Examiners' Report/
Principal Examiner Feedback

January 2016

Pearson Edexcel International A Level
in Chemistry (WCH05) Paper 01

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## General

The paper seemed to be well received. There were two question parts where most students struggled, but apart from these, all questions attracted the full range of marks. There were a number of questions on areas of the specification which were less familiar to the students and also several question requiring students to apply their knowledge to novel situations.
There were several questions on practical areas of this unit and from the responses, it was easy to tell centres where practical work is given the priority and those where students had little experience of working in laboratories.
There were also a number of questions where students failed to read the question carefully before answering the questions.

## Multiple choice questions 1 – 18

The easiest question were:
1 - definitions of d-block and transition elements
15b – nmr
15a – chirality
6 – relationship between equilibrium constant and $E_{cell}$

The hardest items were:
12 – mole ratios of cells
8 – disproportionation
7 – Ordering ions in reducing power
11 – formulae of complex isomers
13 – identification of functional groups

## Question 19

(a) This was an application of their experience of the hydrogen electrode. Unfortunately many students misread the question. They drew a diagram of a hydrogen electrode, or a complete cell, or attempted to draw a methanol fuel cell. Many gained credit for a platinum electrode at 298K, but that was their limit. In drawing gaseous electrodes it is important to ensure the gas gets to the platinum and then into the solution. Many electrodes were closed at the bottom. On the other hand, some were open at the top, so the gas would escape.

(b) Overall, electrons do not contain electrons and should not include the same entities on both sides. Some students did not cancel the water, or had hydrogen ions or electrons present on one or both sides. Several gave the equation fully correct, but in the wrong direction.

(c) Less able students omitted the positive sign, or the unit.

(d) The disadvantage of carbon dioxide emission was well known, the most common correct advantage was ease of transport or storing methanol.

## Question 20

(a) Less than half the students were gave the correct answer to this question. Many did not know that a molecular formula is just the numbers of moles of each element in the compound. Many gave structural formulae.

(b) More than half the students gained no credit, as they did not know the formulae of either sodium carbonate or the organic product.

(c)(i) It was pleasing to see the majority of students apply their knowledge of hydrogen bonds to this unfamiliar situation.
(c)(ii) The majority gave 'lower' or 'the same' so gained no credit. A disturbing number of students said that the internal hydrogen bonds needed to break for the substance to melt.

(d) Nearly two thirds of students were unable to score at all. Many lost the mark for either the acid group or the hydroxyl group. Those who gave the correct formula often omitted the 'di' from the prefix to bromo in the name.

(e)(i) Less than half gained any credit. The most common wrong answer was chloromethane with or without aluminium chloride. More able students often missed a condition - either the acid or the heat under reflux.
(e)(ii) In answering questions on solubility, students were wise to adopt the simple strategy of:
- Bonding between solute molecules
- Bonding between solvent molecules
- Bonding between solute and solvent molecules

Less than half the students could manage the rescue mark for how a hydrogen bond can form between methyl 2-hydroxybenzoate and water.
(e)(iii) Rather surprisingly less than half the students gained any credit. Chemicals needed to wash organic liquids and the reason for their use as well as suitable drying agents need to be known.
(e)(iv) Solvent extraction was the common wrong answer, closely followed by steam distillation.
(e)(v) It was pleasing to see most students applying their knowledge of IR to good effect here. Some omitted to read the question and did not mention the bond involved.
(e)(vi) Most students gave the fully correct answer. The most common problem was the conversion of mass to volume in the last step of the calculation.

## Question 21

(a) Very few students gave $4s^2 3d^4$ as their answer in (i), but it was rare for students to give TWO reasons in (ii). Most limited their response to the stability of the half-filled 3d sub-shell. Many confused 'sub-shell' with 'orbital'.

(b)(i) The common problem with students answering this question was that some of them omitted the zinc and some assumed the reaction was between dichromate(VI) and chromium(II) to get +1.74 V. Most students gained the last mark for recognising that if $E_{cell}$ is positive the reaction is spontaneous.
(b)(ii) The final colour (blue) or the intermediate colour (green), were often omitted.
(b)(iii) The significance of the amount of a hazardous gas seems to elude nearly all students.

(c) It was pleasing to see students applying their knowledge to an unfamiliar complex (though this preparation is an example in the specification).
(i) Some gave 'polydentate' which is true but insufficient.
(ii) Many gave 'dative' rather than dative covalent, but were not penalised for doing so this time.
(iii) This was much more challenging. Phrases like 'each ligands forms two bonds' were insufficient. Clarity of language was needed eg 'each ligand bonds to both chromium atoms/ions'.
(iv) 'Differences in splitting of d-electron energies by different ligands' was rarely seen. Again there was confusion between orbitals and sub-levels and also confusion between radiation emitted and absorbed.

(v) The application of nmr to an inorganic complex proved beyond all but the best students. Many ignored water and gave just one peak. The relationship between peak area and numbers of protons was not well known.

(d) The process of checking that a concentration of a titrant before attempting a titration seemed to be totally unfamiliar to most students, two thirds of whom gained no credit here. Grade A or B students were able to get to a value, but often lost marks for an incorrect or wrongly applied ratio of manganate(VII) to chromium(II). A factor of two as there are two chromium per complex was also often lost.

## Question 22

(a) The less able students just gave X-rays, which is insufficient.

(b) Less than one third of students were thrown by the less familiar structure of naphthalene. The most common error was to omit mention of p-orbital overlap.

(c) The application of the mechanism for aromatic electrophilic substitution was challenging. The equation for the formation of the nitronium ion often contained incorrect entities like $HSO_3^-$, or did not balance. The Wheland diagram was often incorrect, with charges on the electrophile or delocalisation across the wrong atoms. The last step often had the curly arrow starting from the hydrogen and the phrase from the passage 'that substitution takes place at 1, 4, 5 or 8' was usually missed.

(d) Many students gave an incorrect molecular formula for naphthalene but could still gain the second and third marks but unfortunately the equation was often not correctly balanced. The easiest part was the calculation, though the stoichiometry of the reaction was often ignored.

(e) Hydrogen was given but one of the conditions of both a suitable catalyst and high temperature was often omitted. Some students erroneously thought $LiAlH_4$ could be used.

(f)(i) Pleasingly most recognised water as the other product. A few gave hydrogen.
(f)(ii) Despite the clear instruction to refer to the structure of phenolphthalein only about one fifth of students mentioned which atoms or groups of atoms could receive or donate protons.

(g) Common errors were to confuse nitrous and nitric acid and to omit the temperature requirement. The most common was to omit the need to dissolve 2-naphthol in sodium hydroxide. There were a variety of incorrect final formulae, with incorrect nitrogen bonds or with the OH on the single ring.

## Advice to students

- Read the question carefully.
- Practice applying knowledge of reactions to different compounds.
- Practice using $E^\ominus$ values for familiar and unfamiliar reactions.
- Practice calculations to find volumes, concentrations, and masses of reactants and products for familiar and unfamiliar reactions.
- Carry out the experiments, considering why a procedures are being used and how they work.

## Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:
http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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