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General Certificate of Secondary Education

Additional Science 4463 / Chemistry 4421

CHY2H Unit Chemistry 2

Report on the Examination

2009 examination – June series

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Additional Science / Chemistry
Higher Tier CHY2H

General

The candidates appeared to have sufficient time to answer the paper and the majority of the candidates were able to make a good attempt at almost all of the questions. There were many excellent papers, which showed that many of the candidates had an excellent knowledge and understanding of the topics they have studied. As in previous years there were some candidates who would have been better entered for the Foundation tier, since they struggled to score marks on this paper.

Question 1

(a) (i) The vast majority of the candidates were able to draw a good line of best fit. A number of candidates missed the first point at (0,0) and started their graph at the second point. This was allowed, provided that a good straight line was drawn for the rest of the graph. A number of candidates did not have a ruler and consequently failed to draw a reasonable straight line. Other candidates put a kink in their line to include the anomalous point. Candidates would be well advised to draw their line of best fit in pencil, so that they can rub out their first attempt if they wish to improve their line.

(a) (ii) This part was generally quite well answered and reflects the good preparation for ISAs. A wide variety of answers were accepted. The most common misconception seemed to be that some candidates thought that the errors would occur because the intervals between the chosen concentrations were not constant. Some candidates did not understand the question and stated that the errors were as a result of using different concentrations of sodium thiosulfate. We did not accept systematic errors. More able candidates were able to expand on the error, giving clear explanations about how the errors occurred and displayed a good appreciation of practical technique and its limitations.

(b) (i) Very few candidates made the connection between direct proportionality and a straight line graph. Nevertheless, most candidates gained the mark for an answer such as, 'the rate of reaction increases as the concentration increases'. A number of candidates stated that there was, 'positive correlation', and were given a mark. Only a small number of candidates used readings from the graph to show that rate and concentration are directly proportional. A few candidates gave answers which revealed confusion between 'rate of reaction' and 'time taken to react'.

(b) (ii) The collision theory was quite well known and the majority of the candidates gained at least one mark here. A number of candidates discussed the energy or speed of the particles, confusing concentration with temperature effects that had clearly been well drilled. There was also some confusion over the difference between rate of reaction and time taken, so that answers such as 'there are more particles so the reaction will take a longer time', were sometimes seen. References to collisions were often too vague and did not indicate that the frequency of the collisions would increase.

Question 2

(a) Few of the candidates were able to identify the ion which makes the solution acidic here. All possible answers were seen including OCl^-, Cl^-, Cl_2 and H_2O. Some species not shown in the equation were also given as possible answers.

(b) (i) This part was well answered with the majority of candidates gaining two marks. Most candidates gained the correct answer with clear working.

However, errors included:

- Incorrect use of the calculator in adding the correct numbers.
- Ignoring the formula and simply adding 40+35.5+16 to get 91.5.
- Misunderstanding the formula and adding $40 + 35.5^2 + 16^2$ or $40 \times 35.5^2 \times 16^2$
- Calculation of the correct value of the M_r and then doing further calculations with it so that the final answer is incorrect.

(b) (ii) This part was quite well answered with about two thirds of the candidates gaining both marks.

A few candidates gave no working with an incorrect answer, so that no marks could be awarded. Others did not multiply by 100 to gain the percentage or performed incorrect calculations such as 143÷71 x 100. A number of candidates used 35.5 for the mass of chlorine rather than 71. Some candidates rounded down their answer to 49 and lost one of the two marks.

(b) (iii) This part was slightly less well answered than part (b)(ii). Many candidates gave impossible answers larger than 20g and should be encouraged to check that their calculated answer is sensible.

(c) (i) Very few candidates were able to make the link between the OH^- ion and the fact that this could be supplied by an alkali. We accepted any named hydroxide or even just hydroxide. We did not accept base unless the candidate qualified the answer by stating a soluble base. Answers such as, 'add hydrogen oxide' or 'add acid', were common.

(c) (ii) Few candidates understood the term *precipitate* here. A common misconception is that it is a waste product or something left over at the end of a reaction. References to gases, liquids and cloudy were common.

(c) (iii) Many candidates who gave the correct answer to the previous part still gave an incorrect response in this part. Evaporation and electrolysis were common answers! Some candidates gave a list of methods which often included the correct answer but they should be reminded that the examiner cannot choose the correct answer for them.

Question 3

(a) Although the majority of candidates gave the correct response in this part **,** there were a surprisingly large number who gave answers such as, 'to make the casing for the reactor'.

(b) Some outstanding answers were seen here but the majority of candidates still find the effect of reaction conditions on the position of equilibrium very difficult. As in previous years the effect of temperature was better understood than pressure. Many of the candidates tried to explain the effect of pressure in terms of reaction rate and particle

collisions and did not make the connection with the number of reactant and product molecules in the chemical equation.

(c) This was generally well known, but some candidates gave answers such as, 'it is the optimum temperature', which did not answer the question. Answers such as, 'it will not work', were not accepted. Many confused answers in terms of equilibrium yield were seen and reflect the difficulties the candidates find in understanding the difference between rate and equilibrium yield.

(d) This part was poorly answered, with only a minority of the candidates knowing that the gas mixture is cooled or that the ammonia is liquefied. Many incorrect responses were seen including filtration, heating and distillation.

(e) The majority of the candidates correctly gave nitric acid but a variety of other responses including nitrogen, hydrochloric acid and sulfuric acid were seen.

Question 4

There were many excellent answers to this question, which showed that some of the candidates have a deep understanding of the structure and bonding in graphite. The question did, however, discriminate very well between the candidates, since there was an even spread of marks from five to zero. Most candidates realised that the graphite structure is layered and that the layers can slide over each other. More candidates than in previous years knew that each carbon is bonded to three other carbon atoms and that each atom has one delocalised electron. Many of the candidates realised the significance of the giant covalent structure to the high melting point of graphite.

The question also showed that some candidates have misconceptions regarding the structure and bonding in graphite. A significant number of candidates thought that graphite is a metal or that graphite is made of ions. Some gave confused answers in which they described the structure of diamond rather than graphite. Some explained that it is slippery because it has weak covalent bonds or because it is malleable.

Question 5

(a) (i) The majority of the candidates gained the mark for the idea that hydrogen ions have a positive charge.

(a) (ii) This part was not well understood**.** The question was testing the syllabus statement which says - if there is a mixture of ions, the products formed depend on the reactivity of the elements involved. A simple answer such as, 'potassium is more reactive than hydrogen', was all that was required to gain this mark. Some candidates were sidetracked by the idea that potassium is a solid and hydrogen is a gas.

(b) The majority of the candidates balanced the equation correctly, but a significant number still find this skill very difficult. The ratios 5:2 and 3:2 were the most common incorrect responses. Some candidates showed working below the answer and, in general, this helped them to get the mark.

(c) (i) The simple idea that the reaction is reversible was all that was required. Most candidates gave the correct answer, but a large number thought that it was to do with the reaction being exothermic.

(c) (ii) The vast majority of the candidates gained one mark, but few gained two. The first mark was for ideas such as, 'when lithium nitride was present there would not be an explosion' or 'hydrogen stored under pressure could leak'. The second mark was for explaining that the hydrogen is bonded to the lithium nitride, in other words explaining why it is safer. Answers such as 'lithium nitride is a safer fuel' or 'lithium nitride would absorb the hydrogen escaping from the tank' showed that a number of candidates did not read the information given with sufficient care or did not understand the passage.

(d) (i) The simple answer 'smaller' was all that was required and the vast majority of the candidates gained the mark.

(d) (ii) Many candidates simply repeated that the particles are small and did not make the link with larger surface area.

(e) (i) Many candidates gave answers that related to oxygen in this part and consequently did not gain the mark. Some of them thought that oxidation involves electron gain or thought that the lithium atom would gain an electron when it becomes a lithium ion. A significant number of candidates made no attempt at this question.

(e) (ii) This was a difficult question aimed at the A*/A students since it involved the application of their knowledge of ionic bonding to an unfamiliar compound. It is pleasing to report that over two thirds of the candidates gave the correct answer. The loss of three electrons was a common incorrect response.

Question 6

(a) This part was designed to discriminate between the A* and A candidates. The performance of the candidates was slightly better this year than for the equivalent calculation last summer. About one quarter of the candidates were able to complete the calculations and gain all four marks. These candidates usually set out their calculation neatly and in a logical way. A number of candidates lost marks due to untidy working and careless processing of numbers. Candidates should be encouraged to check their calculations using a calculator. A number of candidates worked out the number of moles of each element correctly, worked out the ratio correctly but then did not write the formula of the compound so that they only gained three of the four marks.

A fairly large number of candidates could not convert the number of moles of each element into a correct ratio. This was sometimes caused by difficulty in deciding which number, 0.05, 0.15 or 0.025, or was the smallest number of moles.

As in previous years some candidates incorrectly divided the relative atomic mass by the mass of the element. Error carried forward was allowed so that they could still gain two of the four marks.

About 8% of the candidates were unable to make any attempt at this question.

Mark Ranges and Award of Grades

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