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General Certificate of Secondary Education

Chemistry 4421

CHY3H Unit Chemistry 3

Report on the Examination

2009 examination – June series

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Chemistry
Higher Tier CHY3H

General

This was the fourth 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(b) and (c), question 2 [excluding (a)(iv)] and question 3(d)(i).

However, the following questions proved difficult for over 60% of this cohort of candidates: question 1(a), question 3(c)(i) and (ii), question 4(b) and (c), question 5(b) and question 6(a)(i) and (c)(ii).

Unlike the June 2008 Examination, there appeared to be more candidates who were insufficiently prepared for this examination, for whatever reason. They would have had a poor experience and perhaps would have been better suited to the Tier F Paper.

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 some candidates and were left blank.

Questions 1 and 2 were standard demand questions and were common with questions 7 and 8 on the Chemistry Foundation Tier Paper (CHY3F).

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

Question 1

(a) Only a third of the candidates understood the significance of pressure. Most simply stated that the gas was dissolved in water or bubbled/passed through water, while others just referred to temperature.

(b) (i) 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. The point at $0^{o}C$ was missed by some candidates.

(b) (ii) Almost all the candidates were able to use their graph to estimate the mass of carbon dioxide that dissolves at 10 °C. A few thought it necessary to multiply by 1000 to obtain the answer for 1000g of water.

(b) (iii) This part was well done. However, a significant number of candidates had problems reading the scale on the graph, 0.5 and 0.6 were common errors but many then gained the second mark through consequential marking.

(c) (i) Most candidates were able to interpret the graph correctly. 1.65 seemed to be the popular error.

(c) (ii) Although this was a well-answered question, it caused a number of candidates some difficulty. There was the impression that many candidates think that a line of best fit is a straight line and they seem unaware that a line of best fit could be a curve. However, most identified at least one of the points on the mark scheme. The idea of extrapolation was mentioned less frequently by the candidates.

Question 2

(a) (i) Over three quarters of the candidates knew that calcium ions give a brick-red flame test. Some candidates thought it was a crimson flame, but this is the result for lithium ions.

(a) (ii) Fewer candidates knew that a yellow flame test is given by sodium ions.

(a) (iii) The majority of the candidates knew an advantage of using an instrumental method of analysis. The most common inadequate responses related to cost, easier to do or the elimination of human error.

(a) (iv) Just less than half of the candidates were able to name an instrumental method for detecting elements, atomic absorption spectroscopy/AAS and mass spectrometry were the popular correct responses. Chromatography, infrared spectroscopy, ultraviolet spectroscopy and nuclear magnetic resonance spectroscopy are used to detect compounds. Some candidates gave chemical tests, used litmus, limewater or suggested titration.

(b) This was a very well answered question with nearly all of the candidates gaining credit. It was clear that candidates understood the issues and gave very sensible, rational and mature answers. The most popular correct response was the link with health, tooth or bone development. Some candidates think the word chemical means bad, so suggested that calcium carbonate's unharmful nature must mean it is not a chemical!

Question 3

Parts (a) and (d) were answered quite well, the other parts less so.

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

(b) Less than half of the candidates knew that bromine water was decolourised. It does not go clear and neither does it become discoloured.

(c) (i) Only the best candidates were able to complete and balance the equation. Most candidates had no idea what the products of the reaction were, and charges were frequently omitted/added even when the products' formulae were correct.

(c) (ii) The large majority of the candidates were unable to describe the effect of chlorine on bromide ions. Many candidates thought that a precipitate formed or that there was an effervescence.

(d) (i) The majority of candidates knew that these elements have the same number of outer electrons (7) or need one electron to gain a complete outer shell of electrons. Chlorine and bromine do not have a similar number of outer electrons.

(d) (ii) 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/most, closer/closest, stronger/strongest or easier/easiest. Simply saying easy/easily, close or strong/strongly is insufficient.

Candidates needed to mention outer electron or outer energy level or outer shell somewhere in their answer to receive full credit. Some candidates suggested that a bromine atom loses an electron less easily. Others wrote about bromine having more outer shells than chlorine. Some candidates thought that intermolecular, magnetic or gravitational forces hold the electrons to the nucleus, while others referred to the strength of the bond between electron and nucleus. The third marking point proved elusive for many who often concluded their answer with the words therefore bromine is less reactive rather than therefore bromine gains an electron less easily.

(e) A quite discriminating question.

(e) (i) Less than half the candidates knew that a white precipitate/solid was formed when silver nitrate solution was added to a solution containing chloride ions. Simply saying that the solution goes white or milky is insufficient.

(e) (ii) Even fewer candidates knew that a <u>pale</u> yellow (or cream) precipitate was formed with bromide ions. Candidates should be aware that a yellow precipitate is formed when silver nitrate solution is added to a solution containing iodide ions.

Question 4

This was a very discriminating question. Throughout, many candidates seemed to think that Mendeleev was aware of atomic structure and electron arrangement.

(a) Candidates were asked to give an answer in terms of properties and there were some excellent answers referring to the reactivity of the alkali metals or the lack of reactivity of the noble gases. Some candidates thought that potassium is less reactive than argon or that it should be placed in Group 7. Incorrect or contradictory physical properties would negate an otherwise good answer.

(b) About a third of the candidates correctly mentioned that elements at the top of Group 4 are non-metals while those at the bottom are metals, or suggested that Mendeleev had left one space (for germanium). Candidates frequently referred to the differences in properties without being specific, while others confused metals and non-metals, said carbon is a gas or confused the terms group and period.

(c) Only a quarter of the candidates stated that the whole group of elements could be fitted in at the end or the beginning or after Group 7. Many candidates stated that because it was a whole group of elements it could be fitted in easily without stating where. Many candidates incorrectly thought that Mendeleev predicted the existence of the noble gases and suggested he left gaps for them.

Question 5

(a) A very well answered, high scoring question, with nearly two thirds of candidates gaining full credit and most of the candidates gaining at least two of the three marks. The energy released as bonds are made was often calculated to be 928 rather than 1856.

(b) This was a challenging question that discriminated between the candidates well. 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 making and breaking bonds. Many candidates had difficulty expressing their ideas accurately and precisely without contradiction. A common error was the suggestion that energy is needed to form bonds as well as break them.

(c) (i) A majority of candidates realised the significance of the activation energy and that the spark provided the energy to initiate the reaction.

(c) (ii) A good discriminating question, the better candidates stated that platinum lowered the activation energy. Many of the candidates' responses were confused and many thought that the platinum reacted with the hydrogen exothermically to provide the (activation) energy for the reaction or that platinum itself was the source of the activation energy. Some candidates appeared to misread platinum and wrote about potassium being a highly reactive metal. Those candidates who recognised that platinum is a catalyst for the reaction invariably knew that the catalyst lowers the activation energy.

Question 6

This was a very discriminating question.

(a) (i) With less than a tenth of the candidates gaining credit this was the lowest scoring question on the paper. Large numbers of candidates wrote the formulae correctly but omitted either the positive charge on the ammonium ion, or the charges on both ions. There was also repetition of the reactants and incorrect formulae/charges.

(a) (ii) Just under half the candidates gained credit. A significant number of candidates answered the question in terms of the numbers of ions / concentration of ions. A number of candidates thought that acids and bases were ionising rather than themselves becoming ionised. Some candidates mentioned pH or reactivity.

(b) (i) A significant number of the candidates simply stated that methyl orange was used to detect weak alkalis without any reference to the acid or that phenolphthalein was for detecting strong alkalis without referring to the acid.

(b) (ii) Nearly half the candidates gained three or four 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 drip tube or titration tube. Candidates also failed to gain credit by putting the alkali in the burette, giving the wrong Indicator colour change (to green, colourless or clear being the most common) or changing the indicator (from methyl orange to phenolphthalein 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. A few candidates had only learned titration in the context of salt preparations, and so described repeating the experiment without the indicator. Some candidates used stop watches to time the experiment and others placed the conical flask over a piece of paper with a cross drawn on it. Only a description of an acid / alkali titration gained credit.

(c) (i) Stronger candidates had no problem completing this very simple equation. However, it is surprising that many candidates doing this Chemistry unit are unable to balance ionic equations and write a simple formula such as this. Once again the number of atoms on the right hand side of the equation did not equal the number of atoms on the left of the equation. Basic ideas about equations appear not to be well known or understood.

(c) (ii) Again, the stronger candidates were able to calculate the concentration in moles per cubic decimetre successfully but the others found the question challenging, with much evidence of crossing out, incorrect positioning of the decimal point and random spurious calculations.

Mark Ranges and Award of Grades

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