Examiners' Report
Principal Examiner Feedback

Summer 2019

Pearson Edexcel Advanced Subsidiary Level

In Chemistry (8CH0)

Paper 01 Core Inorganic and Physical Chemistry

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Question 1

This was an easy introductory question. Most candidates answered correctly.

Question 2

Also, a relatively straightforward question for the start of the paper. Most answered correctly but for those who got it wrong, the usual reason appeared to be a misreading of the question, and then giving the electron configuration of a sulfur atom.

Question 3

(a) Again, a straightforward question. Of those who lost a mark, the majority simply omitted the number of protons or the number of neutrons. Possibly just a casual error.

(b) For a few scripts, the presentation was dreadful (just a mass of unrelated figures) and the logic was almost impossible to follow. This calculation was a variation on the usual relative atomic mass calculation and required the calculation of a relative isotopic mass. Most candidates correctly reorganised the usual expression and calculated the correct answer. It seemed that most candidates had been well rehearsed in how to tackle this type of problem.

Just a few candidates simply guessed the answer – given the data, a calculated guess was relatively easy but, while some credit was given for this approach, full marks required a suitable calculation.

Question 4

(a) This was a straightforward recall of thermal stability of Group 2 nitrates and carbonates. No explanation of the trends within the group was expected.

(b) Some aspects of this question proved more demanding. MP2 and MP3 were rarely awarded, although many candidates should have been familiar with the requirement for controlled conditions from their GCSE studies.

MP1 required candidates to provide an outlined method to compare thermal stabilities of two Group 2 nitrates. For one mark the fine detail was not required, merely the outline of a procedure that would work.

A surprising number of answers alluded to the thermal stability of carbonates; bubbling the gas produced through limewater etc. Some even included both nitrate and carbonate thermal stability in their answers

MP2 related to control of conditions; any suggestion of equal heating scored the mark. Only a minority of candidates included any form of heating control.

MP3 also related to control of conditions, namely the same quantity of each nitrate (volume, moles or mass). Very few candidates included this aspect in their procedure.

MP4 had many correct responses, presumably because similar safety precautions have been required in previous papers at this level.

Question 5

(a) Perhaps a little too straightforward. The incorrect responses may have been too obvious.

(b) Most candidates were familiar with the test for sulfate. Many candidates also included the use of an acid to remove carbonate ions and also gave a correct reasoning for doing so, although this was not required to answer this question.

MP1 saw just a few candidates omitting to specify the barium compound used, responding with just Ba^{2+}. Barium hydroxide is not a recognised reagent for this test (although it might just be sufficiently soluble to work.)

MP2 was lost for those few who gave an incorrect test result; the common error was a failure to specify a white ppt.

(c) Again, candidates scored well on this question. The common error (for those few who gave an incorrect response) was a failure to include the water of crystallisation.

Question 6

(a)(i) The flame test procedure was well known, and the majority of answers here were excellent. Most candidates had been prepared well for this question.

(a)(ii) The theory behind flame colours was also familiar to most candidates and nearly all answers here were also very good indeed.

(a)(iii) The majority of candidates correctly deduced (or knew) the reasons for the absence of a flame colour for Mg^{2+}. Answers were equally split between radiation in the UV region and radiation in the IR. As expected, a significant number of candidates confused the lack of flame colour in Mg^{2+} with the bright white light produced when Mg metal burns in air.

(a)(iv) This was also answered well. Encouragingly, many candidates specified that beryllium also does not give a flame colour.

(b)(i) As expected, a small number of incorrect formulae were seen (usually linked to Ag^{2+}), together with examples of those candidates who failed to read the question fully and wrote the name, (instead of the formula).

(b)(ii) A surprising number of candidates thought the correct answer was C, which is illogical because if a substance is soluble in diluted ammonia, it is also likely to be soluble in concentrated ammonia.

Question 7

(a) The majority were able to write a balanced equation here. Common errors included: an incorrect formula for magnesium chloride (e.g. MgCl), and an incorrect state for magnesium chloride (often given as (s)).

(b)(i) The calculation of uncertainty was, for the most part, completed correctly. Common errors included:

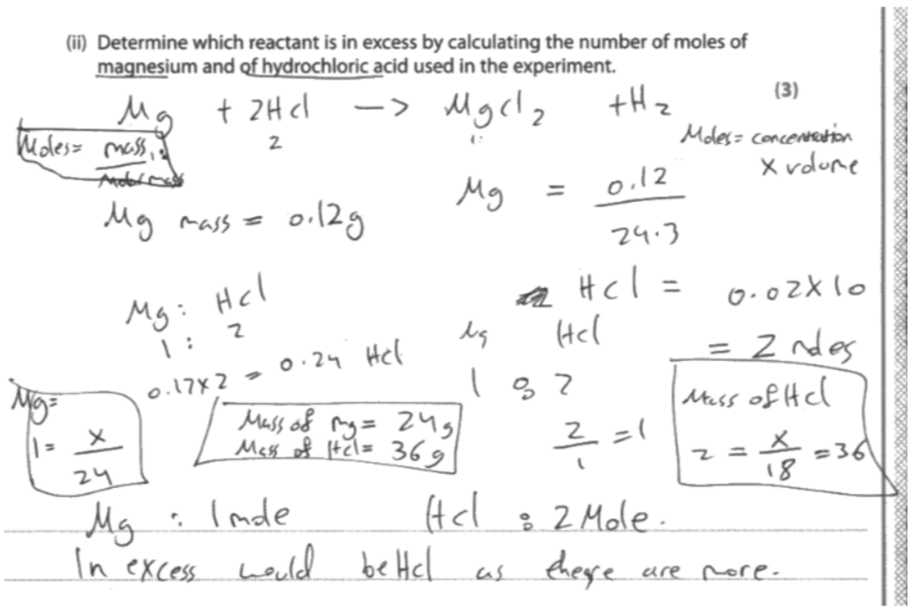
1. Uncertainty given as 10% (incorrect in this instance, for equipment which is only read once).
2. Failure to convert the uncertainty to a percentage.

(b)(ii) The moles of hydrochloric acid (M2) were usually calculated correctly; the moles of magnesium (M1) less so.

MP3 was scored relatively infrequently. In many answers, no evidence was supplied to support the reactant in excess. Of those who did perform some kind of calculation, many just compared the two molar quantities calculated for MP1 and MP2 (which still gives Mg in excess).

A significant number of answers reversed the mole ratio and decided that 2 x 0.002 = 0.004 mol Mg would be required to react with the 0.002 mol acid.

Some answers to this question were so poorly presented that it was almost impossible for markers to discern if transferred error marks could be awarded. (See example below).


(ii) Determine which reactant is in excess by calculating the number of moles of magnesium and of hydrochloric acid used in the experiment.

(3)

Mg + 2Hcl —> Mgcl2 + H2

Moles= mass / Molar mass

Moles= concentration X volume

Mg mass = 0.12g

Mg = 0.12 / 24.3

Hcl = 0.02X10

= 2 moles

Mg : Hcl

1 : 2

0.17x2 = 0.24 Hcl

Mass of Mg= 24g

Mass of Hcl= 36g

Mass of Hcl

2 = x/18 = 36

Mg : 1mole Hcl : 2Mole.

In excess would be Hcl as there are more.

(b)(iii) The answer here depended on the answers to 7(a) and 7(b)(ii), with the possibility of transferred errors from both previous answers. An incorrect decision about the reagent in excess in 7(b)(ii) could mean an answer based on moles of Mg.

7(b)(iv) This calculation had clearly been taught very thoroughly (although not necessarily understood by some candidates). It seemed that some centres might have taught candidates to leave the pressure in kPa and convert the volume to dm^3, this produces the same answer as the (more technically correct) conversion to SI units. Relatively few failed to correctly convert the temperature to K.

For MP1, reassuringly, most candidates wrote the ideal gas equation with V as the subject, although provided the equation was used correctly, MP1 was awarded.

(c)(i) Most candidates recognised the loss of gas before the bung (and delivery tube) were replaced. Occasionally, there were answers relating to leakage from the apparatus. In general, it should be assumed that experimental incompetence, in this example, allowing a leak, will not provide acceptable answers.

There were few answers relating to the presence of magnesium oxide. Of those who gave this answer, even fewer recognised that water would be produced instead of hydrogen.

A significant number thought that hydrogen would be appreciably soluble in water; thinking perhaps of carbon dioxide. A surprising number of answers related to production of carbon dioxide.

(c)(ii) To some extent, the answers in this question depended on recognition of the reasons for lower volume of gas produced. See typical answer and comment below.

MP1 was awarded for any workable procedure that attempted to delay the start of the reaction until the bung was replaced. The fine detail of such procedures was not expected. Acceptable procedures included:

1. Placing the Mg inside a separate container in the acid, replacing the bung, then shaking to mix reactants.
2. Suspending the Mg from the bung, above the acid then, after securing the bung, dislodging the Mg into the acid.

MP2 was awarded for cleaning the Mg. Removal of magnesium oxide was recalled by some candidates, including a few who had not registered the oxide layer as a source of error in Q7(c)(i).

(ii) Describe **two** changes to the procedure that would enable the volume of gas collected to be closer to that calculated in (b)(iv).

(2)

Use a gas syringe as it would be more accurate when measuring the volume and less gas will escape. Use a technique to add the Mg without removing the bung, so no initial gas escapes.

The use of a gas syringe does not enable more gas to be collected because most of the gas is lost before the bung is replaced, and, in this account, part of the procedure has not been modified.

This answer recognises the loss of gas before the bung is replaced but lacks any practical detail about how this might be achieved.

Question 8

(a) Candidates struggled with this question, often scoring just one mark from the available three.

MP1 was most frequently awarded for relating charge on the ions, although well-constructed answers were quite rare.

MP2 was scored relatively infrequently. Of those who discussed radii, there was often confusion between ionic radius, atomic radius and even metallic radius.

MP3 was frequently lost because the wrong type of bonding was assumed to be present - hydrogen bonding and covalent bonding were relatively common.

(b) Responses to this question tended to produce a mark of 2 or 0 depending on whether the charge carriers were thought to be ions or electrons. Many candidates thought that delocalised electrons are present in ionic compounds but that these electrons are unable to flow in the solid state. A significant number thought that these delocalised electrons would be unable to force their way through a solid lattice of ions but would be able to move through a liquid because the movement of ions would let the electrons pass.

(c) It was apparent that most candidates were very familiar with diamond and graphite but less familiar with graphene, to the extent that some completely omitted any reference to graphene. IP5 and IP6 (diamond structure and electrical conductivity) were scored by most candidates. IP4 was also scored frequently (delocalised electrons in graphite). However, IP3 required two responses (the structure and bonding in graphite), the point was therefore sometimes not awarded because one of these two statements had been omitted. Given that some candidates were unfamiliar with graphene, it was unsurprising that IP1 and IP2 were not awarded so frequently. Graphene was often recognised as similar to graphite so IP2 (relating to delocalised electrons in graphene) was awarded. But IP1 (a reference to the single layer/sheet structure of graphene) was often missing.

This question amply illustrated the need for legible writing. The second half of the two words ‘graphene’ and ‘graphite’ sometimes tailed off into an illegible squiggle so that it was impossible to be sure which of the two substances was being discussed.

(d) The majority of candidates scored just one of the available two marks.

MP2 was awarded quite frequently, with most candidates discussing the close packing in iron rather than the idea of space (between the atoms/layers) in graphite.

MP1 was awarded relatively infrequently, perhaps because the previous question related to structure, so few candidates thought about the mass of the individual particles.

(e) This question presented candidates with unusual information and asked them to relate this to the structure of graphite. The response was disappointing. Some candidates seemed aware of the presence of weak and strong bonds, but failed to relate this to the structure, let alone name the types of bonding present. Considerable flexibility was allowed (particularly for MP1) in describing the type of bonds present.

Question 9

(a)(i) The optional responses to this question were, on reflection, perhaps a little too obvious. Candidates had perhaps been taught to expect the paper to include something on disproportionation.

(a)(ii) This question discriminated well with few able to score all four marks but most able to gain at least one or two marks.

MP1 required naming the structure, so that drawing skills were not tested (at this level, many candidates found 3D structures difficult to draw).

MP2 was awarded to candidates that measured bond angle on this compound and found it to be greater than the tetrahedral bond angle. Candidates were simply expected to apply VSEPR principles and predict an angle slightly less than the tetrahedral bond angle. The experimentally determined bond angle was not seen in the range of answers given.

MP3 was awarded for a broad attempt to illustrate the principles used to predict the bond angle (MP2).

MP4 was awarded for reference to a position of minimum repulsion/maximum separation. For an answer at this level, there was no insistence on a link to electron pairs.

(b)(i) Although the numbers are larger than would have been familiar to some, this question was answered well. The responses were evenly divided between those who omitted any number before the KCl and those who inserted a (1). Either response was acceptable.

(b)(ii) Very few good answers scoring all 3 marks were seen because most candidates were unable to interpret the data supplied. They were confused by the negative indices. Their confusion was compounded by the inclusion of data for a second solvent (ethanol). Consequently, few used water alone as the solvent, most opting for a combination of water and ethanol.

Considerable leniency was applied for the mention of filtration of undissolved potassium chlorate (VII) at any stage. However, the mark was not awarded for those who thought that potassium chloride would be filtered off, i.e. failed to understand that potassium chloride is the most soluble component in either solvent.

(c) This question asked candidates to calculate the moles of chlorine (Cl_2) in a swimming pool. The meaning of ppm was described in the question so that no prior knowledge was required. The question also made it clear that chlorine was required as Cl_2, not just Cl. There are several different ways to calculate the answer, but in summary they all break down to three operations; conversion of the pool volume to cm^3 or g, application of 2ppm, conversion of the mass of chlorine to moles.

It was essential that candidates should set out their answers logically for this question because there is a possibility that two errors can cancel the marks. If the 2ppm is not applied (for MP2) and 35.5 is used (instead of 71) for the molar mass of chlorine (MP3), the final answer can still be 70.4. Hence the MS does not specify, 'final answer with or without working scores 3 marks.

(d) Many candidates did not use the equation to reach their conclusions, restricting their answers simply to the effects of more/less chlorine in solution. These answers were not awarded any marks. Zero marks were quite common for this question.

MP1/MP2 required recognition of the variation in HClO (concentration), and its effect on disinfection of the water.

MP3/MP4 required recognition of the variation in HCl (concentration), and its effect on the acidity of the pool.

(e)(i) There was a marked difference in quality of answers between those who were familiar with the solvation of ions, and those who were trying to work out the answer from first principles. Many of the latter suggested hydrogen bonds or attempted to show solvation of both irons by a single water molecule.

The dipoles were often omitted altogether.

(e)(ii) Almost all candidates scored MP1 (for hydrogen bonds with ethanol). Very few candidates were awarded MP2 because in chloroethane either the dipole-dipole attractions or the London forces were recognised, but rarely both.

(f) Frequently the mark awarded for this question was 2 of the available 3. Almost all candidates ignored the fact that one mole of $Ca(ClO)_2$ contains two moles of ClO^- ions. Therefore, the answer was given as 0.80, and M2 was not scored.

Paper Summary

1. The overall impression was that candidates generally had been thoroughly prepared for this examination.
2. Many candidates had clearly practiced with previous papers and were familiar with general requirements. This was particularly true for many of the earlier questions on the paper.
3. This paper had been deliberately ramped, with the early questions (42 marks) providing a relatively easy introduction. The last two questions (38 marks) were more challenging, except for 9(a)(i) and 9(b)(i) (one mark each).
4. Most candidates scored well on the multiple-choice questions throughout the paper.
5. Just a few scripts were illegible (or almost so), requiring extensive rereading to get the sense of some of the words. Spelling mistakes are acceptable but illegible writing can make the marker's task almost impossible.
6. The poor layout of some answers to the numerical problems was problematic. This was especially true of answers where transfer errors could be rewarded (e.g. 7(b)(iii), 7(iv) and 9(c)).

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