Examiners' Report
Principal Examiner Feedback

Ocotber 2022

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

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October 2022
Publications Code WCH12_01_2210_PEF *

General Comment

The mean mark for the paper was 39.7 which is similar to the June 2022 mean of 38.6. Many candidates were well prepared for this examination and were able to demonstrate a good knowledge across the specification. However, a number found the paper challenging and blank spaces were noted in some scripts.

Section A (Multiple choice)

The mean mark for the multiple-choice section was 11.9. The highest scoring questions were 4, 7 and 12, where over 75% of candidates achieved the marks. The most challenging question was 6, where 28 % achieved the mark.

Section B

Question 20

This energetics question proved to have a range of marks. Some candidates scored very well but others found aspects of the Hess cycle very challenging.

(a) The majority of candidates had a reasonable understanding of how to calculate an enthalpy change from the given data. However, a number were confused about which mass to use in the $Q = mC\Delta T$ equation. The mass of copper sulfate was sometimes used instead of the mass of solution and, in a few cases the mass of the solution and copper sulfate were added together. Almost all candidates used the correct temperature change with very few wrongly adding 273. Calculating the number of moles of copper sulfate appeared very straightforward, but incorrect rounding was sometimes seen. However, candidates who had made a mistake calculating the energy change and/or the number of moles were often able to score a transfer of error (TE) mark for calculating the enthalpy change per mole. The final mark required the correct sign and appropriate number of significant figures but many failed to recognise that it was an endothermic change so gave the wrong sign. Quoting too many significant figures was also a common mistake that did not score. Candidates should be reminded there is always a question requiring an answer to an appropriate number of significant figures.

(b)(i) Correctly completing the Hess cycle proved to be quite challenging with arrows frequently seen in the wrong direction, or even double headed and a range of different species, including atoms placed in the box. Those candidates who correctly identified $CuSO_4$ usually gave the correct (aq) state symbol and although extra water molecules were sometimes seen, they were ignored.

(b)(ii) As the Hess cycle in (b)(i) was often completed incorrectly, many candidates were unable to score these marks. However, some who had the arrows in the wrong direction gave the correct calculation, whilst others who had the arrows in the right direction could not work the calculation through, presumably because they appeared confused with how the cycle worked.

Question 21

This wide-ranging question on sulfuric acid was quite discriminating. Many candidates scored well on the first part about bonding and equilibria, but the reactions of halides with concentrated sulfuric acid appeared to be much more challenging.

(a)(i) The topic of intermolecular forces was quite well understood by many candidates and there were some good answers that correctly identified both molecules having London Forces. However, a number negated the mark as they said oxygen also had hydrogen bonds or permanent dipoles forces. Confusion between inter and intra molecular bonding was also occasionally noted.

(a)(ii) The qualitative effects of changing the temperature and pressure on an equilibrium reaction were well known and almost half the candidates scored all four marks. Although most were able to give the correct direction of equilibrium movement, some were unable to justify their answers. A small minority seemed to get their left and right confused so their explanation contradicted their stated direction of movement.

(a)(iii) Those candidates who understood what a reaction profile was were usually able to score at least 3 marks. The most common errors were double headed arrows, arrows in the wrong direction or lines with no arrow heads. However, some candidates drew a Maxwell-Boltzmann distribution curve and so scored no marks.

(a)(iv) Sustainability was not well understood by the majority of candidates and most gave the standard definition of a catalyst so did not score. Those that had a better understanding usually gained a mark for noting the need for energy reduction rather than the catalyst allowing the reaction to take place at a lower temperature.

(b)There was very little middle ground in this question about the reactions of potassium chloride and iodide with concentrated sulfuric acid. Many candidates did not appear to understand the chemistry in sufficient detail and struggled to score more than one mark for noting the formation of HCl (IP1) with potassium chloride. However, those who had a good comprehension of the reducing ability of the halides tended to scored marks for the correct trend (IP5) accurate observations and identification of the product (IP2&IP3). Fewer candidates achieved IP4 as many thought that both were redox reactions, with the iodide causing further reduction. There were some excellent answers that gave three balanced equations with oxidation number allowing access to IP6. Unfortunately, some candidates did not score reasoning marks as they produced incorrect equations and a surprising number commented on the reducing ability of the halogens not the halides.

(c) This calculation was very well done with almost two thirds of candidates scoring both marks. Those who only scored one mark usually achieved this by correctly calculating the number of moles of acid present.

Question 22

This question on alcohols proved to be very accessible to the majority of candidates. Many were able to score very well, but a lack of precision and minor slips cost marks to others.

(a) Unsurprisingly, the majority of candidates knew that alcohols contained the OH group, but access to the second mark proved more challenging. Some may have known what was meant by *primary* but could not express themselves precisely enough and others wrongly through that it meant the OH was on the end carbon. But overall, these definitions were well known and just under half of the candidates scored both marks.

(b) This question on the structures and names of isomeric alcohols discriminated well with many candidates scoring the full five marks and nearly all getting some. The most common errors were incorrectly naming methylpropan-2-ol and a significant number left out the 1 in butan-1-ol.

(c)(i) Rather disappointingly, just over half the candidates failed to score any marks on what appeared to be a fairly straightforward question on an oxidising mixture. Many were able to correctly identify potassium (or sodium) dichromate and although oxidation numbers were not required a number decided to give them. Unfortunately, in many cases these were incorrect so the mark was negated. The acidic nature of the oxidising mixture seemed quite well known but candidate who simply stated acidified or H^+ did not score as the question asked specifically for 'reagents'.

(c)(i) Only about a third of candidates were able to correctly write this equation, as many omitted the H_2O and a significant number were unable to transcribe the given formulae accurately.

(c)(ii) Infrared spectroscopy was a well understood topic and over half the candidates scored both marks by correctly linking peaks to wavenumber ranges and bonds. However, a significant number did not state the bonds that produced the peaks but scored the rescue mark for two correct wavenumber ranges.

Section C

Question 23

This was a relatively unusual style of question covering a wide range of topics loosely related to bicycles.

(a)(i) Almost half the candidates gave the correct equation but of those who made mistakes many used the incorrect formulae for titanium oxide and titanium chloride, despite both being given in the question. A number of candidates also omitted carbon from the equation or gave CO_2 as a product, not CO.

(a)(ii) Many good answers were seen but a considerable number did not answer the question posed. Often candidates either gave the correct oxidation numbers or the correct species being oxidised and reduced and so only scored one mark. A few answers confused oxidation and reduction and Mg forming a +1 ion was also occasionally seen.

(b) The majority of candidates found this question very challenging. Only about a quarter gave titanium oxide as the source of the smoke and far fewer were able to identify the reaction as hydrolysis.

(c) Drawing the structure of a polymer was quite well understood by the majority and about two thirds of candidates scored both marks. However, some candidates were unable to deduce the structure of the polymer from the monomer and double bonds and pentavalent carbon atoms were seen at times.

(d)This question involving detailed knowledge of reagents, conditions and reaction types appeared to be very challenging to the majority and the mean mark was less than three out of eight.

(d)(i) Many candidates appeared to have a reasonable understanding of this substitution reaction. However, a number who identified the correct reagent missed the second condition mark by giving answers such as heat or reflux, when aqueous was required.

(d)(ii) This was less well answered than (d)(i) and of those who realised it was an elimination reaction many gave (alcoholic) KOH as the reagent, presumably as they confused the elimination of an alcohol with a halogenoalkane.

(d)(iii) Many candidate were able to select PCl_5 as a correct reagent, but HCl was a common incorrect answer. Balancing the equation proved to be trickier and H_2O was often seen as an incorrect reagent.

(d)(iv) Candidates found this part of the question the most challenging and many of those who gave the correct condition as alcoholic, did not appreciate the hydroxide was acting as a base and not a nucleophile.

(e) Questions involving calculations are often well answered and that was illustrated here. About a third of candidates scored all five marks and almost all candidates managed to score one or two marks. Most were able to rearrange the ideal gas equation and the majority of errors came through failing to convert the units correctly, in particular changing the volume from cm^3 to m^3.

Summary

In order to improve their performance, candidates should:

- Read the question carefully, note the command word and make sure they are answering the question being asked
- practise converting units in ideal gas equation questions
- Practise drawing Maxwell-Boltzmann distribution curves and reaction profiles diagrams and know the difference between them.
- Check the structures and names of organic compounds carefully
- Practise drawing and calculating Hess cycles, paying particular attention to the direction of the arrows
- Show working for calculations and make sure the sign, units and significant figures are correct

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