Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

October 2019

Pearson Edexcel International Advanced Subsidiary Level
In Chemistry (WCH11)
Paper 01 Structure, Bonding and Introduction to Organic Chemistry

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Introduction

This is the first examination in the Pearson Edexcel International Advanced Subsidiary Level in Chemistry Paper WCH11_01 to be sat in the October series of examinations. The style of the paper is the same as that for the legacy paper WCH01_01 with Section A containing 20 multiple choice questions and Section B containing 60 marks of structured questions.

There are just a few changes to the specification. The energetics topic has been split up and moved to Units 2 and 4. Shapes of molecules and ions has been moved from Unit 2 into Unit 1 and calculations using the ideal gas equation have been added.

Some candidates were very well-prepared for this examination and scored high marks. Many candidates were able to demonstrate that they had a sound knowledge of the topics in the specification and could apply this to the questions with just a few omissions or errors. Other candidates found the paper challenging and would benefit from more preparation to ensure that they know the basic facts, can express their ideas clearly and carry out calculation explaining their working.

Multiple Choice

The mean mark for the multiple choice questions was 14.79.

The highest scoring questions were 1, 2, 5 and 6 with over 85% of candidates achieving these marks. The most challenging question was 4 with 46% of candidates achieving this mark.

Question 21

(a) The majority of candidates drew the skeletal formulae of hexane and cyclohexane but many omitted to balance the equation by adding hydrogen. Candidates should check that all equations are balanced.

(b) Many candidates gave an acceptable name for the cycloalkane **D**. Common errors included giving incorrect numbers or missing out cyclo or di.

The vast majority of candidates worked out the correct molecular formula of **D**.

(c) There was an even spread of marks for this item. Some candidates just drew the 1,2 isomer in different orientations, while others just drew the 1,3 isomer. Many candidates were able to draw two different isomers and the 1,1 isomer proved to be the most difficult to deduce.

(d) Many candidates worked out that the general formula for a cycloalkane is CH_2 so were able to deduce the molecular formula of **E** as C_9H_{18}. A few candidates did not read the question carefully and they gave a structural formula instead of a molecular formula, so they did not receive any credit.

(e) There were some excellent answers seen for this item with the working clearly shown and explained. Some candidates just wrote down some numbers, with no explanation and it was difficult for the examiners to award marks. Candidates must explain their working with a few words and in this calculation the volumes should have been clearly linked to the specific gases. Some candidates chose a long route for this calculation and wasted time by converting volumes to moles and back again showing they did not understand the simpler principle of the ratio of reacting gas volumes. Some candidates did not realise that the oxygen was in excess so there would be some left at the end.

(f) The majority of candidates knew that this was a free radical substitution reaction but some thought that it was electrophilic, and others thought that it was an addition reaction. The majority of candidates completed the equation for the initiation step by drawing two acceptable arrows with half-arrow heads and showing the two chlorine free radicals as products. Common errors included

drawing arrows with full arrow heads and $\bullet Cl_2$ as a product. The majority of candidates were able to write the equations for the two propagation steps with just a few candidates thinking that hydrogen free radicals were formed in the reaction. Many candidates deduced that two cyclobutyl free radicals would join together to form a hydrocarbon but only a small minority could draw the skeletal formula of the product. Some candidates did not read the word 'hydrocarbon' and they included chlorine atoms in their answers.

Question 22

a) The majority of candidates worked out the numbers of protons and neutrons in the nucleus of a chlorine-35 atom, however, a small number also included electrons and lost a mark, and a few used the wrong isotope.

The majority of candidates completed the electronic configuration of a chloride ion correctly, although some gave the electronic configuration of a chlorine atom.

The majority of candidates could calculate the relative atomic mass of the sample of chlorine, although some did not give their final answer to two decimal places and lost a mark. Some candidates did not work out the percentage of chlorine-37 so they tried to do a calculation just using the data for chlorine-35 and lost both marks.

b) There were some clear dot-and-cross diagrams of a chlorine trifluoride molecule. However, some candidates omitted one or both of the lone pairs of electrons on chlorine while others tried to include dative covalent bonds and double bonds. A few candidates did not read the word 'molecule' and drew ions. Many candidates deduced that chlorine had ten electrons in the outer shell, has five pairs of electrons or stated that it 'has expanded its octet'. Many just stated that chlorine has 2 lone pairs and did not refer to the three bonding pairs of electrons so did not score a mark.

Many candidates worked out that ClF_3^+ would have peaks at 92 and 94 in the mass spectrum, using the mass numbers given in the question and scored 2 marks. Some candidates added additional peaks at different m / z values and lost one or both of these marks. Only a minority of candidates used the percentages of the chlorine isotopes given in (a)(iii) to deduce the approximate 3:1 ratio of the molecular ions for the third mark.

Many candidates are familiar with the use of the ideal gas equation in calculations. The most common error was not realising that the volume calculated using that equation is measured in cubic metres and not decimetres so the conversion to cubic centimetres was often incorrect. Some candidates also lost the final mark as they did not give their final answer to two or three significant figures. Candidates should also be advised not to round their intermediate values to one significant figure. Just a few responses were seen where the candidates rounded their values incorrectly. A few candidates did not convert the temperature into kelvin or did an incorrect conversion.

Question 23

a) Many candidates gave the correct colours at the end of the experiment when propane and propene are shaken separately with bromine water. A few candidates incorrectly referred to bromine water as red and some used 'clear' instead of colourless. Some candidates thought that propane and propene were liquids and wrote about layers seen in the test tubes. All candidates should learn about the use of bromine water to distinguish between alkanes and alkenes.

b) Candidates should learn the reagents and conditions needed for all the organic reactions in the specification. There was a lot of confusion in their answers to (i) and (ii) and a lot of incorrect chemistry. Some candidates knew the reagents but did not score a mark as they gave an incorrect

formula e.g. K_2MnO_4 for potassium manganate(VII). If they are not confident with the formulae, they should use the name instead.

c) Many candidates found this item challenging. Many drew the *E* isomer instead of the *Z* isomer while others had an incorrect number of carbon atoms.

d) The majority of candidates were able to calculate the number of double bonds in the alkene. Some candidates who calculated the ratio of alkene to hydrogen as 1:3 then stated there were 2 double bonds in the alkene so lost the second mark. A few candidates tried to calculate the number of double bonds in the 0.010 mol of alkene by using the Avogadro Constant.

e) Some candidates gave clear descriptions of the three changes needed to correct the mechanism and supplemented them by annotating the diagram or drawing a new mechanism. Others struggled to explain what changes are needed. When candidates learn mechanisms in organic chemistry, they should try to understand what is happening and then they will find this style of question easier to answer.

f) The majority of candidates drew an acceptable structure of propene. However, some just drew one repeat unit and others omitted the double bond.

Question 24

a) The majority of candidates completed the electronic configuration of phosphorus using the electrons-in-boxes notation, although a few seemed unfamiliar with this and just wrote the number of electrons in each orbital instead of showing them as arrows.

Many candidates struggled to explain their ideas clearly for (a)(ii). The majority who scored 2 marks stated that the electron being removed in sulfur is paired and there is repulsion between paired electrons, so less energy is required to remove it. Some candidates did not make it clear whether they were writing about phosphorus or sulfur and some wrote about both but often their answers were contradictory, so they lost marks. Candidates would benefit from more practice in answering this style of question.

b) This was another challenging item for many candidates as they needed to use correct terminology and express their ideas clearly. The candidates who scored full marks were able to state the types of structure or bonds and then compare their strength. Some candidates thought that silicon existed as small molecules or had metallic bonding and others wrote that the covalent bonds in the phosphorus molecules break when it melts. Some referred to 'simple covalent bonding' in phosphorus but this is not acceptable for a simple molecular structure with covalent bonds in the molecules. Candidates would benefit from more practice in answering this style of question.

c) Many candidates were able to complete the table to deduce the shape and bond angles in phosphorus(V) chloride. Some missed out the 'bi' in trigonal bipyramidal and some did not know the bond angles of 90° and 120°.

Many candidates found it difficult to predict the formulae of the ions from their shape. They should know that a tetrahedral shape would have four chlorine atoms and an octahedral shape would have six chlorine atoms and this would have been awarded 1 mark. The second mark was for deducing the charges on the ions.

d) The majority of candidates scored the first two marks for using the volumes and concentrations of sodium hydroxide and phosphoric acid to calculate the mole ratio. Unfortunately, some of them lost the second mark as they used a different mole ratio in their equation. Candidates should know that a salt is formed when the hydrogen ions in an acid are replaced by metal ions so in this question two hydrogen ions are replaced by sodium ions, forming the salt Na_2HPO_4.

e) There were many different ways of carrying out the calculation in this item to determine the value of **y** and these were all acceptable, provided the candidates explained their working. A common misunderstanding was to calculate 78.5% of the molar mass of the anhydrous salt instead of multiplying it by 100 divided by 78.5 to work out the molar mass of the hydrated salt.

Paper Summary

In order to improve their performance, candidates should:

- read the question carefully and make sure that you are answering the question that has been asked
- learn the meanings of all the key terms in the specification and use correct scientific terminology in your answers
- remember that the volume of gas in the ideal gas equation is measured in cubic metres
- explain all your working for calculations
- practise drawing *E* and *Z* isomers of alkenes
- learn the reagents and conditions for the organic reactions in the specification
- understand each step in the mechanisms in organic chemistry
- practise answering questions where you have to explain your ideas clearly and logically

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