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Additional Science 4463 / Chemistry 4421

CHY2H Unit Chemistry 2

Report on the Examination

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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 some candidates who would have been better entered for the Foundation Tier paper.

Candidates should be reminded of the importance of bringing a calculator for the numerical questions that form a part of Chemistry examinations. Sadly for such candidates the comment, I do not have a calculator, does not gain any marks!

Question 1 *(Standard Demand)*

The majority of the candidates gained both marks for this calculation in part (a). A number of candidates ignored the formula and simply added 19 + 119 and reached the answer 138. This was awarded one mark since they had shown some understanding of the method of calculation. Some candidates had little understanding of chemical formulae. Answers such as, (19^2 + 119), $(19 + 119)^2$ and (119^2 + 19), were all seen.

Part (b) was less well answered than part (a) and the number of correct responses seemed slightly lower than for similar questions on previous examinations. A number of candidates struggled with long calculations due to lack of a calculator while others did not understand how to calculate a percentage. Candidates were allowed to use an incorrect answer from part (a) in calculating part (b) and could gain both marks if it was calculated correctly. Common errors were (19/157 x 100) or (19/138 x 100). Either of these calculations correctly evaluated was awarded one mark since the candidate understood the principle of the method.

Candidates should be encouraged to look carefully at an answer, once they have completed a calculation, to ensure that it is sensible. A number of candidates gave answers which were greater than 1.2 g in part (c). Candidates could gain this mark using an incorrect answer from part (b) provided that it was correctly calculated.

Part (d) was answered correctly by most of the candidates. One mark was for identifying that the formation of the ion was something to do with electrons and the second mark was for the idea that an electron is gained. A number of candidates lost the second mark because they thought that an electron is shared or lost. A few candidates thought that the ion is formed by losing a proton.

Question 2 *(Standard Demand)*

For part (a) most of the candidates were able to make the link between the low boiling point of propanone and the fact that it would evaporate faster. A simple statement such as, it has a low boiling point, was all that was required.

Part (b)(i) was correctly calculated by the vast majority of the candidates. A few candidates gave the answer 29 rather than 0.29 g.

Part (b)(ii) was less well answered. Many candidates simply restated information given in the question that the mass lost and gained was not the same. Some were distracted by the lamp suggesting ideas such as more electricity going to one electrode than the other. Timing errors or differences in the size or mass of the electrodes were not accepted. Similarly we did not accept answers such as, there was not enough power, it was not a fair test or the experiment was only done once.

A wide range of answers was accepted such as:

- Weighing errors
- Electrodes not being completely dry
- Impurities in the electrodes
- Mass lost in the washing process
- Bits of copper falling off the electrodes

There were some excellent answers to part (c) but in general answers were disappointing given that this is one of only two electrolyses that are specifically given in the specification. The mark scheme was broad and allowed candidates to gain marks in a number of different ways. For example a simple answer such as, the impure copper is the positive electrode and a piece of pure copper is the negative electrode. The electrodes are dipped in copper sulfate solution. Pure copper collects on the negative electrode, was sufficient to gain four marks.

Alternatively some of the more able candidates gave more sophisticated answers such as, Copper atoms at the positive electrode lose electrons to form positive ions. The positive copper ions attract to the negative electrode where they gain electrons to form copper atoms. This would also gain four marks.

A number of misconceptions were seen. For example, some candidates thought that the impure copper would be melted and then two electrodes would be dipped into the molten mixture. Other candidates thought that pure copper atoms would be positive and impure copper atoms would be negative. Some candidates talked about positive and negative electrons where they perhaps meant electrodes.

Some candidates were obviously confused about the meaning of the terms anode and cathode. These are not required in the specification and candidates might find it simpler to refer to positive and negative electrodes.

Question 3 *(Standard Demand)*

About two thirds of the candidates realised that you would need sulfuric acid to make a sulphate for part (a)(i). A range of other answers were seen such as; sulfur, sulfate, hydrochloric etc.

The equation in part (a)(ii) was very poorly answered. State symbols were often not known and in the end we ignored these when we marked the question. Few knew the formula of sulphuric acid and many did not realise that water is a product of this reaction.

Part (b) was well answered with most candidates gaining both marks. The mark scheme allowed them to gain marks in a number of different ways. For example, two mark answers included, the particles move faster and collide more often and the particles have more energy so that more of them have the activation energy.

As in previous years we did **not** allow particles move more as an alternative to particles move faster.

Question 4 *(High Demand)*

This question was well answered with the majority of candidates gaining two, three or four marks.

The mark scheme accepted a wide range of responses so that marks could be gained in a number of different ways. Some candidates thought that the bonding was either ionic or metallic. Reference to ionic or metallic bonding limited their mark to a maximum of three for this question. Some candidates also referred to intermolecular bonding and obviously did not understand this type of structure. Imprecise use of language sometimes lost marks. For example, it has giant covalent **bonds** instead of giant covalent structure.

A simple answer such as, Silica is used to make bricks for furnaces because it has a high melting point. This is because it is a giant structure in which the atoms are joined by strong covalent bonds, would gain all four marks.

A number of candidates gained credit for interesting answers such as, the structure has no free electrons so will be a good insulator and it will be good for keeping the heat in the furnace.

Question 5 *(High Demand)*

Part (a) was a challenging question aimed at A to A* students. The question sought to give the students a question in which the determination of an empirical formula was relevant to a research problem. It is pleasing to note, however, that a fair number of candidates gave perfect answers to this difficult question. The mark scheme was also eased slightly, compared to previous years, to allow more credit to be given to those who completed part of the calculation.

A common error was to divide the A_r by the percentage mass in the first step of the calculation.

In part (b)(i) we looked for the idea that sodium hydroxide was formed or that sodium hydroxide is an alkali. A number of students did not understand the pH scale and thought that an acid must be formed.

In part (b)(ii) students were expected to note from the equation that laurionite is a solid so that it can be separated from the solution by filtration. It was hoped that students would be familiar with using filtration to separate a solid from a solution from their study of salt preparations in section 12.6 of the specification. A number of the students had the misconception that evaporation would be a suitable method of separation.

Question 6 *(High Demand)*

In part (a) the majority of the candidates understood that nanosized particles are very small so that they would pass through pores in the skin, arteries etc. more easily than normal sized particles. Where a mark was lost it was usually for failing to make any comparison with normal sized particles.

Part (b) was usually well answered and a range of answers was accepted. The simplest and most common answer was simply to use information from the passage that they may be toxic to some types of cells. Answers such as, they should be tested to see if they do pass into the body or nanoparticles may have different properties compared to normal sized particles were also acceptable. Vague statements such as, they may be harmful were not accepted.

A wide range of answers was accepted for part (c). The majority of candidates were able to gain a least one of the two marks. A few candidates did not read the question carefully and missed the word not, consequently they did not answer the correct question. A common answer which gained two marks was, testing will be expensive and time consuming.

Question 7 *(High Demand)*

Most of the candidates completed the diagram correctly in part (a).

Some vague answers were seen in part (b) such as, the atoms are close together, and these did not gain credit. However, most of the candidates were able to gain credit for the idea that electrons are delocalised and free to move around the structure.

Question 8 *(High Demand)*

This question was, in general, answered quite well but it did reveal some confusion about atom economy, percentage yield, equilibrium yield and rate of reaction.

Candidates lost marks in a number of ways in part (a). Some simply added the masses of all the products instead of picking out that of the useful product epoxyethane and calculated, 173/173 x 100 = 100%. Others added the masses of all the reactants and products instead of just the reactants and calculated, 44/346 x 100 = 12.7%. A large number of candidates gained both marks by gaining the correct answer, 25.4%. Candidates who did not reach the correct answer could gain one mark for either identifying the M_r of the useful product **or** correctly calculating the total M_r of all the reactants added together.

Many candidates gained one mark in part (b) but fewer were able to gain both. A wide range of answers was accepted including, less waste, less raw materials, ideas related to sustainable use of resources, environmental aspects of less waste etc. We did not accept answers related to cost or energy since it is not possible to make judgements about these simply from the chemical equations.

In part (c) many candidates realised that there would be an increase in the yield but few could explain the reason for this increase. We did not accept answers related to reaction rate since this question was asking about the effect of an increase in pressure on the **equilibrium** yield. An answer such as, the yield will increase because there are fewer product molecules than reactant molecules, was sufficient for both marks. A few candidates gave detailed answers in terms of Le Chatelier's Principle which were, of course, accepted.

The majority of the candidates for part (d) realised that the competing reaction would reduce the yield of epoxyethane.

Mark Ranges and Award of Grades

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