Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

October 2020

Pearson Edexcel International Advanced Subsidiary Level
In Chemistry (WCH11)
Paper 1: Structure, Bonding and Introduction to Organic Chemistry

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Introduction

Most candidates were well prepared for this examination and were able to demonstrate that they had a sound knowledge of the topics in the specification. There was no evidence that candidates ran out of time to complete the paper and the final question was usually attempted. Questions 20 and 21 were quite challenging in nature.

Section A

Multiple Choice

Candidates generally performed well in this section. However, it was noted that candidates scored lower than expected on question 8b and the term "homologous series" may require further emphasis.

Section B

Question 18

a) Part (a) was not answered well by many candidates. Some described shapes, paths or orbits, or listed s, p, d while others said that orbitals were "around atoms" and very few said orbitals were within atoms. More candidates gained credit from the second marking point by stating that an orbital could hold up to two electrons or was where an electron was most likely to be found in an atom. Candidates need more instruction on orbitals being a location within an atom where there is a high probability of electrons being found rather than it being a certainty that electrons are there or a place where atoms "store electrons".

b) Part (b) had varied responses. With most learners able to draw the diagrams seen on the mark scheme but with many of those who tried to describe the shapes in words falling short.

c) Part (c) was also not answered well. Many candidates used spd notation, suggestion a lack of clear understanding between shells, subshells, and orbitals. Errors included talking generally about what could be established, e.g. 'we can identify the number of shells, and how many outer electrons', rather than a specific discussion of the element. The positions of the large jumps in ionisation energy were often misquoted for sodium and some candidates were confused about the order in which the electrons were removed and how many electrons were in each shell. The mark most frequently awarded was the third marking point - for correctly stating that sodium had one outer electron. The second marking point in the mark scheme was the least scored – quite a lot of responses gave the spd notation rather than simply 2,8,1. Successive ionisation energies remains a topic that requires further teaching time.

d) In part (d) the graph was attempted by almost all candidates, but the modal mark was 2 with many failing to produce axes that covered 50% of the grid in both directions. Less able candidates sometimes failed to label their axes appropriately or misread 4.06 as 4.60

and mis-plotted the last point. Candidates were then asked to estimate the fourth ionisation energy for sodium and while nearly all could read an appropriate value from their graph the vast majority could not perform the antilog function on their calculators. Where a value was converted it was almost always correct.
For part (d)(iii) the most frequently occurring correct answers stated by candidates were that both electrons would be removed from a 2p orbital or the same subshell. A minority of candidates incorrectly stated that the ions would have the same electronic structure, or the electrons would be removed from the same 2p orbital. Some candidates failed to score by failing to mention that the electron would be removed. A common error was to write about the similar atomic number or electronic structure.

Question 19

a) Most candidates gained at least one mark here, the most common reason being an incorrect formula for the oxide of chromium (CrO_3) but the rest being correct. However, some included nitrogen atoms which was surprising. In part (ii) the majority of candidates gained the mark while a frequent incorrect answer was “cracking”.

b) Nearly all candidates scored on this question with many scoring full marks. Common reasons for losing marks included incorrect conversion for V (the conversion of Pa to kPa was more successful) and there were regularly errors seen in the use of standard form, or failure to convert K into °C (or thinking the temperature was already in Celsius).

c) Many candidates drew ammonia instead of ammonium for part (i) but even when NH_4 had been drawn correctly candidates regularly forgot the positive charge (or gave the ion a negative charge) or did not show that one of the bonds was coordinate. This meant that 2 marks were awarded infrequently. The candidates then went on to explain the shape and many could state the shape as being tetrahedral they still referred the electron pair in the dative bond as a lone pair when explaining the spacing of the bonding pairs of electrons, this is was often the case even for candidates who had correctly drawn the ion in part (c)(i) and gained both marks. The phrase ‘position of minimum repulsion’ seems to be well known, but sometimes misused for example “the molecules move to a …” or an explanation was given describing the separation of electrons or bonds instead of pairs of electrons.

d) Though most candidates did appear familiar with the hazard symbols a minority failed to read the question and instead identified each symbol in the box instead of ticking those relevant to ammonium dichromate(VI) using the information. Aside from this, the main reason for not scoring all marks here was either not ticking enough symbols or confusing those for flammable and oxidising substances. In part (ii) many candidates could select the correct information from the box though frequently it was not applied to the fact that (most) alkanes are flammable or candidates suggested that mixing the two may initiate a fire rather than enhance one that had already started.

Question 20

a) i) This part was not answered well, with many candidates starting with the wrong molecule and/or attempting condensation polymerisation with propene. When candidates could draw the correct polymer repeat unit and propene, they regularly forgot the "n" on the left-hand side of the monomer so did not score the second mark. Examiners regularly saw repeat units of three carbons in a chain, each carbon bonded to two hydrogen atoms. Candidates need to be reminded that extension bonds should pass through the brackets.

ii) The most frequently seen correct answer here was that the polymerisation of lactic acid produces water and the polymerisation of propene does not. However, a surprisingly large number of candidates finished the sentence with "but propene produces hydrogen" which did not score a mark.

iii) This is on the specification (5.8i) but has not been tested regularly and many candidates did not score this mark. Many stated that the polymer would break down "naturally" or would "decompose in the soil" so did not gain credit.

iv) Reducing landfill and not requiring incineration, along with "renewable" were the most common correct answers seen here with some candidates not gaining credit by stating "no waste produced" rather than less waste or "no pollution". Others gave very vague answers that were not comparative or bullet points of "environmentally friendly", "break down more easily", "carbon neutral", "cheap", "less toxic gases" and "reduce global warming" which were not sufficient to score marks. Being able to recycle biodegradable polymers was not awarded as a mark as many non-biodegradable polymers can also be recycled so this is not an advantage.

b) i) Some candidates confused this answer with the number or position of the double bonds or discussed the restriction around the double bond. When candidates understood the two hydrogens were on each end of the molecule, they often lost the mark for stating "similar" groups on the carbon in the double bond rather than identical or for using the word "molecules" instead of groups/atoms.

ii) Many candidates drew the same isomer here but in a different format i.e. displayed or partially displayed, rotated or with different bond angles, a few drew both isomers without indicating which was their final answer. Some drew the wrong molecule so lost the mark even though the E-form was shown while others did not understand the term "geometric isomer" so drew a position isomer of the molecule.

iii) Many good answers were seen, often candidates referred to sigma and pi bonds before a statement about not allowing free rotation. A few also drew diagrams. Most candidates knew that a double bond restricts rotation, but again there seemed to be some barriers to using this in context, with ‘restricted rotation’ being inserted into sentences where it no longer was a correct answer, such as “restricts rotation of the molecule” and “allows restricted rotation” which were not credited.

Question 21

a) Significant figures were a common problem with candidates often losing the final mark. Many were unsure how to use the density data and the M_r of cyclohexene was frequently incorrect (though candidates could continue to gain subsequent marks).

b) Part (i) was generally well answered with the most common error being candidates starting with orange or “brown-yellow” probably as they are used to using bromine water in experiments rather than bromine liquid. The reaction mechanism in part (ii) was confidently answered by many. Some candidates started with a molecule other than cyclohexene, but the mark scheme still allowed them to access three of the four marks. However, many lone pairs were missing from bromide ions or curly arrows did not start from the lone pair on the bromide ion, so the final mark was regularly not awarded. Candidates need to take more care with the positions of their curly arrows as some were seen originating from atoms rather than bonds or lone pairs, or just going in the wrong direction.

c) The vast majority of candidates could quote “parts per million”, though a few improvisations were seen. In part (ii) the modal mark was 1 for choosing an appropriate concentration. Writing a correct expression and rearranging for V was too challenging for many candidates. Most candidates were unable to calculate a minimum volume for the laboratory or, having performed a calculation, realise than an answer in 10^{-9} dm^3 was likely to be incorrect. Some candidates tried using the molar volume in their calculation. Occasional errors in rounding prevented the third mark from being awarded even when the rest of the calculation had been performed correctly.

d) Many candidates forgot that bromine is diatomic so the most frequently obtained mark was 2. It was noticed that some candidates arrived at their final answer through a different route, using moles not mass.

Question 22

a) Most candidates attempted this naming competently with the main reason for failing to score being an error in the numbering.

b) i) The vast majority of candidates recalled this condition.

ii) A lot of Cl_2 fission was seen for this part with candidates seeming unfamiliar with homolytic fission taking place within other molecules. The first mark was awarded for the correct use of fish-hook arrows on a bond so this could be awarded and many just gave a carbon bonded to a chlorine atom in isolation rather than drawing out molecule X. This meant that the second mark was very rarely awarded as the radical formed from molecule X was not drawn. However, a lot of double headed curly arrows were seen. Some radicals were seen throughout the rest of Question 22 with positive charges instead of the expected dots (these did not gain credit).

iii) Candidates were only asked to write one equation here, but often wrote many lines of propagation reactions. Only the first equation was marked, allowing later mistakes to be ignored and the majority of candidates gained at least a mark here where the question was attempted. Despite the direction "curly arrows are not required" a few candidates still tried to use them. A minority of candidates left this part blank.

iv) Some candidates did not read the instruction carefully here and did not used displayed formulae so could not score. When displayed formulae were used and the first mark achieved the second was often lost because the product was not correct for the two radicals drawn.

v) The most frequent incorrect reaction type seen was "addition" followed by "substitution". Some candidates were not specific enough in naming their product, merely giving "hexabutane" and we saw regular misnaming of the product along the lines of "1-chloro-2-dichloro-3-dichloro-4-chlorobutane".

Summary

To improve their performance, students should:

- read the question carefully and make sure that they are answering the question that has been asked. Good practise would be to underline key words.
- make sure that comparisons are made when required. Candidates should practise using comparative language in class.
- write formulae, symbols, and numbers carefully, checking their legibility. This is especially important as all the papers will be scanned for marking.
- be careful with the precision of curly arrows in organic mechanisms. Lone pairs should also be clearly shown.
- show all working for calculations and give final answers to an appropriate number of significant figures. Candidates should practice using questions to work out what the appropriate numbers of significant figures are.
- ensure they are familiar with both the log and antilog buttons on their calculators.
- refer to dative bond pairs as bonding pairs and not lone pairs when applying electron-pair repulsion theory.
- practise drawing out homolytic fission on molecules other than chlorine and practise using displayed formulae of radicals to show termination products.
- check their understanding of chemical terms in the specification e.g. homologous series, geometric isomer, displayed formula.
- use column headings to label graph axes.
- reread questions and answers, where time permits, to avoid careless mistakes. This includes applying the use of logic when a question asks the for size or a temperature of a room.

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