Examiners' Report

GCE O Level Chemistry (7081)

June 2006

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CHEMISTRY 7081, CHIEF EXAMINER'S REPORT

Paper 1

Question 1
This was well done but it should be noted that 'hydrogen sulphate' was not (an never will be) an acceptable alternative to sulphuric acid in (d).

Question 2
Most candidates scored highly on this question but some thought that iodine is a liquid and that carbon sublimes under normal heating.

Question 3
This was well done although some confused atomic number with mass number.

Question 4
Few candidates knew the colours associated with the chemicals in this question. It should be emphasised that copper(II) carbonate is **green** (not blue-green, etc.) and that it is necessary to differentiate the shades of blue for copper(II) hydroxide and the complex ion formed when excess aqueous ammonia is added.

Question 5
The first parts were often answered correctly but the answer to (e) was frequently given in coulombs and part (f) proved difficult for many.

Question 6
Parts (a) and (b) were well done. In (c)(i), common incorrect responses included that there would be a brown gas evolved and/or that the solution would turn red-brown; the dilute solution obtained would be yellow or orange (yellow-brown). In (c)(ii), a lack of clarity spoilt many answers. 'Chloride' and 'bromide' and 'Cl' and 'Br' were used as (incorrect) alternatives to 'chlorine' and 'bromine' in the explanations. Few candidates stated that chlorine oxidises bromide ions or that chlorine is more reactive than bromine. The equation in (c)(iii) was sometimes unbalanced.

Question 7
Parts (a) and (b) were well done but some spurned the simple answer in (b) of heating the potassium nitrate. Part (c) caused more problems – few stated that a named strong alkali should be added and the test was vague in that those who suggested mixing the ammonia with 'HCl' did not specify the origin of the HCl (e.g. from the stopper of a bottle of **concentrated** hydrochloric acid). A simpler test is to observe red litmus turning blue.

Question 8
The answers were variable – many confused 'hydrolysis' with 'hydrogenation'.

Question 9
The structure of propene was well known but its polymer less so. Candidates were asked to draw the repeating unit but some drew a chain (they were not penalised on this occasion). Part (d) was quite well done but some structural formulae for the dibromopropane had the bromine atoms incorrectly positioned.

Question 10

In part (a), the answer ‘iron + slag’ was not accepted and in (b) it was necessary to include ‘aqueous’ or ‘solution’. Few recognised the process in (c) as cracking but (d) was answered satisfactorily.

Question 11

Very few candidates scored high marks on this question and many scored zero. One simple test that could be applied to both substances was required: the expected answers were ‘add water’ in (a), and ‘add aqueous silver nitrate’ in (b). A number of candidates suggested distinguishing between the acids by adding various metals; although some metals are appropriate, others are not.

Question 12

This calculation proved to be difficult for many candidates because often they did not realise that the number of moles calculated in (a) is the same as the answer to (b)! There were many instances of candidates guessing the answer to (d) as ‘calcium’ but they were not rewarded if they did not have a legitimate calculation leading to ‘100’ in (c). Those who guessed ‘calcium’ could still gain marks for a correct flame test in (e).

Question 13

This was a relatively easy question and the marks were high.

Question 14

This calculation caused problems for many candidates because they tended to use the wrong figures when attempting to find the number of moles of anhydrous salt and water; some simply divided the mass of water by 18 and totally ignored the mass of anhydrous zinc sulphate (or used the mass of the hydrated form).

Question 15

This question caused few problems, the main errors being not including ‘only’ in (b) and a confusion between empirical formula and molecular formula in (c).

Question 16

Many candidates scored high marks on this question; others lost marks through lack of clarity in their answers rather than through a lack of understanding.

(a) The anhydrous calcium chloride is to remove moisture from the air, the water is boiled to expel air and the oil is used to prevent air redissolving in the water. These are simple ideas that need little further explanation.

(b) Parts (i) and (iii) were well answered but in (ii), few candidates realised that there would be salt in the air near the coast and that would enhance the rusting process.

(c) Answers lacked precision and some ignored the instruction to give a reason ‘in terms of level of protection and cost’. It was expected that candidates would read the data regarding protection and cost from the diagram and use the words given but many decided to use their own descriptions such as ‘easily affordable’ and ‘worth the money’ which were quite meaningless in this situation.

Paper 2

General comments

The paper appeared to have been generally well received. The majority of candidates found it difficult to score high marks on Section A, but many good answers in Section B resulted in some excellent overall marks. In Section B Questions 6, 7 and 8 were attempted by similar numbers of candidates, while Question 9 proved the least popular choice.

As has become typical of this examination, calculations were very well done. There was some improvement both in balancing equations and in the quality of diagrams compared to the last series of examinations.

Section A

Question 1

A surprisingly small proportion of candidates appeared aware of the possibility of creating an explosive mixture of hydrogen and air at the start of this experiment, and hence the need to flush the glass tube with hydrogen before igniting the jet. Many candidates failed to state that it is a mixture of hydrogen and air which is explosive and not hydrogen alone. The majority of candidates stated that the hot metal was in danger of reoxidation prior to cooling but failed to comment on the possibility of oxygen from the air getting into the hot tube. A common mistake was to state that the metal oxide (and not the metal) would be reoxidized.

In part (b), the majority of candidates were able to state which species was oxidized and which was reduced. Calculations to find the relative atomic mass of the metal were often fully correct and obtained the maximum mark available. A common error was to omit to subtract 16 from the relative formula mass of the compound.

Question 2

All of the points were frequently plotted correctly, but many candidates failed to draw the correct line of best fit. This should not have been drawn in order to include the anomalous point. The vast majority of candidates were able to identify this point and suggest its correct value.

The majority of candidates were able to calculate the mass of hydrogen released in (b), and use this to calculate the mass of magnesium used. A common mistake was to take the relative molecular mass of hydrogen to be one which led to a factor of two error in the mass of magnesium.

In (c), explanations about the effects of concentration on the rate of reaction were generally less precise than required and frequently failed to get both of the marks available. The two important points were an increase in the number of reacting particles, and therefore an increase in the number of collisions. A fairly common misconception was that increasing concentration increases the speed with which particles move about.

Question 3

Most candidates were able to provide the number of protons and neutrons in the given isotope. Comparisons between the two isotopes had to be given in terms of the structure of the atoms involved. Comments about atomic number and mass number did not receive credit.

About half of the candidates were able to use their knowledge of how reactivity changes passing down Group 1 and the chemistry of the Group 1 metals to obtain most of all of the marks available in (b). A worrying number of candidates suggested that rubidium carbonate decomposed on heating despite rubidium being below sodium and potassium in the group. An alarming number suggested that rubidium sulphate reacted with water in all many of bizarre ways instead of simply dissolving.

Question 4
The ions in copper(II) sulphate were known by almost all candidates although some omitted the species resulting from the ionization of water. The majority of candidates were able to give an equation for the reaction at the anode. A common mistake was to give the equation for the reaction at the cathode.
Most candidates got some way with the calculation in (b) and a sizeable proportion got it totally correct. A common error was to omit the factor of two resulting from each copper ion needing two electrons to become a copper atom. Many candidates were guilty of rounding up answers either midway through the calculation or at the end of it. Candidates must give their answers to the same level of accuracy implied by the data given to them.
A significant proportion of candidates were able to state the effect of reversing the current in (c). However, a worrying number of responses seem to be derived from no more than guesswork.

Question 5
Displayed formulae must show all of the covalent bonds including those in a functional group. Most candidates correctly stated that an esterification reaction takes place in (a)(ii). Despite similar comments being made in previous reports, many candidates are still failing to identify reagents fully i.e. concentrated, as in this case, or in solution as appropriate.
The majority of candidates correctly suggested the use of a carbonate or an indicator to differentiate between ethanoic acid and ethanol in (b). There were a significant number of other incorrect suggestions.
A high proportion of candidates was able to calculate the empirical formula of compound X in (c) and many were able to reason that, since the compound was a carboxylic acid, it must have at least two oxygen atoms hence its molecular formula.

Section B

Question 6
The production of iron in (a) was extremely well known and many candidates scored all or most of the marks available. Lost marks were generally the result of minor indiscretions such as an unbalanced equation.
In order to demonstrate the ionic nature of iron(II) sulphate in (b)(i), candidates needed to dissolve it in water (NOT to melt it) and pass an electric current using a circuit that contained both a bulb and a power source. A common misconception was that solubility in water is evidence of ionic bonding in itself. This is not the case: there are many examples of effectively insoluble ionic compounds, as well as readily soluble covalent ones. In (b)(ii), the tests for the ions Fe^{2+} and SO_4^{2-} were well known although candidates frequently failed to mention that the reagents are used in solution. In order to demonstrate the presence of water of crystallization in (b)(iii), all that was necessary was to heat the compound gently in a test tube and test the liquid which condenses at the cooler end of the tube with a suitable reagent. Many answers were overly complicated and based on incorrect chemistry. The last part of the question was generally not well done. Relatively few candidates were aware that solutions of iron(II) compounds will readily oxidize in the presence of air and that this is accompanied by a colour change from green to brown. Many answers appeared to draw on guesswork rather than a solid knowledge of the chemistry of iron compounds.

Question 7

Statements on the use of a catalyst and the effects of various conditions on the equilibrium were generally in the right direction but insufficiently accurate to score all of the marks available. Comments on the economical and environmental advantages of recycling nitrogen oxide were all too frequently too woolly and circumspect to be worth more than an odd mark at best. The former advantage needed to be tied in to the saving made by needing to oxidize less ammonia in Reaction 1, and the latter advantage needed to mention a relevant specific environmental problem.

Calculation of the volume of reacting ammonia, the mass of ammonium nitrate produced and the percentage by mass of nitrogen in the latter compound were frequently extremely well done and commanded all of the marks available.

A significant proportion of candidates was able to provide the equations for the thermal decomposition of potassium nitrate (although sometimes unbalanced) and the oxidation of carbon and sulphur. Relatively few were able to relate the explosive nature of the mixture when heated to the large amount of heat energy released and the large volume of gas produced.

Question 8

Most candidates were able to give a full account of the fermentation of sugar to form ethanol. The commonest omission was to mention that the reactions take place in solution. Knowledge of the industrial hydration of ethene was generally less complete. The modern method involves reaction with steam in the presence of a catalyst at high temperature and pressure. Hydration via an intermediate compound formed with sulphuric acid is no longer of industrial importance and responses relating to this method did not score all of the marks available.

Calculation of the enthalpy change using the dissociation energies given was generally excellent with many candidates scoring most or all of the marks available.

The reactions of ethanol with the three reagents given in (c) were reasonably well known. A significant number of candidates did not obtain all of the marks available because they gave all of the products of each reaction and did not indicate which of them was the organic product. Common misconceptions were that the reaction with sodium forms sodium ethanoate, and that reaction with concentrated sulphuric acid forms ethanoic acid.

Question 9

This was the least popular question in Section B but most of the candidates who attempted it obtained reasonable marks.

Accounts of the experiments were generally good and often supported by diagrams. Comments on what measurements should be taken were often incomplete or too vague and candidates lost marks accordingly. There were a high proportion of good calculations with candidates obtaining all of the marks available for calculating the percentage of calcium carbonate in the sample.

The effect of bubbling carbon dioxide into limewater was well known by most candidates but relatively few could explain all of the chemistry involved and support their answer with appropriate equations.

CHEMISTRY 7081, GRADE BOUNDARIES

Grade	A	B	C	D	E
Lowest mark for award of grade	75	63	52	47	34

Note: Grade boundaries may vary from year to year and from subject to subject, depending on the demands of the question paper.

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