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General Certificate of Education

Chemistry 1421

CHEM1 Foundation Chemistry

Report on the Examination

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Question 1

Part 1(a) was answered well by most candidates with some writing the electron configuration of Mg rather than the ion. Some candidates wrote subscripts for the numbers of electrons even though the $1s^2$ was given. In part 1(b)(i) many candidates could not give a precise definition. The commonest errors were to mix up moles and atoms or to miss out the gaseous state. Many candidates missed the state symbols from the equation in part 1(b)(ii) and some gave equations showing the removal of 2 electrons. Part 1(b)(iii) was not well answered. There was a good attempt at part 1(b)(iv). In part 1(c) the trend was generally well known as was the increasing nuclear charge. Imprecise technical language cost several candidates a mark -"a bigger nucleus" is not the same as "a nucleus with a bigger charge". Part 1(d) was well answered with most candidates knowing the deviation and the explanation. Marks were lost for not stating that the paired electrons were in the p orbital and some thought they were in the 2p orbital. There were many correct answers to part 1(e).

Question 2

Parts 2(a)(i) and (ii) were generally answered well although a disappointing number of candidates were unable to calculate the M_r for the given formula correctly in part 2(a)(i). Candidates should be able to give their answers to three significant figures when this degree of precision is given in the data in the question. Some candidates used only one significant figure or truncated their answers. Part 2(a) (iii) proved more challenging with many candidates missing out the factor of 1000. Several errors were made in part 2(b) including using an incorrect total for the M_r of the reactants, using 17 instead of 34 for ammonia, and failing to multiply by 100. Candidates would find it beneficial to learn the definition of atom economy and write it at the start of their answer. A surprising number of candidates failed to answer part 2(c) correctly. Some attempted a calculation, which was not needed, and failed to achieve the correct answer. In part 2(d) the equation PV= nRT was well known but some candidates were unable to rearrange this to calculate n or were unable to convert temperature and pressure into the correct units. The empirical formula calculation in part 2(e) was tackled well by a large number of candidates. Weaker candidates found difficulty getting started and some only calculated the water percentage. Some candidates then divided 55.9 by 18 and gave the answer as 3.

Question 3

Candidates answered part 3(a) well with only a few losing marks for simply referring to ‘hydrogen’ or ‘dipole bonds’. Part 3(b) was done well by many candidates. Weaker candidates did not show hydrogen bonds from the lone pair. There were a number of recurring errors including water as HO_2, partial charges missing or the wrong way round. Part 3(c) was generally answered well with candidates relating their answers to comparisons between IMF’s. Candidates found part 3(d) more challenging and there were several answers in terms of the greater attraction between the outer electrons and the protons in the nucleus or electronegativity differences. Part 3(e) was generally well answered with candidates knowing the type of bonding and making an attempt at the explanation. Marks were lost for general descriptions of dative covalent bonding rather than referring specifically to the species given in the question. The type of bonding in part 3(f) proved a good discriminator. Although many candidates gave the correct type of bond, weaker ones suggested covalent or metallic bonds. The explanation also proved more difficult. Many lost marks for breaking IMF’s as well as, or instead of, ionic bonds. Candidates who knew about strong electrostatic attractions often failed to say that this was between oppositely charged ions.

Question 4

Part 4(a)(i) was generally well answered with weaker candidates missing out the word ‘only’ in the explanation. A surprising number of candidates thought that saturated meant that double bonds were present. The general formula in 4(a)(ii) was well answered. Incorrect answers included C_nH_{n+2} or other careless errors. The equation in part 4(b)(i) was generally well done, with thankfully few examples of 16O instead of $8O_2$. Some candidates misread "completely" as "incompletely" and showed the formation of carbon monoxide. Some candidates wrote a correct equation for the complete combustion of propane rather than pentane. Candidates answered part 4(b)(ii) well with marks generally lost for reference to acid rain or the ozone layer. Some candidates failed to see the reference to a solid pollutant in part 4(c) and suggested carbon monoxide. The equation in part 4(d)(i) was generally answered well. Weaker candidates found difficulty working out the formula of the alkene. Part 4(d)(ii) was not well answered with many candidates giving ‘fuel’ or an alkene as their answer. Although 4(d)(iii) was answered well by many candidates, a disappointing number seemed to confuse cracking with fractional distillation and mentioned the separation of molecules. The rubric statement about candidates being marked on their ability to use good English was well illustrated by some of the answers to this question. "A high temperature is needed to break the molecules apart" is ambiguous - it could refer to breaking bonds within molecules or to overcoming forces between molecules. The naming in part 4(e)(i) produced several incorrect answers. The commonest errors were to miss out the ‘di’ before the bromo or put the wrong numbers in the name. The type of isomerism in part 4(e)(ii) was generally well known although some candidates simply stated ‘structural’ – which was given in the question.

Question 5

A substantial number of candidates were not able to produce an exact definition in part 5(a). Many marks were lost through the omission of vital words such as "mass" or "atom", or mixing moles and atoms in their answer.

Part 5(b) was moderately well done but many candidates identified the element rather than the block it was in. The electron configuration was generally well known with the commonest errors being [Ar] $4s^2$ $4d^2$ and $3d^4$. A significant number of candidates could not calculate the number of neutrons and many gave non-integer answers such as 25.9.

In part 5(c) many candidates were able to calculate the relative atomic mass correctly but did not then identify the element. Weaker candidates included 93 x 0 = 93 in their calculation or divided by 100. A small number used 91.2 as the atomic number and therefore identified protactinium.

The great majority of candidates scored the first 2 marks in part 5(d). However, many did not actually identify the isotope, often merely stating that it would be the lightest that would be deflected the most. A disappointing number misinterpreted the mass spectrum and selected 91 because it had the least abundance. A surprising number wrote that the heaviest ions would be deflected the most.

Part 5(e) was not well answered. Although many candidates knew that detection of ions involved the production of a current, relatively few mentioned the relationship between the size of current and the abundance of ion. Common incomplete answers included "the more ions that hit the detector, the greater the abundance". A very small number of candidates thought a current was produced by the ion giving electrons to the detector.

Question 6

A pleasing number of answers scoring full marks were seen. The structure of AsF_5 was generally well done although candidates struggled with the name of the shape. Generally the structure of ClF_2^+ was more demanding and many candidates only showed one lone pair. A large number of candidates thought that the ClF_2^+ ion was linear.

Fewer than 1% of candidates interpreted the ion as the difluoroiodomethyl cation, for which full credit was available.