Examiners’ Report
Principal Examiner Feedback

October 2024

Pearson Edexcel International Advanced Subsidiary Level in Chemistry (WCH12) Paper 01 Energetics, Group Chemistry, Halogenoalkanes and Alcohols

General comment

Many candidates had prepared well for this paper and were able to apply their knowledge of the topics in the specification to familiar and novel situations. However, it appeared that some did not seem to have a good basic understanding of organic nomenclature, the formation of London forces and the thermal decomposition of nitrates. However, calculation questions were once again done with impressive accuracy and there was no evidence of candidates running out of time.

The mean mark for the paper was 44.3 and the multiple choice, Section A, had a mean of 13.7. The most accessible multiple choice questions were 13b (nucleophilic substitution) and 12 (alcohols) and the most challenging questions were 5 (thermal decomposition and flame tests) and 15 (infrared spectroscopy)

Question 16

16(a)(i) Whilst there were some excellent answers to this straightforward question involving heating the crystals until the mass did not change, many candidates simply said heat for longer or weigh without heating. Others incorrectly chose to add a drying agent or use a filter paper to dry the crystals.

16(a)(ii) Calculation errors were rare and most candidates were able to correctly work out the value of X, using a variety of methods and score full marks. Where mistakes were made, most involved using 6.92 g rather than 6.04 g for the moles of the anhydrous salt.

16(b) The use of $q=mc\Delta T$ in (b)(i) was well known by most candidates with many scoring full marks. However, selecting the wrong mass for the calculation was a common mistake with both 7.56 g and 107.56 g being seen, instead of 100 g. Although the majority worked out the temperature change correctly, some converted the temperature to K by adding 273. A number of candidates also missed out the negative sign and a few failed to give the answer to the required 2 or 3 significant figures. Part (b)(ii) did not score so well. Often arrows were in the wrong direction and the state symbols inconsistent with the elements. However, candidates who got the cycle correct were usually able to calculate the enthalpy change accurately in (b)(iiI).

16(c)(i) Drawing a diagram that showed the interaction of ions with water proved to be quite challenging to many students. The easiest diagrams to interpret showed the ions as labelled circles and the water molecules with their displayed formula correctly orientated. However, these were very much in the minority and diagrams with missing diploes, incorrect or missing charges and the wrong formula of the ions were commonly seen. A significant number also gave the formula of water as HO_2.

16(c)(ii) Rather surprisingly, many candidates found this question quite challenging. In essence the question was about the test for sulfate ions but the novel context seemed to throw many. Incorrect suggestions about how to remove the toxic barium ions included neutralisation or answers related to the relative reactivity of the two metals. The majority made a fair attempt at the equation but a number of candidates did not seem to understand how to write an ionic equation and magnesium ions were often left in.

Question 17

17(a)(i) The structure appeared to confuse many candidates and fewer than half were able to correctly name the iodoalkane. Methane or ethane derivatives were commonly seen and the incorrect spelling of iodo also cost marks.

17(a)(ii) In contrast, drawing the structural formula generally scored well with a minority having the wrong number of carbon atoms.

17(b)(i) This question was answered well by the majority of candidates. Although the spelling of precipitate proved problematic to some, the mark scheme allowed phonetic or near miss spellings so most were able to access the marks. A number reversed the colours of the precipitates and some candidates simply gave the formula of silver chloride and silver iodide but did not give the observations that were required.

17(b)(ii) The relative strengths of the carbon to halogen bonds were well known but fewer candidates were able to describe the haloalkanes as tertiary and primary. Many mentioned the relative stability of carbocations which was not required and others mistakenly stated that the halogenoalkanes were carbocations. Occasionally, otherwise good answers lost a mark as the candidate did not refer to the particular structure.

17(c)(i) The equation scored better than the naming of the nitrile product. Candidates who gave the molecular formula of pentanenitrile, generally got the equation correct, but in a number of cases the Cl or K went missing from the products so the mark was lost. The naming of the organic product proved very problematic for many and amine, amide, nitride, and cyano were seen regularly instead of nitrile, the correct group. The length of the carbon chain also caused a problem with a number not including the nitrile carbon in the stem of the name and incorrectly naming it as butanenitrile.

17(c)(ii) The importance of this reaction proved to be one of the most challenging questions on the paper. Very few candidates appreciated that a carbon had been added to the chain and there were many incorrect vague answers seen.

Question 18

Q18(a)(i) This calculation was well understood with almost half the candidates scoring full marks. Where errors were made, most involved incorrectly converting the units which often resulted in nonsensical formula mass values of below 1 or above 1000.

18(a)(ii) Both the name and formula of ethanol were often seen and scored the mark but the main error was rounding 45.76 to 45 and suggesting a formula of C_2H_5O which was one hydrogen atom short.

Question 19

19(a)(i) This question was found to be particularly challenging with over half the candidates failing to score. Many did not read the question carefully and simply described the trend in London forces down the group rather than explaining how London forces were formed. Where marks were scored it was mainly for M2 with a reference to induced dipoles. Although reference to a spontaneous dipole was sometimes seen, very few candidates explained how the motion of electrons caused it so M1 was rarely awarded.

19(a)(ii) This question was well answered and although some candidates commented on the size of the atoms, most then went on to the include the number of electrons so scored the mark. However, in some cases marks were lost for additional wrong reasons.

19(a)(iii) Almost all candidates were able to identify the hydrogen bond as the cause of the higher boiling temperature and scored the mark. However, a number then continued to give extra information that was not required, presumably as they did appreciate what response the command word ‘state’ required.

19(b)(i) Disproportionation is a topic that is well known and half the candidates scored full marks on this question. Where marks were dropped it was usually for not stating which species was oxidised and some candidates unfortunately got oxidation and reduction reversed.

19(b)(ii) This novel equilibrium question scored quite well with a number of candidates achieving full marks for a clear explanation of why the equilibrium moved to the right. However, only about half the candidates recognised that the sodium hydroxide would react with acid and a number of responses referred to the exothermic or endothermic direction or the side with fewest moles, neither of which would score. A few answers stated that the equilibrium would shift to the left as the NaOH reacted with the chlorine and were awarded one mark.

Question 20

20(a)(i) Rather surprisingly, this equation proved to be quite challenging with fewer than half the candidates scoring both marks. Common mistakes included wrong or missing state symbols, with $H_2O(aq)$ and LiOH(s) regularly seen and unbalanced equations.

20(a)(ii) The reaction of lithium with water was well known and most candidates were able to make two correct observations. However, there is still some confusion about what an observation is with a number of candidates saying hydrogen was formed instead of saying what they observed, i.e. bubbles or fizzing. Others gave extra detail such as how to test for the gas which was not required.

20 (b) Very few candidates were able to give the correct formula of lithium nitride and the majority guessed at some formula involving NO_x. However, many did specify that the lithium nitride was formed by lithium reacting with the nitrogen in air, albeit often with oxygen which was an allow on mark scheme. Although rare, there were some excellent answers from candidates who wrote balanced equations showing the formation of the lithium nitride.

20(c)(i) Most candidates were able to write the correct equation from the two cell reactions. Where mistakes were made, they usually involved failing to cancel the electrons or lithium ions from each side.

20(c)(ii) This question was well answered with about half the candidates scoring both marks. Most were able to correctly calculate the oxidation numbers of the cobalt but some didn't state that it was a reduction reaction and so lost a mark. There were also some generic statements concerning how the oxidation number was decreasing without being specific on the values involved.

20(c)(iii) This question was found to be particularly challenging with many blanks and over half the candidates failing to score. Despite the membrane requiring similar properties to the membrane in fuel cells, there was a general lack of understanding. Many wrongly suggested the membrane should be a conductor and so allow the electrons to pass through and others simply commented on it being inert or unreactive.

20(d)(i) Calculation errors were rare and most candidates were able to correctly work out the empirical formula. However, at times the ratio was the wrong way round and a number of candidates simply gave the mass ratio, scoring a salvage mark.

20(d)(ii) About half the candidates correctly gave a reason why the alloy was better with stronger being the most common correct response. Very few referred to the density of the alloy as lightness was a far more common answer. However, in a number of responses it was not clear whether the answer was referring to the alloy or the individual metals.

20(e) This question was one of the most challenging on the paper and proved to be an excellent discriminator. Candidates who understood the thermal decomposition reactions of Group 1 and 2 scored well but the majority struggled to explain why the ions of lithium and magnesium were similar in size and write balanced equations. IP1 was rarely awarded as candidates overlooked the simple fact that magnesium had one more shell than lithium. Likewise, the equations in IP2 and IP3 were particularly disappointing due to poor balancing and incorrect formula. Where IP4 was awarded, it was usually for the different products being in the equation rather than a standalone statement. IP5 was often achieved for a general trend, but many responses were too vague and did not refer to the ions. A comparison was required for IP6, and rarely seen, but even when the ions were mentioned many candidates failed to mention what was being polarised so the IP was not awarded.

In order to improve their performance, students should

- always read the information in the question carefully, noting the command words and instructions in bold type
- learn the difference between an observation and an inference
- learn and understand the differences in the thermal decomposition reactions of Group 1 and Group 2 compounds
- shown working when carrying out calculations and then do a sense check on the answer i.e. if you are calculating a molar mass, ask yourself if the value of your answer could be a valid molar mass
- practise applying the rules of IUPAC nomenclature to nitriles and halogenoalkanes (and other compounds relevant to the specification)
- practise writing equations for reactions relevant to the specification