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Examiners' Report/
Principal Examiner Feedback

January 2016

Pearson Edexcel International A Level in Chemistry (WCH04) Paper 01

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General

It was clear that many students had prepared well for this examination. Most were able to apply their knowledge to the context of the questions with accuracy and awareness. Occasionally, there were responses where the student appeared to have learned a stock answer and failed to apply their knowledge within the context of the question. This may have resulted in the loss of full marks for an item but some marks were usually scored. Some questions contained quite lengthy and unstructured calculations. For students who laid out their calculations clearly the logic was immediately clear. Others however presented an apparently random scattering of numbers and such students frequently lost their way in these longer calculations.

Section A

The mean mark for the multiple choice section of the paper was 14.85 which is comparable to previous years. The most difficult questions proved to be 8 and 10 where less than half the students were successful. The highest scoring questions were 3(b) and 6 where approximately 90% of students achieved success.

Section B

Question 16

Most students were able to provide at least one method of following the progress of the reaction. However, marks were sometimes lost for casual mistakes such as colorimetry/ bromide ion in place of colorimetry/bromine. The use of a gas syringe was often given as the means of tracking the evolution of carbon dioxide but no mention was made of volume. Other common errors included the mis-spelling of colorimetry as calorimetry.
Many students were able to draw a suitable graph for question 16(b)(i). The axes scales were usually chosen to occupy more than half the available scale on the graph provided but occasionally the chosen scale was very difficult to check; scales that require the use of a calculator to plot points should be avoided. The most common error was the omission of **concentration** for the bromine. Some students were unable to recognise that the time intervals were not evenly spaced and consequently utilised non-linear scales. This made it difficult (but not impossible) to determine constant half-lives in 16(b)(ii). Most students were aware that first order reactions have a constant half-life but the numerical values quoted were sometimes approximate and were not the values on the graph. Students who chose to determine rate at various bromine concentrations rarely determined the gradient of the tangents to the line and even fewer related gradient to bromine concentration.
16(b)(iii) was generally poorly answered. Most students simply reiterated that a large excess of methanoic acid was used; information which is given at the start of the question. Relatively few were able to recognise that the excess is used in order that there is almost no concentration change.
The rate equation was usually written correctly and it was pleasing to see that almost all students wrote the full expression and remembered to include the rate constant. The evaluation of the rate constant and its corresponding unit analysis were also correctly achieved by the majority of students.

Question 17

Question 17(a) started with a very simple naming exercise as an introduction and the vast majority of students were able to name compound **A** correctly.
However, 17(b) was poorly answered. Many students seemed unfamiliar with the iodoform test and of those who were, many were either unable to give the correct reactants or failed to realise that the question required a **description** of the test.

In 17(c), most students were able to give a suitable test to show that **B** was not an aldehyde but some gave two such tests and a significant number did not also include a Bradys reagent test. More importantly, a significant number of students did not comprehend the question fully and failed to recognise that for full marks, both tests requires the test, result and deduction; it was the deduction that was often omitted. Students should also have noted that the question states that **B** is not an aldehyde. There was evidence here that the aldehyde test(s) were sometimes simply reiterated with little comprehension of the context within the question.
The displayed formula of **A** was usually correct in 17(d) and the suggested reducing agent was usually lithium tetrahydridoaluminate, although many interesting variations on the spelling of the name were seen. Most students were more confident of the formula than the name.
For the reaction mechanism in 17(e)(i), the majority of answers were usually partially correct. Errors included the omission of the negative sign in the intermediate, and more commonly, the CN group was bonded through the N atom instead of the C. It appeared that students were unaware that this indicates a different compound. The use of curly arrows seemed to be better appreciated this session, although the arrow from the carbonyl bond to the oxygen was sometimes started from the carbon atom rather than the bond itself.
In 17(e)(ii) the explanation for the lack of rotation of plane-polarised light was usually recognised as a consequence of a racemic mixture (again there were many examples of innovative spellings), and the attack by the cyanide ion from either side was also quite well known. However, many students were casual with their reference to the planarity of the reaction site and it was commonly claimed that the molecule itself was planar.

Question 18

Most students were able to write a correct expression for the equilibrium constant. The most common error was the inclusion of square brackets (sometimes used in conjunction with P).
Most students were able to gain at least one mark for 18(b) by giving units commensurate with their equilibrium expression from 18(a). Those who failed to recognise the mole ratio of carbon monoxide to hydrogen usually lost the first marking point but could still gain the rest of the marks. There was a great disparity in the quality of the presentation of the calculations; at their best, the calculations were clearly and logically presented, at their worst there was a mass of unexplained figures in which the student had frequently lost their way. There was a specific requirement for the final answer to be presented to three significant figures.
18(c) was poorly answered. Many students attempted to relate the change in Kp with temperature to ΔS_{total} and hence the change in ΔS_{surr} . This gives only the direction of change in ΔS_{surr} and not the sign of ΔS_{surr}. Most of those who recognised the sign of ΔH then correctly used $-\Delta H/T$ to determine the sign.
The transesterification question, 18(d), appeared to be unfamiliar to a significant number of candidates. Of those who were able to deduce the correct products, a mark was sometimes lost for an incorrect formula of propane-1,2,3-triol (usually because of an incorrect number of hydrogen atoms on the second carbon). However, it was pleasing to see that the product ester was usually written with the correct sequence of atoms in the ester linkage.

Question 19

Questions 19(a), (b) and (c)(i) should have provided an easy introduction to this question but the justification in 19(c)(i) was sometimes lacking. Students were usually successful in looking up the correct Ka values (although some quoted ethanoic acid in place of propanoic acid) but some then failed to compare these values to justify their decision. Students scored less well on Q19(c)(i). In their

response here students should be aware that $COOH^-$ implies the loss of the wrong H atom. The pH calculation was almost always correct.
While most students were able to write the correct equation for the reaction between sodium hydroxide and propanoic acid, the buffer calculation in 19(e)(ii) proved more difficult. The majority of students were able to score at least one mark by correctly writing one of several possible equations. However, clear thinking was required to complete the rest of this calculation and the disorganised way in which some calculations were presented indicated confusion in the student's mind. The logic was sometimes difficult to follow. Those who simply used the concentrations of reactant given at the start of section (e) had ignored the strong hint given by the equation in 19(e)(i). For 19(e)(iii), the explanation of the action of a buffer when alkali is added should have been relatively straightforward but some students failed to mention that the buffer contains a reservoir of both the acid and the (conjugate) base. The most common reason for the loss of a mark in this question was a failure to recognise that the change in [acid]: [base] would be very small.

Section C

Question 20

The sequence of questions 20(a)(i), (ii) and (iii) were all linked. The majority of students could complete Q20(a)(i) correctly, although a few looked up the standard molar entropy of N_2O instead of NO_2. The correct sign (-) and units were generally included, which was pleasing to see. In 20(a)(ii) however, a significant number of students correctly determined the entropy change of the surroundings but then inexplicably omitted the calculation of the total entropy change. The calculation of the temperature in 20(a)(iii) was for some students a more difficult concept. It is important to recognise that the reaction ceases to be spontaneous when $\Delta S_{total} = 0$, (not when $\Delta S_{total} > 0$ or < 0), and this should be stated at the start of the answer to the question.
In 20(b) most students were aware that a catalyst lowers the activation energy. However, they then failed to ask themselves why it should be necessary to lower this activation energy. The correct observation, that 'the reaction has a high activation energy', was not commonly given.

Question 21

The identification of functional group in 21(a) required the student to recognise and name the ester group. Those who responded with a structure (–COO) had not recognised that this answer is ambiguous and could be an ester or a carboxylic acid.
Most students were able to score some if not all the marks for 20(b)(i). The link between the mass spectrum and M_r was sometime tenuous, however. Most students were able to identify ethanoic acid.
Some students were clearly getting tired by this stage of the paper and the answers to 21(b)(ii) were less secure. Some failed to identify Z as an alcohol (a ketone was often suggested). Of those who did identify Z as an alcohol, most also recognised that the resistance to oxidation indicated a tertiary alcohol. The structural formulae offered in this section were sometimes very unclear and centres may need to do more work with this aspect of the subject. The equation for the reaction with sodium was frequently unbalanced. The use of $C_4H_{10}O$ in the equation is ambiguous since other classes of compound also have that formula.
In 21(b)(iii), the question requires the student to write a **displayed** formula. Many students did not display the methyl groups although the ester linkage was shown correctly. A transferred error was permitted here for esters formed from a primary or secondary alcohol suggested in part (b)(ii).

The proton nmr analysis in 21(b)(iv) was relatively simple for those students who had a correct structure in part (b)(iii). Transferred error marks were available for those who had suggested an ester based on butan-1-ol or butan-2-ol but these compounds produce more complex nmr spectra, making the task more difficult for the student. The number of peaks was often identified correctly as was the area ratio. The splitting pattern was less well explained and students often lost this mark because the justification was missing (use of the n+1 rule or alternative answer based on lack of protons on the neighbouring carbon atoms).

Advice for students

- When answering multiple choice questions do not leave any question unanswered. It is generally possible to eliminate one or more of the responses even if you are unsure which of the others is correct.
- Where the question specifies the number of significant figures in an answer, this will generally be in bold at the start of the question. Students should be aware that rounding off too early in the calculation may affect the accuracy of the final answer and they should retain at least the required number of significant figures and preferably more throughout the calculation. It is the final answer that must be presented to the required number of significant figures.
- Take special care with units. Some questions specify that units must be included. It is important that the units are written correctly. When working quickly it is easy to omit the indices, eg, mol dm^{-3} s^{-1} may be written as mol dm^{-} s^{-}. Check your answers carefully, including units.
- Be very careful not to make rounding errors, eg, 778.7 should be rounded to 779 not 778.
- When interpreting a mass spectrum, students are advised to make it clear that they understand the link between the molecule ion peak and Mr. Remember to refer to the mass spectrum.
- When drawing graphs make sure that both axes are identified and have the correct units; look carefully at the way the variables are identified in the data table. Choose scales that do not require the use of a calculator to check the accurate plotting of the points.
- Practice drawing **smooth** curves for those graphs where the data suggest a curve.
- Ensure that you follow the instructions where formulae are required. If the question asks for a **displayed formula** then write a displayed formula and not a formula that is part displayed and part structural.
- Take special care with the start and finish points of curly arrows.
- For questions that require predictions about an nmr spectrum it is often useful to write out a displayed formula for the molecule involved and identify the key nmr features on the displayed formula. You can then go on to describe and justify these features if necessary.

Grade Boundaries

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