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 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 examination paper can be downloaded from OCR.

3-3 grade

Like all exam boards, we have awarded a 'safety net' grade of 3-3 for higher tier GCSE Combined Science candidates in 2018 where appropriate so that they are not disadvantaged by being the first to sit a new GCSE. To help teachers making difficult decisions about higher versus foundation tiers in 2019, OCR will be providing further guidance and extra webinars during the Autumn term.

Paper J260/06 series overview

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

To do well on this paper candidates need to have a good factual knowledge and be ably to apply it. 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.

Candidate performance overview

Candidates who did well on this paper generally did the following:

- Performed calculations using the mole concept: 4c(ii), 4d(i), 4d(ii).
- Produced clear and concise responses for Level of Response question: 5.
- Used the information in the question and their knowledge to explain concepts:3a(ii), 7a, 9a, 9b.

Candidates who did less well on this paper generally did the following:

- Found it difficult to recall factual information. 1a, 6a, 9b, 10a, 10b.
- Produced responses that lacked detail, sometimes simply repeating information provided. 1b(ii), 3a(ii), 3b(ii), 4a.
- Showed little practical knowledge: 4b, 6b, 6c, 6d, 10a.

Question 1(a)

1 The elements in Group 7 (Group 17) of the Periodic Table are called the halogens.

(a) Each element has a different state and colour at room temperature.

Draw lines to connect each **element** with its correct **state** and **colour** at room temperature.

State	Element	Colour
		Green
Solid	Chlorine	
		Dark grey
Liquid	Bromine	
		Pink
Gas	Iodine	
		Red/brown

[3]

Able candidates were able to recall the states and colours of all three halogens. Most candidates knew at least some of the properties. The properties of chlorine were the best known. Lower ability candidates struggled with responses that required recall.

Question 1(b)(i)

(b) **Table 1.1** shows what happens when some halogens react with hydrogen.

Element	**Reaction with hydrogen**
Bromine	Reacts steadily when heated.
Fluorine	Explodes at room temperature.
Iodine	Reacts slowly when heated.

Table 1.1

(i) Describe the trend in reactivity of the Group 7 elements with hydrogen.

....

.... **[1]**

Question 1(b)(ii)

(ii) A mixture of chlorine and hydrogen explodes when a small spark is added.

Does this fit the trend of the reactivity of the other Group 7 elements with hydrogen?

Explain your reasoning.

....

....

.... **[2]**

Most candidates correctly identified the decreasing reactivity of the halogens down the group for part (i). Others did not identify a trend and just stated that all reacted with hydrogen. The most able candidates were also able to use the information to explain how the reactivity of chlorine fitted between that of fluorine and bromine. Others struggled to explain themselves and while they referred to chlorine's position in Group 7 they did not relate this to the properties given in Table 1.1.

Question 1(c)

(c) The halogens also react with reactive metals.

Question 1(c)(ii)

(ii) Other metals also react with bromine to form metal bromides.

The formula of the metal bromide depends on the number of electrons in the outer shell of an atom of the metal.

Complete **Table 1.2** which shows the products formed when different metals react with bromine.

Metal	Periodic Table Group	Number of electrons in outer shell of atom of metal	Ion formed by metal	Formula of metal bromide
Potassium	1	1	K^+	KBr
Magnesium	2			
Aluminium	3			

Table 1.2

[3]

Most candidates were able to correctly identify the number of electrons in the outer shell from the information in the table. Others went on to identify the ions formed. Higher ability candidates were also able to deduce the formulae of the bromides from the information given.

Question 2(a)

2 Most cars are fitted with catalytic converters.

Harmful gases from the car engine react together in the converter to form less harmful gases.

(a) The catalyst in the converter increases the rate of the reactions between the gases.

Use ideas about energy to explain how catalysts increase the rate of a reaction.

....

.... **[2]**

More able candidates understood that catalysts lower the activation energy of a reaction. A few also understood that it did so by providing another route for the reaction to go. Many thought that the catalyst supplied energy to the reactants rather than lowering the energy needed for reaction to occur.

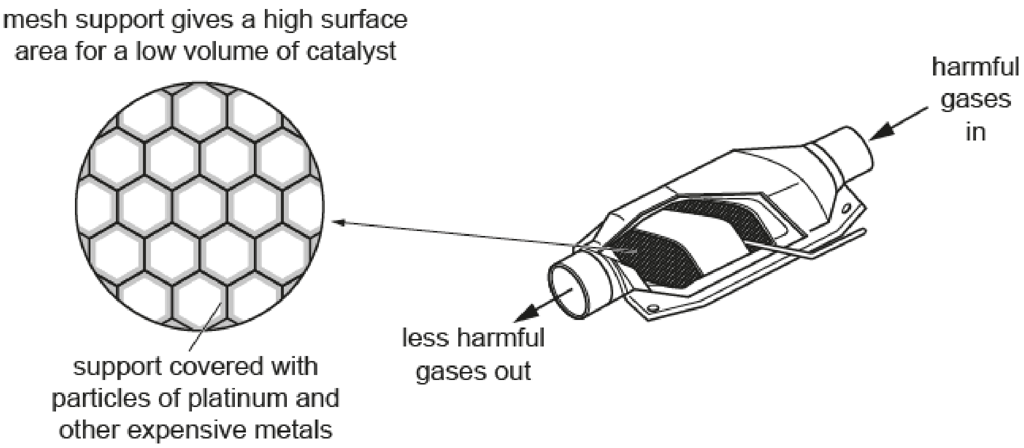
OCR support

The Transition Guide for J258/J260 Chemical Patterns provides support for teachers on helping learners to understand patterns in the periodic table, including Group 7 elements. http://www.ocr.org.uk/Images/318142-chemical-patterns-transition-guide.pdf

The Delivery Guide for C2.4, Learner Resource 10 Group 1 and Group 7 compounds also supports the teaching of the specification content. https://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-combined-science-b-j260-from-2016/delivery-guide/topic-gcsb008-c2-chemical-patterns/delivery-guide-gcsbdg036-c24-how-are-equations-used-to-represent-chemical-reactions

Question 2(b)

(b) Platinum and other very expensive metals are used as catalysts in the converter.
Very small particles of the metals are spread in a thin layer over a support.
This means that a very low volume of metals is needed to give a very high surface area.



Suggest the advantages of using a low volume of catalyst with a high surface area.

Low volume ....

....

High surface area ....

....
[2]

Higher ability candidates understood that a low volume of catalyst was an advantage because of the high cost of the catalyst. Some also realised that a high surface area allowed more contact between reactant particles and the catalyst. Others thought that the low volume stopped the converter from being blocked up. Some candidates stated that a catalyst would increase the rate of the reaction or remove more harmful gases without relating it to low volume or high surface area.

Question 2(c)(i)

(c) (i) The surface area to volume ratio of a particle of a catalyst can be calculated by using this formula:
surface area to volume ratio = surface area of particle ÷ volume of particle

The table shows the particle size and surface area to volume ratio for fine and coarse powders.

Particle	Fine powder	Coarse powder
Size (nm)	500	5000
Surface area to volume ratio (nm^{-1})	0.012	0.0012

How is the surface area to volume ratio of a particle related to its size?

....

....

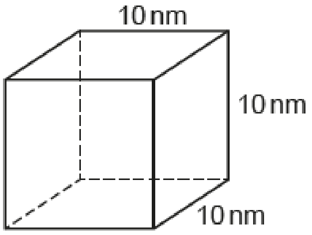
.... **[1]**

This question required candidates to use the data in the table to relate particle size to the surface area to volume ratio and many did so successfully. Others did not use the table and recalled the relationship between particle size and surface area from memory.

AfL Candidates are advised to read all the information at the start of each part of a question carefully to make sure they understand what they are being asked to do.

Question 2(c)(ii)

(ii) Catalysts are now made from nanoparticles. A nanoparticle in a catalyst is shown in the diagram.



Calculate the surface area to volume ratio of the nanoparticle.
Assume that it is a cube with sides of 10 nm.

Surface area to volume ratio of the particle = ... nm^{-1}

[4]

Many candidates successfully calculated the surface area to volume ratio of the cube. Some did not multiply the surface area of one face by 6. Others did not find a ratio from their surface area and volume even though the formula was given them at the start of part (c)

Question 3(a)(i)

3 Many compounds found on Earth and other planets contain hydrogen.

(a) Water is a compound of hydrogen with oxygen. It is found in very large amounts in the Earth's seas.

Water is added to the sea when ice caps melt.

In sunlight, plants use water for photosynthesis to make glucose.

(i) Which statements are **true only for melting**, which are **true only for photosynthesis** and which are **true for both**?

Put a tick (✓) in one box in each row.

	True only for melting	True only for photosynthesis	True for both
It is a physical change.			
It is a chemical change.			
New substances are formed.			
It involves an energy change.			

[2]

Most candidates knew that melting is a physical change, photosynthesis is a chemical change and that new substances are formed in photosynthesis. Common misconceptions were that both were physical changes, that both were chemical changes, or that both formed new substances. Most candidates also understood that both changes involved a change in energy. Some thought that either only melting or only photosynthesis involved an energy change.

Question 3(a)(ii)

(ii) Use the particle model to explain why the ice caps are a fixed shape but water in the sea can flow and change shape.

....

....

....

.... **[3]**

This question required candidates to discuss the difference in particle behaviour in solids and liquids. Able candidates compared the movement of particles in the two states and explained this by reference to intermolecular forces. Many candidates omitted reference to particles and so gave answers which just restated the question.

Exemplar 1

Because ice caps is ~~the~~ solid, particles are held in fix position, there is strong force of attraction between particles so particles within the ice caps cannot move. However, water is liquid, there is a weaker force of attraction between particles, meaning particles are randomly arranged and can move around. **[3]**

AfL

This candidate shows how to use the particle model in answering the question. Their response has referred to particles throughout. They clearly state that the particles in the solid are fixed and those in a liquid can move. They also compare the forces of attraction between the particles in the solid and the liquid.

Exemplar 2

Ice caps are solids, the particle model shows that solids vibrate around a fixed position and do not change shape whereas water in the seals is liquid and so is free to move and change shape to fit any container. **[3]**

AfL

This candidate does not refer to particles or the particle model in answering the question. Their response restates the stem of the question without adding any explanation of why ice and water behave differently.

Question 3(b)(i)

(b) Water, methane and ammonia are compounds of hydrogen with other elements.

Some scientists think that life on other planets could be based on methane or ammonia instead of water.

The table shows some properties of water, methane and ammonia.

Compound	Formula	Melting point (°C)	Boiling point (°C)
Water	H_2O	0	100
Methane	CH_4	–182	–164
Ammonia	NH_3	–78	–33

(i) Which statements about water, methane and ammonia are **true** and which are **false**?

Put a tick (✓) in one box in each row

	True	False
Water has the lowest melting point.		
Methane has the weakest forces between its molecules.		
The boiling point of methane is higher than the melting point of ammonia.		
Water has the highest relative formula mass.		

[2]

This question asked candidates to compare the properties of water, methane and ammonia using data from the table and their own knowledge. Candidates were most successful in comparing the melting and boiling points. Many candidates showed a good understanding of the data given.

Question 3(b)(ii)

(ii) The average surface temperature of Earth is 14 °C.
The average surface temperature of Mars is –55 °C.

Use the data in the table to predict the state of ammonia on each planet.

Explain your answer.

....

....

....

.... **[3]**

Higher ability candidates identified that ammonia is a gas on Earth and a liquid on Mars and justified this by comparing the temperature on each planet with the melting and boiling points. Some candidates only quoted the temperatures without explaining their significance. Others were unable to use the temperatures correctly and so did not predict the states correctly.

Question 4(a)

4 Indigestion may be caused by excess acid in the stomach. Kai and Jane investigate indigestion tablets.

The active compound in each tablet is calcium carbonate which reacts with excess acid.

(a) Kai and Jane react solid calcium carbonate with dilute hydrochloric acid.

The products of the reaction are calcium chloride, carbon dioxide and water.

This is the equation for the reaction.

$$CaCO_3(s) \quad + \quad 2HCl(aq) \longrightarrow CaCl_2(aq) \quad + \quad CO_2(g) \quad + \quad H_2O(l)$$

Kai says that after the reaction, the mass of products must equal the mass of the reactants.

Jane predicts that the mass will decrease during the reaction.

Explain why they are **both** correct.

Kai ....

....

Jane ....

....

[2]

Higher ability candidates used the Law of Conservation of Mass to explain why the mass of products must be the same as the mass of reactants. The best responses explained that the atoms are just rearranged during a reaction. Most candidates realised that the loss of a gas caused the decrease in mass during the reaction. Others did not explain the relevance of gas formation with some suggesting that it was because the gas was lighter or less dense.

AfL

It is important for candidates to identify what they are being asked to do. When candidates make an attempt to answer the question that has been asked this will be credited. Weaker candidates will often restate the question in their own words rather than attempting to provide a relevant response.

Question 4(b)

(b) Jane does an experiment to find out the total mass of carbon dioxide made when one indigestion tablet reacts with dilute hydrochloric acid.

Describe how Jane could do her experiment.

Include a list of the apparatus she could use and the measurements she should record.
You may include a diagram in your answer.

....

....

....

....

.... **[4]**

Higher ability candidates understood the need to weigh all the reactants at the start and the products at the end in order to find the difference. Some understood the need to use a balance and attached a gas syringe so that the carbon dioxide would not be lost. Other candidates struggled to use their experience of practical work to produce a simple plan. Many did not include a balance in their list of apparatus. Some described an experiment to measure rate of the reaction instead of one to measure the total mass of CO_2 produced.

Question 4(c)(i)

(c) Jane repeats her experiment four times.

Here are her results.

Experiment	**1**	**2**	**3**	**4**
Mass of carbon dioxide made (g)	0.22	0.18	0.24	0.17

(i) What is the range of Jane's results?

Range = ... **[1]**

Question 4(c)(ii)

(ii) Calculate the mean value for the mass of carbon dioxide made.

Give your answer to **2** decimal places.

Mean value = ... g **[3]**

Candidates showed a good understanding of both range and mean. A few thought that the lower end of the range was 0.18 instead of 0.17. Some calculated the mean correctly but did not give the answer to 2 decimal places.

OCR support

Appendix 5e Mathematical skills requirement, in the specification outlines the context for teaching the required mathematical skills.
http://www.ocr.org.uk/Images/234597-specification-accredited-gcse-twenty-first-century-science-suite-combined-science-b-j260.pdf

The Mathematical Skills Handbook for GCSE (9-1) Science provides guidance of the required mathematical skills.
http://www.ocr.org.uk/Images/310651-mathematical-skills-handbook.pdf

Question 4(d)(i)

(d) The label on the tablets says that each tablet contains 500 mg of calcium carbonate.

(i) Jane works out that there are 0.005 moles of calcium carbonate in 500 mg.

Show by calculation that she is right.

[2]

Higher ability candidates understood the need to calculate the relative formula mass of calcium carbonate in order to find the number of moles. Some were also able to convert mg to g. Most lower ability candidates made some attempt to manipulate the numbers but without applying an understand of the relationship between moles and mass.

Question 4(d)(ii)

(ii) Jane reacts 0.005 moles of calcium carbonate with dilute hydrochloric acid.

$$CaCO_3(s) + 2HCl(aq) \longrightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

Calculate the mass of carbon dioxide made in the reaction.

Mass of carbon dioxide = ... g **[2]**

Able candidates understood the need to find the mass of one mole of carbon dioxide. Some did not use the equation to find the number of moles of carbon dioxide made from 0.005 moles of calcium carbonate. Many lower ability candidates did not attempt this question.

OCR support The How many atoms in my signature lesson element is a short engaging learning activity which supports this topic.
http://www.ocr.org.uk/Images/170200-how-many-atoms-in-my-signature-activity-instructions.pdf

Question 5

5* The table shows the type of bonding and the melting points of the chlorides and oxides of the elements in Period 3 of the Periodic Table.

	Period 3 chlorides						
Formula	$NaCl$	$MgCl_2$	$AlCl_3$	$SiCl_4$	PCl_3	SCl_2	Cl_2
Bonding and structure	ionic		simple covalent				
Melting point (°C)	801	712	193	–68	–92	–80	–101
	Period 3 oxides						
Formula	Na_2O	MgO	Al_2O_3	SiO_2	P_4O_6	SO_2	Cl_2O_7
Bonding and structure	ionic			giant covalent	simple covalent		
Melting point (°C)	1275	2800	2045	1700	24	–72	–92

Describe the pattern shown by the melting points of the chlorides and oxides. Use ideas about bonding and structure to explain why the melting points are different.

.... **[6]**

This is a higher demand level of response question that was designed to stretch grades 7–9 candidates and give them an opportunity to demonstrate the depth of their knowledge. Most candidates were able to use the data to identify some patterns in the data. Higher ability candidates explained these patterns in terms of bond strengths relating this to type of bonding and structural arrangement. Candidates were most successful when they used the question to structure their response.

Misconception Candidates who confused covalent bond strength with intermolecular bonds.

Question 6(a)

6 Mia is investigating vitamin tablets. She reads the label on a bottle of vitamin tablets and it says that the tablets contain other ingredients.

(a) The tablets are a formulation.

What is the difference between a formulation and a pure substance?

....

....

.... **[2]**

Many candidates were able to explain the difference between a formulation and a pure substance. A few confused formulation with formula. .More candidate were able to describe a formulation correctly than were able to describe what a pure substance was. Pure substances were often described as a single element or as a single type of atom

Question 6(b)(i)

(b) The other ingredients in the tablet include coloured dyes.

Mia uses chromatography to separate the dyes.
She starts by crushing a tablet and mixing it with water.

She finds that some of the ingredients in the tablet dissolve in the water but the dyes do not.

(i) How can she tell that the dyes have **not** dissolved in the water?

....

.... **[1]**

More able candidates understood that if the dyes did not dissolve in water then the water would remain uncoloured. Several candidates described how dyes behave during chromatography.

Misconception It is important to read and understand the question that is being asked. Weaker candidates may only see trigger words and then write a prepared response to these trigger words.

Question 6(b)(ii)

(ii) What should she do to make a solution of the dyes?

....

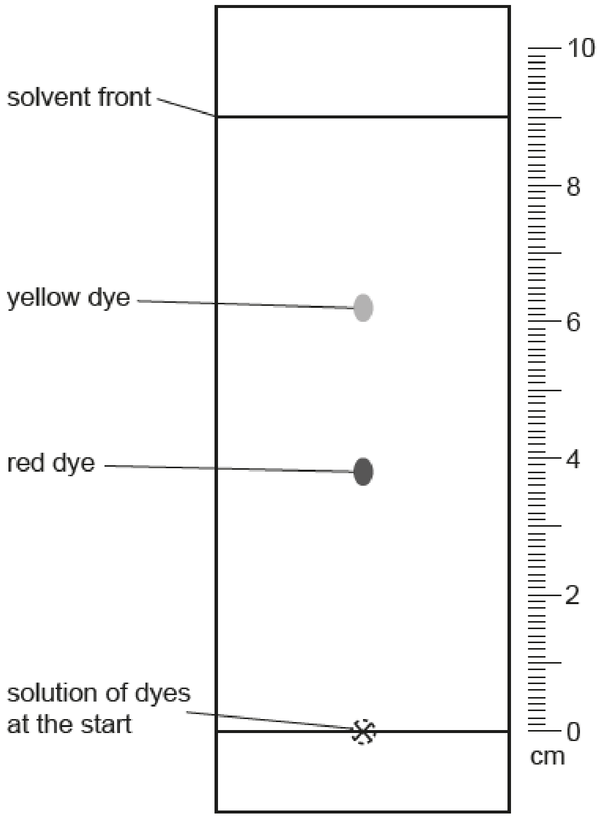
.... **[1]**

The idea of using a different solvent was not well known by candidates. Melting, evaporation and distillation were more common responses.

Question 6(c)(i)

(c) Mia takes a solution of the dyes and does a chromatography experiment.

Here are her results.



(i) Use the scale given on the diagram to complete the table of results.

	Distance moved by solvent (cm)	**Distance moved by dye (cm)**
Red dye		
Yellow dye		

[2]

Many candidates correctly read the distances moved by the dyes and solvent from the scale given. Some did not read the values accurately. Others measured the distance from the solvent front to the dye instead of from the start to the solvent front, giving the distance moved by the solvent as 2.8 cm or 5.2 cm instead of 9.0 cm.

Question 6(c)(ii)

(ii) Mia uses this formula to calculate the R_f value of each dye:

$$R_f = \frac{\text{distance moved by the dye}}{\text{distance moved by the solvent}}$$

How could she use the R_f values of the dyes to check that they are the dyes listed in the tablet ingredients?

Tick (✓) **two** boxes.

Repeat the same experiment and compare R_f values. ☐

Compare the R_f values when different solvents are used. ☐

Compare the R_f values with a reference table of known dyes. ☐

Do an experiment to find the R_f value for pure samples of the listed dyes. ☐

[2]

Most candidates knew that Mia should either compare the R_f values with reference tables or that she should do an experiment to find the R_f values for pure samples of the listed dyes. Higher ability candidates chose both. The most commonly chosen incorrect answer was to repeat the same experiment and compare R_f values.

Question 6(d)

(d) Explain why it was **not** necessary to use a locating agent in this experiment.

....

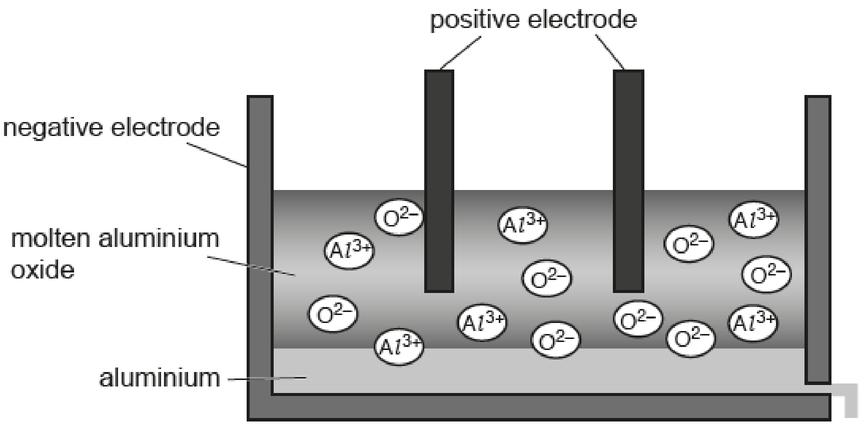
.... **[1]**

Most candidates realised that a locating agent was not needed because the dyes were visible without its use. Some thought that a locating agent was an alternative to measuring the distance.

Question 7(a)

7 Aluminium is extracted from aluminium oxide by electrolysis.

Aluminium oxide, Al_2O_3, is an ionic compound.



(a) The aluminium oxide must be molten in this process so that it conducts electricity.

Explain why aluminium oxide conducts electricity when it is liquid but not when it is solid.

....

....

.... **[3]**

The highest ability candidates described the difference in movement of the ions in a liquid and in a solid. Many thought that the current was a flow of electrons and others that it was atoms. Some thought that there was more space for ions to pass through a liquid.

Question 7(b)(i)

(b) (i) Complete the table to show the product and half equation at the positive electrode.

Electrode	Name of product	Half equation
Negative	aluminium	$Al^{3+} + 3e^- \rightarrow Al$
Positive		

[3]

Most candidates correctly identified the product as oxygen. Some high ability candidates gained marks on the half equation. Many did not give the correct formula for oxygen gas. Others thought that the oxide ion gained two positrons (e^+) rather than losing two electrons (e^-).

Question 7(b)(ii)

(ii) Complete the following sentence by putting a ring around the correct words:

The reaction at the negative electrode is **oxidation / reduction** because

electrons are **gained / lost**. **[1]**

Higher ability candidates used the half equation for the negative electrode given in the table to identify that as electrons are gained the reaction must be reduction. The most common incorrect response was that the reaction was oxidation because of the loss of electrons.

Question 7(c)

(c) Alex does an experiment to find out if he can make aluminium at room temperature.
He starts by making a solution of aluminium sulfate.

He reacts solid aluminium oxide with dilute sulfuric acid to make a solution of aluminium sulfate in water.

Complete and balance the chemical equation for this reaction.
Include the state symbols.

aluminium oxide + sulfuric acid → aluminium sulfate + water

.... (s) + ...H_2SO_4 (aq) → $Al_2(SO_4)_3$ (........) + $3H_2O$ (........)

[2]

Higher ability candidates were able to balance the equation and give the correct state symbols. Most candidates were able to do one or the other. Some candidates did not give the correct formula for aluminium oxide even though it is printed in the stem at the beginning of Q7. Others thought that aluminium sulfate was a solid although it was described as a solution in the question.

AfL Candidates should be encouraged to look back through the information given in the question particularly when they are asked to write chemical equations such as these.

Question 7(d)(i)

(d) Alex passes electricity through the dilute solution of aluminium sulfate he has made. He expects aluminium to form at the negative electrode.

He finds that a gas forms at the negative electrode instead of aluminium. He tests the gas with a lighted splint and it gives a squeaky pop.

(i) Explain why aluminium is **not** formed at the negative electrode.

....

.... **[1]**

Question 7(d)(ii)

(ii) Name the gas that forms at the negative electrode and explain why this gas is produced during the electrolysis.

....

....

....

....

.... **[3]**

Many candidates correctly identified the gas produced as hydrogen. High ability candidates knew that this was because hydrogen is less reactive than aluminium and some that it was formed by hydrogen ions gaining electrons. Some thought that aluminium did not form because its ions are negative. Others thought that oxygen was produced at the cathode rather than hydrogen.

Question 8(a)

8 The Haber Process manufactures ammonia by reacting nitrogen with hydrogen.

$N_2(g) \quad + \quad 3H_2(g) \quad \rightleftharpoons \quad 2NH_3(g)$ **exothermic**

(a) Explain why this reaction cannot produce a yield of 100%.

....

....

.... **[3]**

Able candidates understood that it was the reversibility of the reaction which prevented a 100% yield. Some were able to go on to explain that the reaction would come to equilibrium. A small number discussed the balance of the forward and reverse rates of reaction. Many candidates focussed on the exothermic nature of the reaction resulting in a loss of energy to the surroundings.

Question 8(b)(i)

(b) The table shows the yield of ammonia at different conditions of temperature and pressure.

	Percentage yield of ammonia at equilibrium				
	Temperature (°C)				
Pressure (atm)	**100**	**200**	**300**	**400**	**500**
10	–	51	15	4	1
25	92	64	27	9	3
50	95	74	40	15	6
100	97	82	53	25	11
200	98	89	67	39	18
400	99	95	80	55	32

(i) Describe the effect of changing the temperature and the pressure on the **percentage yield** of ammonia produced.

Temperature ....

....

Pressure ....

.... **[2]**

Most candidates made use of the data in the table to describe the effect of changing the temperature and pressure on the percentage yield. A few did not state what the change was and said that the temperature causes an increase in yield instead of an increase in temperature produces an increase in yield. Some discussed the effect of temperature change on pressure. Others discussed the effect of temperature on the frequency of collisions between reactants.

Question 8(b)(iii)

(iii) The conditions chosen for the manufacture of ammonia are 400–450 °C and 200 atmospheres pressure.

For each condition, give a reason why it is chosen rather than the one that gives the highest yield.

Temperature ....

....

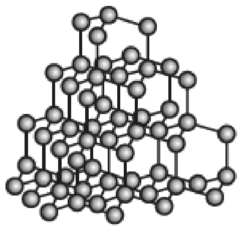
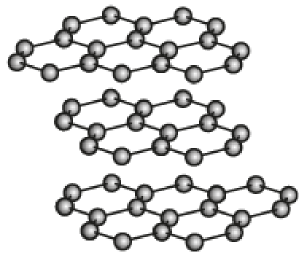
Pressure ....

.... **[2]**

Able candidates compared the conditions given with the ones they had identified as giving the highest yield and so realised that the manufacture used a higher temperature and a lower pressure than those needed for the best yield. Some could then explain that a higher temperature would increase the rate of the reaction. Others realised that there are cost and safety implications of using high pressures. Many answers were too vague with comments such as ‘makes it more reliable’ or ‘stops it being toxic’. A few suggested that high temperatures would denature the enzyme.

Question 9(a)

9 Diamond and graphite are allotropes of carbon.

	Diamond	**Graphite**
Structure		
Hardness	very hard	soft, flakes easily
Electrical conductivity	does not conduct	high

(a) Describe two similarities and two differences between the **structures** of diamond and graphite.

Similarities:

1 ....

....

2 ....

....

Differences:

1 ....

....

2 ....

....

[4]

Able candidates realised that both structures are giant covalent structures. A few went on to comment on the different numbers of bonds or the presence of layers in graphite. Some just said that they are both allotropes or both contain carbon atoms. Many described the differences in properties rather than the differences in the structures.

Question 9(b)

(b) Use ideas about structure and bonding to explain why the hardness and electrical conductivity of diamond and graphite are different.

Hardness ....

....

....

Electrical conductivity ....

....

....
[4]

Many understood that the hardness was affected by the bond strengths and the effect of the layers. Some were able to explain the difference as strong bonds throughout diamond but weaker bonds between layers in graphite. Some did not link bond strength with differences in structure. Others referred to intermolecular or ionic bonds. Some knew that electrical conductivity in graphite was due to movement of electrons. A few went on to explain why graphite had mobile electrons when diamond did not. Many related electrical conductivity to strength of bonds or space between the atoms.

Question 10(a)

10 pH values can be used to compare the acidity of different acids.
The pH of an acid can be measured by reading the display on a pH meter.

(a) Describe a different way that the pH of an acid can be measured.

....

.... **[2]**

Most candidates knew that some sort of indicator was needed to measure the pH of an acid. Some correctly identified universal indicator as the indicator needed. Some did not go on to describe the need to use a chart to identify the pH from the colour. Many chose litmus paper or described that you should “look at the colour change” but did not mention any indicator being added.

Question 10(b)

(b) Ling tests the pH of solutions of a strong acid and a weak acid. Both acids have the same concentration.
She finds that the strong acid has a much lower pH.

Explain why the strong acid has a lower pH than the weak acid.

....

....

.... **[2]**

High ability candidates understood that the strength of an acid is due to the production of hydrogen ions. Some were able to relate this to either the amount of ionisation of the acid or the concentration of hydrogen ions. A few were able to discuss both amount of ionisation and hydrogen ion concentration. Some understood the relevance of hydrogen ions but thought that it was the amount of hydrogen ions that is important rather than the concentration. Candidates struggle to understand that a large volume of acid will have a large amount of hydrogen ions even if the concentration of hydrogen ions is low. Many candidates did not explain the difference between a strong and a weak acid and just listed the pH values for the types of acid.

Question 10(c)

(c) The table shows information about three different acid solutions.

Complete the table for the three solutions.

Acid solution	**Concentration of solution (mol/dm^3)**	**pH**	**Concentration of hydrogen ions (mol/dm^3)**	**Type of acid**
1	0.1	1	1×10^{-1}	strong
2	0.01	2	1×10^{-2}	....
3	0.1	5	....	weak

[2]

Almost all candidates identified acid 2 as being a strong acid. Most were also able to use the pH to find the concentration of hydrogen ions in acid 3. Some used the concentration of the acid and assumed that it was fully ionised.

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