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General Certificate of Secondary Education

Chemistry 4421

CHY3H Unit Chemistry 3

Report on the Examination

2011 examination – January series

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Chemistry
Higher Tier CHY3H

General

This report should be read in conjunction with the published Mark Scheme.
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. Many candidates wrote neatly and expressed themselves clearly, but there were some whose answers were difficult for examiners to read. The following questions were well answered by the majority of the candidates: Question 1, Question 2, Question 3(b) and Question 4(b)(iii).
Question 6(a)(i) was very poorly attempted, and the following questions proved difficult for over half of this cohort of candidates: Question 4(a)(i) and (b)(ii), Question 5(c)(i), Question 6(c), Question 6(c)(ii) and Question 7(b). A significant minority of the candidates left parts of the following questions blank: Questions 5(c)(i), 6(a)(i)(iii) and (c).
It is clear that the CHY3H Paper was unfortunately not appropriate for some candidates. These candidates would have had a less than positive experience, and perhaps would have been better suited to the Foundation Tier Paper (CHY3F).
Questions 1, 2 and 3 were standard demand questions and were common with Questions 5, 6 and 7 on the Chemistry Foundation Tier Paper (CHY3F).

Question 1 (Standard Demand)

a) (i) The graph was usually drawn well. Candidates should use a sharp pencil and avoid drawing multiple lines when attempting to draw a smooth curve. Candidates were expected to draw a smooth curve through all the points.

a) (ii) Almost all the candidates were able to use their graph to find the mass of sodium chloride that dissolves at 60^{o}C.

a) (iii) This part was well done. However, a significant number of candidates had problems reading the scale on the graph, usually misreading the second point as 35.6 (even though it was given in the table); some divided values or subtracted from 100.

b) Most candidates recognised that the y-axis scales were different or described the effect this had such as the scale in B being less precise. Candidates who wrote about experimental error or lack of accuracy gained no credit.

Question 2 (Standard Demand)

a. Only a quarter of the candidates gained both marks. Most candidates knew that chlorine kills bacteria/micro-organisms but weaker candidates simply stated it was to “clean” the water or “remove” bacteria. Chlorine is not used to “kill bad chemicals”. However, the majority of candidates did not state that filtering removes solids or insoluble material. Instead, they mistakenly referred to *screening*, rather than *filtering*, and stated that filtering removed all sorts of debris including rocks, trees, branches, dead animals and rubbish. Filtering does not remove hardness.

b) (i) The majority of the candidates were able to extract the information from the passage to suggest two advantages of the portable method of testing for arsenic. However, identifying the disadvantage was problematic for many who

thought that the equipment was used to remove arsenic from the water rather than measure the amount of arsenic present. A significant number of candidates did not understand the difference between *accuracy* and *precision*.

b) (ii) While most candidates realised the importance of avoiding bias, it should be noted that many candidates also think that industrial companies inherently lack integrity and are dishonest.

Question 3 (Standard Demand)

a. This part discriminated well. Many candidates did not realise that **C** represented the products – carbon dioxide and water, or that **B** represented the activation energy. It would appear that some weaker candidates had never seen a diagram of this type and identified the letters as representing "before flight", "during flight" and "stopped"!

b. The majority of the candidates were able to use the energy diagram to suggest that the reaction was exothermic. Other creditworthy responses were "combustion" and "oxidation". The popular incorrect responses were "endothermic" and "chemical".

Question 4 (High Demand)

a) (i) Only a quarter of candidates gave examples of named elements with a supporting comment. The majority just repeated the question stem about "every 8th element having similar properties".

a) (ii) A third of the candidates gained both marks, a third gained 1 mark, while a third gained no credit. The most common response referred to the lack of gaps for new elements by Newlands. There were vague references to Newlands' age, experience and reputation, as well as lack of evidence and proof. It was also suggested that he was not a proper scientist as he was only a chemist!

b) (i) The majority of the candidates stated the order of reactivity for the halogens but were unable to explain the trend using the data provided, or gave answers in terms of electron structure. Often it was unclear where bromine fitted into the pattern and sometimes fluorine was mentioned. Some candidates identified potassium iodide as the most reactive and potassium chloride as the least reactive. Many candidates were also careless with terminology, referring to the *halide* rather than the *halogen* in their response.

b) (ii) Surprisingly, nearly two-thirds of the candidates were unable to complete the equation by adding "Br_2". Incorrect responses included 2Br, 2Cl, Br, OH^- and various interhalogen entities such as $ClBr_2$ and BrCl.

b) (iii) The majority candidates knew that these elements have 7 outer electrons. Other candidates did not specify the "7" or gave non-electronic answers including "they are halogens" or "have the same properties". Others thought they had 1 outer electron, 7 shells or even 7 outer shells.

c) Most candidates gained some credit for explaining the trend in reactivity down Group 1. In a question such as this, a comparison is required and so it is essential to include comparative terms such as less, further, weaker or easier. Simply saying easy/easily, far or weak is insufficient. Candidates should be careful not to say that potassium has "more *outer* shells" when they mean "more shells". A minority of candidates still persist in writing about magnetic, gravitational or bonding attractions, and did not gain the

second marking point. Candidates must make it clear in their answer when they are referring to the outer shell electron.

Question 5 (High Demand)

a) About half the candidates knew that the test for carbon dioxide was that limewater gave a white precipitate or turned milky. The test for carbon dioxide does not involve adding hydrochloric acid or adding limewater to the reacting mixture. Other candidates gave flame tests, extinguishing splints, exploding gases or using litmus/universal indicator.

b) Just under half of the candidates were aware that the colours would mix or that one colour might predominate and mask the other. Many candidates referred to incorrect colours, while others suggested that sodium and potassium give the same colour flame.

c) (i) Two-thirds of the candidates did not know the test for a sulfate. Incorrect reagents included sodium hydroxide, silver nitrate, bromine water, barium sulfate and hydrochloric acid (without the barium chloride). A flame test is not used. Some candidates did not give a reagent but just suggested that a white precipitate was formed on the off-chance that credit would be given! It was not.

c) (ii) Under half of all candidates knew that sodium hydroxide gives a white precipitate with magnesium ions. Many candidates thought that a gas is produced or suggested that the precipitate dissolves in excess alkali. Some thought that magnesium ions give a bright light.

Question 6 (High Demand)

a) (i) This was the least well answered question on the Paper - only a small minority of the candidates were able to complete the equation correctly. Of those candidates who recognised the ethanoate ion, the majority failed to put a charge on the ion.

a) (ii) This was better answered than in previous years with over 50% of the candidates correctly explaining the meaning of *weak* in terms of ionisation. The concept has nothing to do with “ions ionising” or the acid/base ionising other substances or dilution/concentration or the number of ions formed or the speed of ionisation.

a) (iii) Over half the candidates knew that the Brønsted-Lowry definition of acids is that they are proton donors. Some candidates unsuccessfully hedged their bets and wrote about protons donors and hydrogen ions (H^+), while others referred to pH numbers.

b) (i) Nearly half the candidates gained credit. However, a significant number of the candidates simply stated that phenolphthalein was used for a weak acid without reference to the alkali. Candidates who correctly answered in terms of methyl orange received credit.

b) (ii) Just under a half of all candidates gained 3 or 4 marks for describing how this titration should be done. Some candidates confused burette with pipette, or did not know the correct name for “burette” – it is not a titration tube. Candidates did not gain credit for stating the wrong indicator colour change (to colourless or clear were the most common), or changing the indicator (from phenolphthalein to methyl orange or universal indicator) or forgetting to take the final reading of

volume at the end of the titration. A colour change is needed for the indicator rather than simply saying titrate to the "end-point" or until "neutral". However, the methods of achieving accuracy in titrations were well known, particularly that the substance in the burette is added slowly. Some candidates used stop watches to time the experiment. A surprising number of candidates started with acid/vinegar in the burette despite being told in the question that the acid/vinegar was in the conical flask! The added acid then, of course, would turn phenolphthalein colourless. Candidates did not gain credit if the alkali (sodium hydroxide) was not mentioned, for example if they added vinegar to the acid.

c) The better candidates were able to calculate the concentration in moles per cubic decimetre successfully but the others found the question challenging. "0.16" was a common incorrect response. The use of $M_1V_1 = M_2V_2$ was rarely seen.

Question 7 (High Demand)

a) Although half the candidates gained full credit, this type of calculation was not attempted quite so well as in previous examinations. There were many careless errors – incorrect bond energies used and many candidates were unable to work out how many bonds were broken or formed.

b) 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. A very common error was the suggestion that energy is needed to form bonds as well as break them.

Mark Ranges and Award of Grades

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