Examiners' Report/ Principal Examiner Feedback

January 2014

Pearson Edexcel International GCSE
in Chemistry (4CH0) Paper 1C
Science Double Award (4SC0) Paper 1C

Edexcel Level 1/Level 2 Certificates
Chemistry (KCH0) Paper 1C
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4CH0 & KCH0 (1C) Principal Examiners' Report – January 2014

Question 1

This was a straightforward question about separation and subsequent crystallisation. The vast majority of candidates scored full, or nearly full, marks. The most common error was to state evaporate instead of filter in the last answer.

Question 2

Parts (a) and (b) were correctly answered by most candidates. In (c)(i), the thermometer was usually identified, but some candidates failed to recognise in part (ii) that the boiling point of water was lower than the melting point of the solid. There was some confusion between melting points and boiling points. Part (iii) was mainly well answered, but some candidates referred to the need to have a **constant** temperature, which of course is not possible when the liquid is being heated. However, stirring will help to produce a liquid that has the **same** temperature throughout. Another error was to refer to the necessity to help the solid dissolve.

Question 3

In part (a), nitrogen and oxygen were regularly identified from the table as the two main gases present in air, but surprisingly few were able to name argon as the gas that makes up most of the rest of air.

Only primary industrial or commercial uses of nitrogen were accepted in (b), so answers which stated only that it was used to make nitric acid or fertilisers did not score.

In (c), most chose sulfur dioxide as the gas in polluted air that causes acid rain. Although carbon dioxide does lower the pH of rain water, it does not lower the pH sufficiently for the rain to be classified as 'acid rain'. Common incorrect answers were sulfur and carbon monoxide.

Those candidates who kept to a simple word equation in (d)(i) invariably scored both marks. Iron(II) oxide was a common mistake for rust, and some merely wrote rust as the product rather than (hydrated) iron(III) oxide. Some chose to write a chemical equation. This was not penalised but those who chose this route invariably made a mistake in either a formula, commonly Fe_2 for iron, or in balancing.

The calculation in (d)(ii) was well done by most. The final answer should have been given as 21, since this degree of precision is in agreement with that of the data supplied. However, answers given correctly to more than two significant figures were not penalised. Those candidates who did not subtract 63 from 80 to obtain the volume of oxygen, and therefore obtained an answer of 78.75, should have realised that this is considerably larger than the percentage of oxygen in air, which after all was quoted in the table at the beginning of the question. Candidates would do well to apply common sense in situations such as these.

Question 4

It was very disappointing to see that very few candidates appreciated the role of ethanol as a solvent in the extraction of the orange colouring from the rose petals. Some who realised that it was acting as a solvent then discussed its use to dissolve the petals rather than the orange colouring. There were many references to ethanol having a lower boiling point, a greater reactivity or a higher concentration than water. Some thought it was used to sterilise the petals. In (a) part (ii) the most common correct answer was water bath, or a suitable description of a water bath. Far too many candidates appeared not to appreciate that ethanol cannot be heated safely using a Bunsen flame. Filtration was the most common correct answer given in (a)(iii), with chromatography being the most common incorrect answer.

The diagram of the chromatogram was well done by many, but others failed to recognise that there would be two separate dots, with at least one of them being above the original spot of the orange colouring, and both of them being below the final solvent front.

Question 5

In part (a), very few candidates were able to recognise A as a tap funnel, although a number stated that it was a burette, which was allowed. Fewer still were able to identify B as a conical flask and even fewer that C was a gas jar. A number of candidates chose the allowed alternative answer for C of measuring cylinder. Candidates should realise, however, that a diagram of a piece of apparatus showing no graduation marks cannot be that of a measuring instrument.

Most candidates were able to identify in (b) that the limewater will go milky, but very few were then able to go on to state that the solid will disappear as a result of the second reaction when an excess of carbon dioxide is added. It was hoped that candidates would use the state symbols to make suitable deductions regarding the observations. Candidates should also be aware that an observation of bubbles in unlikely to score when the question refers to the gas being ‘bubbled through’ limewater.

The higher density of carbon dioxide relative to that of air was often recognised as the other property that makes the gas suitable for use in fire extinguishers. Some, however, stated that carbon dioxide was heavier than air, which was not accepted.

Most recognised that a solution of pH 5.6 is best described as weakly acidic.

Question 6

Part (a) was well answered with the only mark lost commonly being a boiling point outside of the acceptable range.

Most recognised the relationship between boiling point and relative formula mass, although some were thrown by the negative values at the beginning of the table. Some negated an otherwise correct answer by stating that the two variables are directly proportional to one another, when the numbers clearly show that this is not the case.

In (d), a correct displayed formula of butane was commonly seen, but some then went on to show a second molecule of butane with a bent backbone rather than the formula of methylpropane. Candidates should also be aware that when a displayed formula is asked for **all** of the atoms and bonds need to be shown to score.

Not as many candidates as expected were able to apply their knowledge of the reaction between methane and bromine in order to suggest an equation for the substitution reaction of ethane with bromine. Some chose to show a double substitution, which is perfectly acceptable, but then gave hydrogen, not hydrogen bromide, as the other product. Quite a number thought this reaction was an addition and, although around half of the candidates stated that ultraviolet radiation was required, many stated that the mixture needed to be heated, which was not accepted.

Question 7

The explanation of the term exothermic in part (a) was well known, but some lost the mark for not qualifying the energy that is given out as either thermal or heat.

Almost all candidates scored both marks for the diagrams of the oxygen atom and the oxide ion in parts (b) and (c). However, in (d) the explanation for the high melting point of magnesium oxide was rather poorly answered. Despite the help offered in part (c), a significant number of candidates thought that magnesium oxide was covalently bonded. Others ruined an otherwise good answer by referring to intermolecular forces. Those who described ionic bonding often only scored two of the available four marks by failing to mention that oppositely-charged ions were present in a giant structure. A full explanation of the high melting point of an ionic compound must contain a reference to the very large number of ions present. The amount of energy required to overcome the force of attraction between a single pair of oppositely-charged ions is very small. However, the energy requirement is high when there is a very large number of these forces to overcome.

In (e), the name of the salt produced was well known and there were very few instances where the writing of the formula had to be penalised owing to inappropriate use of lower and upper case letters or numbers in the wrong place.

Question 8

Part (a) was well answered with most candidates being aware that the number of outer shell electrons in an atom is responsible for the chemical properties of an element. Melting point was usually identified in (b) as being the property in the table that displayed a clear trend, although some chose density even though there was no clear trend for the three elements given.

The test for hydrogen has been asked many times and the vast majority are now scoring this mark, although some still refer to glowing spills instead of lit ones, and some simply refer to 'the squeaky pop test'. It would be nice to see more candidates appreciating that hydrogen has to be mixed with air before it will 'pop' on ignition. In (c)(ii), the most common mistake was to refer to water as aqueous rather than liquid. Candidates should also be aware that words will not score when symbols are asked for. Most recognised that the final solution would turn red litmus blue although some confused litmus with pH paper and wrote purple, and there were some candidates who thought the litmus paper would be bleached. Of those who scored the first mark, most went on to give a correct explanation.

In part (d), the examiners expected candidates to confine their answers to similarities and differences that could be observed but, since this was not specifically asked for in the question, answers such as 'both form an alkali' or 'both form a hydroxide' were accepted. Most scored both marks for the similarities and at least one mark for the differences. Common mistakes were to state that different gases were produced or that both gave a flame but the colour was lilac with potassium and red with lithium. Presumably there was some confusion here with flame tests.

In (e)(i), it was disappointing to see that many candidates were unable to copy correctly the given formula of lithium oxide; LiO_2 was very common. Other mistakes in formulae were Li_2 for lithium and O for oxygen. Of those who managed to get all formulae correct about half were then able to balance correctly the equation. By contrast the balancing of the equation in part (ii) was generally well done.

Question 9

The plotting of the points was mostly done accurately although some incorrectly drew their 'curve' in a dot-to-dot fashion. The readings taken from the graph were generally accurate and most candidates were able to deduce the relationship between temperature and time, although some did not answer the question by referring to the rate of the reaction instead of time. It should be noted that the relationship between temperature and time is not one of inverse proportionality, although this was ignored on this occasion.

The effect of an increase in temperature on the rate of a reaction is more complicated than the effect of an increase in concentration. It is very important to recognise that, although the particles will, on average, be moving faster, the increase in collision frequency that results from this has no significant effect on the increase in the rate of reaction. To explain this accurately it is important to state that the average kinetic energy of the particles increases such that there are now more collisions that have an energy equal to or greater than the activation energy. This, in turn, results in an increase in the frequency of successful collisions. There were very few answers that included a reference to activation energy. Candidates should also be aware that the phrase 'increased chance of collision' has little meaning here.

The most common correct answers encountered in 9(c) were 'same concentration of each solution' and 'same volume of each solution'. Candidates should be aware that the word 'amount' has a specific meaning in Chemistry. It refers to the number of moles of substance. Hence, strictly speaking, it is incorrect in this instance to give 'same amount of solution' as an answer. However, this was overlooked on this occasion.

Question 10

The thermometer readings were accurately recorded by the vast majority of candidates. The most common mistake was to give 10.6 as the initial temperature. Candidates should also realise that when a temperature **change** is asked for it is good practice to include a sign, although missing signs were not penalised on this occasion. In this question each sign is positive since each change is an increase.

In part (b), many realised that a change in surface area was the key factor although some thought that smaller sized chips would have provide a smaller surface area. Of those who correctly identified a larger surface area, very few went on to explain that the thermal energy/heat would be generated faster and hence transferred to the water more quickly. However, many did realise that the reaction would be quicker and this was allowed for the second mark.

Part (c) was very poorly answered. Careful reading of the information provided was required to identify that the acid is in excess in both reactions, hence the number of moles of acid present is of no consequence. Most candidates failed to recognise that the same amount of thermal energy is generated in both reactions but a larger volume of water needs to be heated in the second experiment, hence the temperature rise would be lower.

Question 11

Part (a) was well answered although some failed to offer a reason for their answer and others stated that oxidation had taken place because the carbon had lost electrons rather than gained oxygen.

Most recognised in (b) that magnesium was more reactive than titanium, but some lost the explanation mark through careless use of language. For example, candidates should have stated that magnesium displaces titanium and not that it displaces chlorine.

In part (c), the examiners expected candidates to draw on their knowledge of the general principles involved in distillation of liquid mixtures to reach the conclusion that magnesium chloride and titanium must have different boiling points. Again, however, there was some confusion between melting points and boiling points, and some thought that magnesium chloride could be separated by distillation because it was soluble in water.

All three marks were regularly gained in part (d), although some lost marks through not reasoning scientifically, stating for example that the non-toxicity of titanium was a relevant property for its use as a propeller, or that having a high melting point was important when used in a hip replacement.

Question 12

The better candidates scored both marks for the calculation in (a)(i), although the usual error of using the atomic number of magnesium, rather than its relative atomic mass, was sometimes seen. In (a)(ii), some candidates simply multiplied their answer to (a)(i) by 2 instead of using the data supplied. Even those who managed to obtain 0.004 and 0.01 frequently failed to score in (b) since they compared these two numbers directly rather than using the 1:2 ratio in the reaction.

Question 13

The vast majority of candidates managed to score one mark in (a) with many scoring both. However, some simply gave nitrogen and hydrogen as their answers instead of the raw materials from which these gases are obtained.

Again, most strong candidates managed to score three marks in (b). Where marks were lost it was often for the omission of units or for giving a temperature and/or pressure outside of the accepted range. There was some confusion with the conditions required for the contact process, particularly with the pressure.

Most knew that HNO_3 represented nitric acid but there were a few fanciful names such as hydrogen nitrogen trioxide. The most common unacceptable answer was hydrogen nitrate.

There are a variety of methods that can be used to solve the problem set in part (d) and most of these were seen in candidates' answers. The better candidates usually scored full marks here, sometimes without showing any working. However, the examiners would recommend that candidates do show their working, preferably with some explanation of the steps being taken, so that some credit can be given for the method employed when the final answer happens to be incorrect.

Question 14

Question (a) was asked last summer and the responses seen this time were, unfortunately, no better than then. The emphasis in this question is that the reaction **IS** in dynamic equilibrium. Hence it is insufficient to state that the reaction is reversible; it is essential to state that both forwards and backwards reactions are actually taking place.

Also, it is insufficient to state that the amounts, or concentrations, of reactants and products are equal or the same. This is rarely the case in a reaction in equilibrium. The correct statement to make is that the amounts, or concentrations, of the reactants and products remain constant over a period of time. This situation is a result of the rate of the forward reaction being equal to the rate of the backward reaction, hence this statement also scores.

It was extremely pleasing to see in both (b)(i) and (b)(ii) very few mentions of le Chatelier's Principle. Candidates need to be aware that this principle has severe limitations in its use and that it offers no explanation of why the position of equilibrium sometimes shifts when a condition of a reversible reaction is changed. It was also equally pleasing to see very few incorrect statements such as 'the reaction tries to increase the temperature' or 'the reaction tries to reduce the pressure'. It is an unfortunate outcome of the reliance on le Chatelier's Principle that candidates make these false statements and hence the examiners would strongly suggest that the principle is not taught or referred to when discussing the qualitative effects of changes of conditions on the position of equilibrium.

The strong candidates who recognised that the amount of methanol would increase in each case usually gave good reasons in terms of the exothermic nature of the reaction and the decrease in number of moles of gas in forming the product. Some, however, thought wrongly that the amount of methanol would decrease with a decrease in temperature since the rate of reaction would decrease, and that the amount of methanol would increase with an increase in pressure since the rate of reaction would increase.

The chemical equation in (c)(i) was not as well answered as was expected. Despite being told that methanal and water are the only products, hydrogen was sometimes given. Again, some candidates gave the formula of oxygen as O. Of those that did manage to get all formulae correct, a significant number did not balance correctly the equation.

Most knew that a catalyst increases the rate of a chemical reaction but a number lost the second mark by being too imprecise. For example, a catalyst does take part in the reaction, if it did not it could not affect the rate, but it is not used up in the reaction. It would be nice to see candidates stating that the catalyst is chemically unchanged at the end of the reaction rather than merely stating that it does not chemically change. This is not the case for some catalysts such as vanadium(V) oxide in the contact process. It changes into vanadium(IV) oxide during the first stage of the reaction, but is then converted back into vanadium(V) oxide in the second stage.

Most good candidates recognised that a catalyst provides an alternative route of reaction and that this, alternative route, has a lower activation energy than the original reaction pathway. It is not correct to merely state that a catalyst lowers the activation energy of the reaction, but this was overlooked.

The answers to the equation in (d) suffered the same fate as those in part (c)(i). An added complication for many was that they could not work out that the products of complete composition of methanol would be carbon dioxide and water.

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