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General Certificate of Education

Chemistry 1421

CHEM1 Foundation Chemistry

Report on the Examination

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General Comments

This paper is marked electronically and candidates were instructed to use a black ball-point pen or black ink so that the answers could be seen clearly. Unfortunately, a large number of candidates failed to follow this instruction and their papers were difficult to mark.

Candidates were told that answers written in the margins or on blank pages would not be marked and yet there were many candidates who did not follow this instruction. There was sufficient space allowed for candidates to answer each question on the lines provided but some candidates used up most of the lines by repeating the stem of the question in their answer. Centres are strongly advised to prepare their candidates as to how they should complete their answers i.e. in black pen and with answers only on the lines provided. There should be no need for any additional sheets.

The paper allowed candidates to demonstrate their ability and understanding of Foundation Chemistry. The standard of numerical answers was variable and the standard of written English was sometimes poor. Answers were occasionally ambiguous and therefore could not be awarded marks.

Question 1

In part (a) the majority of the candidates scored full marks with some losing marks by referring to a charge of + rather then +1, or putting a + (plus) or a – (minus) sign in the relative mass column. The answer to part (b) was well done with only a few writing 'Transition metals' rather than stating the block that tungsten is in. Some candidates did not score marks in part (c) since they did not look for the atomic number in the Periodic Table and some could not remember how to calculate the number of neutrons. Candidates generally answered part (d) well although a few put 'detect' as one of their answers and this was given in the stem of the question. Some tried to explain how the ions were formed but this was not asked for. Part d (ii) was well answered. In part (e) candidates lost the second mark by not knowing that the isotopes have the same electron configuration. Many answers just stated that isotopes had different numbers of neutrons and/or same number of protons. The calculation in part (f) was very well done although some candidates lost the second mark by not giving their answer to two decimal places.

Question 2

The definition required in part (a) was generally well known. Common errors included reference to a single electron or omitting covalent bond. Part (b) was quite a good discriminator with many candidates merely giving 'dipole-dipole interaction' or just 'hydrogen'. Part (c) also discriminated well. Many candidates relied upon attraction between the partial charges on the hydrogen and nitrogen neglecting the importance of the lone pair on the nitrogen atom. Most candidates knew about co-ordinate bonding and scored the first mark in part (d). The idea of sharing a pair of electrons was well known although the direction of donation was often wrong or unclear. Many scored both marks in part (e) and some good 3-D diagrams were seen. Candidates lost marks by omitting the H atoms, replacing the As with N or P and stating the shape as bipyramidal or planar. Part (f) proved difficult for weaker candidates. There were a few who failed to realise the significance of the negative signs and thought that AsH_3 had the higher boiling point and some referred to breaking covalent bonds rather than intermolecular forces. The equation in part (g) was usually correctly balanced.

Question 3

In part (a), atom economy, being a relatively new type of calculation, posed a few problems with candidates unsure of which relative formula masses to use. Some candidates inverted the formula and a few incorrectly copied the 79.9 as 79 into their working. Most candidates realised that the HCl needed to be sold although incorrect answers referred to recycling or just using the HCl. Most candidates could calculate the number of moles in part (b) (i) but then some could not use the equation to answer part (b) (ii) and even more could not use the correct molecular mass formula in part (b) (iii). Part (b) (iv) was more demanding with many candidates not using their answer to part (b) (iii) or realising that a yield of over 100% was impossible.

Question 4

Many gave correct definitions in part (a) (i). Common errors included the use of 'mole' in either the first or second mark rather than in both or neither. Some candidates did not refer to the gaseous state. The trend in ionisation energies in part (a) (ii) was generally well known although weaker candidates suggested the increased nuclear charge was due to increased neutrons. The last mark here was more difficult to score with similar shielding being omitted or contradicted with increased radius.

In part (a) (iii), the majority of candidates chose aluminium although many did not score both the explanation marks. Many did not state that the electron being removed was from the 3p orbital or a higher energy orbital and some confused the explanation with sulfur and talked about repulsion of electrons. In part (b) every element was seen although phosphorus was a very common wrong answer. Of those who correctly chose silicon, many lost the explanation marks by referring to intermolecular forces or not stating that the covalent bonds needed to be broken.

Question 5

Most candidates correctly calculated the number of moles in part (a) (i) but errors were made in part (a) (ii) by candidates who failed to divide by 2 or sometimes multiplied by 2. There were quite a few errors involving powers of ten and in part (a) (iii) not all candidates used the value 0.548 in their calculation. Part (b) was generally done well although some candidates tried to identify their metal using the atomic number and not the relative atomic mass. A small number gave fluorine as their answer not realising that it was not a metal.

Question 6

Many candidates scored full marks in part (a). The commonest errors were to omit the word 'only' in the definitions of saturated and hydrocarbon, or to confuse saturated and unsaturated and state incorrectly that alkanes have double bonds. Some candidates lost the last mark because they wrote alkene or alk?ne in which the fourth letter was insufficiently clear. In part (b) a few candidates scored full marks although the majority scored about half marks. Many answers did not refer to the difference in boiling point of the fractions and many confused fractional distillation with cracking or referred to a furnace rather than a tower with a negative temperature gradient. Many described structural features of the fractionating column e.g. bubble caps and made no reference to the size of the molecules and their related boiling points. Most candidates scored well in part (c) although some candidates lost the first mark since they did not refer to large molecules being broken into small molecules. The equation was generally well answered and the catalyst well known. There was a good understanding of the supply and demand situation for the various fractions although some lost this mark by simply referring to the greater usefulness of some fractions.

Although many correct equations were seen in part (d) there were many errors usually with the coefficient for oxygen. The catalyst was generally known although zeolite and rubidium occurred frequently.

The second equation was less well done with candidates using N_2O or NO_2 rather than NO. Also, N appeared as a product rather than N_2. The equations, even those with the correct species, were often unbalanced. More candidates scored the last mark for stating that water was a greenhouse gas rather than it absorbs i.r. radiation. Of those who mentioned the term 'greenhouse', many lost the mark since they thought that global warming occurred because CO_2 or SO_2 dissolved in the water and made the water acidic. There was confusion with acid rain and the ozone layer.

Most candidates scored at least one mark in part (e). Common errors referred to incomplete combustion of the petrol and suggestions which did not amount to satisfactory testing.

In part (f) candidates were not always aware that isomers must have the same molecular formula. Some wrote about the different types of structural isomerism whilst a few confused their answer with stereoisomerism. A great variety of answers was seen for the name of the structure with common errors including 2,4,4 trimethylpentane, the omission of 'tri' or the name propane or octane rather than pentane.