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General Certificate of Secondary Education

Chemistry 4421

CHY3H Unit Chemistry 3

Report on the Examination

2010 examination – January series

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Chemistry
Foundation Tier CHY3H

General

This was the fifth examination of the present Specification.

The examination challenged less capable candidates, but the more able and better prepared were able to score well. A sympathetic mark scheme enabled candidates to gain credit for a wide range of chemical knowledge and understanding.

The following questions were very well answered by the majority of the candidates: question 1, question 2, question 4(c) and question 6 [except for part (c)(ii)].

However, question 5(c) was very poorly attempted, and the following questions proved difficult for nearly two thirds of this cohort of candidates: q 3(b) and (c), question 4(a), question 6(c)(ii) and question 7.

Although many candidates wrote neatly and expressed themselves clearly, it was noticeable that there were others whose subject knowledge and powers of expression give cause for concern. Unusually for this paper, parts of some questions were not attempted by about a tenth of the candidates and left blank: those were questions 3(c), 4(a), 4(b), 5(c)(ii), 7(a) and 7(b)(i).

Questions 1, 2 and 3 were standard demand questions and were common with questions 6, 7 and 8 on the Chemistry Foundation Tier Paper.

Question 1 *(Standard demand)*

(a) Most candidates knew why chlorine is added to drinking water. However, candidates need to write that chlorine kills bacteria rather than just removes bacteria. Weaker candidates simply stated it was to clean or neutralise the water, or to kill bad chemicals.

(b) The poisonous nature of chlorine was well known and the majority of candidates were able to state the effects of too much or too little chlorine. Weaker candidates did not go far enough in their response and gave vague answers such as too little chlorine ~~wouldnt~~wouldn't keep the water clean.

(c) Nearly all of the candidates appreciated that chlorination is a cheap and easy to use method. Simply saying that many people would die if the water was not chlorinated received no credit.

(d) (i) Most candidates realised the importance of obtaining a balanced view and avoiding bias.

(d) (ii) The idea that scientists had knowledge and experience was usually mentioned. It is interesting to note that many candidates suggested that the views of scientists could be trusted but those of politicians could not.

(d) (iii) Most candidates suggested that evidence and data was reliable, factual or based on proof.

Question 2 *(Standard demand)*

(a) The graph was usually drawn well. Candidates are strongly advised to use a sharp pencil and avoid drawing multiple lines when attempting to draw a smooth curve. Candidates should be encouraged to develop their graph drawing skills as candidates who are careless should not be surprised that their attempts gained no credit.

(b) Almost all the candidates were able to use their graph to estimate the mass of chlorine that dissolves at 30°C. A few thought it necessary to multiply by 1000 to obtain the answer for 1000g of water. Some thought it was 4.8.

(c) Well done. However, a significant number of candidates had problems reading the scale on the graph, usually misreading the solubility at 80°C as 2.2 rather than 2.4. Others wrote 10 + 2.4 = 12.4 or 10 – 2.4 = 8.6.

Question 3 *(Standard demand)*

(a) Well answered but there were a number of candidates who simply wrote OH without any indication of charge. Other incorrect responses included Na, Na^+, H^+, H^-, ammonia and sodium hydroxide.

(b) Less than a third of the candidates gained credit. A significant proportion of candidates answered the question in terms of the numbers of ions / concentration of ions. A common misconception is that acids and bases ionise other substances rather than themselves becoming ionised. Some candidates suggested strong alkalis had a high pH, or were very reactive, while others suggested they ionised quickly or that the bonds were strong.

(c) Again, less than a third of the candidates gained any credit. Many candidates are still under the misapprehension that a strong alkali requires more acid to neutralise it than a weak acid and answered the question by performing a titration. A surprising number of candidates used litmus as a means of determining the pH or colour. These candidates failed to score despite quoting the correct colour comparison or the correct pH comparison. Others suggested using magnesium and timing the reaction.

Question 4 *(High demand)*

(a) Better candidates had no problem with this simple recall question. However it was clear from the responses that many candidates are unfamiliar with simple tests for ions. Candidates most commonly confused the test for a sulphate with the test for a chloride and used silver nitrate. Others used barium chloride and silver nitrate, while others suggested using barium, barium solution or barium sulphate. Bromine water is not used, and neither are flame tests, chromatography or electrolysis. Some candidates did not give a reagent but merely suggested that a white precipitate was formed on the off-chance that credit would be given! It was not.

(b) A significant number of candidates scored the first mark but did not suggest that the precipitate dissolves in excess sodium hydroxide. Many candidates quoted the nitrate test and the use of aluminium in that test. Some candidates even suggested that the sodium in the sodium hydroxide would react to produce hydrogen.

(c) Most candidates scored some marks here but many did not read the question carefully enough, confused ammonium ions and aluminium ions, and included in their answer the fact that aluminium ions gave no flame colour, without recognising that aluminium ions are present in all three alums. Some weaker candidates suggested that potassium alum would be more reactive than sodium alum.

Question 5 *(High demand)*

(a) The majority of the candidates recognised that Mendeleev left gaps in his periodic table for undiscovered elements but the second mark was less frequently obtained. A significant number of candidates referred incorrectly to there being gaps in the atomic weights and this led Mendeleev to leave gaps in his table. Many candidates think that Mendeleev was aware of atomic structure, electron arrangement, protons and atomic number.

(b) While most candidates knew that the number of electrons in the outer shell defined the group number, many had problems expressing themselves accurately. For example, candidates received no credit for suggesting that elements in the same group have the same outer shell, or that they have the same number of outer shells. There are no such terms as relative atomic number or atomic mass numbers, and neither are reactivity and reactions interchangeable. Many candidates believe that the modern periodic table is still arranged in atomic mass / weight order.

(c) (i) The idea of inner shells being filled is not understood by the majority of the candidates. The better candidates were aware that the outer shell of electrons was the same (or similar) in all the transition metals but frequently their answer was answered in terms of overlapping shells and electrons being able to shift between the two. A significant number of the candidates did not answer the question but simply stated various properties of transition elements or mentioned delocalised electrons to explain electrical conductivity.

(c) (ii) Very poorly answered and few candidates gained credit. Very many candidates attempted to answer the question in terms of protons and atomic numbers, rather than explaining that the second shell has a maximum of 8 electrons or that the second shell cannot expand its octet to 18.

Question 6 *(High demand)*

(a) The majority of the candidates were able to use the energy diagram to suggest why the reaction was endothermic. Poor use of English let candidates down and typical incorrect responses include products produce more energy than reactants, energy in is less than energy out meaning energy has been adsorbed and more energy taken in than was used.

(b) Most candidates knew that the activation energy is the energy needed to start a reaction. Simply stating it is the energy to activate a reaction received no credit. Some candidates thought it was the energy produced by the reaction.

(c) (i) Three-quarters of the candidates calculated the energy change for the reaction. The majority of the errors were made by candidates failing to take the stoichiometry of the equation into account or making simple arithmetic errors.

(c) (ii) Many candidates did not read the question carefully but gave an answer in terms of the energy of reactants and products rather than in terms of bond energies. Many candidates also had difficulty expressing their ideas accurately and precisely without contradiction. Once again, a very common error was the suggestion that energy is needed to form bonds as well as break them.

Question 7 *(High demand)*

(a) Although the better candidates demonstrated their knowledge and understanding well, many candidates have little idea of the Brønsted-Lowry theory. A large number of the candidates could state that an acid is a proton donor but many of these candidates answered the second part of the question in terms of the amino acid providing hydroxide ions. A significant number of the candidates did not gain the mark for stating that a proton is a hydrogen ion, indeed many of the correct responses simply stated proton donor and proton acceptor.

(b) (i) Again, stronger candidates were able to calculate the concentration in moles per cubic decimetre successfully but others found the question challenging.

(b) (ii) Far too many candidates used litmus or methyl orange. Of those candidates who knew phenolphthalein, many were unable to spell the word correctly.

Question 8 *(High demand)*

There were some excellent concise answers. However, this question posed problems for many of the candidates. It was clear from the responses that many candidates were referring to mechanical filtering rather than chemical filtering. A large number of candidates were aware of ion exchange but their descriptions were frequently spoiled by references to metallic calcium and magnesium, rather than the ions that cause hardness. Similarly, candidates referred to replacing these ions with sodium and hydrogen. Many candidates did not gain credit because of their lack of precision with language. Good candidates were aware of filter jugs, however the contents of the filters and the function of the contents were not well known and again the lack of precise language penalised candidates. For example: silver nitrate (rather than silver) used in the filter and carbon removing chloride (rather than chlorine) from the water. Many candidates suggested that households are fitted with distillation units, or that water coming from the tap is screened, flocculated and chlorinated in the kitchen!

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the **Results statistics** page of the AQA Website.