CHEMISTRY (US)

Paper 9185/13
Multiple Choice

Question Number	*Key*	*Question Number*	*Key*
1	**D**	21	**B**
2	**B**	22	**D**
3	**C**	23	**C**
4	**C**	24	**B**
5	**B**	25	**B**
6	**A**	26	**D**
7	**D**	27	**A**
8	**D**	28	**C**
9	**A**	29	**D**
10	**C**	30	**C**
11	**C**	31	**A**
12	**A**	32	**C**
13	**B**	33	**A**
14	**C**	34	**B**
15	**D**	35	**C**
16	**B**	36	**A**
17	**D**	37	**B**
18	**A**	38	**D**
19	**B**	39	**D**
20	**B**	40	**A**

General Comments

Very few questions can be said to have been found to be easier. In fact only **Questions 3** and **28** were answered correctly by more than 50% of the candidates.

Comments on Specific Questions

Question 4

The correct answer was **C**. The most commonly chosen incorrect answer was **A**, chosen by 44% of candidates. This suggests that while some candidates knew that increasing temperature causes the modal energy value to be higher, they also incorrectly believed that increasing temperature causes the modal energy value to be possessed by a higher number of molecules.

Question 7

The correct answer was **D**. The most commonly chosen incorrect answer was **C**, chosen by candidates. These figures suggest that substituting the data in the question into the ideal gas eq using $n=m/M_r$, and rearranging the equation, proved to be too difficult a task.

Question 12

The correct answer was **A**. The most commonly chosen incorrect answer was **D**, chosen by 44% of candidates. Candidates needed to know the correct decomposition reaction;

$$Mg(NO_3)_2 \rightarrow MgO + 2NO_2 + \frac{1}{2}O_2$$

giving a ratio of 92/16 which is 1/0.174.

Question 18

The correct answer was **A**. The most commonly chosen incorrect answer was **B**, chosen by 78% of candidates. Candidates needed to know the formula of the ammonium ion, and had to select a formula for the cyanate ion that would give ammonium cyanate the empirical formula CON_2H_4, the same as urea.

Question 22

The correct answer was **D**. The most commonly chosen incorrect answer was **B**, chosen by 78% of candidates. The four isomers are methylpropene, but-1-ene, *cis* but-2-ene, and *trans* but-2-ene.

Question 26

The correct answer was **D**. The most commonly chosen incorrect answer was **B**, chosen by 56% of candidates. Candidates that chose **B** did not appreciate that 2-methylbutan-2-ol, a tertiary alcohol, cannot be oxidised by acidified potassium dichromate(VI). Those that chose **C** did not appreciate that pentan-1-ol is oxidised to propanoic acid which has stronger hydrogen bonding and therefore a higher boiling point. Pentan-2-ol will be oxidised to pentan-2-one, which has no hydrogen bonding and therefore has a lower boiling point than pentan-2-ol, so the answer is **D**.

CHEMISTRY (US)

Paper 9185/23

AS Structured Questions

Key Messages

Candidates are to be reminded to read questions carefully and check answers thoroughly. Candidates would have benefitted from this particularly in **Questions 1(b)** and **(d)** where there were unbalanced equations, **Question 1(c)** where there was often no sign in the final answer and in **Questions 3(a)** and **(b)** where names were used, rather than symbols/formulae.

Candidates are also reminded that their working in calculations should be shown to ensure that due credit can be awarded.

General Comments

This paper tested candidates' knowledge and understanding of important aspects of AS Level chemistry. The overall standard achieved by candidates was similar to last year with a reasonable knowledge of organic chemistry shown by many candidates.

Comments on Specific Questions

Question 1

The ability to apply Hess' Law correctly is an important skill in AS level chemistry. There were many good answers to this question although a significant number of candidates struggled with the calculation.

(a)

(i) The majority of candidates gave a correct answer. The most common error was to give the incorrect number of outer electrons for sulfur. This was usually, but not always, associated with a similar error for the number of outer electrons for carbon.

(ii) This was generally well answered although a small number of candidates incorrectly thought that a linear shape involved a bond angle of 120^{o}.

(b)

(i) This was correctly answered by the majority of candidates.

(ii) Fewer candidates gave a fully correct definition for the standard enthalpy change of combustion of CS_2. A significant number did not refer to one mole of CS_2 or state that the reaction must be carried out with an excess of oxygen or air. A small number referred to '... the energy required to... ' and were given no credit because combustion is always an exothermic reaction. Examiners expected candidates to begin their answers with a term such 'It is the enthalpy change when ...'.

(c) Many candidates were able to carry out this calculation correctly although some, whose calculation was correct, could not be awarded full credit as their answer did not include a sign as the question required. A significant number of incorrect answers involved arithmetic errors. A very small number of candidates attempted to answer this question in terms of S_8 rather than S. These candidates did not understand that $\Delta H_f^{\ominus}$ for SO_2 refers to the formation of 1 mol of SO_2 from 1 mol of S atoms and unnecessarily divided the value of $\Delta H_f^{\ominus}$ for SO_2 by 8.

(d)

(i) This was quite well answered with many candidates correctly deducing the ident... products,

(ii) Fewer candidates were able to give two correct oxidation states in this part.

Question 2

An understanding of and ability to apply Le Chatelier's Principle are important to success in AS level chemistry. There were many good answers to **(a)** but **(b)** was less well answered with a significant number of candidates struggling with the calculation.

(a)

(i) There were many good answers to this part. However, some responses did not make it clear that Le Chatelier's Principle applies to a chemical equilibrium.

(ii) The majority of candidates applied Le Chatelier's Principle correctly to the given equilibrium. Some candidates explained the effects of the changes they proposed on the rate of the reaction rather than on the yield of methanol.

(b) There was a good number of correct answers to this calculation although some were obtained by using the solution of a quadratic equation which was unnecessary. The syllabus, in ***section 7(f)***, makes it clear that such a method is not required. Reasons for not obtaining full credit were incorrectly deducing the equilibrium concentrations, incorrect expressions for K_c or arithmetical errors.

Question 3

The concept of periodicity lies at the heart of inorganic chemistry in the A Level chemistry syllabus. Those candidates who had studied periodicity carefully answered this question well. However, there were many answers that revealed a lack of knowledge and understanding of the relevant material.

(a) Many candidates gave quite good answers to this part. A small number gave names rather than formulae of the elements as required.

(i) The majority of candidates correctly gave a noble gas as their answer. The most common incorrect answer was H.

(ii) This was generally well answered although C was a popular incorrect response.

(iii) Although there are only two elements that are liquid at room temperature, a significant number of candidates did not give Br as their answer.

(iv) This was generally well answered.

(v) While Si was a popular and correct response, A*l* was often given in its place.

(vi) This was less well answered with many candidates not knowing that phosphorus can form the P^{3-} anion.

(vii) Candidates struggled to give the correct answer to this question, many giving an element that will react with water – such as Na – rather than one that will then form a solution that can behave as an oxidising agent.

(b) Answers to this part were generally sound although some candidates made careless mistakes in their formulae.

(i) This was generally well answered although SiO_2 was a frequent incorrect answer.

(ii) While many candidates answered this part correctly, a significant number gave MgO as their response although it has a slow reaction with water.

(iii) There were many incorrect answers to this part with $MgSO_4$ being a common incorrect response.

(c) This part was less well answered with many candidates struggling in **(ii)**.

(i) Many candidates knew that SiO_2 has a giant molecular structure which gives rise to its high melting point. However, some candidates described the process of melting as breaking intermolecular bonds rather than the strong covalent bonds within the SiO_2 macromolecule.

(ii) This part was poorly answered by many candidates, a significant number of whom did not know how to interpret the data. Although the majority understood that all three elements had simple molecular structures, many of these candidates were unable then to explain the difference in melting points in terms of van der Waals' forces. Too often the molecular formulae of the three elements – and hence the numbers of electrons in each molecule – were not given. As a result, any explanation in terms of van der Waals' forces was incomplete.

One common misunderstanding among some candidates was that when melting simple molecular elements the covalent bonds within the molecules rather than the weak intermolecular forces between them are broken.

Question 4

Questions on organic chemistry largely test a candidate's ability to recall the relevant material and many candidates were able to do this. However, many answers involved incorrect organic chemistry.

(a)

(i) Many candidates confident in organic chemistry gave good answers here. Some candidates drew displayed formulae so that they could check their structures and Examiners welcomed this. There were, however, many careless answers with hydrogen atoms missing from structures or extra carbon atoms included.

(ii) This was often poorly answered with many incorrect reagents being quoted.

(b) Answers here were generally of a poor quality, with a significant number of candidates not being secure in their knowledge of these reactions. In the case of the one reaction that does occur – that with HCN – many products were incorrect because they did not include either a nitrile group or a hydroxyl group.

(c) Here a significant number of candidates did not read the question and incorrectly offered litmus as the reagent.

Question 5

This question tested candidates' ability to apply their knowledge and understanding of organic reactions in an unusual context. While some candidates coped very well with the question, many struggled to decide which of the two functional groups in allyl alcohol would react with each reagent.

(a)

(i) This was quite well answered although some candidates drew structural formulae with missing hydrogen atoms.

(ii) This was less well answered with many candidates incorrectly believing that Br_2 would react with the –OH group in allyl alcohol.

(iii) Similarly, many candidates incorrectly thought that cold, dilute, acidified potassium manganate(VII) would react with both functional groups in the alcohol.

(iv) While many candidates correctly gave ethanedioic acid as the product of the reaction, a significant number thought that methanoic aid or methanal would also be formed.

(b)

(i) Many candidates correctly identified this reaction as an example of nucleophilic s… Those candidates who simply gave 'substitution' as their answer were not awarded cred…

(ii) This was well answered by many candidates.

(c)

(i) Fewer candidates answered this part correctly. Some incorrectly described heating the reagents under reflux which would produce propanoic acid.

(ii) This was generally well answered.

(d) Only a minority of candidates recognised that in this reaction the use of the ruthenium(IV) catalyst enables the reduction of the alkene group and the oxidation of the alcohol group in a single step reaction.

CHEMISTRY (US)

Paper 9185/35
Advanced Practical Skills 1

Key Messages

- The reading of scales on apparatus and the recording of the readings must be to a suitable level of precision. Thermometer readings should be recorded to the nearest 0.5 °C.
- The plotting of points on graphs and drawing lines of best fit requires the use of a sharp pencil and a long ruler. Points should be plotted precisely and lines of best fit should have balanced points either side of the line with anomalies/outliers ringed or labelled as such.
- Conclusions and inferences must be drawn from the actual results of tests carried out.
- Greater care is needed in supplying answers to the correct number of significant figures or decimal places.
- Instructions in the rubric need to be read and acted upon.

General Comments

The Examiners thank Supervisors at Centres who supplied experimental data for **Question 1** for each Session/Laboratory. Centres are reminded that the following documentation for each session and for each laboratory within a session should be included in the script packet:

- a list of the candidates present and a seating plan for the laboratory,
- a copy of the examination paper with the Supervisor's experimental results.

If candidates are not to be disadvantaged it is important that every candidate can be linked to a particular session/laboratory and to a corresponding set of Supervisor's results. Regrettably a number of Centres do not provide, or provide incomplete, Supervisor information. Also, Invigilators/Supervisors at Centres running more than one session, and/or using more than one laboratory should instruct their candidates to complete the Session/Laboratory boxes on the front of the examination paper.

Examiners take steps to obtain the missing data through CIE but this information is often unobtainable and candidates may be disadvantaged as a consequence.

This paper proved accessible to most candidates; a wide range of credit being awarded. Almost all candidates completed the paper indicating that there were no time constraints.

Comments on Specific Questions

Question 1

The majority of the candidates completed the practical work, drew clear, correctly labelled tables, and were able to gain credit for drawing the graph and the calculation.

(a) Almost all candidates recorded the balance readings to the same number of decimal places, recorded the mass of **FA 1** used correctly and noted all the required thermometer readings. However, a minority of candidates did not record all thermometer readings to .0 °C or .5 °C, as is expected with a calibration at 1 °C, or recorded all of the 8 readings at .0 °C. The majority of candidates gave suitable headings to their tables and displayed the units of mass and temperature correctly. Very few candidates were not awarded credit for accuracy and in fact many obtained full credit.

(b) Almost all candidates labelled the axes correctly though a significant number chose scales that did not occupy over half the available space as they started the temperature axis at 0 °C. The plotting was generally good though some candidates were imprecise in the placing of points and so[...] blobs to denote points which were not centred in the correct position. Credit for lines of [...] awarded to the majority of candidates though some did not have balanced points for the seco[...] had a positive gradient for both lines. Credit was least frequently awarded for the temperature c[...] at 2½ minutes. This was owing to a large minority of candidates not extrapolating the two lines to [...] time and by using a line with positive gradient joining the point at 2 minutes with that at 3 minutes.

(c) Candidates should be encouraged to read through practical instructions completely before starting work. A significant number of candidates incorrectly started recording thermometer readings every minute as in **(a)** which was unnecessary and costly in terms of time. There was evidence from some that insufficient stirring was carried out. However, many candidates gained full credit as they drew suitable tables and the accuracy was good.

(d) While most candidates calculated the heat energy produced or absorbed in **(i)** and **(iii)** correctly, some used the mass of solid instead of the volume of solution even though the specific heat capacity was given in $J\,cm^{-3}\,{}^{o}C^{-1}$. Most candidates correctly calculated the formula masses of **FA 1** and **FA 2** and many answered **(ii)** and **(iv)** in two stages, first calculating the number of moles used and then calculating ΔH. This is clearly acceptable but care must be taken not to approximate intermediate answers to too few significant figures. Most candidates converted J to kJ and recorded the correct signs in **(ii)** and **(iv)**. The last part of the calculation proved more challenging for some as a number of Hess' law diagrams were incorrectly drawn so the final answer was incorrect. Credit was frequently awarded for working as most candidates showed working in the correct direction in their calculations. Credit for appropriate significant figures was less frequently awarded.

(e) Many candidates gained full credit in this section but there are still some who appear unaware that the maximum error in calibrated apparatus is ± half the smallest division or that a temperature change involves two thermometer readings. Credit in **(ii)** was available as error carried forward, and only very few did not use the temperature change from **step 2** in their calculations.

(f) The majority of candidates stated that the student in **(i)** was incorrect but many did not continue with a valid reason for this. Only the clearest thinking candidates were able to gain full credit in **(ii)** and most did not gain any. The majority found the mean mass and mean temperature which was not a valid approach. Of those who treated the two sets of results individually, many used a formula mass from **(d)** to help them calculate ΔH values and only a few used the more elegant method of comparing ratios. However, the majority of those treating the results individually were awarded full credit.

Question 2

Although many candidates gave good answers here, some ignored the instruction to give the full name or formula of any reagent selected for a test. Use of the Qualitative Analysis Notes helps with the descriptions of precipitates formed with aqueous sodium hydroxide and ammonia.

(a) Almost all candidates gained at least partial credit here. The most common omission was that the precipitate formed with **FA 4** turned brown in air. Some of the descriptions of the precipitates did not agree with the wording in the Qualitative Analysis Notes.

(b) Almost all candidates selected to use the products with excess sodium hydroxide but some omitted the necessity of heating the mixture. A more common error was not specifying that it is the gas that should be tested with red litmus paper. Almost all candidates were able to identify **FA 4** as having a positive result but a significant number also identified ammonia being evolved from one or both of the other mixtures indicating a lack of care when carrying out the procedure.

(c) It is important that candidates note the instruction to use the full name or formula of a reagent selected for a test; there were many instances of Ba^{2+} or OH^{-}. Many candidates selecting aqueous lead nitrate appeared unaware that a white precipitate may form with the chloride as well as the sulfate and so did not gain full credit for observations. Again, it was important to specify that it was the gas which turned red litmus blue when warming with sodium hydroxide and aluminium. Those who tested for chloride/sulfate initially were at an advantage as the third test did not have to be carried out on any other than **FA 5**. Those testing all three solutions, even when this test was carried out last, often missed the evolution of ammonia with **FA 4**. Candidates should be encouraged to read the instructions carefully as they were asked to 'identify positively' which anion was in each salt and some deduced nitrate in **FA 5** by elimination.

(d) Almost all candidates gained at least partial credit for the deductions. The marking po[...] credited was for the cation in **FA 5** as many omitted either Pb^{2+} or Al^{3+}. The other commo[...] either to omit NH_4^+ or place it in more than one salt. However, most candidates were able to [...] that **FA 4** contained Fe^{2+} and SO_4^{2-} and that **FA 3** contained Cr^{3+} and Cl^-. Slightly less commo[...] that only **FA 5** contained NO_3^-. However, there was no evidence that candidates were rushed at [...] end of the paper.