# Examiners' Report
# Principal Examiner Feedback

October 2023

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

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**General Comments**

Many learners demonstrated a good knowledge and understanding of the material covered in Unit 2 of the specification as well as the underlying concepts of the AS course. Calculations, especially those of a standard nature were well dealt with and predominantly answers were clear and well structured. Questions where the application of understanding to novel situations was required proved challenging for many. Some resorted to reproducing learned answers to similar questions in previous papers, which did not answer the question posed.
There was very little evidence that learners experienced problems with having insufficient time.

The mean mark for the multiple-choice section was 11.6. The most challenging question in this section was Q1, where 34% achieved the mark and the highest scoring questions were Q6 and Q11(b) , where 77% achieved the mark.
The mean mark for the paper was 37.5

**Question 18**
**(a)(i)** Many learners find producing ionic equations, even simple ones, difficult. Full equations often appeared with no further work or as working but without cancelling the spectator ions. A few ionic equations for the formation of NaCl were also seen.
**(a)(ii)** The question was generally answered well with the majority of responses gaining a mark for one mole of water being formed. Where values for standard conditions were stated, they were usually correct
Few scored both marks, with the most common error being to quote that energy was "required", suggesting that neutralization is endothermic.
(**b)(ii)** A surprising number of responses showed no lines of best fit. Poor ones included a few sketched by hand and an occasional dotted line. The real problem was with the extrapolation and vertical line at 120 s. It appeared that many had not realised that the temperature change at 120 s was required. When marks were lost in part (i), the calculation could often be given marks on TE. However, many learners had failed to appreciate that the temperature was measured after the solutions had been mixed and the mass therefor heated was 50g not 25g. M2 was often scored with M3 on TE although a few thought that this was an endothermic reaction and failed to include a minus sign.
**(b)(iii)** Some learners did not realise that an explanation was required in their response and just stated that there would be a difference without saying whether it would be more or less exothermic or giving a reason. Frequent references to the temperature change being lower were seen. It would appear that these learners had not appreciated that the change in heat capacity was the reason for the difference. Stating that the enthalpy change would be more exothermic or more negative produces a clearer answer than just "greater" or "larger" when an exothermic energy change is being referred to.

**18c(ii)**. The required mechanism question was generally accurate with a significant number of learners gaining full credit. The placement of curly arrows seems to have improved. There were three fairly common mistakes which were:

- missing the minus sign on the hydroxide ion
- missing or incorrectly placing the lone pair on the oxygen of the hydroxide ion
- giving the SN1 mechanism via a primary carbocation

**18c(iii)**. This was reasonably well known and the request for the solvent rather than reaction conditions meant M2 was frequently scored. All possible reaction types were seen for M1. Nucleophilic elimination or ethanoic or ethanolic acid occasionally lost the mark.

**19a(ii)**. There were few correct answers to this question with only the most able learners successful. Many found the procedure of calculating the moles of the silver iodide precipitate and then using that result to evaluate the mass of potassium iodide in the original mixture too complex. Many resorted to dividing the mass of the precipitate by the mass of the original sample, ignoring the fact that the cations were different and those in the sample were mixed. This tactic gained no credit.

Those learners who thought that the Mr of both the silver iodide and potassium iodide would be needed and managed to calculate them successfully were rewarded with a mark, even if they did not complete the whole process.

**19b.** This was answered well. Many of those who did not score both marks were correct in assigning oxidation numbers but forgot to say which species was oxidised and reduced. The oxidation number of chlorine caused some problems with values ranging from 0 to -4.

**19c.** Most gained one mark, although often for the colours reversed or putting the same colour, usually purple or colourless in both boxes.

**19d.** This discriminated well with the full range of marks awarded. Many learners recognized that marks could be gained for naming the intermolecular forces present in iodine, hexane and water. These were commonly scored but sometimes subsequently lost by adding permanent dipole-dipole forces. There were often thoughtful explanations on the relative solubility of iodine in hexane and water though the tendency to resort to “like dissolving like” was frequently seen with little further explanation. A common misconception was that hexane had more electrons than iodine. Another mistake often seen was that iodine reacted with hexane to form iodohexane.

Comments on individual indicative points:

IP1and 4. Some referred to the idea that iodine/hexane is non-polar, but did not mention the resultant London forces.

IP2: This was very often clearly stated.

IP3: This seemed well understood but sometimes the mark could not be awarded since a clear statement comparing the two intermolecular forces was absent.

IP5: This was often expressed in terms of “like dissolves like” with no recognition of the similarity of the intermolecular forces in the individual materials and hence the ease with which dispersion forces could be formed between iodine and hexane. Some very clear explanations were seen.

IP6: Rarely seen. Very few recognised that London forces between water and iodine would be weak and very few compared these with the energy required to break the hydrogen bonds in the solvent.
A few lost a reasoning mark for the incorrect comparison of the number of electrons in hexane with iodine.
**20(a)(i).** This well-known equation in ionic form was challenging for many. A few could write this directly and several went via (or stopped at) a suitable full equation. Common problems were an incorrect charge on the carbonate ion, balancing $H^+$ and additional electrons.
**20(a)(ii).** As expected, this was answered correctly by the vast majority of learners but some incorrect answers included, dirty, opaque, cream, grey or just a precipitate with no indication of colour. A number could not resist adding effervescence.
**20(b)(i).** Learners who did not read the question carefully frequently confused the titre volume with the volume pipetted into the conical flask. Thus, using 25 $cm^3$ in the calculation of the mols hydrochloric acid and 18.95$cm^3$ in the calculation of the amount of calcium hydroxide in 1$dm^3$. A number left their answer as a concentration and did not convert to a mass. In the conversion to a mass the Mr of calcium chloride was often seen.
**20(b)(ii)** Again, an explanation was required. It is not acceptable to just state that the titre would be different. Many responses mentioned reactivity rather than solubility and referred to the Group 2 metal rather than the hydroxide. Even when the correct comparison between the solubility had been made, some learners failed to appreciate that, since more hydroxide ions would be in solution, the titre would be larger.
**20(c).** Some very good answers were seen, although after a good explanation some sadly forgot to state the effect on the acidity and lost the final mark. A very common error was to assume that because carbon dioxide is a gas the change in the position of equilibrium must be due to changes in volumes of gases. Another misconception was that $H_2CO_3$ caused the increase in acidity and not $H^+$(aq).
**21(a)(i).** The majority of responses scored all three marks in a rather straightforward exercise. The most common error was to round the moles of oxygen to 0.04 which gave a different mole ratio and led some to impossible formulae. A few did not work out the amount of oxygen at all, showing a lack of attention when reading the question.
**21(a)(ii).** Since a majority had correctly determined the empirical formula, it was surprising that learners were much less successful in using their result from (i) and the mass spectrum to find the molecular formula.
It seemed as though some did not understand what the mass spectrum was showing, in particular the molecular ion peak mass.
**21(a)(iii).** Many responses to this question only achieved 1 mark, usually for the alkene. Formulae were generally safer as some lost M1 for just "double bond". A very few knew that carbon dioxide was released by reaction with an acid but failed to specify a carboxylic acid or COOH group would be present.

**21(a)(iv).** Many found this difficult but most gave combinations of C,H and O with the correct masses. A few correct answers failed to score due to the absence of a positive charge.
**21(a)(v).** It was very difficult to score this mark if mistakes had been made in earlier parts. Many learners struggled to draw a formula with both functional groups present. It is unfortunate when those who manage to get this far disregard the information about the isomer required.
**21(b)(i).** Most candidates gained M1, either from labelling the graph or their written answer. M3 was the least regularly awarded with many neglecting to use the word successful. Learners could have made better use of the graph as some did not use it at all.
**21(b)(ii).** Another equation which was not well done. The structural formula of propenal is given in the question but many failed to correctly transcribe it, usually losing the double bond. Many also added water to the product side. Some used molecular formulae, usually incorrect.
**21(c)(i).** This reaction is not well known so many incorrect reagent and conditions were seen. By far the most common was acidified dichromate with 'heat under reflux', resulting in the loss of M2.
**21(c)(ii).** Many learners did not understand what was meant by sustainability. The usual explanation was in terms of numbers of steps or energy use without being specific. Many of those who appreciated that crude oil was part of the reason discussed it in terms of being burnt, rather than looking at how the question said it was being used.

**Paper Summary**

Based on their performance on this paper, candidates should:

- Read all of the questions carefully and use the information provided to help you frame your answer.
- Do not round intermediate values of calculations.
- Take note of the command words used in questions.
- Practise calculations arising from practical exercises.

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