Qualification Accredited

Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

TWENTY FIRST CENTURY SCIENCE COMBINED SCIENCE B

J260

For first teaching in 2016

J260/06 Summer 2023 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 is 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.

Paper 6 series overview

J260/06 is the higher tier paper for the chemistry unit for the GCSE (9-1) Combined Science B (Twenty First Century Science). The paper covers all of the chemistry content of the specification.

To do well on this paper candidates need to have a good factual knowledge and to be able to apply it. They need to be able to structure their responses to text based questions.

They need to have experienced a range of practical techniques and have an understanding of when such techniques are applied.

They need to have a range of basic mathematical skills.

Candidates were well prepared and most were able to complete all the questions, showing that all topics had been covered. However, the quality of writing in the longer, open responses was weaker than normal, and some candidates struggled to express their ideas clearly.

Most candidates were able to complete all the questions and there was no evidence of issues with time management.

Candidates who understood the stages of a practical produced good responses to the practical based questions. Those who tried to remember the stages were less successful.

Assessment for learning

Many candidates struggled with longer response questions. They should be encouraged to break down such questions before they start writing to make sure they cover the points required, paying particular attention to the command word used which should guide them to what is required.

Assessment for learning

Candidates should be reminded that, although a correct final answer for a calculation with no working shown will always be given full credit, an incorrect answer with no working shown cannot be given partial credit. Writing down their working will also remind candidates what they have calculated which will lead to greater success in multi-step calculations.

Assessment for learning

Candidates should be helped to understand why each stage of a practical is carried out as this will help them to remember the stages and adapt them as necessary to answer a specific question. Those candidates who just follow a recipe find it harder to recall all the stages.

Candidates who did well on this paper generally:	**Candidates who did less well on this paper generally:**
• structured responses to longer answers such as Questions 1 (b), 4 (c) and 8 (a) • handled numbers in standard form (Question 5 (b)) and understood the need to convert units (Question 6 (c) (i)) • understood basic practical techniques and used them to plan an experiment they had not done (Question 7 (b) (i)) and adapt them to fit a specific requirement (Question 6 (b)) • made sure answer matched the command word.	• lacked knowledge/recall, e.g. Question 2 (c) (principles of chromatography) Questions 3 (a) (i) and 3 (a) (ii) (neutralisation), Question 5 (a) (development of the atom) and Question 5 (c) (Group 0) • struggled with calculations Question 5 (b) (magnification and use of standard form) and Question 6 (c) (multi-step mole calculations) • struggled with recalling and writing chemical formulae – Question 5 (d) (i) (recall formula of hydrogen) and Question 9 (b) (writing formulae from given ions) • lacked understanding of the formation of ionic bonds and dot and cross diagrams (Question 9 (a) (ii) and 9 (a) (iii)).

Question 1 (a) (i)

1 The combustion of fossil fuels for energy produces harmful substances.

(a) (i) Draw lines to connect each **harmful substance** with the description of its major source.

Harmful substance	**Major source**
Carbon monoxide	Combustion of sulfur impurities in fossil fuels
Particulates	Incomplete combustion of fossil fuels
Nitrogen oxides	Oxidation of nitrogen at high temperatures.
Sulfur dioxide	

[2]

Most candidates knew the source of these harmful substances and there were very few incorrect links made. Candidates were asked to link all the harmful substances with their source but many only linked three of the substances as there were only three sources as both carbon monoxide and particulates are formed from incomplete combustion of fossil fuels.

Question 1 (a) (ii)

(ii) Explain **one** problem caused by increased amounts of sulfur dioxide in the atmosphere.

....

....

....

.... **[2]**

The best responses showed that they understand that sulfur dioxide dissolves in water to form an acid and then went on to explain the harm that this 'acid rain' causes. Some identified the production of acid rain without identifying the damage caused. Weaker responses made vague references to harming ecosystems or causing air pollution while some identified issues linked to other pollutants, e.g. damage to ozone layer or global warming.

Question 1 (a) (iii)

(iii) Describe **one** method that is used to decrease the amount of harmful substances put into the atmosphere by petrol cars.

....

.... **[1]**

Most candidates were able to identify a method to reduce the emissions either by reducing the emissions per car or by reducing the number of petrol cars. Most of the unsuccessful candidates had not focused on the question and so gave ways of reducing the amount of harmful substances in the air instead, e.g. planting more trees.

Question 1 (b)

(b) The combustion of fossil fuels produces carbon dioxide. Most scientists now accept that recent climate change can be explained by increased carbon dioxide emissions.

Fig. 1.1 shows the change in concentration of CO_2 in the atmosphere over time.

Fig. 1.1

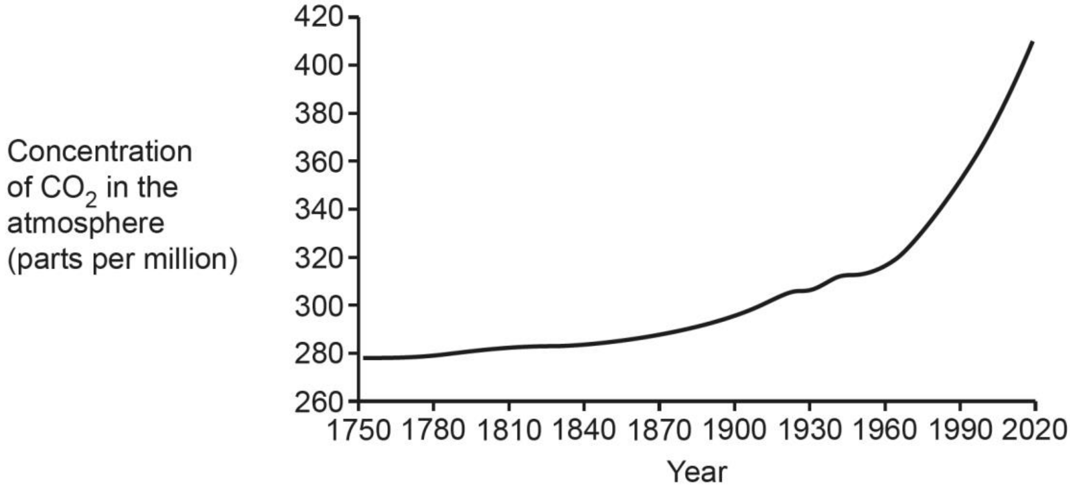


Fig. 1.2 shows the change in world carbon dioxide emissions from fossil fuels over time.

Fig. 1.2

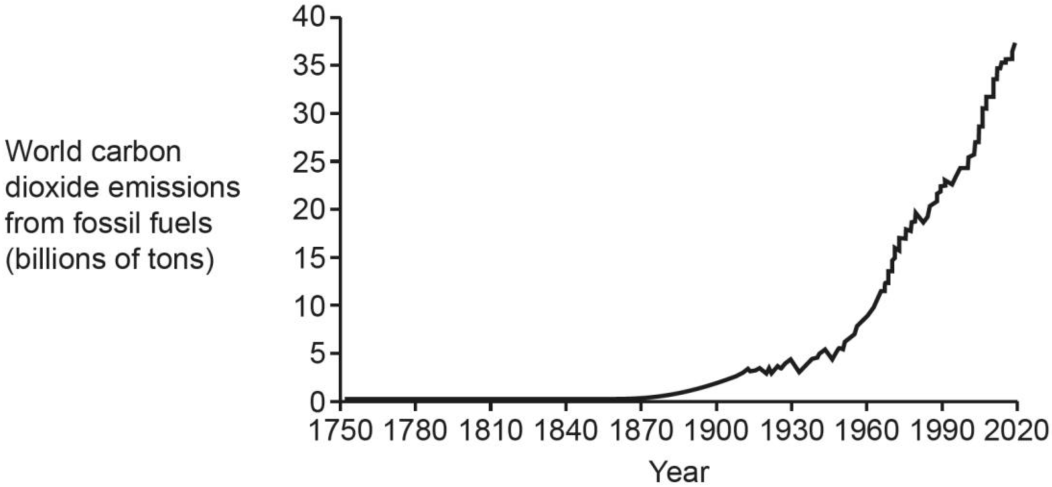
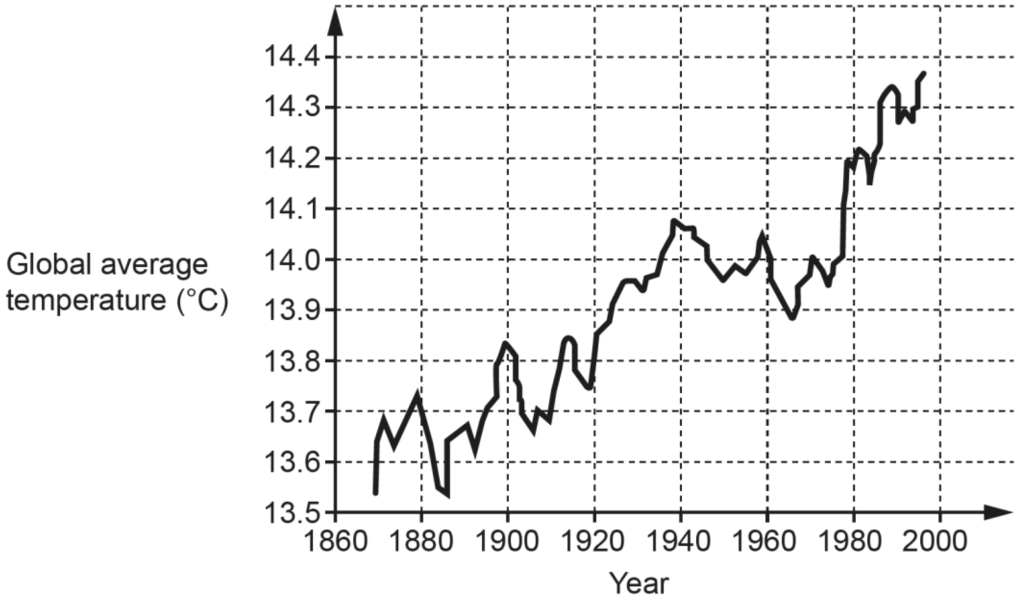


Fig. 1.3 shows the change in global average temperature over time.

Fig. 1.3



Describe the trends in **Fig. 1.1** and **Fig. 1.2 and** explain how this can be used with **Fig. 1.3** to show that human activity is causing the global temperature to increase.

....

....

....

....

....

.... **[4]**

The best responses were those carefully matched to the question. These started with a detailed description of the trends in Fig. 1.1 and Fig. 1.2, including both the general increase in both and a further detail they shared, e.g. both starting to increase in 1870 or big increase starting in 1960. They then went on to compare either the increasing concentration of CO_2 or the increasing carbon emissions from fossil fuel use and explain why this shows how human activity is causing the global temperature rise. Many just stated that all three graphs went up without making the link clear and others did not link to human activities such as increased use of fossil fuels or deforestation.

Exemplar 1

After the year 1870 in Fig 1·2 and 1·1 carbon concentration and emmisions increase, this is after the industrial revolution which saw increased factories and vehicles being powered by carbon and peterol. These ~~details - can~~ 2 graphs combined with ~~F~~ fig 1·3 shows that as CO_2 in the atmosphere **[4]** increases so does the average global temperature.

This candidate has carefully followed what the question is asking. They have made a clear comparison between Figures 1.1, both the idea of them both increasing and the extra detail showing they match, in this case the idea that increase starts around 1870 for both. They then gave an example of a human activity that produces carbon dioxide which started around the same time as the increases. Finally, they clearly link increasing carbon dioxide in the atmosphere with the increase in temperatures shown in Figure 1.3. All can be deduced from the data which was what was being asked. This response scores all 4 marks.

Question 2 (a)

2 A company called Healthyfood make food colourings.

The diagram shows the label from one of their food colourings.

Healthyfood
Orange food colouring
All ingredients natural and tested
Ingredients: dye 1, dye 2, solvent

(a) A representative for Healthyfood says that the food colouring is pure.

A scientist says that it is not pure.

Explain the different meanings of the word 'pure' used by the Healthyfood representative and the scientist.

Healthyfood representative ....

....

Scientist ....

.... **[2]**

The best responses used the information given to help them explain how the word 'pure' is used differently in science than in everyday use. They used the label to illustrate that in everyday use pure things are thought of as being natural or safe whereas a scientist would not consider this food colouring as pure as it contains more than one substance. Weaker responses described a pure substance as containing only one element or one type of atom.

Question 2 (b)

(b) The table shows the melting points of some substances.

Substance	Melting point (°C)
A	42
B	60–66
C	92–98
D	104

Which **two** substances are chemically pure?

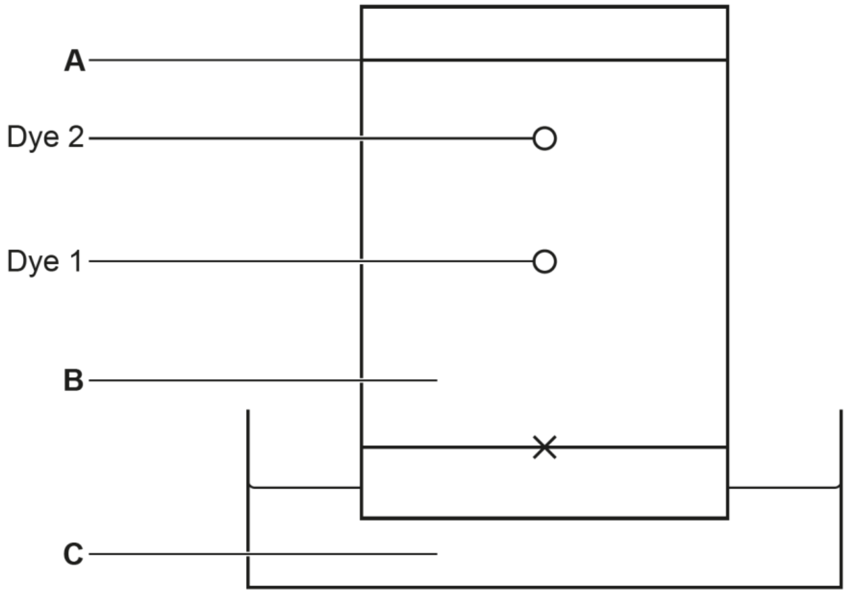
.... and .... **[1]**

The majority of candidates understood that chemically pure substances have a single melting point and so correctly identified A and D as the chemically pure substances.

Question 2 (c) (i) and (ii)

(c) The dyes in the food colouring can be separated using paper chromatography.

The diagram shows the apparatus used to separate the dyes and the chromatogram that is produced.



(i) Draw lines to connect each letter with its correct label.

A	Mobile phase
B	Solvent front
C	Stationary phase

[2]

(ii) Which property causes the dyes in the food colouring to separate?

Tick (✓) **one** box.

Their different boiling points. ☐

Their different colours. ☐

Their different distribution between phases. ☐

Their different melting points. ☐

[1]

In Question 2 (c) (i), high achieving candidates correctly identified all three labels. Many more were only able to identify one, with A correctly identified as the solvent front appearing most often. In Question 2 (c) (ii), nearly as many candidates incorrectly identified colour as the property causing the dyes to separate as those correctly identifying the distribution between phases.

Misconception

?

Many candidates think that the property that causes separation during chromatography is colour.

Question 2 (d) (i) and (ii)

(d) The chromatogram can be used to find the Rf values for the dyes.

(i) Measure the distance moved by dye 1 and by the solvent.

Use a ruler.

Distance moved by dye 1 = ... cm

Distance moved by solvent = ... cm **[2]**

(ii) Calculate the Rf value of dye 1.

Use this formula.

$$\text{Rf} = \frac{\text{distance moved by the dye (cm)}}{\text{distance moved by the solvent (cm)}}$$

Rf = ... **[2]**

Most candidates measured both of the distances in Question 2 (d) (i) correctly with only the lower achieving candidates unable to measure either of them. Almost all candidates went on to correctly calculate the Rf value for Question 2 (d) (ii) from their measurements.

Question 3 (a) (i) and (ii)

3 **(a)** One type of reaction is called neutralisation.

An example of a neutralisation reaction is when magnesium hydroxide reacts with nitric acid.

(i) Describe neutralisation by naming each **type** of compound in this reaction.

$$Mg(OH)_2 + 2HNO_3 \rightarrow Mg(NO_3)_2 + 2H_2O$$

.... + ... → .... + water

[2]

(ii) Neutralisation can also be described as the reaction between ions.

Give the formulae of the ions that are involved in neutralisation **and** the product of the reaction of these ions.

Ion from nitric acid ....

Ion from magnesium hydroxide ....

Product ....

[2]

High achieving candidates knew that neutralisation can be described as either acid plus base/alkali giving salt and water or H^+ ions from an acid plus OH^- ions from an alkali give water. Most responses to Question 3 (a) (i) gave the names of the compounds with a few giving the state. In Question 3 (a) (ii), most gave a random selection of ions, some correctly listed all the ions and both products without identifying those that were involved in neutralisation.

Question 3 (b) (i)

(b) When some metals are added to acids, bubbles are seen in the solution.

(i) Complete the word equation for the reaction between zinc and hydrochloric acid.

zinc + hydrochloric acid → .... + ...

[2]

Most candidates were able to identify at least one of the products formed when zinc reacts with hydrochloric acid, with many identifying both zinc chloride and hydrogen. The most common error was to choose water instead of hydrogen.

Question 3 (b) (ii)

(ii) Explain why bubbles form very quickly when zinc is added to the acid but very slowly when lead is added to the acid.

Use ideas about electrons in your answer.

....

....

....

.... **[2]**

There were a few excellent responses that identified electron loss occurred when metals react and so zinc must lose electrons more easily than lead. There were some vague answers that just said that zinc was more reactive than lead and many discussed zinc losing electrons but lead gaining them.

Question 4 (a) and (b) (i)

4 Crude oil is a mixture of different length hydrocarbon chains.

(a) Explain how modern life is dependent on hydrocarbons from crude oil.

....

....

....

.... **[2]**

(b) (i) Cracking is used to turn the longer-chain hydrocarbons into more useful products.

Describe how the products of cracking are more useful than the long chain hydrocarbons.

....

....

....

.... **[2]**

In Question 4 (a), the best responses referred to both the dependence of transport on hydrocarbons from crude oil and on the use of these hydrocarbons as a feedstock for the manufacture of well used products such as plastics. Most only referred to their use as a fuel for transport. High achieving candidates went on to describe, in Question 4 (b) (i), why the products of cracking are more useful. Most chose to explain that shorter chains make better fuels although some described the production of alkenes and their ability to be turned into a greater variety of products. Many candidates simply repeated the stem of the question without identifying the products of cracking as being either shorter or unsaturated.

Question 4 (b) (ii)

(ii) When decane, $C_{10}H_{22}$, is cracked, one of the products is ethene, C_2H_4.

Complete the symbol equation to show the formula of the other product.

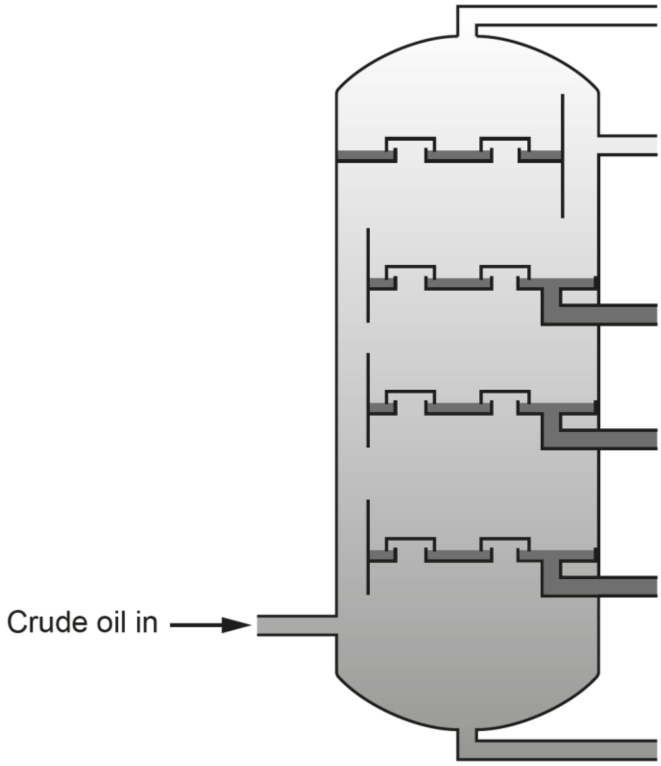
$C_{10}H_{22} \rightarrow C_2H_4 +$ .... **[1]**

Most candidates successfully calculated the correct formula as C_8H_{18}. A few candidates added the formulae given to get $C_{12}H_{26}$ while others calculated the numbers of atoms correctly but did not give a formula, e.g. $C_8 + H_{18}$.

Question 4 (c)*

(c)* The mixture of hydrocarbons in crude oil is separated using fractional distillation.

The diagram shows the apparatus used by industry.



Describe how crude oil is separated using fractional distillation **and** explain why the separation occurs.

Use ideas about the size of molecules **and** intermolecular forces.

....

....

....

....

....

.... **[6]**

The best responses to this level of response question described how and why separation of the hydrocarbon chains occurs during fractional distillation, explaining that hydrocarbons are vapourised by heating on entry and that the shorter chain hydrocarbons reach higher up the column before condensing because their intermolecular forces are weaker and the tower gets cooler as you go up. Most chose to describe shorter chains as vaporising at lower temperatures / higher up the column, but included good explanations based on intermolecular forces and so were still able to score well. Weaker responses included reference to breaking of covalent bonds, cracking/production of smaller molecules.

Exemplar 2

Crude oil is boiled and introduced in the tower as a gas, from the bottom of the tower. The tower is hottest toward the bottom and gets cooler as the ~~[illegible]~~ you go up the tower. ~~Bigger~~ longer molecules of hydrocarbon will condense near the bottom of the tower as they are bigger meaning stronger intermolecular forces, so more energy needed to break them so a higher boiling point. While ~~smaller~~ shorter ~~a~~ hydrocarbons will condense near the top as they are smaller so they have weaker intermolecular forces and therefore require less energy to break them so they have a lower boiling point. There are condensers through the tower to separate ~~[illegible]~~ the liquid hydrocarbons.

[6]

© OCR 2023 Turn over

This response includes a clear description of how the hydrocarbons are separated during fractional distillation. They have made clear that vapours are produced by heating the crude oil and that these vapours rise up the column, condensing as they meet gradually cooler temperatures, leaving longer chains at the bottom while shorter chains reach the top. In this case, they have chosen to explain each stage at the appropriate part of the method, giving a clear account linking size of molecule with strength of intermolecular bonds. The whole account is in a logical, easy to follow order and is a clear Level 3, 6 marks.

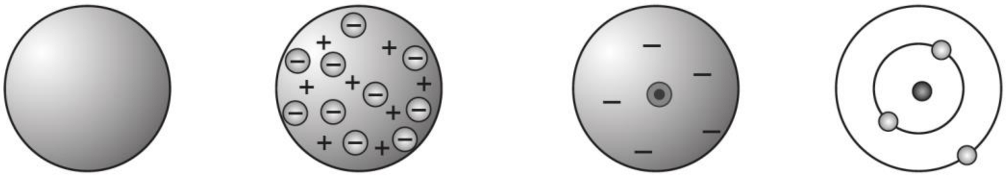
Assessment for learning

Candidates need lots of practice in planning a level of response question. Jotting down key points that will fully cover all parts of the question will help them to write their response in a clear and logical sequence.

Question 5 (a)

5 (a) Around 1800, Dalton stated that atoms are the smallest particles that exist.

The models show how the atomic model has developed further over time:



Draw lines to connect each scientist with **how and why** the model was changed.

Scientist	How model changed	Why model changed
Bohr	Solid positive sphere with small negative particles embedded in it.	Most of mass and positive charge must be in a small volume.
Rutherford	Small, heavy, positive nucleus with electrons orbiting in space around it.	Electrons must be in fixed orbits.
Thomson	Positive nucleus with electrons in shells in space around it.	Atom must contain smaller particles.

[2]

Most candidates were able to connect at least one scientist with how and why the model of the atom was changed. The best known was Thomson.

Question 5 (b)

(b) The diameter of an atom is approximately 50 000 times bigger than its nucleus.

The diameter of an atom is approximately 1×10^{-10} m.

Estimate the diameter of a nucleus.

Diameter of nucleus = ... m **[2]**

Many candidates completed this calculation correctly. Others were able to get some credit for correct handling of numbers in standard form, provided that they showed their working.

Question 5 (c) (i) and (ii)

(c) Group 0 elements exist as single atoms and are very unreactive.

(i) Why are Group 0 elements very unreactive?

....

.... **[1]**

(ii) Give **two** physical properties of Group 0 elements.

1 ....

2 ....

[2]

High achieving candidates knew the properties of the Group 0 elements and gave the answer of 'full outer shell' for Question 5 (c) (i) and suitable properties for Question 5 (c) (ii). Many candidates used reactivity as a property, some discussed trends down the Group but most just gave random, inappropriate properties.

Question 5 (d) (i)

(d) Group 1 elements react with water to form a metal hydroxide and hydrogen.

(i) Complete the symbol equation for the reaction of sodium with water.

sodium + water → sodium hydroxide + hydrogen

2............. + 2............. → 2NaOH + ...

[1]

The symbols for sodium and water were well known but most did not know that hydrogen is diatomic.

Question 5 (d) (ii)

(ii) Complete the table by predicting the observations for the reaction of rubidium with water.

Element	Formula of hydroxide	Observations
Lithium	LiOH	Fizzes steadily; slowly becomes smaller until it disappears.
Sodium	NaOH	Fizzes rapidly; melts to form a ball; quickly becomes smaller until it disappears.
Potassium	KOH	Burns violently; quickly melts to form a ball; disappears rapidly, often with a small explosion.
Rubidium	RbOH	

[2]

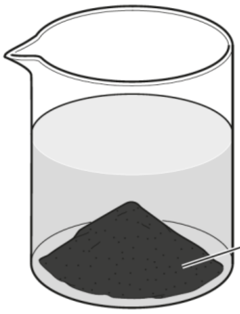
Most candidates understood that the observations would show a greater reactivity for rubidium than potassium. A few struggled to suggest anything other than there would be an explosion. Good suggestions included 'disappears instantly' or 'burns very violently'.

Question 6 (a) (i), (ii) and (b)

6 Alex plans to make a pure, dry sample of copper sulfate crystals.

(a) Alex adds solid copper oxide to aqueous sulfuric acid in a beaker until **no** more solid reacts.
This is the symbol equation for the reaction:

$$CuO(s) + H_2SO_4(aq) \rightarrow CuSO_4(aq) + H_2O(l)$$



(i) Why should there be some solid copper oxide left in the beaker?

....

.... **[1]**

(ii) Alex finds that the reaction is slow.

Give **two** ways in which Alex can make the reaction faster.

1 ....

2 ....
[2]

(b) When the reaction has finished, Alex uses the contents of the beaker to make pure, dry crystals of copper sulfate.

Describe the method that Alex uses.

....

Those candidates that understood the stages for the production of copper sulfate crystals gave clear description throughout. They understood, for Question 6 (a) that adding excess copper oxide meant that all the sulfuric acid was used up so that the solution was only copper sulfate and water. In Question 6 (b) (i), they matched their suggestions for speeding up the reaction to this experiment, e.g. increasing concentration of the acid instead of just increasing the concentration. Candidates struggled to include all the stages of the production of crystals for Question 6 (b) (ii). Removal of the copper oxide by filtration was rarely seen and where it was included, some candidates then tried to extract crystals from the residue. Most candidates knew that they needed to remove the water, but many evaporated to dryness. Washing of the crystals was not seen often.

Question 6 (c) (i), (ii) and (iii)

(c) Alex used 20 cm^3 of 0.5 mol/dm^3 sulfuric acid.

(i) Calculate the number of moles of sulfuric acid used.

Use the formula: concentration $(mol/dm^3) = \dfrac{\text{number of moles}}{\text{volume } (dm^3)}$

Number of moles of sulfuric acid = ... **[3]**

(ii) How many moles of copper sulfate are formed?

Use the symbol equation and your answer to **(c)(i)**:

$CuO(s) + H_2SO_4(aq) \rightarrow CuSO_4(aq) + H_2O(l)$

Number of moles of copper sulfate = ... **[1]**

(iii) Calculate the mass of copper sulfate crystals formed.

The relative formula mass of the copper sulfate crystals is 249.6.

Use your answer to **(c)(ii)** and the relationship:

$\text{number of moles} = \dfrac{\text{mass of substance (g)}}{\text{relative formula mass (g)}}$

Give your answer to **1** decimal place.

Mass of copper sulfate crystals = ... g **[3]**

Most candidates were able to substitute into and rearrange a formula for Question 6 (c) (i) although most either did not convert the units of volume or converted them incorrectly. Higher achieving candidates understood that the equation showed a 1:1 relationship between moles of acid and moles of copper sulfate so that their answer to Question 6 (c) (ii) should be the same as their answer to Question 6 (c) (ii). Most did not use the equation but involved a range of other things such as relative formula mass. Most candidates that showed their working were able to gain marks in Question 6 (c) (iii) with many gaining full marks on error carried forward from previous parts of the question.

Assessment for learning

Candidates can substitute into and rearrange a formula but often do not understand what they have calculated and so find it difficult to move through a multi-step calculation like this. Help with understanding what their numbers mean will help candidates make the link from one step to the next.

Misconception

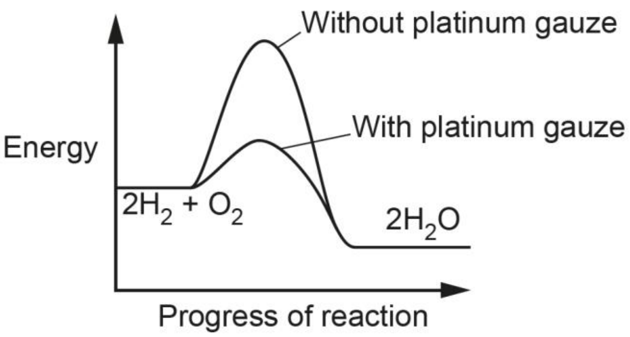
Many candidates think that equations compare masses rather than directly comparing moles.

Question 7 (a) (i)

7 This question is about exothermic and endothermic reactions.

(a) Hydrogen reacts with oxygen to form water.

To observe the reaction, a platinum gauze is required.
The diagram shows the energy profile for the reaction with **and** without a platinum gauze.



(i) Why is this an example of an oxidation reaction?

.... **[1]**

Many candidates used generic definitions of oxidation such as loss of electrons rather than applying their knowledge to this equation as the question asked.

Question 7 (a) (ii)

(ii) State the role of the platinum gauze **and** explain why it causes the reaction to occur.

Role ....

Explanation ....

....

....

.... **[3]**

Most candidates understood that the platinum was acting as a catalyst, lowering the activation energy or both. The best responses went on to explain why lowering the activation energy allowed the reaction to start.

Question (7) (a) (iii)

(iii) The table shows some bond energies.

	Bond energy (kJ / mol)
H-H	436
O=O	498
O-H	464

Calculate the energy change for this reaction:

2 H-H + O=O $\rightarrow$ 2 H-O-H

Energy change = ...kJ **[3]**

Most candidates correctly calculated the energy needed to break the bonds in the reactants and many also correctly calculated the energy released on making bonds. Some did not see that there were 2 moles of water and so 4 x O-H bonds not two. Others saw there were 2 x O-H bonds and 1 x H-H bond in the product. The best responses showed understanding that the overall energy change was the energy of bonds broken minus the energy of bonds made.

Question 7 (b) (i)

(b) A student reads in a textbook:

'When solid ammonium nitrate dissolves in water the reaction is endothermic.'

(i) Describe an experiment the student could do and their expected results to confirm the statement in the box.

Experiment ....

....

....

....

Results ....

....

[3]

High achieving candidates understood that an endothermic reaction would have a decrease in temperature and so designed an experiment where ammonium nitrate was added to water and the temperature taken before and after. Most candidates realised that they should add the ammonium nitrate to water but did not know what they should measure.

Misconception

Many candidates did not understand that the solution is the main part of the surroundings for the reaction and so if the reaction was endothermic then the temperature of the solution would go down.

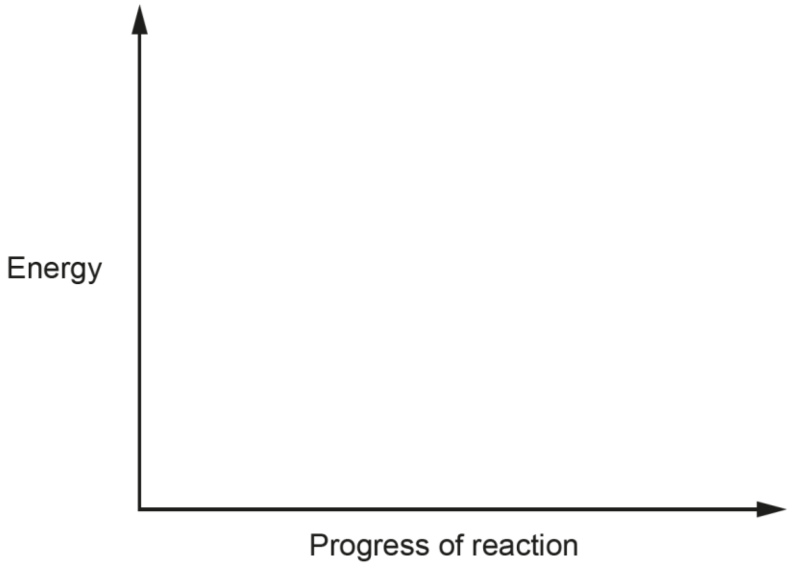
Question 7 (b) (ii)

(ii) Complete the energy profile for ammonium nitrate dissolving in water.

Label the energy profile to show the:
- activation energy
- reactants
- products.

Use the equation:

$$NH_4NO_3\ (s) \longrightarrow NH_4^+\ (aq) + NO_3^-\ (aq)$$



[3]

There were many clear diagrams with reactants and products identified and in the right positions and the activation energy shown as between the reactants and the peak. Many candidates labelled the peak of the curve as activation energy and many had the products at lower energy than the reactants.

Question 8 (a)

8 Manufactured products can often be made from a range of different materials.

A company wants to make saucepans. A good saucepan needs to spread heat evenly, be easy to lift and be durable.

The table shows the properties of some materials.

Material	Melting point (°C)	Thermal conductivity (W/mK)	Density (kg/m^3)	Scratch resistance (1 = low 10 = high)
Copper	1085	401	8900	3
Aluminium	660	235	2700	2.5–3
Polymer	160–210	0.19	1300	2
Lead	327	35	11000	1.5
Glass	1250	1.14	2230	5

(a) The company has chosen to use copper to make saucepans.

Evaluate the company's choice.

Use the table.

....

....

....

....

....

.... **[4]**

The best responses to this compared the properties of copper and the other materials with the requirements of a good saucepan given in the question. Many candidates just listed or compared the properties and so were not evaluating the data as required.

Question 8 (b)

(b) Suggest **one** other factor that should be considered by the **company** when deciding which material to use.

....

.... **[1]**

Candidates gained the mark by choosing suitable factors affecting the company, such as cost or availability of the material. Others chose factors already covered in the data such as heaviness or durability and so did not gain credit.

Question 8 (c) (i)

(c) Companies also need to consider the life-cycle assessment of a product when comparing materials.

A life-cycle assessment analyses the environmental impact of each stage of a product's lifetime.

(i) One of the things considered during the manufacturing stage of the process is the use of the raw materials.

Describe **two** other resources which should be considered during the **manufacturing** stage.

1 ....

....

2 ....

....

[2]

There were a few clear choices of water and energy as the two resources other than the raw materials to consider. Many chose things to consider that were not resources such as recyclability, sustainability, and effect on the environment.

Question 8 (c) (ii)

(ii) Describe one **other** stage of a product's lifetime which should be considered in a life-cycle assessment.

....

.... **[1]**

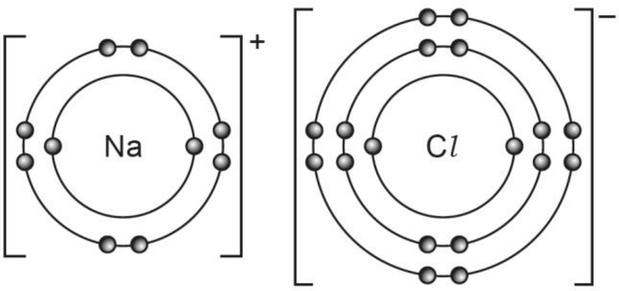
Most candidates chose a suitable other stage to consider, with transport and disposal appearing frequently. Others chose manufacturing (which had already been covered) or were too vague with answers such as re-using or pollution caused.

Question 9 (a) (i)

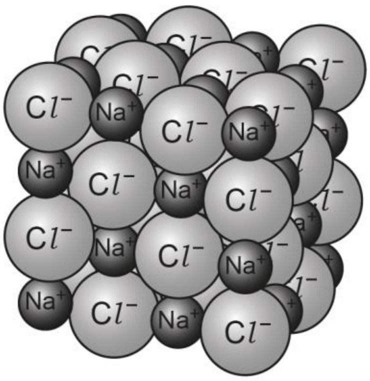
9 Compounds are bonded together ionically or covalently. Models are used to represent these compounds.

(a) Sodium (electron arrangement 2.8.1) reacts with chlorine (electron arrangement 2.8.7) to form sodium chloride. Sodium chloride is bonded ionically.

Two models are shown to represent sodium chloride:



Dot and cross model



3-D model

(i) Describe **one** limitation of representing sodium chloride by each of these models.

Dot and cross model ....

....

3-D model..

....

[2]

There were some good responses with clear limitations of each structure, e.g. the dot and cross diagram not showing structure, shape or relative sizes or the 3D model not showing electron arrangement or scale of ions. Some had the right idea but did not gain the mark as they referred to atoms or molecules instead of ions.

Question 9 (a) (ii)

(ii) Explain how the ionic bond is formed in sodium chloride.

Use ideas about electrons and electrostatic forces in your answer.

....

....

....

.... **[2]**

Many candidates discussed what happened to the electrons as the bond is formed, although some referred to sharing rather than the idea of transfer. Few referred to the bond as the electrostatic attraction between oppositely charged ions.

Question 9 (a) (iii)

(iii) Magnesium (electron arrangement 2.8.2) reacts with oxygen (electron arrangement 2.6) to form magnesium oxide.

Draw the dot and cross diagram for magnesium oxide.

[2]

There were some good diagrams showing both the correct electron arrangement and charge of the ions formed, with some just getting one or the other correct. Many tried sharing electrons or drew a single arrangement of shells for the compound formed.

Question 9 (b)

(b) Iron also forms ionic compounds.

Complete **Table 9.1** by giving the formulae of the compounds formed from the ions present.

Table 9.1

Compound	Ions present	Formula of compound
Iron(III) bromide	Fe^{3+} Br^{-}	....
Iron(III) sulfate	Fe^{3+} SO_4^{2-}	....

[2]

Higher achieving candidates were able to write formulae by balancing the charges of the given ions, although some only managed the $FeBr_3$. Most candidates did not know that the charges must balance and so some just put a 1:1 ratio, e.g. FeBr, others had them the wrong way round, e.g. Fe_3Br while some changed the formula of the sulfate ion.

Assessment for learning

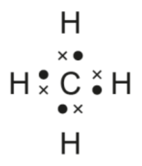
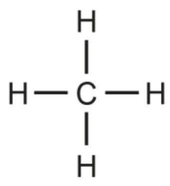
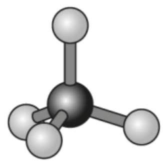
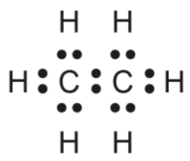
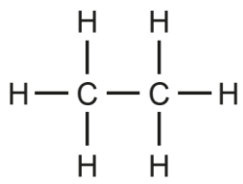
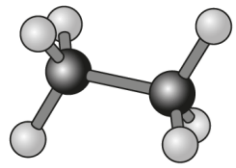
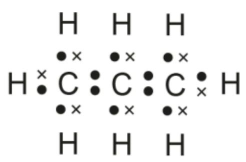
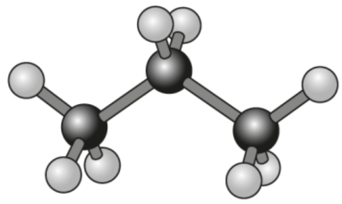
Candidates need more practice in the use of charges on ions to determine the formula, with explanations why incorrect formulae do not have this balance of charges.

Question 9 (c) (i)

(c) Hydrocarbons are bonded covalently.

Table 9.2 shows different ways of representing three hydrocarbons.

Table 9.2

Name	Dot and cross model	2-D model	3-D model
Methane			
Ethane			
Propane			

(i) Complete **Table 9.2** by showing the 2-D model of propane. **[1]**

Almost all candidates successfully drew a 2-D model of propane with just the occasional slip such as missing bonds or hydrogens.

Question 9 (c) (ii)

(ii) All these models show the number of each atom and the order in which the atoms are joined together.

Describe **one** limitation of representing the structure of propane that is true for **both** the dot and cross model **and** the 2-D model.

....

.... **[1]**

Successful responses identified that it was the arrangement in space that is not shown in these two models. Others referred to the relative sizes of the carbon and hydrogen atoms. Many said that they did not show the structure even though the question said that they did.

Question 9 (c) (iii)

(iii) The empirical formula shows the simplest ratio of atoms in a molecule.

What is the empirical formula of ethane?

.... **[1]**

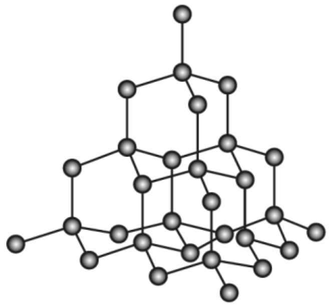
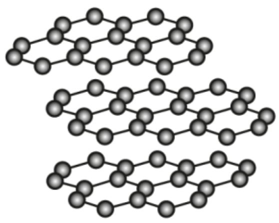
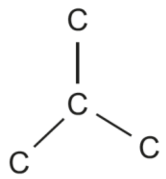
High achieving candidates successfully gave the empirical formula of ethane. Most did not know what an empirical formula is and gave the molecular formula instead. Some gave the correct ratio without converting to a formula.

Question 9 (d)

(d) Some elements form giant covalent structures.

Table 9.3 shows the structures of two allotropes of carbon.

Table 9.3

	Diamond	**Graphite**
3-D model		
2-D model		

Complete **Table 9.3** by showing the 2-D model for diamond. **[1]**

Most candidates drew a diagram showing a carbon attached to four others. Some overcomplicated things and drew lots of carbons with many having more than four bonds.

Supporting you

Teach Cambridge

Make sure you visit our secure website **Teach Cambridge** to find the full range of resources and support for the subjects you teach. This includes secure materials such as set assignments and exemplars, online and on-demand training.

Don't have access? If your school or college teaches any OCR qualifications, please contact your exams officer. You can forward them this link to help get you started.

Reviews of marking

If any of your students' results are not as expected, you may wish to consider one of our post-results services. For full information about the options available visit the OCR website.

Access to Scripts

For the June 2023 series, Exams Officers will be able to download copies of your candidates' completed papers or 'scripts' for all of our General Qualifications including Entry Level, GCSE and AS/A Level. Your centre can use these scripts to decide whether to request a review of marking and to support teaching and learning.

Our free, on-demand service, Access to Scripts is available via our single sign-on service, My Cambridge. Step-by-step instructions are on our website.

Keep up-to-date

We send a monthly bulletin to tell you about important updates. You can also sign up for your subject specific updates. If you haven't already, sign up here.

OCR Professional Development

Attend one of our popular CPD courses to hear directly from a senior assessor or drop in to a Q&A session. Most of our courses are delivered live via an online platform, so you can attend from any location.

Please find details for all our courses for your subject on **Teach Cambridge**. You'll also find links to our online courses on NEA marking and support.

Signed up for ExamBuilder?

ExamBuilder is the question builder platform for a range of our GCSE, A Level, Cambridge Nationals and Cambridge Technicals qualifications. Find out more.

ExamBuilder is **free for all OCR centres** with an Interchange account and gives you unlimited users per centre. We need an Interchange username to validate the identity of your centre's first user account for ExamBuilder.

If you do not have an Interchange account please contact your centre administrator (usually the Exams Officer) to request a username, or nominate an existing Interchange user in your department.

Active Results

Review students' exam performance with our free online results analysis tool. It is available for all GCSEs, AS and A Levels and Cambridge Nationals.

Find out more.

Need to get in touch?

If you ever have any questions about OCR qualifications or services (including administration, logistics and teaching) please feel free to get in touch with our customer support centre.

Call us on
01223 553998

Alternatively, you can email us on
support@ocr.org.uk

For more information visit
- **ocr.org.uk/qualifications/resource-finder**
- **ocr.org.uk**
- **facebook.com/ocrexams**
- **twitter.com/ocrexams**
- **instagram.com/ocrexaminations**
- **linkedin.com/company/ocr**
- **youtube.com/ocrexams**

We really value your feedback

Click to send us an autogenerated email about this resource. Add comments if you want to. Let us know how we can improve this resource or what else you need. Your email address will not be used or shared for any marketing purposes.

I like this **I dislike this**

Please note – web links are correct at date of publication but other websites may change over time. If you have any problems with a link you may want to navigate to that organisation's website for a direct search.

CAMBRIDGE
UNIVERSITY PRESS & ASSESSMENT