece of metal and gentally place it in the water, on the Surfale. lithium will be least reactive, it shouldn't do much. Sodium will gentally glide across the water whilst producing bubbles. Potassium will rapidly dart around the water, Potassium is most reactive. **[6]**

A Level 2 response attempted the second part of the stem, describing what results would be observed. The candidate is expected to add their own knowledge to the stimulus material to describe a general reaction of a group 1 metal in cold water. To achieve Level 3, candidates had to note that the demonstration was intended to show the trend in reactivity and address this point as well. **Exemplar 8** gained Level 3, 5 marks.

Question 10 (a)

10 Alex collects some samples of minerals from a spoil heap near an old mine.

Alex tests two samples of minerals, **A** and **B**, to identify the ions that they contain.

(a) He carries out flame tests on each sample and compares his results (**Table 10.1**) to a reference book of flame colours for some metal ions (**Table 10.2**).

Alex's results

Mineral	Flame colour
A	green
B	orange-red

Table 10.1

Reference book

Metal ion	Flame colour
copper	blue-green
calcium	orange-red
iron	varies with temperature blue/green/yellow/orange
zinc	green

Table 10.2

Use information from **Table 10.1** and **Table 10.2** to explain why Alex cannot be certain which ions are in the samples.

....

....

....

.... **[3]**

Many candidates identified ambiguities in the colours given in the reference book data as a source of uncertainty allowing three different responses for Mineral A and two for Mineral B.

Question 10 (b) (i)

(b) Alex makes a solution of a sample of each mineral in water and does some further tests.

The tests he carries out, and his results, are shown in **Table 10.3**.

Mineral	Test	Result
A	Add dilute sodium hydroxide.	blue precipitate
	Add dilute hydrochloric acid.	fizzes, gas given off turns lime water milky
	Add dilute silver nitrate.	white precipitate
B	Add dilute sodium hydroxide.	white precipitate does not dissolve in excess
	Add dilute hydrochloric acid.	no change
	Add dilute silver nitrate.	white precipitate

Table 10.3

(i) Alex thinks that mineral **A** contains two negative ions.

How can you tell from the results that Alex is right?

....

.... **[1]**

These tests were almost completely unknown to foundation candidates. Sodium hydroxide is being used to confirm the presence of metal ion so is not relevant here but the acid shows the presence of a carbonate ion and the silver nitrate a chloride.

Question 10 (b) (ii)

(ii) Identify the ions in mineral **A** and mineral **B**.

Choose words from this list.

copper **calcium** **iron** **zinc** **carbonate** **chloride** **sulfate**

Ions in mineral A	Ions in mineral B
....	....

[3]

Since the anion tests were not recognised in the previous part question, many candidates returned to the flame tests and restated which metals could have been present in the minerals.

Question 10 (c)

(c) Alex also has an emission spectroscopy machine to analyse samples of minerals.

Give **one** advantage of using an emission spectroscopy machine, rather than flame tests or chemical tests, to identify samples.

....

.... **[1]**

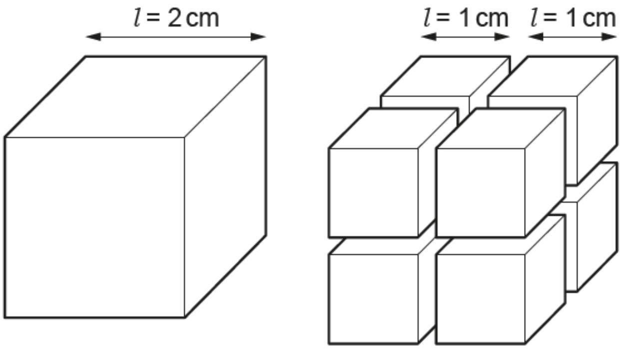
Most candidates were aware of the use of emission spectroscopy. However, few could give a specific advantage for an instrumental technique over a laboratory test, taking refuge in generalisations like "more reliable" without enough detail.

Question 11 (a) (i)

11 Silver nanoparticles are used in some socks to remove the smell of sweaty feet.

Silver nanoparticles have different properties to larger pieces of silver because they have a different surface area to volume ratio.

(a) The diagram shows what happens when a larger cube of silver is cut into eight smaller cubes.



The volume and surface area of a cube can be worked out using these formulae:

volume = $l \times l \times l$

surface area = $6 \times l \times l$

Table 11.1 shows the volume, surface area, and surface area to volume ratio for the larger cube.

Property	**Larger cube**	**Smaller cubes**
Total volume (cm^3)	8	....
Total surface area (cm^2)	24	....
Surface area to volume ratio (per cm)	3	....

Table 11.1

(i) Complete **Table 11.1** by filling in the blank spaces for the eight smaller cubes.

Use this space to show your working.

[3]

A common error here was to calculate the volume and surface area of just **one** of the smaller cubes. Candidates who took this approach could still score the mark for the ratio.

Question 11 (a) (ii)

(ii) Use ideas about surface area and volume to explain why nanoparticles of silver have a different surface area to volume ratio than larger silver particles.

....

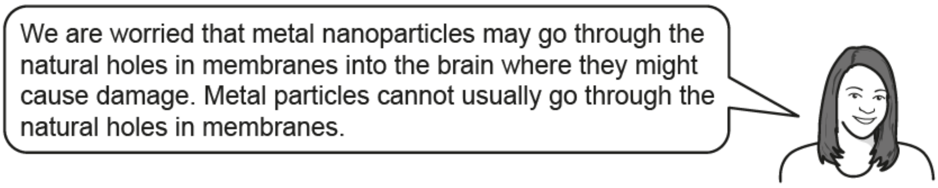
....

.... **[2]**

Most candidates seemed to understand that nanoparticles have special properties due to their small size. Many are also familiar with the concept of the ratio of surface area to volume in study of rate of reaction, but they did not often find it easy to explain in words what the ratio means.

Question 11 (b) (i)

(b) New research has shown that nanoparticles may be used to treat cancer. However, some scientists are worried about the negative effects of nanoparticles on the body.



(i) Explain why metal nanoparticles may be able to enter the brain even though metal particles usually cannot.

....

....

....

.... **[2]**

In this item, the small size of nanoparticles (or the relatively larger size of "regular" metal particles) must be compared to the size of the gaps in membranes. Credit cannot be given for simply copying out some of the text from the speech bubble above.

Question 11 (b) (ii)

(ii) Use ideas about **risk** and **benefit** to evaluate the use of nanoparticles in socks and to treat cancer.

....

....

....

....

....

.... **[3]**

The focus of the question here is to **evaluate** the use of nanoparticles in both contexts. The risks are probably similar in each case (as outlined in the previous item) but the benefit of potentially curing cancer is much greater than the benefit of curing smelly feet, so the benefit outweighs the risk in the case of cancer, but perhaps not in the case of foot odour. Many candidates wrote at some length about the potential risks and benefits of each but did not evaluate them as required.

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