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Examiners' Report/
Principal Examiner Feedback

January 2016

Pearson Edexcel International A Level
in Chemistry (WCH01) Paper 01

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January 2016
Publications Code IA043120*

General

Some students were very well-prepared for this examination and scored high marks. Many students 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 errors or omissions. Some students would benefit from much more preparation to ensure that they know the basic facts, can express their ideas clearly and carry out calculations, showing their working.

Section A

The mean mark for the multiple choice questions was 13.55, which is slightly lower than for some past papers. The highest scoring questions were 3 and 9a, with 90% of students achieving these marks. The most challenging question was 2, with just 8.4% of students achieving this mark.

Section B

Question 18

Although many students knew the meaning of the term 'relative atomic mass' in (a)(i), many did not score three marks due to the omission of key words or use of incorrect terminology. Some students did not refer to 'weighted mean' or 'average' mass so they lost the first mark. Some students referred to an element instead of an atom, so they lost the second mark. A few students referred to an individual isotope, possibly confusing this with relative isotopic mass. Some students just compared the mass of an atom with 1/12 of a carbon-12 atom or compared it with 12 g of carbon-12, so they lost the third mark.

Many students scored both marks for (a)(ii), showing a clear understanding of how positive ions are formed in a mass spectrometer. Some students just mentioned the use of an electron gun without describing what it does. A few students just stated that positive ions are formed and omitted to say that the outer electron is knocked off to form the positive ion. A small number of students did not read the question carefully and they attempted to describe the injection and vaporisation of the sample followed by acceleration, defection and detection of the ions once they are formed. A few students mentioned highly charges electrons instead of high energy or high speed electrons.

Many students scored both marks for (a)(iii) as they were able to carry out the calculation correctly and give their answer to three significant figures, although some misinterpreted this as three decimal place. Some students lost a mark as they gave more than three significant figures in their final answer. A small number of students calculated an incorrect value from correct working and a few included an incorrect unit, such as % after their answer. Students should not include any units for a relative atomic mass. A few students transcribed numbers from the table incorrectly, although they could gain the second mark if they made only one such error. A few students rounded the numbers in the table to three significant figures before carrying out the calculation. Students should be aware that incorrect rounding will be penalised.
The majority of students stated that strontium is in the s block of the periodic table. A small number placed a number in front of the s, e.g. 5s, and did not score a mark.
A disappointingly large number of students thought that strontium chloride has covalent bonding so they did not score any marks for this question. Some students did not use the periodic table, even though they had just looked up strontium in the previous question to see that it is in the s block, and they showed a strontium ion with 1 positive charge. Students should be encouraged to make use of the periodic table on the back of the examination paper to help them with their answers. A few students showed one

strontium atom combined with four chlorine atoms, possibly confusing strontium with silicon. Incorrect symbols used for strontium included S and St and these lost a mark. Many students scored 2 marks for the balanced equation and state symbols; however, many students do need more practice at writing balanced equations. Some students completed the equation with hydrogen or oxygen instead of water, so they lost both marks. Some students thought that a nitrate ion had a 2- charge so the formula for nitric acid was frequently written incorrectly as H_2NO_3 and strontium nitrate as $SrNO_3$. Students should be encouraged to write the state symbols clearly as they will not be given the benefit of the doubt if (s) looks like (g).
A large majority of students scored 3 marks for calculating the correct empirical formula. Some incorrect answers included: dividing the relative atomic masses by the percentages, multiplying the relative atomic masses by the percentages, rounding the numbers too early in the calculation, rounding numbers incorrectly (for example, rounding 3.993 to 3), using atomic numbers instead of relative atomic masses (even though these were given in the question) and writing numbers or symbols carelessly and making slips. A few students calculated the correct ratio but then applied it incorrectly to give Sr_4C_2O.

Question 19

The majority of students scored two marks for (a)(i) as they knew the order of filling the sub-shells and how the orbitals are filled. A few students labelled the sub-shells incorrectly and a few filled the orbitals incorrectly.

Although many students did score 2 marks for (a)(ii), there were a significant number who used the terms orbital, shell and sub-shell interchangeably, showing a lack of understanding. Some students referred to an 'energy shell' and it was not clear whether they meant energy level, shell or a combination of these. Students should be discouraged from using this term. Some students chose to answer the opposite question and described why phosphorus has a higher first ionization energy than sulfur. These students scored one mark for a correct answer in terms of the stability of the half-filled 3p sub-shell. Incorrect answers often included references to size and shielding.
The majority of students scored both marks for the equation showing the third ionisation energy of phosphorus. Common incorrect answers included: incorrect state symbols or no state symbols, adding an electron to the P^{2+} ion to form P^{3+}, removing three electrons from a phosphorus atom and using an incorrect symbol for phosphorus.

Many students struggled to express their ideas clearly in (b)(i). Correct points were often poorly expressed and surrounded by irrelevant points and incorrect chemistry. Some students repeated the same point two or three times and did not make it clear whether they were discussing nitrogen or phosphorus and they seemed to swap part the way through so their responses appeared to contain contradictory statements. Imprecise language, for example, just stating that phosphorus is bigger than nitrogen, is not rewarded. Students should refer to the correct types of particles, so nitrogen atoms have a smaller radius than phosphorus atoms, does score a mark, although the use of ions or molecules here is incorrect and loses the mark. Many students did score the first two marks but they often lost the third mark as they did not concentrate on comparing the attraction between the nucleus and the outer electron. A few students stated that nitrogen and phosphorus have the same nuclear charge or the same effective nuclear charge.
The majority of students were able to draw a correct dot and cross diagram to show the bonding in a molecule of nitrogen. Common errors included: drawing a single or double bond instead of a triple bond and omitting the lone pair on each nitrogen atom. Some students drew two nitrogen atoms alongside each other but with a large gap and it was not clear that they were sharing electrons.
Many students scored two marks for calculating the number of molecules in the sample of phosphorus. Common errors included: using the atomic number of phosphorus as 15

instead of the relative atomic mass given in the question, not noticing that the formula of phosphorus molecules is P_4 so not multiplying the relative atomic mass by 4 to find the relative molecular mass and multiplying the number of molecules by 4 in the second step in the calculation.

Question 20

Many students were able to draw the displayed formulae of the three correct isomers. The most common error was that of twisting or rotating pentane and/or 2-methylbutane. Students should check that they have drawn completely different isomers. A few students omitted one or more hydrogen atoms and they were penalised. A few students chose to draw more than three isomers, with the additional isomer(s) being incorrect, such as a cyclic compound, or a duplicate of one already drawn. These students lost a mark for not reading the question. They should have crossed out the isomer that they did not want to be marked.
Many students could classify the reaction as free radical substitution but unfortunately some of them negated a mark by including other incorrect words such as heterolytic.

Many students did score full marks for (b)(ii) and (iii) but some students showed a misunderstanding between which species were free radicals and which were molecules. It was not unusual to see unbalanced equations. The formation of hydrogen free radicals in (ii) always resulted in no marks for that part. A few students included an additional incorrect equation and they lost a mark. Some students ignored the instruction to start with C_5H_{12} and started with a different species. A few students wrote an equation to form 2Cl in (iii) instead of Cl_2.

The majority of students carried out the calculations in (c) correctly. In part (i) some students did not convert their answer into kilojoules. Only a very small number of students were unable to calculate the number of moles in part (ii). In part (iii) some students rounded their answer incorrectly, some forgot to include the minus sign and some gave an incorrect unit. Common incorrect units included kJ/mol^{-1} and kJ mol^{-}. Students did find it more difficult to score marks for (c)(iv) and (v). In part (iv), many were able to give one or two reasons for the large difference between the Data Book values and the experimental value. Common answers that did not score a mark included: not measured at standard conditions, measurement errors in the thermometer or balance and evaporation of water. These were not incorrect but they would not account for the large difference between the values, so they were not penalised. Very few students gave the best answers for part (v) that the experimental errors are greater than the differences between the Data Book values or that the experimental value is less exothermic than all of the Data Book values. However, some students did score a mark if they realised the significance of all the Data Book values being close together. Some students wrote about mean bond enthalpies in both parts of this question, even though these were not relevant here. A few students discussed the degree of covalent/ionic character, possibly confusing this with lattice energies. Many students just re-stated the question.

Many students were able to complete the Hess cycle and carry out the calculation correctly in (d). Some students did not included state symbols for the elements in the box and some used incorrect species such as 12H and 16O. Different students drew all combinations of arrows pointing upwards and downwards, showing that they were not really clear about what the arrows represent. A significant number of students did not use the balancing numbers in their calculation; however they were given a mark for a correct consequential answer with the correct sign.

Question 21

A surprisingly large number of students wrote the name of the alkene instead of the molecular formula in (a)(i).
Many students scored one mark for knowing and correctly expressing one of the marking points. Fewer students were able to score both marks. A few students were confused by the idea of rotation or lack of it and some thought that the molecule was unable to rotate. The use of molecular models may help to clear up this misunderstanding. Many students omitted to say that each carbon atom in the double bond has two different groups attached and a small number incorrectly referred to 'molecules' attached to the carbon atoms. Students should try to use correct scientific terminology in their answers.
The majority of students knew that bromine water was needed for Reaction 1. A common incorrect answer was BrOH.
Many students were able to identify propane-1,2-diol as the organic product **A**. Some students lost the mark by a poor structure or by giving a correct structure and an incorrect name. Students should always make sure that they draw a bond between a carbon atom and the oxygen atom of the OH group and not the hydrogen atom. Some students gave a molecular formula but this does not show which carbon atoms the OH groups are joined to as does not identify **A**. Some students gave propane-1,3-diol as the product showing that they did not understand the concept of addition reactions of alkenes.

The majority of students wrote the correct colour change in (b)(iii). A few students confused potassium manganate(VII) with potassium dichromate(VI) and wrote orange to green.

Many students were able to draw the correct mechanism in (b)(iv) and score full marks. Common errors included: omitting the dipole on HBr or writing full charges instead of partial charges, imprecise curly arrows, omitting the lone pair or the negative charge on the bromide ion, showing a partial charge on the bromide ion and drawing the intermediate to form 1-bromopropane instead of 2-bromopropane. A few students did not read the question and drew the mechanism for the addition of Br_2.
Many students were able to draw two correct repeat units of the poly(but-2-ene). Common errors included: missing one or more hydrogen atoms, drawing 8 carbon atoms in a chain with no CH_3 branches and missing one or both continuation bonds. A few polymers were seen with double bonds left it. A few students drew two separate repeat units but repeat units should always be drawn joined together.

Many students were able to carry out the two calculations in (d) correctly. Some students worked out incorrect relative molecular masses for the two compounds as they did not realise that two hydrogen atoms are lost when the carbon atoms join to form a ring structure. However, they were only penalised once for this error. Some students seemed unfamiliar with percentage yield calculations and they just found the percentage of one mass over the other.
In order to improve their performance, students 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.
- be careful how you use the words atom, ion and molecule and always check that you have referred to the correct type of particle.
- show all your working for calculations.
- use the periodic table to help you to work out the bonding in unfamiliar compounds and the charges on ions.
- check to make sure that equations are balanced.
- draw all of the hydrogen atoms on displayed formulae of organic compounds.
- check that the sign and units are correct in calculations involving enthalpy changes.

- be careful how you draw curly arrows in organic mechanisms.
- draw the structure of the monomer before attempting to draw the structure of a polymer.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:
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