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General Certificate of Secondary Education

Additional Science 4463 / Chemistry 4421

CHY2H Unit Chemistry 2

Report on the Examination

2010 Examination – June series

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Additional Science / Chemistry
Higher Tier CHY2H

General

The paper discriminated very well across the range of grades from A* to D. Many excellent scripts were seen and a number of candidates gained full marks. There were also a few candidates who would have been better entered for the F tier paper.

Virtually all of the candidates were able to make a good attempt at most of the questions and there appeared to be sufficient time for candidates to complete the paper.

Question 1 ***(Standard Demand)***

(a) (i) The vast majority of the candidates were able to obtain the relevant data from the diagram and correctly complete the word equation. A few candidates gave chemical formulae instead of words which were accepted if correct.

(a) (ii) Was also quite well answered with most candidates identifying that iron is a catalyst. Some answers focused on the properties of iron such as low reactivity, good conductor of heat or simply the idea that it is a metal without explaining why iron is used in this reaction. Simple answers such as it makes the reaction go faster or it is a catalyst were all that was required. Some of the candidates gave higher level responses such as, it lowers the activation energy, and these were also accepted.

(a) (iii) We were looking for two of the following three ideas:

- the mixture is cooled
- the ammonia turns into a liquid
- the nitrogen and hydrogen remain as gases

A minority of the candidates gained both marks although there were some excellent answers which showed a very good understanding of the separation process. If a candidate did not score any of the above points we allowed one mark for either identifying that the mixture is separated in the condenser or for stating that the unreacted nitrogen and hydrogen is recycled. Common misconceptions were that the mixture is filtered or that the ammonia is heavier than the nitrogen and hydrogen. Answers to this question showed that many candidates do not understand the function of a condenser or the process of condensation.

(b) Most of the candidates were able to calculate the relative formula mass. A correct answer gained two marks but one mark could be gained if there was evidence of an intention to add the correct numbers. Errors included multiplying the atomic masses and adding 1+14+16 = 31.

(c) Most of the candidates correctly identified the correct answer, C, but some were not able to show how they arrived at their answer and consequently only gained one mark. Those candidates with correct working usually gave 39/101x100 and/or 13/101x100.

Question 2 ***(Standard Demand)***

(a) (i) Was very well answered with the vast majority of the candidates being able to pick out the idea of different properties from the text. Some candidates gave correct examples of specific properties such as a flame test and we accepted these responses.

(a) (ii) Many of the candidates gave correct answers related to the status of the scientists. A variety of other answers were accepted including ideas which overlapped with part (a)(iii) such as the idea that experiments could be repeated. We also accepted answers related to the strength of the evidence. Some candidates used the word they in their answers and did not make clear whether they were referring to Crawford and Cruikshank or the other scientists.

(a) (iii) We were looking for answers such as: other scientists obtained similar results or the experiments were repeated. A number of candidates simply stated that other scientists agreed with Crawford & Cruikshank and this was insufficient to gain credit.

(b) (i) It is pleasing to note that most of the candidates have a good grasp of the experimental design aspects of How Science Works and were able to gain the mark. The most common correct responses were that the amount of chloride or the amount of water should be kept the same. We accepted answers which used the term amount but candidates should be encouraged to use terms such as mass or volume. We also allowed the idea that the **starting** temperature should be kept the same. Vague answers which simply stated temperature were not accepted. Some confused answers were seen which suggested controlling the temperature **after** the chlorides had been added to the water and were obviously given no credit! Some candidates thought that the amount of hydrochloric acid used should be controlled confusing the addition of water to strontium and barium chlorides with the preparatory experiment of adding hydrochloric acid to strontianite and barium carbonate.

(b) (ii) Many of the candidates demonstrated a sound understanding of the terms exothermic and endothermic by giving a clear explanation of the reasoning for their choice of experiment 2. Some candidates, however, still find difficulty in linking a temperature drop with endothermic. To gain this mark they had to both identify the correct experiment **and** give a correct reason for their answer. Answers such as experiment 1 because the reaction has taken in energy so the temperature goes up showed that the candidate did not really understand the meaning of endothermic. A simple answer such as Experiment 2 because the temperature has gone down was sufficient to gain this mark. Some candidates incorrectly use the words heat and temperature interchangeably.

(b) (iii) Was well answered with many candidates clearly stating that one was exothermic and one endothermic. A simple answer such as the temperature goes up for one and down for the other was also sufficient to gain the mark. Many vague or confused answers were seen for this question.

(c) Was very well answered with many of the candidates gaining the mark for the simple answer, it is positive. There were also a number of confused answers involving positive electrodes, electrons or atoms and these were not given credit.

Question 3 ***(Standard Demand)***

(a) Almost all of the candidates gained the mark in this part. Diagrams were generally clear although a few candidates attempted to correct mistakes by crossing out their crosses!

It was often difficult for the examiner to adjudicate as to what was crossed out in these diagrams. Errors included four electrons on the first shell and two on the second and two on the first shell and six on the second.

(b) (ii) Many of the candidates did not appreciate that it is the hardness of the diamonds that makes them particularly suitable for cutting tools rather than their strength. A few candidates gave high melting point which was accepted as an alternative to hardness.

Most of the candidates were able to gain some of the marks but few gained all three. Some very good answers were seen which linked the structure and bonding in diamonds to their hardness but the question also revealed some misconceptions. A surprising number of candidates thought that the number of bonds made by each carbon atom is three despite the diagram on the previous page of the question paper. Candidates should be encouraged to make full use of the information given in the questions. The bonding in diamonds was variously described as ionic or metallic whilst others thought that the intermolecular bonds in diamond are very strong. These misconceptions limited the number of marks available to the candidate. Many vague answers were seen which linked hardness to the compactness of the structure or to it having a tight structure, and such answers did not gain credit.

(c) This part was similar to part (b)(ii) in that few candidates gained all three marks whereas many gained one or two.
The mark scheme contained four main marking points, two relating to graphite and two relating to diamond. The four main marking points are listed below:

Graphite

- Has delocalised electrons (We also accepted it has free electrons or it has electrons that can move through or around the structure. We did not accept the statement, the electrons can move, since this is true of all electrons whether or not delocalised.
- Because each carbon is joined to three other carbon atoms **or** one electron from each atom is delocalised.

Diamond

- Has no delocalised / free electrons (We did not accept, the electrons do not move, for the same reasons as above.)
- Because each carbon atom is joined to four other carbon atoms **or** because all of the electrons are used for bonding.

The candidates were able to score any three of the four marking points.
Many candidates were able to gain two marks, for identifying that graphite has delocalised electrons whereas diamond does not, but few were able to explain why in terms of the number of bonds formed by each carbon atom or the use of electrons in bonding.

A number of candidates lost a mark because they only referred to graphite in their answer and made no comment about diamond. As in part (b)(ii) the question revealed many misconceptions. Some candidates gave an excellent description of why metals conduct electricity in terms of positive ions in a sea of electrons rather than the reason for graphite's conductivity. Other incorrect responses included ideas such as, it conducts electricity because the layers can slide over each other or it conducts electricity because it is a metal.

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

(a) (i) Many of the candidates find the type of calculation encountered in part (a)(i) very difficult but despite this over two fifths of them gained three marks. In this calculation the three marks could be gained for the correct answer even if there was no working but candidates should always be encouraged to show their working.

Please note that in some calculations marks are specifically awarded for working. In such cases the candidates will be warned with a statement such as; You must show all of your working to gain full marks. An error in calculation would lose all three marks if no working is shown. It would be helpful to examiners if candidates would set out their working clearly since it is difficult to award marks to a jumble of numbers.

The question revealed that a significant number of candidates do not fully understand the use of numbers and formulae in chemical equations. These candidates calculated the mass of $2NaN_3$ to be (2x23) + (3x14) = 88.

(a) (ii) The majority of the candidates gained the mark in this part. They could do this by multiplying their answer from (a)(i) or the value given in the question by 0.86. A number of the candidates lost this mark because they divided by 0.86 rather than multiplying. The question tested the ability of the candidates to apply basic mathematical skills to solve a simple but unfamiliar chemical problem.

(b) (i) Most of the candidates were able to correctly balance the equation in this part by inserting the numbers 2 and 5 into the correct places. We also accepted multiples of the equation such as;

$$20Na + 4KNO_3 \rightarrow 10Na_2O + 2K_2O + 2N_2$$

Unfortunately, some candidates who attempted to write such an equation did not adjust the already balanced reagents and products.

It is pleasing to see evidence of working shown above or below the chemical equation but candidates must be careful to ensure that such working does not become confused with their answer.

(b) (ii) This was a difficult question even for the A* candidates. The question tested the ability of the candidates to link the statement in the specification, Metal oxides and hydroxides are bases. Soluble hydroxides are called alkalis to the unfamiliar situation given in this question. We accepted a number of answers such as they are corrosive, they are bases, they are alkalis, they are irritants and they attack living tissue, and it is pleasing to note that almost two fifths of the candidates gained the mark. Incorrect responses included those who had misread the question and who gave answers in terms of the high reactivity of sodium and potassium. A few candidates incorrectly thought that sodium oxide and potassium oxide are acidic oxides.

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

(a) This part tested the candidates understanding of the use of precipitation reactions to prepare insoluble salts.

(a) (i) Many of the candidates found difficulty in interpreting the information given in this part. A disappointingly large number gave lead chloride as a soluble lead compound even though it specifically states in the information given that silver and lead chlorides are insoluble. Others gave answers which did not contain the required ion such as giving the answer, magnesium nitrate, for a soluble lead compound. Some candidates simply copied statements from the table such as, all nitrates, rather than naming a compound. Many candidates found difficulty in understanding the naming of inorganic salts and gave answers such as iodine chloride or simply one word answers such as iodine.

(a) (ii) The information given at the start of the question gives clues to the answer to this part. They are told that lead iodide is formed as a precipitate and in the equation lead iodide is shown as PbI_2**(s)**. We accepted filtration, decanting and centrifugation as possible answers. A large number of candidates gave incorrect answers such as electrolysis, evaporation and even using a magnet.

(b) Some excellent answers were seen in this part which displayed a good understanding of the process of ion formation. Unfortunately there were also many confused and jumbled answers. A number of candidates did not read the question carefully and described what would happen if magnesium iodide decomposed to form lead and iodine. Such answers would describe magnesium ions gaining electrons and iodide ions losing electrons. Many candidates use iodine/iodide and magnesium/magnesium ion interchangeably creating answers which were difficult to mark. Some candidates described the sharing of electrons between the magnesium and iodine atoms and did not understand the idea of electron transfer.

(c) Few of the candidates were able to gain both marks here but a fair number gained one. Where candidates gained one mark it was usually for linking the high melting point to the strong bonds between the ions. To gain the second mark candidates could either identify that it is a giant structure or that the strong bonding is as a result of the attractions between the oppositely charged ions. Some vague answers were seen which referred to tight or close bonding and such answers did not gain credit. Some confused answers talked about ideas such as intermolecular forces, covalent bonding or molecules and were limited to a maximum of one mark if there were other creditworthy ideas.

Question 6 *(High Demand)*

(a) The effect of pressure on equilibrium yield is not well understood at GCSE level so it is not surprising that few candidates gained the mark in this part. We accepted answers such as, there are the same number of (*gaseous*) particles on both sides of the equation. Other candidates stated that there are, the same number of atoms on both sides of the equation, which, although a true statement, does not answer the question. Some candidates simply stated that the reaction is reversible and did not gain any credit.

More of the candidates were able to link the fact that the forward reaction is exothermic to the fact that the best equilibrium yield is obtained at low temperatures

(b) A few candidates confused exothermic and endothermic, while other incorrect answers attempted an explanation based on le Chatelier’s principle, but only restated the information given in the question.

(c) Discriminated very well between the candidates. A good number of candidates gained all three marks with significant numbers gaining two or one. Very few candidates scored no marks. There were four marking points:

- Particles gain energy
- Particles move faster
- Particles collide more often
- More of the collisions are successful **or** more of the particles have the activation energy

Any three of the four points were required to gain the full three marks. Some candidates did not base their answers on particle theory as instructed in the stem of the question whilst others thought that energy is created or gave inaccurate statements about the activation energy.

(d) Few of the candidates gained both marks but most gained one. It was hoped that candidates would give one advantage for the manufacturer and one for the environment. In the end we accepted any two ideas from a list. A simple answer such as, the manufacturer would need to use less fuel so that less carbon dioxide is produced, would be enough for two marks. We did not accept the vague statement it is cheaper, but we did accept, lower fuel costs. Similarly, the statement, more pollution, was not enough to gain credit but if they went on to say more pollution produced by burning fossil fuels they were awarded the mark.

Mark Ranges and Award of Grades

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