Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

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Pearson Edexcel International Advanced Level in Chemistry (WCH14)
Paper 01 Rate, Equlibria and Further Organic Chemistry

General Comment

It was clear that there were some very well-prepared candidates who were able to give a clear demonstration of their chemical knowledge and understanding and thus score very high marks. All candidates had ample opportunity to gain credit for expressing what they had learnt in their studies of chemistry.

However, it was also evident from a number of questions that candidates struggled with the application of knowledge and understanding from AS modules to novel situations and A2 topic areas. Chemistry is a subject which continues to build on prior knowledge and understanding so it is vital that candidates grasp how to apply such learning to new topics studied.

Furthermore, it remains an concern that candidates do not always pay close enough attention to the questions set and their specific requirements. Much time and thought is spent in the creation of such questions and in stating exactly what is needed. Candidates do lose significant credit when these demands are not met.

Section A – Multiple Choice Questions 1 to 15

There was less differentiation between candidates at the grade E and grade A boundary than would have been ideal. The question which candidates found the most difficult was 10(a) where the key point was that the equlibrium would not be affected because of the equal number of moles each side of the equation but rather than the increase in pressure would lead in a increase in the number of particles in the same space. This would result in a more purple mixture. Question 13(c) was also found to be very difficult which may have been because candidates had to apply the effect on two connected equibrium equations.

The questions which were answered most often correctly were numbers 1, 14 and 15.

Section B

Question 16

In part (a) most candidates could identify the hydrogen bonding present in pentan-2-ol as the reason for the higher boiling temperature but not so many went on to link it to the extra energy required to break these bonds.

The identification of the chemical tests required to distinguish between the compounds in part (b) and (c) were done well.

The majority of candidates correctly identified the reagent required for part (d) and that the melting point, of the derivative or precipitate produced, would be compared to others

in a database. However not all included reference to the need for recrystallization of the precipitate which is essential. A small minority mentioned boiling point instead of, or as well as, the melting point which was not accepted.

It was disappointing in part (d) to see many candidates incorrectly referring to nucleophilic substitution, S_N1/S_N2, despite often clearly referring to nucelophilic addition in their answer. These candidates automatically lost M1 and M2. In addition, a significant number of candidates stated that the nuclephilic attack by the cyanide ion on the planar carbonyl group only applied to one of the ketones. This was also penalised.

At times it was unclear if the candidate was referring to the optical activity or the chiral carbon of the starting ketone rather than the product of the reaction with KCN but benefit of doubt was given wherever possible. It is important for candidates to be aware that this may not always be the case. This type of comparison question is worthy of more practice by candidates.

Question 17

The requirement in part (a) of identifying the number of peaks in the carbon-13 NMR spectra was answered very well. It was pleasing to see that most candidates did label the equivalent carbon atoms as requested.

The infrared ranges which were allowed in part (b)(i) were generous but still there were candidates that went beyond these. For example, the range for ester X was 1.8 – 2.8 and so an answer of about 3 did not score. Such errors have been seen in previous series and so candidates do need to take more care in this area.

The labelling of the splitting patterns in part (b)(ii) proved to be an effective discriminator as it allowed the less able to gain some credit whilst the more able often scored all four marks.

The displayed formula of the ester required in part (b)(iii) was only correctly drawn by about a third of all candidates. One error noted was that a molecule was drawn which would have had only 2 peaks in its proton NMR spectrum but an aldehyde instead of an ester was given. The molecular formula with two oxygen atoms was repeated in the question so this error should not have been made. This is another reminder to double check answers to make sure that they match the question asked.

Question 18

The extended open response question in part (a) was another very effective discriminator. The full range of marks was observed. The majority of candidates understood that primary halogenoalkanes undergo S_N2 whilst tertiary halogenoalkanes undergo S_N1. In addition, most gained credit for showing that they understood that the hydroxide ion was only in the rate-determining step of 1-bromobutane. Credit was awarded for correctly-drawn curly arrow reaction mechanisms but at times there were missing charges which

negated an otherwise good mechanistic step. The point which proved to be only scored by the most able was clear mention that the steps in the mechanism with the 2-bromo-2-methylbutane and the hydroxide ion were slow then fast. In order to avoid a double penalty, one indicative point was awarded if reference to this difference in rate was omitted.

Nearly all candidates scored the mark for the colour change observed in the titration for (b)(i) but about half gave the colour change the wrong way round.

The ability of the candidates to draw graphs is good with over half the candidates scoring full marks for part (b)(ii). However there continue to be slips in either the plotting of points or in omitting the units when labelling axes. The point for the rate at a volume of $30cm^3$ was the one most frequently misplotted. Likewise the deduction of the reaction order from the graph for part (b)(iii) was excellent. Occasionally an answer without a justification was seen and alas this did not score. This is another reminder to re-read the question so that all facets are addressed.

Part (c)(i) and the determination of a gradient was generally done well but frequently answers were given which were not to two significant figures as required and so one mark was lost. The mark for the additional line on the graph required for part (c)(ii) was often awarded but the second mark for the jusitification was only rarely awarded. Candidates could justify the less steep line because of a slower rate but did not go on to state that the plateau was the same because the concentrations or amounts used were the same.

Question 19

Three quarters of all candidates gained credit in part (a) but only half of these gave two reasons. Reference to the increase in the number of moles and to the production of a gas were seen equally.

Part (b) proved to be one of the most challenging questions on the paper. Many vague answers which filled the six lines were seen but frequently did not gain any credit. Candidates do need to recall knowledge and understanding from AS modules. Reference to the ions being fixed in a lattice and so unable to move but when dissolved in solution these ions could then move and collide for reaction was required. These are not difficult concepts and so the application of key ideas from AS modules are important to recall.

The entropy calculation is part (c) was high-scoring but it was disappointing to see how many candidates did not include a sign despite the request in the question.

Part (d) was another question which many candidates found very challenging. The drawing of such diagrams is well worth more practice. In these diagrams the inclusion of appropriate state symbols, the direction of the arrows and the correct labelling of these arrows is very important. Failure to do such things resulted in many losing marks.

Section C – Question 20

It was surprising that about a quarter of all candidates failed to gain any credit for an atom economy calculation in part (a). However those who were able to recall and apply their understanding from this AS topic did gain the marks.

A similar spread of marks was observed in part (b) and is an echo of the need for application of understanding from AS.

By contrast, the balancing of the equation in part (b)(i) was done very well with the majority scoring both marks. Unfortunately the inability to apply prior knowledge reappeared in part (b)(ii) because only about half of all candidates correctly gave the observation of brown fumes due to the nitrogen dioxide. This was an application of the knowledge of the thermal decomposition of Group 1 and 2 nitrates from WCH12.

The vast majority of candidates were able to select an appropriate indicator in part (d)(i) for each of the two equivalence points but the colour at the end-point was not so well-answered. It would be worth centres reviewing with their candidates the fact that the colour range quoted in the Data Booklet is not the colour change at the end-point. However most candidates understood the issue of the mixing of the colours was the answer needed in part (d)(ii).

A small minority of candidates could not determine any K_a values from the graph in part (d)(iii). Generally those who could attempt this question scored 3 or more because they understood what was required. The main issue to feedback to candidates is that answers given to one signficant figure are rarely acceptable. It was disappointing to see answers which went through the detailed process only to give 0.05 mol dm^{-3} as an answer. If this was seen then one mark was lost.

Only about one fifth of all candidates scored the mark for part (e)(i). It was not unusual to see reference to the retention factor, R_f, which applies to paper chromatography and TLC instead of retention time which applies to HPLC. Perhaps this would be a useful topic to review by centres and their candidates.

The calculation in part (e)(ii) was very well-answered with most scoring either two or three marks.

Just over half of candidates gained some credit in part (f). It was not uncommon for unbalanced equations to be seen which would not have been difficult to have corrected. Another example of the need to double-check answers.

Summary

To improve their performance, candidates should:

- make sure that knowledge and understanding from earlier AS modules is retained and recalled for application to novel situations with A2 topics
- stick carefully to the infrared spectroscopy ranges which are allowed by the Data Booklet
- draw on the practical work undertaken when answering questions
- of compounds represented in such a way can be properly answered
- take care to avoid contradicting correct details within an answer as this will often negate marks
- make sure that the numerical answer given from a calculation has an appropriate number of significant figures
- make time to read and then re-read the question to make sure that the answer given does actually address the one being asked
- always check the number of marks allocated to each question part so that the depth of the answer given and the number of points being made matches the demand of that question
- reserve time at the end to check that all the answers are fully correct so that any corrections required can be made