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General Certificate of Secondary Education

Chemistry 4421

CHY3H Unit Chemistry 3

Report on the Examination

2008 Examination – June Series

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Chemistry
Higher Tier CHY3H

General

This was the second examination of CHY3.

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

Questions 1 and 2 were standard demand questions and were common with Questions 6 and 7 on the Chemistry Foundation Tier Paper (CHY3F).

This Report should be read in conjunction with the published Mark Scheme.

Question 1 *(Standard Demand)*

The hydrogen ion (H^+) was identified by most candidates in part (a)(i). A common error was the negative hydrogen ion (hydride ion) H^-, and candidates who gave a symbol with an unclear charge gained no credit.

Part (a)(ii) discriminated well. Universal Indicator, the use of magnesium or zinc or the use of carbonate or marble chips was well known, together with an appropriate comparative result. Candidates who chose Universal Indicator did not always describe the appropriate colours, red or pale red for a strong acid **and** orange or yellow for a weak acid. A weaker acid does not turn UI a paler shade of red. Adding an unspecified metal or an inappropriate metal such as sodium or copper gained no credit but candidates were able to obtain the second marking point if they suggested that the stronger acid reacted faster etc. The most common incorrect response was to use titration or the addition of an alkali with the suggestion that the stronger acid would require more alkali for neutralisation. Litmus indicator does not distinguish weak and strong acids. A minority of candidates did not attempt to describe an experiment but sought to explain how the acids dissociated, but those who correctly discussed conductivity received credit.

Both parts of (b) were well answered and it was clear that generally candidates understood the issues and gave very sensible and mature answers.

Most candidates in part (b)(i) made the link between death and cancer, and the addictive nature of nicotine was well known. A few candidates made comments about the extra health care costs and the NHS. Some candidates suggested that the pressure group was likely to say that chemicals made from nicotine were likely to have similar properties to nicotine, and that it was safer to ban nicotine and all nicotine products, including vitamins and vegetables.

In part (b)(ii) the risk of pellagra and its symptoms was frequently mentioned, as was the fact that niacin is a vitamin and/or an important part of our diet. Few candidates mentioned tax revenue from nicotine containing products, but human right issues were vigorously defended and perceived benefits were sometimes mentioned.

Question 2 *(Standard Demand)*

In part (a) most candidates drew a reasonably smooth curve through the points using a sharp pencil and extrapolated the curve to 55.5 g per 100 g of water at 35^{o}C. Candidates should be encouraged to develop their graph drawing skills, as candidates who are careless will not be surprised that their attempts gained no credit.

Most candidates mentioned that the curve changed direction or decreased after 35^{o}C in part (b).

In part (c) almost all candidates recognised that repeating the experiment or taking an average made the results more reliable.

In part (d) most candidates realised that sodium sulfate had maximum solubility between 34 and 35 g per 100 g of water. 55.5 was a popular distractor, as was 30.

For part (e) most candidates correctly used their graph to calculate the maximum mass of sodium sulfate that dissolves in 100 g of water at 10^{o}C.

For part (f) the answer (27) was often correct and where it was not, candidates usually scored one mark for reading one of the points (19 or 46) from the graph correctly.

Many correct answers were seen in part (g) but they were sometimes poorly expressed, and some candidates mixed up the terms solute and solvent. A saturated solution is not one where a substance is completely or fully dissolved, and neither is it a solution to which no more substance can be added. Other incorrect responses included reference to double bonds or the solution being very wet. Terms such as absorbs and soaks up should be avoided.

Question 3 ***(High Demand)***

This question discriminated well between the candidates.

In part (a) the test for ammonium ions was often confused with that for nitrate, so that aluminium or Devarda's Alloy was used in addition to sodium hydroxide. Candidates who did this were usually able to score the second marking point for a correct result. In some cases it was not clear whether the candidate was testing the ammonia produced or the solution itself. A number of candidates who correctly identified ammonia did not receive credit because they then suggested that ammonia turns blue litmus red. Some candidates wrote about the Haber Process. The use of flame tests was a common incorrect response. There is no such substance as ammonium gas.

The test for carbonate ions was better known in part (b). Again, it wasn't always clear from candidate responses whether it was the carbon dioxide or the ammonium carbonate that was being tested with limewater.

Question 4 ***(High Demand)***

Most candidates on part (a) realised that the oil is a barrier preventing Group 1 metals from reacting with oxygen or water. Some candidates thought that air contains hydrogen.

Part (b) was a good discriminator. As usual, multiples or fractions were allowed so long as the equation was correctly balanced. A few candidates attempted to change the formulae to make the equation balance. Na_2 was sometimes seen and some candidates changed H_2 to H_2O.

Part (c) was less well done, and many candidates either said that the metals themselves are alkalis or contain OH^- ions. The importance of water should be stressed.

Part (d) was an excellent discriminator as usual, and some excellent answers were seen. In a question such as this, a comparison is required so it is essential to include comparative terms such as more or most, closer or closest, stronger or strongest or easier or easiest. Simply saying easy, close or strong is insufficient. Candidates needed to mention the outer electron or outer energy level or shell somewhere in their answer to receive full credit. Some candidates suggested that a potassium atom gains an electron or that potassium loses an outer atom. Others wrote about electron shells being lost or that potassium had more outer shells than sodium. Some candidates thought that intermolecular, magnetic, gravitational or electromagnetic forces hold the electrons to the nucleus, while others referred to the strength of the bond between electron and nucleus. Some candidates linked potassium's reactivity to it having more electrons to react. Weaker candidates missed the middle marking point about

weaker forces of attraction and scored 2 marks, or just said that the atoms were bigger and so reacted more easily for 1 mark.

Question 5 ***(High Demand)***

Many candidates scored both marks on part (a)(i), but also many gained 1 mark for one of the steps in the calculation. The weakest candidates had 108 as the numerator rather than the denominator. A minority of candidates rounded or truncated their calculations inappropriately. There was a feeling that the quality of the answers was centre dependent.

On part (a)(ii) many weaker candidates thought it was because the coin was only 90% silver to begin with. Others thought that the other metals in the coin might rust. Some candidates suggested that oxidation would cause the coin to gain in mass while others suggested that the oxidation products would have less mass.

Part (b)(i) was a good discriminator which was quite well answered although weaker candidates thought that spectroscopy or spectrometry would be sufficient. Credit was given for AAS. Common responses that received no credit included nmr, ir, chromatography, electrolysis and the use of a flame test.

Part (b)(ii) proved challenging for many candidates. Many just restated the question and discussed the destructive nature of chemical analysis without any reference to instrumental techniques. Large numbers of candidates thought that no sample of the coin was required at all for instrumental analysis. Typical answers stated that some sort of radiation was needed and this had no effect on the coin. Instrumental methods are preferred because only a very small amount of material is needed.

Question 6 ***(High Demand)***

The majority of candidates understood the question and correctly identified the *symbol* as B in part (a).

Good candidates mentioned the similar properties of either the alkali metals or the halogens and gained 2 marks on part (b). Many candidates scored 1 mark for a generalised comment such as every eighth element has similar properties. Some candidates were careless in the use of language and referred to moving along a group or moving down a period.

Good candidates did well on part (c), the lack of gaps for undiscovered elements and elements sharing positions were the favourite responses. Mixing metals and non-metals, or elements with different properties within the same group was also popular with many. Incorrect ideas included a supposed lack of credibility as a chemist, his youth (look at the photograph!), religious belief, competing theories, lack of proof and ignorance of atomic structure at the time. Some candidates thought that Mendeleev pre-dated Newlands. Some candidates suggested that Newlands used the same element twice.

Most candidates correctly recognised that the alkanes are not elements but compounds on part (d). The idea that alkanes are a *mixture* of two elements was a popular incorrect response. Some candidates suggested that the alkanes had not been discovered at the time!

Question 7 ***(High Demand)***

This was a challenging question that discriminated well.

For parts (a)(ii) and (b)(ii), there was evidence that some candidates had not read the question carefully and did not take notice of the key phrases in terms of the energy level diagram and in terms of bond energies respectively. Many candidates had difficulty expressing their ideas accurately and precisely without contradiction.

For part (a)(i) most candidates were able to use the diagram to explain how they knew that the reaction was exothermic, and some candidates gave a response based on bond energies when in fact this understanding was better placed in (b) (ii). Some candidates thought that the energy given out was represented by the activation energy being released.

For part (a)(ii) good candidates wrote about the lowering of the activation energy but weaker candidates suggested that the catalyst provided additional energy for the reaction. Some candidates did not refer to the energy level diagram but gave responses based on surface area or increasing the rate of the reaction.

Part (b)(i) discriminated well and with the help of consequential marking most candidates gained some credit for the calculation. Some ignored the balancing numbers on one side or the other and scored 2 marks, while others got both energy totals incorrect but were able to obtain 1 mark if they calculated the difference correctly.

The most common error on part (b)(ii) was the suggestion that energy is used up in both bond breaking and bond forming. Some candidates thought the reaction was exothermic because there were more reactants than products.

Question 8 *(High Demand)*

A generally well-answered question and the sympathetic mark scheme allowed candidates the opportunity to gain full credit, by discussing filtration and chlorination. Candidates needed to say that chlorine kills bacteria rather than just removes bacteria. Filtration and screening were frequently confused. Flocculation or precipitation in the correct context were seldom seen, although the use of aluminium compounds was sometimes mentioned. Common non-creditworthy responses included screening, incorrect ideas about flocculation or aluminium sulfate aggregating insoluble solid particles like dirt, rather than soluble material, boiling and/or distilling the water, the use of ion-exchange columns in water treatment plant and a number of ways of treating water in the home using jug kettles with silver filters, ion exchange and washing soda for removing hardness. The question was not about sewage treatment.

Mark Ranges and Award of Grades

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