Examiners' Report
Principal Examiner Feedback

October 2020

Pearson Edexcel Advanced Subsidiary GCE
In Chemistry (8CH0)
Paper 1: Core Inorganic and Physical Chemistry

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Introduction

Although the entry for this paper was relatively small, a broad spectrum of achievement was seen; some papers exhibiting high quality answers throughout. However, there were a significant number of blank answer spaces, where questions were not attempted. Other answers (e.g. 6cii, 7b) suggested that, although there had clearly been preparation using previous papers, subtle changes in the phrasing of the questions were sometimes missed by the students.

Question 1

1a This multiple choice question on the electron configuration of an ion was similar to those asked in previous years. Most students answered competently. Relatively few fell into the obvious trap of giving the electronic configuration of the atom as opposed to the ion

1bi and **1bii** This question is not usually asked in this form, although it is within the specification. Both questions relate to electron spin, with the up and down arrows being used to represent the opposite spin of electrons. . Less able students struggled to find the correct terms to describe 'spin' in this question, with some just referring, incorrectly, to electrons in different orbitals.

Question 2

2ai and **2aii** Both of these multiple choice questions were answered successfully by the majority of students Very similar questions have been asked in previous years and those who had prepared thoroughly using past papers scored particularly well on these questions,

2bi This question involved the change in first ionisation energies across a period. Similar questions have been asked in numerous previous papers, yet the answers were surprisingly poor.

2bii This question involved an interpretation of information provided by the successive ionisation energies of sodium. The significance of large 'jumps' in IE was not recognised by less able students, who tended to focus on the general rise in IE (often with incorrect reasoning).

Question 3

3ai Mistakes and vague thinking were prevalent in this question about the covalent bond: common mistakes included the use of atoms (rather than nuclei) and mention of a single shared electron (rather than a pair).

3aii Although students would not have been familiar with hydrazine they were provided with enough information to apply simple rules and, by analogy with ammonia, the majority of students were able to produce a correct dot-and-cross diagram.

3aiii Estimation of the bond angle also required an analogy with ammonia.

3b This 3 mark question related to hydrogen bonding. Most students mentioned hydrogen bonding. Common errors in the diagrams usually involved omission of the relevant lone pair, or the bond angle was clearly not 180°.

3c This question asked students to recognise the significance of states in an unfamiliar chemical equation, (i.e. look at the states of reactants and products), and to recognise the nature of the products.

Question 4

4ai While it was clear that most learners had some idea about these two basic definitions, the lack of precision in many of the answers meant that full marks were not often awarded.

4aii Most students were able to provide a correct explanation of 'isotopes', although a few confused isotopes and isomers. However, the use of the isotopes of potassium to illustrate answers was less successful, and was ignored by some learners. Where a question stipulates the use of data to illustrate an answer, it can be assumed that marks will be allocated to this skill.

4aiii This question about relative atom mass occurs frequently and most candidates had clearly prepared well for this calculation, scoring both available marks. The format of this question was slightly different from that used in some previous papers in that students were required to extract the relevant information from a table. Very few calculations used the rounded isotopic mass; most students recognising that a calculation to four SF requires data with the same (or greater) precision.

4bi Most students recognised that ions are deflected by a magnetic field.

4bii The ion pathways were not described well by the majority of students; some thought that ions were deflected little because the ion had no charge. A relatively common error just linked path B to the isotope with greatest abundance.

4biii The majority of candidates seemed to be unaware of the reasons for evacuating a mass spectrometer and could suggest no logical answer.

Question 5
Most of Q5 related to practical situations. These questions were answered well with most candidates having seen the practical experiments or having been well prepared for questions on the relevant topic.

5ai A multiple choice question. This straightforward redox question was answered correctly by the majority of learners.

5aii A multiple choice question. This question related to Q5ai but also required the student to use additional density data and recall the colour of iodine in the relevant solvent. Most students were either able to deduce the correct answer or, having seen the experiment, correctly recall the result.

5bi A multiple choice question. This question relates to the use of concentrated sulfuric acid as an oxidising agent in the reaction with iodide ions. Those who had completed the relevant practical experiment found this relatively straightforward and it could also be answered using redox principles. However, many learners found this question quite challenging.

5bii Again this is a very straightforward question for any student who has used ammonia gas as a test for hydrogen chloride. Although the reactant here is hydrogen iodide, the reaction can reasonably be expected to be similar.

5ci Students generally struggled with this question which is based on a practical situation. Students were expected to interpret solubility data and apply this to the separation of two solids on the basis of differential solubility.
Many students seemed to lack knowledge of the methods available to encourage the precipitation of solutes from a solution. Furthermore, few students seemed familiar with the procedures used to separate and dry the product of filtration. However, a few extremely good answers were seen, presumably from students who could recall this or a similar practical situation.

5cii This test for iodide was answered well. It has been set on many past papers and most students seem very familiar with it.

5d This multiple choice question required students to select some relevant data from a table and use this to identify a trend within a group. From this they could then make a reasonable prediction. Few problems were anticipated or seen and most of the responses were correct.

Question 6

6a A multiple choice question. This question required students to interpret a given chemical formula and follow up with a basic calculation. The task was simplified by the provision of the molar mass of malachite within the question. Most candidates were able to complete this calculation successfully.

6b This question tested recognition of some of the observable features of a chemical reaction, the answers being available by application of basic chemical principles. However, many students seemed to struggle with this practical situation and relatively few fully correct answers were seen.

6ci This question has occurred relatively frequently in past papers, and many of the answers were clearly well rehearsed. Most students scored very well on this question.

6cii Again, this is a very common question (for the first three marks). It has appeared in most of the past papers at this level. However, the 4^{th} mark focussed on a slightly different aspect and many students failed to read the question sufficiently thoroughly to score the 4^{th} mark, which relates to why different elements produce different coloured flames

6di This was a calculation to find the maximum volume of gas that might be produced by the thermal decomposition of a fixed mass of malachite. The ideal gas equation was provided, giving a clue to the expected method of calculation.
Students were generally accurate in giving their answer to an appropriate number of significant figures. But they were less secure with the units. The ideal gas equation gives an answer in m^3 if all quantities are converted to SI units. If the pressure is left in kPa the answer is in dm^3 etc.
Students could be advised to convert to SI units first; this then defines the units of the final answer.

6dii Those who converted their answer to di) into cm^3 had already (and perhaps inadvertently) matched the units for their calculation of uncertainty. Many students knew how to match units, and did it well.

6diii A variety of different methods can be used for this calculation This illustrates the need for a logical procedure or a careful explanation of the calculation so that the lines of reasoning are clear. In such instances marks might be gained for a partially correct answer
Some candidates provided clear calculations that were easy to follow at each stage. In some instances a few words of explanation were also provided to explain the logic. However, there were also some less successful answers which were poorly set out, being little more than a scattered mass of figures.

Question 7

7a This question asked about 'periodicity'. In general terms, students found this question challenging. There was little recognition of the repeating pattern of properties in periodicity. Some students therefore focused simply on the trend across one period (omitting to comment on the repeating pattern in the next period). Many thought that the atomic radius would increase across a period, while some others discussed a trend down a group and omitted trends across a period completely. This question was not answered well.

7b This long answer question focused on structure and bonding across a period. Two indicative points focused on the metals on the LHS of the period. Two indicative points on elements with giant structures (although B was ignored because students might expect to have no knowledge of this element) therefore the focus was on diamond, and two IPs for the simple molecules on the right of the period i.e., N_2, O_2, F_2 and Ne. For each of these pairs of marks, the first indicative point mark was awarded for a correct comment on structure while the second IP related to the bonding
It was clear that some students had been working with a previous paper that discussed diamond in the equivalent longer answer question. However, responses relating to the structure of diamond were disappointingly confused in some answers
A wide range of marks was seen in the answers to this question, from zero to full marks. Students might usefully try to identify the key points of these longer answer questions; in this instance ensuring the use of all period 2 elements and covering both structure and bonding in the elements (not their compounds).

Question 8

8a This question asked for two equations: for the thermal decomposition of a group 1 nitrate and for the thermal decomposition of a group 2 nitrate. Disappointingly, very few fully correct answers were seen for either nitrate. Although CaO was often recognized as a product in the second equation, the other products were usually incorrect. A correct equation for the thermal decomposition of sodium nitrate seemed to be particularly challenging.

8b The effect of a cation on the thermal stability of anions has proved to be a challenging question on previous papers. While there were a few correct comments on the relative polarizing powers of Na^+ and Cs^+, students had difficulty in linking this polarizing power to the distortion of electron clouds (or bonds) in the nitrate anion. The answers to this question were generally poor, perhaps indicating that students were fatiguing towards the end of the paper.

8ci This equation was correctly recalled (or deduced) by the majority of students.

8cii Most students recognized the presence of ionic bonding but relatively few seemed aware of covalent bonding within the carbonate ion.

8ciii Disappointingly few candidates were able to link high decomposition temperatures with the need to break strong bonds within the carbonate ion. Many attributed the high decomposition temperature to the presence of ionic bonding, thus neglecting the production of ionic bonds in one of the products.

Summary

In order to improve their performance, students should:

- ensure that their writing is legible. Remembering that examiners are unfamiliar with their handwriting
  ensure that their grammar is sound. The whole sense of a sentence can be changed by one omitted word
- read the question carefully and make sure that they are answering the question that has been asked.
- when they reach the longer answer question, remember that it is a test of ability to organise information. Students should ensure that they answer the question that is being asked, not simply reiterate everything they know on the subject
- write concisely and avoid making the same point multiple times
- make sure that comparisons are made when required
- write formulae and numbers carefully, checking their legibility
- organise logically and explain the steps in calculations. A simple statement is often sufficient, e.g. ‘calculate moles of pure malachite’
- be careful with the precision of curly arrows in organic mechanisms
- show all working for calculations and give final answers to an appropriate number of significant figures
- not assume that any question is identical to those set in previous years, even if the question specification is the same
- make sure they understand the difference between reagents and conditions, including when catalysts are involved
- refer to both bond pairs and lone pairs when applying electron-pair repulsion theory
- reread questions and answers, where time permits, to avoid careless mistakes.

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