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Examiners' Report January 2010

GCE Chemistry 6CH02

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Introduction

This Unit 2 examination was intended to test the candidates' knowledge and understanding of the chemical principles learned in unit 1 and their ability to apply them in a modern context. The time allowed for this paper was extended to 1 hour and 30 minutes and there was no evidence that candidates found themselves short of time to complete the paper. Overall, the paper was challenging but high marks were accessible to the well-prepared and thoughtful candidate who was able to read and correctly interpret questions, frame short but precise answers and set out calculations clearly and logically. However, while many candidates gave fluent answers to standard questions, only the better candidates demonstrated the analytical skills needed to apply their knowledge in less familiar contexts. This reliance on learned material was most apparent when candidates attempted to answer questions different from those that had been posed. Candidates would do well to ensure that they understand accurately the basic vocabulary of Chemistry and establish the habit of setting out calculations clearly and logically. Candidates should be able to write balanced equations and have a range of laboratory experience.

Section A

Most candidates scored well on the multiple choice section, showing an understanding over the full range of material tested. Only question 10b caused real difficulty across the entire candidate range; close reading of the question would have made it clear that the measurements continued until the alkali was in excess and that the conductivity would rise after the end-point. To a much lesser extent questions 1 and 7 proved testing even for the better candidates.

Section B

While there were many excellent responses, a few candidates lost marks through a lack of precision in their answers, using inaccurate vocabulary and drawing the wrong type of organic diagram or placing bonds incorrectly.

Section C

In this section the initial passage set the context for questions that both drew directly from the material and required the use of concepts learned in the unit to understand references in the text. The requirement to analyse and to synthesise ideas meant that many candidates found this section the most challenging.

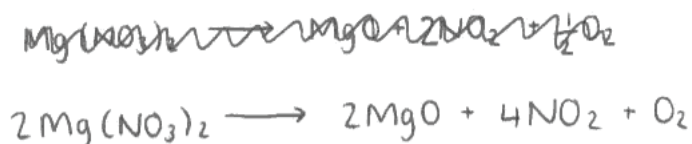
Question 16

Parts (a) and (b) of this question produced many excellent answers but marks were frequently lost because candidates were unfamiliar with the products of the thermal decomposition of the two nitrates, particularly of sodium nitrate, and because equations were not balanced. The explanation for the trend in stability within a group is a well-established requirement at this level but marks were needlessly lost by candidates who understood the basic principles but used the terms atoms, ions and even molecules, as though they were interchangeable. Some candidates attempted to answer this question by referring to periodic trends in stability.

Example 1

- (a) (i) Write an equation for this reaction. State symbols are **not** required.

(2)



- (ii) Calcium nitrate decomposes in a similar way to magnesium nitrate, but at a higher temperature.

Explain why the two nitrates have different stability to heat.

(2)

$\text{Ca}(\text{NO}_3)_2$
 Because Ca is more thermally stable than $\text{Mg}(\text{NO}_3)_2$.
 This is because Ca^{2+} is a larger cation than Mg^{2+} , extra shell, therefore has a less charge density than Mg^{2+} .
 This means it has a decreased ability to distort the large NO_3^- anion (the more distortion the more unstable).
 So $\text{Ca}(\text{NO}_3)_2$ is more stable.

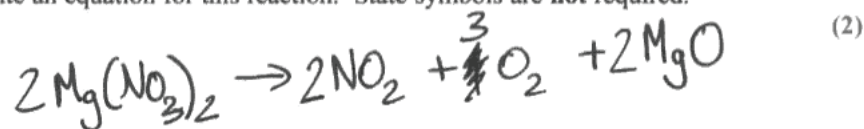

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Examiner Comments

This answer is exemplary: the candidate identifies the key requirement of the question in the first sentence and thereafter uses the correct terminology precisely and concisely to deliver an exact response.

Example 2

(a) (i) Write an equation for this reaction. State symbols are **not** required.



(ii) Calcium nitrate decomposes in a similar way to magnesium nitrate, but at a higher temperature.

Explain why the two nitrates have different stability to heat.

Magnesium has a higher charge density than calcium so it has a greater polarising power as a result it can distort the electron cloud in the bond to a greater extent introducing more covalent character so it is easier to thermally decompose. (2)



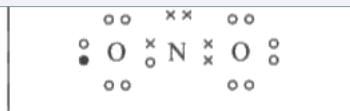
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Examiner Comments

Here the candidate has recalled some relevant ideas (charge density, polarising power and distortion of the electron cloud) but precision is lacking: the nature of the calcium and magnesium particles is not specified and the bond is not identified.

In 16(c) many candidates did appreciate that they were expected to identify the bonds and understand that double bonds were shorter than single bonds however, there were a surprising number of responses that referred to bond angles and valence shell electron pair repulsion theory. Here and elsewhere in the paper there were candidates who believed the terms double bond and π to be synonymous.

Example 3



Scientists have found that the bonds between nitrogen and oxygen in the nitrate ion are all the same length. Is the student's suggestion supported by this evidence? Explain your answer.

(1)

No because the 3 covalent bonds are all different; π bond, dative covalent bond, and covalent bond. They have different lengths.



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Examiner Comments

This was another common error. The candidate has correctly identified the types of bond represented in the structure but assumes that different types of single bond will have different lengths

16(d) produced many high quality explanations of the effects of temperature and pressure at equilibrium however, the observation mark in 16(d)(i) was very frequently lost by candidates simply stating which product would be formed in greater quantity or by seeming to assume that the starting point was entirely N_2O_4 rather than an equilibrium mixture as stated in the question. Again some candidates used careless language and failed to identify which direction of the reaction was exothermic or endothermic.

Example 4

(d) Nitrogen dioxide gas can dimerize to dinitrogen tetroxide, N_2O_4 , a very pale yellow gas, as shown in the equation below.



- (i) What would you see when an equilibrium mixture of these gases is warmed gently? Explain your answer.

(2)

As the equilibrium is warmed the equilibrium would shift towards the left side, so the ~~the~~ yellow gas of N_2O_4 would disappear and ~~it~~ would produce more nitrogen dioxide.

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Examiner Comments

This candidate understands how equilibrium responds to temperature but has missed the target altogether by failing to give an observation and failing to refer to the thermicity of the reaction.

Example 5

(d) Nitrogen dioxide gas can dimerize to dinitrogen tetroxide, N_2O_4 , a very pale yellow gas, as shown in the equation below.



- (i) What would you see when an equilibrium mixture of these gases is warmed gently? Explain your answer.

(2)

★ The reaction is exothermic so the equilibrium would shift left, decreasing the amount of N_2O_4
★ Therefore the pale yellow colour would no longer be seen. (could see brown NO_2 gas).

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Examiner Comments

Note the use of the phrase 'the reaction is exothermic' omitting the word 'forward' and the assumption that the system starts with pure N_2O_4 and changes to NO_2 .

16(e) produced some excellent answers but some candidates frequently omitted to explain that collisions at the higher temperature were more likely to have sufficient energy to react. Relatively few candidates annotated the diagram in support of their answer.

Example 6

Use the distributions to explain why gases react faster when the temperature is increased.

(2)

Gases react faster when the temperature is increased because the proportion of particles (represented by the area on the graph) with an energy greater than ~~that~~ ^{that} of the activation energy is greater at a higher temperature. This means that more particles have sufficient energy to react when they collide hence a faster rate of reaction. Also an increase in temperature causes the molecules to ~~move~~ ^{move} faster so there is a higher rate of collisions with the reactant.

(Total for Question 16 = 12 marks)

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Examiner Comments

This candidate touches all the required points and refers to the diagram.

Question 17

Some candidates misread 17(a) as requiring a test for a halide rather than a halogen. In contrast 17(b)(i) produced many excellent answers; for the most part candidates calculated the oxidation numbers confidently and understood how this related to reduction although some did assume that no more explanation was required. 17(b)(ii) exemplified two recurring features of the responses: the answers of many candidates gave the impression that they had never seen this reaction in the laboratory and a significant number of candidates give inferences when observations are required. In this question some candidates resorted to suggesting the absence of the observations given for the reaction between potassium bromide and concentrated sulfuric acid.

Example 7

Show, by use of oxidation numbers for sulfur, that the sulfuric acid has been reduced.

(2)

The oxidation number of S in H_2SO_4 is +6.
The oxidation number of S in SO_2 is +4. The oxidation number has decreased, so the number of electrons has increased, meaning S has been reduced.

(ii) State TWO observations, which would differ from those with potassium bromide, when potassium iodide reacts with concentrated sulfuric acid.

(2)

- The brown liquid would not be produced (as there is no Br in the reaction)
- The reaction would continue further and $H_2S_{(g)}$ would be produced. (so no SO_2 would be produced)
- (The S would be further reduced.)
↳ ∴ no ~~white~~ sharp smelling gas would be produced.



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Examiner Comments

This is a typically excellent answer to 17(b)(i) followed by a rather hopeful mixture of observations that would not be made and inferences in 17(b)(ii).

Example 8

Show, by use of oxidation numbers for sulfur, that the sulfuric acid has been reduced.

(2)

The oxidation number for sulfur has decreased from +6 to +4 therefore the sulfuric acid has undergone reduction.

(ii) State TWO observations, which would differ from those with potassium bromide, when potassium iodide reacts with concentrated sulfuric acid.

(2)

a yellow ppt is observed, A smell of bad eggs can be perceived.

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Examiner Comments

This candidate is very concise but very accurate also.

17(b)(iii) was generally answered very well the common error being to calculate the oxidation number of sulfur in H_2S as +2. 17(c) only caused a problem to candidates when the word ethical was overlooked or not understood. This often led to some complex and sometimes fanciful chemistry in support of using tablets. As in 17(a) with bromine and bromide, there were candidates who confused fluorine and fluoride.

Example 9

(c) In areas where the natural concentration of fluoride ions in rocks is low, some water authorities add fluoride to the water supply to improve the dental health of children. An alternative would be to supply free fluoride tablets.

Give ONE reason why it could be considered more ethical to supply free fluoride tablets rather than to add fluoride compounds to the water supply.

(1)

Because one person could take in too much fluoride ions the fluoride ions could react with other compounds in the water pipes and oxidise them as it is a very strong reducing agent - the oxidised product could be dangerous.

(Total for Question 17 = 8 marks)

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Examiner Comments

This candidate has not noted the ethical dimension of this question, assuming that, if something is hazardous, it must be unethical and then assuming that fluoride ions must be strongly reducing.

Question 18

This question tested some basic organic chemistry and required a sound knowledge of the reactions of alcohols and of their structure and nomenclature. The typical error in 18(a)(i) was, once again, to give an inference (e.g. hydrogen or a gas evolved) rather than an observation (effervescence). The command phrase 'What would you see / observe' must always be interpreted by the candidate as requiring a statement of the changes that would be immediately apparent while carrying out the experiment in the laboratory. Many candidates were able to give the formula of a compound that is formed when sodium reacts with butan-1-ol or one of its isomers but a significant minority were unfamiliar with this reaction and suggested a structure in which the sodium was bonded directly to the carbon chain. Some candidates gave displayed formulae where structural formulae were required and vice versa.

Example 10

18 Butan-1-ol and three other alcohols, X, Y and Z, are isomers.

- (a) (i) Give TWO observations you would make when any one of the alcohols reacts with sodium.

(2)

There could be fizzing or bubbling and an ~~alkoxide~~
~~alkoxide~~ alkoxide will be produced. It would be
a vigorous reaction.



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Examiner Comments

Here the candidate has sought to pad out the answer by repetition (fizzing and bubbling are acceptable alternatives to effervescence but only score once), vigorous is too vague to score a mark and 'alkoxide will be produced' is an inference.

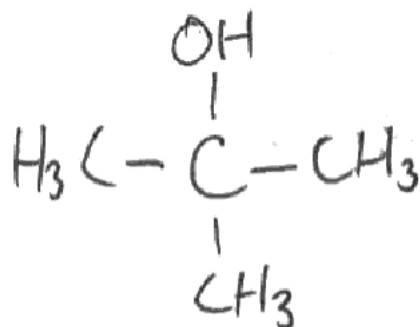
In 18(b) most candidates knew that the tertiary alcohol would be resistant to oxidation and were able to draw the structure. Fewer candidates were able to name the compound. While in 18(c) two errors recurred: giving the wrong primary alcohol (butan-1-ol rather than 2-methylpropan-1-ol) and giving the diagram of the oxidation product rather than the alcohol.

Example 11

Isomer X does **not** react with a mixture of potassium dichromate(VI) and sulfuric acid.

Draw the displayed formula of X and name it.

(2)



When isomer Y is heated under reflux with a mixture of potassium dichromate(VI) and sulfuric acid, it forms 2-methylpropanoic acid.

Deduce the structural formula of the alcohol Y.

(1)

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Examiner Comments

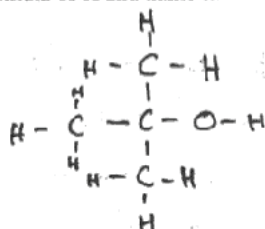
This candidate will have scored the mark but only just. The structure given is not strictly a displayed structure, as only the central carbon atom is displayed fully, and the bond joining the carbon and the oxygen is far from clearly belonging to the oxygen.

Example 12

(b) Isomer X does **not** react with a mixture of potassium dichromate(VI) and sulfuric acid.

Draw the displayed formula of X and name it.

(2)



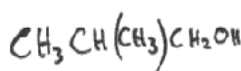
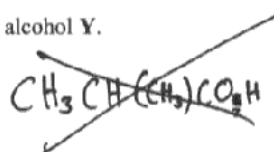
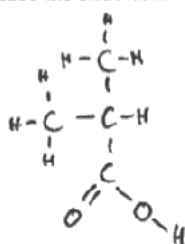
Name

2-methylpropan-2-ol

(c) When isomer Y is heated under reflux with a mixture of potassium dichromate(VI) and sulfuric acid, it forms 2-methylpropanoic acid.

Deduce the structural formula of the alcohol Y.

(1)



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Examiner Comments

Here the answer to 18(b) is perfect but note that in 18(c) the candidate has offered two answers to the same question, one of which is right and the other is wrong, scoring zero.

18(d)(i) was a very straightforward and high scoring question but 18(d)(ii) caused unexpected difficulties. Some candidates referred to the compounds rather than their spectra (e.g. 2-methylpropanoic acid has an O-H bond but Q (butanone) does not) and others used some very non-standard terminology in discussing spectra (spikes, troughs and curves rather than peaks or absorptions). Many candidates were unable to suggest an appropriate reagent for converting an alcohol into a chloroalkane and quite a number suggested sodium hydroxide which would effect the reverse reaction. In contrast most candidates knew that a white precipitate would be formed in 18(f)(i). 18(f)(ii) was a challenging question which required a good understanding of the principles of solubility and the ability to apply them to the specific situation. There were a number of excellent answers to this question but many candidates ignored the specific requirement to consider the hydrogen bonding and attempted to answer the question in terms of the dispersion forces while others essayed vague generalities such as 'like dissolves like'.

Example 13

*(ii) Both ethanol and water contain hydrogen bonds. By considering the hydrogen bonding on these two solvents, suggest why 2-chlorobutane is more soluble in ethanol than in water.

(2)

There are two hydrogen bonds on H_2O compared to the one on ethanol. This means less energy is required to break the ethanol hydrogen bond. ~~the ethanol hydrogen bond is weaker than the water hydrogen bond~~


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Examiner Comments

This candidate makes it all look very easy, targeting the two points with admirable conciseness.

Example 14

*(ii) Both ethanol and water contain hydrogen bonds. By considering the hydrogen bonding on these two solvents, suggest why 2-chlorobutane is more soluble in ethanol than in water.

(2)

2-chlorobutane cannot form hydrogen bonds due to the chlorine atom being too big. It can form permanent dipoles and London forces. It is more soluble in ethanol due to the fact ethanol has more electron than water - therefore it can form a stronger bond with London forces.


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Examiner Comments

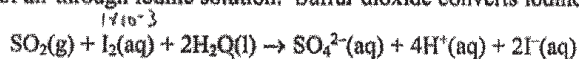
In marked contrast to example 13, here the candidate attempts a rather different question to the one asked. This candidate knows something about intermolecular forces and that the solubility of covalent compounds is determined by their interaction. However, the key factors have not been identified.

Question 19

In 19(a) most candidates knew that starch was used as the indicator in the titration of iodine with thiosulfate although acid-base indicators (especially phenolphthalein) were not uncommon. 19(b) produced some excellent answers and the scoring of this question underlined the importance of structuring the answers to numerical questions logically and providing brief explanations at each stage. Common errors were multiplying (rather than dividing) the number of moles of thiosulfate by two in 19(b)(ii) and simply leaving the calculated moles of iodine reacting with sulfur dioxide in 19(b)(iii) rather than deducing the number of moles of sulfur dioxide. The need for this latter stage is clearly signalled in the question. 19(b)(iv) was most likely to cause difficulties with some understandable confusion with the units required and, more surprisingly, some uncertainty about whether the moles of sulfur dioxide should be multiplied or divided by the M_r .

Example 15

(b) The amount of sulfur dioxide in the atmosphere can be measured by passing a known volume of air through iodine solution. Sulfur dioxide converts iodine to iodide ions.



In an experiment, 100 m^3 of air were passed through 100 cm^3 of iodine, concentration $0.0100 \text{ mol dm}^{-3}$. The remaining iodine was titrated with sodium thiosulfate solution and reacted with 12.60 cm^3 of sodium thiosulfate, concentration $0.100 \text{ mol dm}^{-3}$.

(i) How many moles of iodine were present in the solution of the iodine at the start of the experiment?

$$\begin{aligned} \text{moles} &= c \times v & (1) \\ &= 0.01 \times \frac{100}{1000} = \underline{1 \times 10^{-3} \text{ moles } \text{I}_2} \end{aligned}$$

(ii) How many moles of iodine remained in the solution at the end of the experiment?

$$\begin{aligned} \text{moles } \text{Na}_2\text{S}_2\text{O}_3 &= \frac{12.6}{1000} \times 0.1 = 1.26 \times 10^{-3} \text{ moles} & (2) \\ \text{moles } \text{I}_2 &= \frac{1.26 \times 10^{-3}}{2} = \underline{6.3 \times 10^{-4} \text{ moles } \text{I}_2} \end{aligned}$$

(iii) Calculate the number of moles of iodine which reacted with the sulfur dioxide, and hence the number of moles of sulfur dioxide in 100 m^3 of air.

$$\begin{aligned} 1 \times 10^{-3} - (6.3 \times 10^{-4}) &= 3.7 \times 10^{-4} \text{ moles } \text{I}_2 \text{ reacted with } \text{SO}_2 & (2) \\ &1:1 \text{ ratio} \\ &\therefore \underline{3.7 \times 10^{-4} \text{ moles } \text{SO}_2} \end{aligned}$$



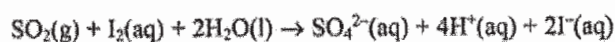
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Examiner Comments

This is an exemplary response. Each stage in the calculation is clearly set out and annotated with sufficient but not excessive explanation of the logic behind each step.

Example 16

- (b) The amount of sulfur dioxide in the atmosphere can be measured by passing a known volume of air through iodine solution. Sulfur dioxide converts iodine to iodide ions.



In an experiment, 100 m³ of air were passed through 100 cm³ of iodine, concentration 0.0100 mol dm⁻³. The remaining iodine was titrated with sodium thiosulfate solution and reacted with 12.60 cm³ of sodium thiosulfate, concentration 0.100 mol dm⁻³.

- (i) How many moles of iodine were present in the solution of the iodine at the start of the experiment?

$$\begin{aligned} \text{moles} &= 0.01 \times \frac{1000}{1000} \\ &= 0.001 \text{ moles.} \end{aligned} \quad (1)$$

- (ii) How many moles of iodine remained in the solution at the end of the experiment?

$$\begin{aligned} \text{moles of } \text{S}_2\text{O}_3^{2-} &= \frac{12.6}{1000} \times 0.1 \\ &= 0.00126 \end{aligned} \quad (2)$$

$$\begin{aligned} \therefore \text{moles of } \text{I}_2 &= \frac{0.00126}{2} \\ &= 0.00063 \text{ moles} \end{aligned}$$

- (iii) Calculate the number of moles of iodine which reacted with the sulfur dioxide, and hence the number of moles of sulfur dioxide in 100 m³ of air.

$$\begin{aligned} \therefore \text{reacted} &= 0.001 - 0.00063 \\ &= 0.00037 \text{ moles of } \text{I}_2 \text{ reacted.} \end{aligned} \quad (2)$$



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Examiner Comments

The only error here is the only too common one of leaving the calculation hanging in 19(b)(iii).

Many candidates experienced difficulties with 19(c) although this type of analysis forms a key element of the experimental aspects of the specification. Candidates who appreciated that very specific answers were required and framed their responses accordingly scored well. Some candidates referred to the effect of the various changes on the rate of the reaction and suggested that speeding up or slowing down the reaction would benefit the experiment accuracy.

Example 17

(c) Explain whether the changes below would or would not improve the experimental procedure for measuring the concentration of sulfur dioxide in air used in (b).

(i) The 100 cm³ of iodine was divided into 25 cm³ samples before titration. (1)

~~No, the concentration of I₂ would be~~ Yes, providing the concentration of iodine was constant throughout, it would give chance for ~~repeatability~~ repeats, improving reliability of the results.

(ii) The concentration of sodium thiosulfate used to titrate the iodine was changed from 0.100 mol dm⁻³ to 0.050 mol dm⁻³. (2)

A larger volume of sodium thiosulphate would be needed to ~~completely~~ react with the I₂ and this would reduce the percentage error of the burette because a larger volume was used.

(iii) 150 m³ of air was passed through the iodine. The solutions used were of the same concentrations as in the original experiment. (2)

If ~~more~~ ~~more~~ a greater volume of air was used, more iodine would react. That means less iodine ~~was~~ would be left over for the titration which would be worse for the experimental procedure as less sodium thiosulphate would be used and the percentage error would be greater.

(Total for Question 19 = 13 marks)



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Examiner Comments

This is an excellent answer; each point is analysed with specific reference to the question concerned and the comments are relevant and to the point.

Example 18

(c) Explain whether the changes below would or would not improve the experimental procedure for measuring the concentration of sulfur dioxide in air used in (b).

(i) The 100 cm³ of iodine was divided into 25 cm³ samples before titration.

(1)

It will improve it, as titration will be easier to carry out.

(ii) The concentration of sodium thiosulfate used to titrate the iodine was changed from 0.100 mol dm⁻³ to 0.050 mol dm⁻³.

(2)

It will not improve, as there will be problems due to uncertainty (% error).

(iii) 150 m³ of air was passed through the iodine. The solutions used were of the same concentrations as in the original experiment.

(2)

It will not improve, it, because the results might not be as accurate as we want it to be.



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Examiner Comments

In contrast, this candidate attempts to deal with the question with generalisations about errors in experiments and none of this is worthy of credit.

Question 20

This question was undoubtedly the most demanding on the paper, nevertheless there were some excellent responses when candidates displayed the required knowledge and understanding of the specification and the analytical skills needed to apply these to the specific contexts. 20(a) produced some excellent answers from candidates who were aware of the different types of bonding in graphite. Candidates do need to be aware that the terms 'intramolecular' and 'intermolecular' are not appropriate when discussing the bonding in a giant covalent substance.

Example 19

* (a) Why are the bonds **within** a layer of carbon atoms in graphite stronger than the bonds **between** the layers of carbon atoms?

(2)

The bonds within the layer of carbon atoms are strong covalent bonds, ~~however~~ the whereas the bonds between the layers of carbon atoms are weak electrostatic forces from the delocalised electrons.



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Examiner Comments

Here the candidate gains the first mark for identifying the strong covalent bonds within the layer but the description of the forces between the layer is insufficient for the second mark.

Example 20

*(a) Why are the bonds **within** a layer of carbon atoms in graphite stronger than the bonds **between** the layers of carbon atoms?

(2)

★ Graphite layer → each carbon is covalently bonded
to 3 others
→ Each layer is attracted to the next
due to Van der Waals forces
★ Carbon atoms → just have Van der Waals between
atoms.



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Examiner Comments

Here the candidate has done well and the first four lines should gain the two marks; unfortunately, the final statement contradicts the first and a mark is lost.

Example 21

* (a) Why are the bonds within a layer of carbon atoms in graphite stronger than the bonds between the layers of carbon atoms?

(2)

because the carbon delocalised fourth electron from ^{the} carbon atoms in graphite are not attached to their neighbouring carbon atoms, this causes the hexagonal sheets to slide over each other. The bonds within a layer of carbon atoms are attached by very strong covalent bonds, which are stronger than the intermolecular forces between the layers of carbon atoms.

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Examiner Comments

The use of the term intermolecular forces is inaccurate here so the first mark only is scored.

While many candidates correctly identified the movement of delocalised electrons as responsible for the conductivity of graphite in 20(b), relatively few were able to score the second mark. Too many were content to offer the reverse argument (electrons do not flow between the layers) without attempting to suggest why.

Example 22

(b) The data below gives the relative electrical conductivity of a pure graphite crystal.

Relative conductivity in plane of carbon hexagons	Relative conductivity perpendicular to plane of carbon hexagons
3.7	0.0017

Explain why the relative electrical conductivity of graphite differs with direction.

(2)

In each plane there are delocalised electrons because each carbon is only bonded to 3 others. It is the delocalised electrons that allow electrical conductivity. There is less movement of electrons between planes, which is why the conductivity perpendicular to the plane is less.



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Examiner Comments

This is a typical response which would gain the first mark but the candidate needed to apply the knowledge shown to access the second mark.

Example 23

Explain why the relative electrical conductivity of graphite differs with direction.

(2)

The graphite carbon atoms in graphite form 3 bonds between each other so electrical current can flow through the delocalised electrons from the structure but is not a sixth bond. The distance between the layers is bigger and there are less delocalised electrons between the layers compared to the plane of carbon hexagons.



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Examiner Comments

Here the candidate has taken the argument that vital stage further and attempted a plausible explanation of the difference in electrical behaviour based on advanced level understanding of conductivity.

Although most candidates were able to identify the force between the layers in graphite, the answers to 20(c) suggested that the nature of this force was not well understood with many answers suggesting the introduction of an additional new force (covalent bonding, permanent dipole interactions and hydrogen bonding) rather than a strengthening of the existing London forces by the addition of an extra electron.

In 20(d) most candidates were able to suggest a benefit of using a light activated catalyst although some implied that light could always be generated without energy input and there were some attempts to focus on the benefits of using a catalyst without reference to light. Provided the candidates knew the formula of methanol, writing the balanced equation for its formation rarely proved difficult.

Most candidates achieved a creditable mark for 20(f), applying their knowledge of the ways in which chemical systems might impact on the environment to the specific issues related to the processes described in the passage. Those who scored poorly on this item either relied on environmental generalities or confused the different processes mentioned. There were some excellent responses.

The majority of candidates were able to score in 20(g) provided they were alert to the specific nature of the question; sports equipment gained no credit.

Grade boundaries for GCE 08 Chemistry**6CH01/01**

Grade	Max. Mark	A	B	C	D	E
Raw boundary mark	80	48	41	35	29	23
Uniform boundary mark	120	96	84	72	60	48

6CH02/01

Grade	Max. Mark	A	B	C	D	E
Raw boundary mark	80	51	45	39	33	27
Uniform boundary mark	120	96	84	72	60	48

6CH04/01

Grade	Max. Mark	A	B	C	D	E
Raw boundary mark	90	56	50	44	38	33
Uniform boundary mark	120	96	84	72	60	48

Maximum Mark (Raw): the mark corresponding to the sum total of the marks shown on the mark scheme.

Boundary Mark: the minimum mark required by a candidate to qualify for a given grade.

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