Pearson

Examiners' Report

Principal Examiner Feedback

January 2018

Pearson Edexcel International Advanced Subsidiary Level

Chemistry (WCH01)

Unit 1: The Core Principles Of Chemistry

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Introduction

There were many questions on the paper that gave candidates across the whole-ability range numerous opportunities to show the depth of their knowledge and understanding. No reports nor was there any evidence seen which indicated that candidates were short of time such that they had difficulty in completing the paper. The calculation questions on the paper provided a further means of differentiating between candidates of varying ability which, resulted in the full range of marks for those questions. As has previously been the case, candidates found the most demanding questions to be those where application of chemical concepts and principles was required.

Multiple Choice

The multiple choice section had an average score of 13.5 which was slightly higher than previous series. Only question 4(c) had a percentage of less than 30% gaining the mark and only one question with more than 90% scoring the mark. Hence the vast majority of questions were found to be challenging by candidates and provided a means to test their chemical ability.

Question 16

The first part (a) on fractional distillation was generally well answered. However, it was frequently observed that candidates do need to be much more careful in reading the exam question and then giving the answer required. For example, in (a)(ii) the question required the “name of an alkane” present in a particular fraction. Many candidates gave the answer “refinery gases” which is the name of the fraction concerned but is not the name of an alkane and so did not score. Part (iii) in this section tested candidate’s ability to appreciate the part that chemistry plays in the real world in that the demand for petrol is greater than that which can be met simply by fractional distillation of crude oil and so further processing is required. Generally only the more able candidates understood this point.

Part (b) focussed on the cracking of crude oil and in part (ii) the most common error that students made was the failure to write the equation to produce octane and instead wrote decane. There was no credit given for this because the first mark was for the correct formulae of octane and ethene, and the second mark was for balancing but there was no balancing needed with decane. Thus, another reminder to answer the question which is set.

The questions in part (c) were about reforming and in part (i) it was good to see that many centres teach their candidates that the presence of branched-chain alkanes increases the octane number of petrol and reduces ‘knocking’. An answer referring to ‘more efficient combustion’ was allowed but not just that it was “more efficient” without explanation of context. There were some incorrect ideas such as ‘less energy needed for combustion’ and that more energy per mole was released. In part (ii) a reforming equation was required with skeletal formulae and a full spread of marks was observed. Skeletal formulae remain one of the more difficult chemical skills for candidate. There were occurrences of formulae with either too many or too few

carbons and also the presence of additional reactants and/or products which meant that the equation did not balance.

The molar calculation of part (d) proved a most effective discriminator and yielded the full spread of marks, for the most part according to the ability of the candidate. The question has the word ‘three’ emboldened to highlight the need for the final value to be given to three significant figures but this was often either ignored or forgotten and so resulted in at least one mark being lost. The other most common error was the use of the molar volume of gas equation to convert the 10.0 cm^3 volume of pentane into moles. Unfortunately, these candidates had failed to note or to read that the question had stated that pentane is a liquid and not a gas which is why the density of pentane was given so the mass and then the number of moles could be determined.

Candidates clearly know about the environmental impact that chemical can have and were able to write at some length in part (e). However, the phrasing used must be correct and oftentimes the answer given was not. It was frequently stated that a non-renewable fuel “cannot be used again”. Clearly this is incorrect as no fuel can be used again as once it is burnt then it is broken down. It is likely that this is not what was meant by these candidates, but the examiners can only mark what is written. Thankfully it was rare to see candidates writing about all different types of climate change but there was the occasional mix-up between destruction of ozone and global warming.

Question 17

In (a)(i) a description of the differences between a sigma and a pi bond was required and those candidates who clarified their comments with a diagram were certainly helped. The difference in the way the orbitals overlap was most commonly seen but the difference in the number of areas of overlap was most often awarded from the diagram drawn.

Part (a)(iii) was another example illustrating the importance of reading the stem of the question in order to answer correctly. The stem referred to the molecular formula C_4H_8, which was emboldened was emphasis, and so the requirement was to draw and name an alkene with this formula that does not have E-Z isomerism. It was evident that a considerable number of candidates missed the point of the question by drawing and naming ethene which did not gain any credit. In addition, pentavalent carbons were seen and names that did not match the structure drawn.

The completion of the reaction scheme in (b)(i) produced a wide spread of marks which reflected the ability of the candidates. It was surprising that the aspect which was most poorly answered was the hydrogenation reaction and not the oxidation to the diol. The other issue seen with some answers was not the understanding of the addition of bromine or oxygen but that the number of hydrogen atoms on the carbon atoms was too many, for example $CH_3CH_2BrCH_2Br$. This was really just a careless slip because the formula of propene was given in the centre of the page, with the correct number of hydrogen atoms on each carbon atom. In (b)(ii) a few responses

did not score because of the lack of continuation bonds and some responses incorrectly drew the repeat unit with the carbon-carbon double bond still in place.

Part (c) was also a most effective discriminator along grading lines as candidates of all levels of ability had the opportunity to gain credit and demonstrate their knowledge and understanding. The bullet points in the question highlighted the key points that the examiners were looking for and so those candidates who took a keen note of these generally scored highly. Some candidates omitted to add the dipole on the hydrogen bromide molecule, but the first bullet point requested ‘any relevant dipoles’ and so one mark was lost.

One reminder that is worth making is that the curly arrow from the bromide ion intermediate must originate from a lone pair of electrons and not the negative charge. It would be beneficial for centres to re-emphasize this. This would have helped those who incorrectly gave the bromide a partial negative charge instead of a full negative charge.

A discriminating question proved to be part (d) because a wide range of response were seen from comments on the increasing reactivity of group 2 elements to those that simply restated the information in the question by stating that barium hydroxide solution has more hydroxide.

Question 18

The instruction in part (a) was to complete the definition of first ionisation energy and so an attempt to present an often-asked question in a slightly different way. The phrasing of the question in this way meant that any equations given were not awarded any credit as might have been the case on previous exam papers. This is another reminder to always answer the question as given. Occasionally reference was seen to the loss of electrons from ‘a compound’ which is clearly incorrect but the better prepared candidates gave both marking point by referring to the gaseous state of the atoms and that the process involved one mole.

Part (b) was aimed at the higher ability candidates and it proved to be just such a type of question. Only the more discerning candidates could effectively describe the electrostatic attraction between the nucleus and the electron which required heat to be broken. The less able candidate simply explained the meaning of endothermic or give the stock phrase that ‘bond breaking required energy’, neither of which scored the mark.

The circling of the crosses on the sketch in (c)(i) also proved to be a testing question for candidates. Any circles drawn over the number three were penalised. There was no distinct pattern as some candidates appreciated that the first two crosses represented electrons being removed from an s orbital, while others only circled the first cross but then did correctly circle the cross to the far right. The shape of the p orbital was well-answered, with only a small minority incorrectly drawing three p orbitals rather than the required single orbital or drawing the ‘electrons-in-boxes’.

The answers to part (d) caused the most problems in terms of the amount of writing given frequently extended down the side of the exam paper and on additional pages. This was really not necessary and came as a result of another example of not properly reading what was required by the question. The question required a simple description of the trend in the first four successive ionisation energies. However many candidates also attempted to give an explanation which was not needed and for which no credit could be given. This obviously took candidates a significant amount of time to consider and to compose but for which they got no marks. This time and effort could have been used elsewhere to much better effect and serves to emphasise again the importance of reading and answering the question as set. How frustrating it would be to miss out on a grade by for example one mark because of the lack of time to double-check answers and make suitable correction all due to spending excessive time on answering a question unnecessarily.

The question in part (e) tested the appreciation of candidates for the reason why orbitals of equal energy are occupied singly before pairing occurs. A range of suggestions were offered but the majority of candidates did realise that this reduces the repulsion between electrons.

Question 19

The completion of the Born-Haber cycle and lattice energy calculation provided to be challenging but also accessible for the majority of candidates so that marks were scored by the vast majority of candidates. However, the challenge posed by the question also proved to be an effective discriminator and marks awarded covered the full marking rang possible. The main errors in part (a) were:

- the omission of number 2 before the electrons at the top left position and the omission of state symbols for each species
- missing state symbols
- the lack of arrow heads to indicate enthalpy change direction.

Part (c) was perhaps the hardest question to mark on the paper because of the somewhat nebulous answers that were given. For example, it was not sufficient to simply state that calcium oxide bonding was ionic but rather that the bonding was almost 100% ionic as the point of the question was a comparison with the covalent character exhibited by calcium iodide. Likewise, it was not sufficient to state that the calcium oxide is not covalent because this does not state what the bonding in calcium oxide is. It was frustrating to see so many candidates referring to ‘iodine’ instead of iodide or to ‘oxygen’ rather then ‘oxide’. The ion is clearly the species in the compound and a candidate must be very careful to be consistent with this point in their answers. Wording of this type was penalised once only in any answer given. Other incorrect wording was seen when candidates attempted to describe the polarisation occurring. For example, it was not uncommon to see a response describe calcium iodide as being polarised rather than the iodide ion itself being polarised. Occasionally the calcium ion was described as being polarised rather than being the ion that causes the polarisation.

The calculation in (d)(i) produced a wide spread of marks but candidates found it easier than the earlier molar calculation because about 40% of candidates scored maximum marks and over 80% were able to score at least one mark. However candidates not rounding up to 1SF during a molar calculation was also evident in this question and was penalised because of the affect on the final value obtained.

The application of chemistry to the real world was evident in the question in part (d)(ii). The majority of candidates understood the need to insulate the drink in order to reduce heat loss or to keep the drink warm. It was only a small minority of practical-thinking candidates who appreciated that the insulation also served to protect the handling of the hot drink.

For the final question examiners were given a list of four requirements for a successful answer to this question, and one mark could be awarded for any possible combination of two of these four requirements. Common errors were:

- y axis label of 'enthalpy change' instead of enthalpy
- omission of the value for the enthalpy change despite the stem of the question specifically stating that this was necessary or the omission of the arrow head showing the direction of the enthalpy change
- incorrect or missing or additional formulae such as CaOH instead of $Ca(OH)_2$ or no H_2O given as a reactant or O_2 / H_2 added incorrectly as a product
- missing state symbols even though these were also asked for in the question stem

Summary

One of the major themes that really needs to be stressed to candidates again and again is for them to read the question very carefully. It is always advisable, some would say vital, for candidates to make sure that they make the time to re-read the question to ensure that it is answered fully. In reinforcement of this point, it is also always important to allocate time to re-read answers so that any obvious errors can be corrected.

It remains crucial that candidates can give correct chemical formulae and that chemical terms are used in their correct context so when commenting on ions for example, reference to 'iodine' instead of 'iodide' is incorrect. The penalising or answers such as these can make the difference between grades and so greater care and accuracy is vital.

Finally, the practical aspect of chemistry and its application to the real world always needs to be emphasised so that candidates appreciate that chemistry is of true importance to all of our lives. Practical activities are always an excellent and enjoyable way to highlight the importance of chemistry and to stress its significance to young people today.

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