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FOREWORD

This booklet contains reports written by Examiners on the work of candidates in certain papers. **Its contents are primarily for the information of the subject teachers concerned**.

CHEMISTRY

Paper 0620/01
Multiple Choice

Question Number	*Key*	*Question Number*	*Key*
1	**B**	21	**D**
2	**D**	22	**D**
3	**C**	23	**B**
4	**D**	24	**D**
5	**C**	25	**A**
6	**A**	26	**D**
7	**A**	27	**D**
8	**C**	28	**D**
9	**D**	29	**B**
10	**A**	30	**B**
11	**B**	31	**C**
12	**C**	32	**C**
13	**D**	33	**B**
14	**B**	34	**C**
15	**D**	35	**B**
16	**B**	36	**C**
17	**C**	37	**A**
18	**A**	38	**B**
19	**D**	39	**B**
20	**B**	40	**A**

General comments

Candidates achieved a mean mark of 26.6, with a standard deviation of 6.7. These statistics are satisfactory as also was the reliability coefficient. No question was unduly easy. Candidates found some were marginally harder than expected and a few were much harder. These latter especially are commented on below.

Comments on specific questions

Question 8

This had a very high discrimination. The lower-scoring candidates tended to favour response **B** which suggests that they were merely counting atoms rather than electrons.

Question 12

Very slightly hard but again good discrimination. Response **B** was the most popular wrong choice: this avoided the 'chemical' distractors but hints at a lack of certainty about heat changes during changes of state.

Question 14

An easy question but response **C** was somewhat popular.

Question 15

About a third of the lower-scoring candidates chose **B** (more than those answering correctly) – but both **B** and **C** involve reduction of a metallic oxide by using carbon.

Question 18

Decidedly and unexpectedly hard. Some 80% of the lower-scoring candidates chose **B** as did about a third of the higher-scoring candidates. This might be explained by a lack of care in reading the question, i.e. an unthinking disregard of the word 'salt'.

Question 19

Also disappointingly hard. The insolubility of zinc hydroxide is in the syllabus – from the use of sodium hydroxide in testing for aqueous zinc ions. Possibly another example of lack of reading care in that the very popular response **C** might have been mistakenly taken to show an insoluble solid going to a solution of a salt.

Question 24

The similar popularity of responses **A**, **B** and **C** hints at guessing by the lower-scoring candidates.

Question 26

The relative popularity of response **B** seems to show that it is extremely difficult to persuade a significant number of candidates that copper does not react with dilute acid.

Question 31

About two thirds of the lower-scoring candidates seemed to have guessed between responses **A**, **B** and **D**.

Question 32 and Question 35

About half of all candidates chose **D** in **Question 32**. This is rather surprising. The "oxy" hints at oxygen and the "ene" of acetylene implies an unsaturated hydrocarbon. These facts are even more explicit in **Question 35**! In this latter question, however, nearly half of the lower-scoring candidates chose **C** despite this molecule having oxygen in it.

Question 37

The statistics again suggest that lower-scoring candidates guessed.

Question 38

Nearly 40% of the lower-scoring candidates chose **A** – a lack of understanding or of careful reading?

Question 40

Only half of the higher-scoring candidates answered correctly and half of the lower-scoring candidates chose **B**. In general, candidates perhaps lack confidence about the organic sections of the syllabus.

Paper 0620/02
Paper 2 (Core)

General comments

Many of the candidates tackled the paper well and good answers were seen in some parts of the paper, e.g. **Question 1**. However, in every question, many candidates found at least two parts which they found difficult. Some quite straightforward questions, e.g. identifying which oxides are metal oxides and the uses of some elements, proved difficult for candidates. In general, the rubric was well interpreted and most candidates attempted all parts of each question. The standard of English was generally good. Although most candidates had a good knowledge of formulae many were found to have a poor knowledge of general organic and inorganic reactions. For example, many could not identify a fermentation reaction or define reduction. Many candidates had difficulty with **Question 3 (a)**, where they were required to draw a suitable apparatus for investigating a reaction which produces a gas. Inadequate knowledge of suitable chemical apparatus has also been commented on in previous Principal Examiner Reports. There were some instances where candidates disadvantaged themselves by giving multiple answers, especially in **Question 6 (e)** and **(f)** but it is encouraging to note that most candidates confined themselves to a single answer in questions requiring a box to be ticked or a specific answer to be ringed. It was encouraging to note that many candidates showed a good ability at balancing simple equations when the formulae were given. A considerable number of candidates appeared to have difficulty in explaining electrolytic processes (**Question 6**). This follows the general pattern from this paper in previous years. Tests for ions were not well known, the tests for chloride and aluminium ions proving a stumbling block for candidates. This has also been commented on in previous Principal Examiner reports. Candidates often disadvantaged themselves by careless and non-specific writing. As in previous examinations, few candidates explained environmental effects in a convincing way, e.g. in **Question 4 (b)(ii)** many candidates referred merely to ‘burning’, ‘factories’ or ‘from cars’ without reference to fossil fuels or exhaust gases. Organic chemistry proved to be a stumbling block for many candidates but it was encouraging to note, that most candidates’ answers to calculations, e.g. **Question 2 (e)(ii)**, were generally good.

Comments on specific questions

Question 1

Most candidates tackled this question well and many obtained at least two-thirds of the marks available. The uses of argon, helium and oxygen were, in general, not well known. It was encouraging to note that most candidates could draw electronic structures of atoms well.

(a)(i) The commonest error here was to choose chlorine as an element with five electrons in the outer shell rather than nitrogen. Many candidates appeared not to use their full Periodic Table at the back of the answer booklet to answer this. Neon or helium were also seen quite often as incorrect.

(ii) This was generally well answered. The commonest error here was to choose neon or helium as having diatomic molecules. Many candidates seem unclear about the structure of these gases (see also part **(v)** below). The incorrect answer, sulphur, was rarely seen, even though it is in the same group as oxygen. The commonest correct answers seen were chlorine and oxygen.

(iii) This was invariably correct.

(iv) This was invariably correct, with helium and krypton being most commonly chosen.

(v) This was the least well done in this section. Argon and krypton were often given as answers. This indicates that many candidates do not appreciate, firstly, what a giant structure is and, secondly, that noble gases exist as isolated atoms.

(vi) This was generally correct, with C, N and O being most commonly seen.

(vii) About 20% of the candidates chose oxygen as being the most common gas in the air rather than nitrogen. Few responded with other incorrect responses.

(b)(i) A use of argon was not well known. Many gave vague answers such as ‘for light’. A not uncommon error was to suggest that it is used for the lamp filament. This could not be given credit. It also suggests that many candidates do not know the state of argon or the meaning of the word filament.

(ii) Most candidates implied that helium was used in balloons but some failed to obtain the mark because they wrote ‘used in a hot air balloon’. This may reflect a failure to understand that helium is not one of the main gases in the air. A few candidates made vague references to ‘flying’ which could not be credited.

(iii) Some candidates wrote vague answers here. An answer such as ‘in hospitals’ is too vague to give credit. Many merely wrote ‘for respiration’ or ‘for breathing’. These were marked in context, but it must be stressed that these might also be considered as rather vague answers if this were not a Core Paper.

(c)(i) The electronic structure of argon was well known, the most common error being to place two electrons in the outer shell.

(ii) The idea of a full outer shell in noble gases was not appreciated by many candidates. The commonest incorrect answer was ‘because it is a noble gas’. This does not give a reason. Some candidates failed to gain the mark because they failed to explain the outer shell, e.g. ‘there are full electrons’ will not gain a mark although ‘all the shells are full’ will. Another common error was to suggest that ‘there are no electrons in the outer shell’. This does not imply that the shell below is full.

Question 2

Most candidates scored at least two-thirds of the marks available on this question. However, few knew the test for chloride ions.

(a) Most candidates realised that the formula for sodium chloride is $NaCl$. The most common errors were to put $NaCl_2$ or to think that the formula for sodium is S. Candidates should be encouraged to use the Periodic Table supplied to check formulae.

(b) Most candidates realised that evaporation (of the solvent) was required. The commonest error was to suggest that the solution should be filtered. This probably arises through not reading the question properly or not understanding the word 'solution'.

(c) Most candidates ticked the correct box, the most common error being to suggest that an aqueous solution of sodium chloride contains oxide ions (4^{th} box).

(d) The test for chloride ions was not well known. Many candidates tested with litmus or other indicators. Candidates at this level should be discouraged from including oxidation numbers unless they are absolutely sure of their ground. A few candidates wrote 'test with silver (II) chloride' – this was not given the mark.

(e)(i) Although many candidates identified calcium sulphate, many apparently cannot identify the formula for a sulphate ion and put incorrect answers such as 'limestone', 'calcium sulphur oxide' or 'calcium sulphur'.

(ii) Most candidates obtained the correct formula mass (136). The commonest error was to use atomic numbers instead of atomic masses. It might be noted that many candidates put g after the answer. This is obviously incorrect, although it was not penalised here since only one mark was available.

(iii) This was generally well done. The commonest error was to omit the 2 in front of the H_2O.

(iv) Most candidates realised that the reaction involved hydration. A minority of candidates suggested, incorrectly, that the reaction involved fermentation or combustion.

(v) This question was reasonably well done, about one-third of the candidates gaining both marks and most gaining one mark. The commonest error was to put SO_4 or HSO_4 on the left instead of H_2SO_4.

(vi) Over half the candidates realised that the reaction gave out heat continuously and so kept the mine warm. A minority of candidates merely repeated the stem of the question and gave the answer 'because it is exothermic' or stated that 'it gave out energy'. The latter answer is not accurate enough, since energy comes in many forms.

(f) Only about half the candidates obtained the correct answer here, indicating that many either did not know the percentage of oxygen in the air or did not understand how to go about answering the question. The commonest incorrect answers were to suggest that the level of oxygen was either 'the same' or, the surprisingly more commonly seen, '¼ of that of the outside air'.

Question 3

This was probably the second most difficult question on the Paper from the candidates' point of view, with very few achieving full marks for part **(a)** and only slightly more giving convincing answers to part **(b)(iii)** and **(c)**.

(a) Candidates often find it difficult to answer questions involving apparatus diagrams. A minority of candidates left this blank. Candidates should be encouraged to draw and label apparatus for relevant experiments, especially those involving measuring rate of reaction by analysis of gas volume. Some candidates suggested using measurement of mass as a method, but this would not give good results since the hydrogen peroxide is in aqueous solution and hence the change in mass would be too small to measure. Some candidates used appropriate apparatus but did not indicate that it was graduated. In this respect, many drew pictures of gas jars rather than measuring cylinders. It was clear that these were gas jars, because in many instances they were labelled as such. Many drew beakers instead of flasks (and labelled them 'flask'), although this was not penalised as long as the beaker was closed at the top. A common error was to suggest that the apparatus should be heated.

(b)(i) The definition of a catalyst was more poorly done this session compared with previous sessions. Many just gave the name of a catalyst presumably through misreading the question as 'what is the catalyst?'.

(ii) Although many candidates identified X as the catalyst producing oxygen the fastest, there were few convincing explanations as to why. Many candidates did not make a comparison. An answer such as 'it produces 55 cm^3 of gas in 30 seconds', tells us nothing of a comparative nature. Many just repeated the stem of the question by saying that 'it produces the gas at the highest speed'. In order to obtain the marks, some idea of comparative time (to produce a given volume of gas) needed to be given.

(iii) Few candidates focused on the fact that the amount of hydrogen peroxide use was the same in all three experiments and many candidates were content to put that the hydrogen peroxide had finished reacting or been all used up or that the same amount of catalyst had been used.

(iv) The properties of transition metals were not well known. Many candidates still think that all transition metals are magnetic and that the metals themselves are coloured. To gain the mark for colour, the word '(transition metal) compound' is important. A considerable number of candidates failed to read the question properly and gave properties of metals in general, e.g. electrical and thermal conductivity.

(c) Most candidates obtained the mark for the idea that the particles move faster, but the more difficult second mark for increasing collision frequency was rarely seen. Many candidates merely repeated the stem of the question and wrote that the 'reaction went faster' in trying to gain the second mark.

(d)(i) The definition of a catalyst was also more poorly done this session compared with previous sessions. Ideas of enzymes being living things still persist. Many candidates also fail to realise that the word 'natural' relates to all things in nature including rocks etc. – the word does not equate to 'biological'. Similarly, the word 'organic' has a wider meaning than the word 'protein'.

(ii) Response B was the commonest incorrect response to this question. Many candidates seem to have just looked for the formula for ethanol on the right hand side of the equation rather than looking at the nature of the reactant and co-product.

Question 4

This question proved to be a good discriminator, with few candidates obtaining full marks in parts **(a)** and **(b)**. Many candidates also found part **(d)** demanding. As has been mentioned before in Principal Examiner reports for Core Chemistry, processes such as reduction are often poorly understood by candidates.

(a) Many candidates failed to identify two basic oxides. It was common for a candidate to lump together an acidic oxide (usually sulphur dioxide) with a basic oxide. The reason for their choice was rarely given, the most common response merely being to state the implication in the stem of the question that they formed alkalis when dissolved in water. This merely redefines the word basic.

(b)(i) Although sulphur dioxide was often a correct response, many candidates suggested that sodium oxide contributes to acid rain. This response was most often given by those candidates who put this oxide as an incorrect response to part **(a)** of the question. This may suggest that such candidates equate 'highly reactive oxides' with acid rain.

(ii) As has been noted in previous Principal Examiner reports, environmental aspects of Chemistry are poorly understood by many candidates. There were many vague answers. Many candidates referred merely to 'burning', 'factories' or 'from cars' without reference to fossil fuels or exhaust gases. Many referred to fertilisers or nitrogen dioxide coming from the air when it reacts with oxygen (without the intervention of lightning).

(c)(i) Most candidates scored the mark for calcium oxide.

(ii) Few candidates realised that heat was required to decompose calcium carbonate to calcium oxide. Most wrote about catalysts or specific catalysts or the need for oxygen. Some confused heating with combustion.

(d)(i) Although many candidates had an inkling that differences in reactivity were involved, most gave very vague answers or merely referred to 'strength of sodium compared with carbon' (not even stronger reductant).

(ii) Although many candidates scored at least one mark for the equation, a significant minority put oxygen or carbon monoxide on the right.

(iii) A suitable definition of reduction was not well known. The commonest correct answer given referred to loss of oxygen from a compound. However, many candidates did not think clearly enough and put 'loss of oxygen from an element'. Far too many candidates referred to a decrease in size or mass of a compound, suggesting that they were using the word reduction in an everyday sense rather than in a chemical sense.

Question 5

As noted in previous years, organic chemistry continues to be a stumbling block for many candidates. Few candidates obtained more than half marks on this question and the test for unsaturation was not well known.

(a) Although many candidates gave the correct answer (methane), a large proportion put 'ethane'.

(b) Most candidates recognised that **A** and **B** belonged to the same homologous series, although it was not uncommon to see the combination **C** (alcohol) and **E** (carboxylic acid). Candidates should be advised to learn to distinguish between these two groups of compounds.

(c)(i) Many candidates chose the correct answer (**C**) but a considerable number focused on the O – H group of the carboxylic acid, rather than considering the – CO_2H group as a whole.

(ii) Few candidates drew the displayed formula of ethanol correctly. Many failed to put in an O – H group at all or forgot the bond between the oxygen and hydrogen.

(iii) Very few candidates knew how ethanol was made industrially from ethene. Most candidates referred to fermentation, the use of enzymes, addition of oxygen or, most commonly, the use of water (rather than steam). The use of a catalyst was seldom mentioned.

(d)(i) Most candidates could identify an unsaturated hydrocarbon.

(ii) The test for an unsaturated hydrocarbon was not well known, even though they were keyed into the word 'unsaturated' in part **(i)** of the question, where most identified an unsaturated hydrocarbon correctly. Many candidates referred to the use of litmus. Many of the candidates who recognised the bromine water test failed to gain the second mark because they thought that the bromine water did not change colour.

(e)(i) Few candidates identified compound **E** as ethanoic acid. 'Butanoic acid' and 'methanoic acid' were the most common errors followed closely by 'ethanol'.

(ii) About a quarter of the candidates found difficulty in identifying a suitable test for acidity. A common error was to state that an 'indicator paper' should be used without reference to the type of indicator paper. Candidates should also be advised not to mix up colour and pH, e.g. stating that the colour (of Universal Indicator Paper) should be between 1 and 6.

Question 6

As in previous years, candidates find the concept of electrolysis difficult. Few candidates obtained more than two-thirds of the marks on this question. The main stumbling blocks were part **(b)** and part **(f)(ii)**. Many candidates failed to gain marks for parts **(e)** and **(f)(i)** because they made quite extensive lists of reasons/properties, some of which were not correct. It must be stressed, that if candidates give several reasons where only one is required, the presence of an incorrect answer will negate the presence of a correct answer. If additional answers are considered neutral, however, no penalty is given. Many candidates did not appear to use the information in the table.

(a) Few candidates realised that aluminium oxide was used in the electrolysis. Some candidates put the answer 'bauxite' which was not marked correct since this is an ore i.e. an impure rock containing aluminium oxide. Many candidates put 'aluminium', thus showing that they did not understand the word 'compound'.

(b) This was poorly done. Many candidates wrote incorrectly about electrons or particles moving rather than ions moving.

(c)(i) Although many candidates realised that carbon/graphite electrodes were used for the electrolysis of aluminium oxide, a range of other metals were suggested, the most common incorrect answers being 'platinum' or 'copper'.

(ii) Most candidates recognised that the aluminium ions move towards the cathode during electrolysis, but the explanation in terms of charges was not always convincing, few actually stating that the aluminium ions are positively charged. Many candidates realised, however, that the ions and cathode were oppositely charged.

(d) Most candidates scored at least two of the three marks available. Various combinations of incorrect answers were seen here, the commonest being 'increased, bauxite, chemical'.

(e)(i) Many candidates suggested that aluminium was stronger than copper, despite the data in the table. Candidates who wrote less dense and cheaper or stronger were penalised because the information shown in the table shows that the last two answers are incorrect.

(ii) Most candidates obtained the mark here. Of those who did not, many failed to use the data in the table and wrote about steel rusting.

(iii) Many candidates failed to use the information from the table correctly and suggested that steel was more conductive than aluminium.

(iv) Most candidates obtained the mark for 'ceramic'. The most common incorrect answer was 'graphite'.

(f)(i) Most candidates understood that aluminium is used in aircraft bodies because it is lightweight, but some negated this mark by suggesting that aluminium was cheap, when the table shows that it clearly is not.

(ii) The test for aluminium ions was not well known, many candidates leaving this blank. A few candidates did not take sufficient care when writing their answers. Several wrote that 'a soluble precipitate is formed' when they meant 'a precipitate which dissolves in excess (sodium hydroxide)'. Candidates are also recommended to stick to suggesting one reagent. If they write 'add sodium hydroxide and ammonia', they cannot get the third mark because it would be unclear whether the precipitate would dissolve or not (unless they make the distinction between ammonia and sodium hydroxide clear).

Paper 0620/03

Paper 3 (Extended)

General comments

Candidates are being entered for this paper who have progressed little beyond the Core Syllabus. Unfortunately they are awarded very low marks and often do not attempt all the questions. If they had been entered for Paper 2, it is probable that they would have been able to attempt a higher proportion of the questions. Candidates entered for this paper should have a chance, however slight, of attaining Grade B. For the cohort under discussion this is an unrealistic target.

Candidates should be strongly advised not to offer more responses than the number required by the question. Similarly they should not offer alternative answers unless invited to by the question. No advantage will accrue by using these tactics, it is more likely they will result in a lower mark than if the instructions had been followed.

Once again it might be beneficial to ask teachers to remind future candidates of the adage – what cannot be read cannot be marked. This year there was an increase in the incidences of illegible and near illegible work.

Comments on specific questions

Question 1

(a)(i) There was some confusion between ionic and metallic structures. The required response was "lattice". Many candidates simply repeated the information in the stem of the question.

(ii) Macroscopic properties were needed – hard, brittle, soluble in water, poor conductor when a solid, good conductor when molten or in aqueous solution etc. High melting point and high boiling point were not accepted as two properties only one. Strong bonding, solid or crystal at room temperature were not credited with the mark.

(b)(i) The formula of the magnesium ion was usually correct.

(ii) A far more variable standard for the nitride ion – N^{2-}, N^{-}, N_2^{2-} were noted.

(iii) If parts **(i)** and **(ii)** were correct then this formula of magnesium nitride would also be correct and conversely if they were incorrect so would the formula.

(iv) They have different charges, this was not an acceptable reason, 2+ and 3+ are different but they would not attract. Mere repetition of the stem – they are attracted to each other did not suffice, opposite charges or electrostatic attraction were the key ideas. Some candidates explained why ions are formed, that to have a complete outer energy level instead of giving the reason for the attraction.

Question 2

(a)(i) Evaporation, vaporisation and changing from a liquid to a gas were more common than boiling.

(ii) Vague comments about time or the length of the line were offered instead of the melting point would be lower or the melting would not occur at a single temperature but over a temperature range.

(iii) A high proportion thought that the curve would level off at point F and there would be an extra plateau.

(iv) This table was generally well answered by the majority of the candidates. A particular problem with the first row was that candidates tried to hedge their bets – **C** to **D** "quite far apart" and for **E** to **F** "very far apart". The responses should have been close and far apart. Possibly some were influenced by the knowledge that **C** to **D** was the liquid phase and they made the usual mistake of believing that the liquid phase is intermediate between solid and gas. It is not, the particles are still close, the evidence for this is the similarity of the densities of the two phases. In the second row both words fast and random were required, frequently only one was given. "No" and "yes" was enough to warrant the award of both marks. This row was treated as an invitation to discuss shape and volume without necessarily giving a direct answer to the question.

(b) In the first word equation, water was far more common than hydrogen and in the second, zinc metal was usually given not zinc oxide.

(c) The majority could not write this equation. The formula for ethanoic acid was given as C_2H_5OH or CH_3CH_2COOH. The formula of sodium ethanoate presented comparable difficulties – CH_3CONa or $CH_2COOHNa$.

Question 3

(a)(i) The rate of the forward reaction decreases with time because the concentration of the reactants decreases, both marks awarded. The idea that the reactants are being used up without specifying concentration was awarded one mark. Typical errors were that all the reactants were used up, that the change in rate was due to the thermicity of the forward reaction and that the molecules are trying to attain equilibrium.

(ii) The concentration of the products or the reactants on the right hand side increases with time. The errors that featured in **(i)** were encountered in this part.

(iii) Many realised that the reaction was at equilibrium but then wrote that the forward reaction = the back reaction, no mention of rate, or that the concentrations of reactants and products were equal. Another misapprehension was that the reaction had stopped.

The possible marking points for this part were as follows:

- reaction has come to equilibrium
- *rates* equal
- no change in concentration
- amounts of reactants and of products remain the same.

(iv) The addition of hydrochloric acid moves position of equilibrium to the left. The $BiOCl$, a precipitate, reacts with the acid to form $BiCl_3$ which is a colourless solution. Explanations of this quality were given but others lacked clarity and involved inappropriate Chemistry, such as redox.

(b) This part was slightly better answered with many candidates having some appreciation of the underlying concept.

(i) Equal number of moles or volumes of reactants and products, so position of equilibrium not affected.

(ii) Provided the focus was on the number of moles of gaseous reactants compared with the number of moles of gaseous products, a model answer was easily constructed – the equilibrium moves to the right as this side has fewer moles or has the smaller volume.

Throughout this question there was a tendency to try and explain in terms of reaction rate. In part **(ii)** a typical comment was when the pressure is increased the rate of the forward reaction is faster than that of the back reaction. Initially this is true but the question is about equilibrium and when the reaction is at equilibrium, the rates are equal but the concentration of nitrogen dioxide is now higher than previously.

Question 4

(a)(i) The majority were familiar with the general characteristics of a homologous series and offered a selection from the following list.

- general (molecular) formula
- same functional group
- common methods of preparation
- physical properties show trend – bp increase with n
- same chemical properties
- consecutive members differ by CH_2.

Mistakes were:

- same molecular formula
- same structural formula
- same physical properties
- defined isomerism.

(ii) $C_8H_{17}OH$ Mass of mole = 96 +17 + 17 = 130g/mol

Many gave 96 that is simply 8 x 12.

(b) Well answered.

(c)(i) The formula of pentan-1-ol was given on the paper.

$CH_3CH_2CH_2CH_2CH_2OH$

Many gave the displayed formula of this isomer, its mirror image or the above formula with a few extraneous right angles. There were pentavalent carbon atoms such as $–CH_2(OH)–$. Candidates could be advised to ensure that the point of attachment is correct e.g. $–CH_2OH$ not $–CH_2HO$.

(ii) A pleasing proportion answered this part correctly.

carbon dioxide and water or pentanoic acid (and water)

pentene or pent-1-ene

pentanoic acid

A frequent mistake was to give propene etc. The last question relating to oxidation attracted various names – potassium pentanoate, pentyl pentanoate and various dichromates.

Question 5

(a)(i) The two lines involving the isotopes of strontium were usually correct. In the third line many forgot that the particle is an ion and gave 30 not 28 electrons.

(ii) The explanation that they have different numbers of neutrons was awarded only partial credit. The same proton or atomic number was also required. Relative atomic mass was not accepted, this is a macroscopic concept being the mean of the mass numbers of the isotopes in a naturally occurring sample of the element.

(iii) There were two difficulties. Some candidates thought that the number of electrons in an atom of strontium is 88 not 38 and the other was to write 2 + 8 not 8 + 2.

(b)(i) It is not necessary to mention froth flotation. Heating or roasting the ore in air and reducing the zinc oxide with carbon or carbon monoxide were the required points. Roasting the ore in air does not form the metal. This equation is wrong.

$ZnS + O_2 = Zn + SO_2$

(ii) Virtually everyone knew a use of zinc. The most popular were galvanising, alloys and sacrificial protection. Although zinc compounds are used in medicine, this is not a use of the metal.

(c)(i) Many suggested metal chlorides rather than hydrochloric acid.

(ii) Candidates should realise than ionic equations must balance by number of atoms of each element and by charge. There were a lot of careless mistakes.

- symbol of strontium given as St and that of chlorine as CL
- $Sr^{2+} + 2e = 2Sr$
- $2Cl^{-} + 2e = Cl_2$
- $Cl^{-} = Cl + e$.

(iii) Most knew that hydrogen was one of the products. Strontium metal instead of strontium hydroxide was a frequent error.

Similarly even though chlorine was mentioned in the stem, it was given as one of the other products of electrolysis. Carbonates, carbon dioxide and oxygen were also suggested.

(d)(i) In both parts, oxide and hydroxide were mixed up, zinc hydroxide, not oxide, was the typical error in this part. The conditions are pass *steam* over *heated* zinc. A widespread belief was that high pressure or a catalyst was needed in addition to high temperature.

(ii) The oxide was more common than the hydroxide. The equation proved to be a real challenge both in terms of formulae and balancing. Frequently hydrogen was not included in the equation. The phrase “no conditions” is not equivalent to – it reacts with cold water. Despite only one mark being allocated to this part, candidates added high pressure or a catalyst is needed.

Question 6

(a)(i) moles of $NiCO_3$ reacted = 0.08

mass of nickel carbonate reacted = 9.52 g

mass of nickel carbonate unreacted = 2.48 g

(ii) maximum number of moles of hydrated salt = 0.08

maximum mass of salt = 0.08 x 281 = 22.48 g

percentage yield 10.4/22.48 x 100 = 46.(3)%

Part **(i)** proved to be easier than **(ii)**. The first hurdle was to realise that the number of moles of carbonate was given in the question that is 0.08 moles. Some thought that the number of moles was 0.1 and wrote the following:

moles of $NiCO_3$ reacted = 12/119 = 0.1

mass of nickel carbonate reacted = 11.9 g

mass of nickel carbonate unreacted = 0.1 g

(b)(i) Common mistakes were:

- to state that the burette was filled with rubidium sulphate solution
- not to name the acid
- to describe a titration with hydrochloric acid
- to suggest that excess rubidium hydroxide was added and the excess filtered off.

(ii) A wide variety of salts were suggested to make calcium fluoride, not all of which were soluble in water. The old adage that all sodium salts and all nitrates are soluble in water would have been useful when answering this question. The salts had to be named, a soluble calcium salt and a soluble fluoride did not score. Those who knew the two reagents usually scored one or two marks. Washing and drying the precipitate was rarely seen. A variety of methods were suggested – displacement reactions, acid/base and the use of fluorine water. Only two were acceptable, that is precipitation using two soluble salts and direct synthesis.

Question 7

(a) Quite well answered with steam reforming and electrolysis being the popular choices. Errors were the fractional distillation of liquid air, metal and acid and the back reaction in the Haber process.

(b)(i) Most knew that the catalyst was iron. The usual mistakes were to give platinum and nickel or to define the term catalyst instead of giving its name.

(ii) There were many pleasing explanations of the type – the forward reaction is exothermic, a decrease in temperature favours this reaction with an increase in the yield. Other candidates discussed it from the view point of the endothermic back reaction with equal success. Candidates seem "happier" with thermicity and equilibria than any other aspect of equilibrium Chemistry.

Inevitably there were unsuccessful attempts to explain the increased yield in terms of reaction rate. There is no obvious reason why some candidates gave the explanation in terms of pressure instead of temperature but they did.

(c)(i) Those who understood the idea that bond forming is exothermic and breaking is endothermic had no difficulty in gaining three marks. For the rest it was a lottery whether they scored or not. Their difficulties were compounded by uncertainty as to which 3 moles of bonds were broken. Double and triple bonded hydrogen molecules were given as well was double bonded nitrogen molecules.

(ii) There were some truly excellent answers. More energy is released by bond forming than is used in bond breaking. Calculations were performed to show that the overall energy change is –75 kJ. Typical mistakes included were not using data from the table, energy of reactants is greater than that of the products. A true statement which can only be derived from the table by showing that the reaction is exothermic. A significant proportion thought that bond breaking released energy or that the forward reaction only involved the formation of N-H bonds.

Paper 0620/04

Coursework

General comments

As always there was only a limited entry for coursework in the November session. The work of candidates moderated, was, in all cases, of an appropriate standard. It was not necessary to change any of the marks awarded by Centres.

There were minor issues concerning Centres sticking to the procedures in the syllabus. In particular few details were given of the assessment of Skill C1. Since there is no written product for this skill, it is particularly important for Centres to give the following information regarding C1 assessments:

- a copy of the instruction sheet given to the candidates
- a copy of the mark scheme used to assess the candidates performance
- a tick list showing how marks were awarded to each candidate.

The provision of this information would enable Moderators to ensure that candidates were being assessed fairly. Lack of this information increases the difficulty faced by Moderators in making sure all candidates are assessed to the same standards.

Paper 0620/05

Practical Test

General comments

The majority of candidates successfully completed both questions. A few Centres had some difficulty in setting up Experiment 1 so that it was possible to complete in time. Any difficulties encountered were taken into consideration when marking the scripts. A wide range of marks were seen and most Centres found the examination to be a good test of candidates' practical abilities. A minority of Centres failed to provide any Supervisors' results. Others only provided results obtained for one question. Supervisors' results are taken into consideration when marking the scripts for both questions.

Comments on specific questions

Question 1

The vast majority of candidates successfully completed the table of results. Some were unable to convert the times into seconds.

(a) Points were generally plotted correctly though some inappropriate scales were seen. Best fit straight line graphs, as requested, were rare and curves and 'medical charts' were common.

(b) Three observations were required. The question discriminated well with only the stronger candidates scoring full marks. Reference to bubbles/effervescence/fizz, slowing down and clearing were the key points. Many candidates described the solution as going colourless when it was in fact colourless to start with.

(c)(i) Candidates were confused regarding the time for the solution to clear and the rate of the reaction. Experiment 5 with solution T was the fastest reaction and took the longest to clear.

(ii) The explanation required was concerning the greater concentration of acid in solution T and some description of collision theory. Weaker candidates described the rapid evolution of the gas bubbles without any attempt at an explanation.

(d)(i) Generally poorly answered. Some candidates did not understand the term *excess*.

(ii) A good discriminating question. Many vague answers referred to reactants being used up with no details. More able candidates described marble chips still being visible at the end of the reaction or testing the solution to determine its pH etc.

(e) Two different sources of error were required and suggestions for improvement. Good answers covered two of these points:

- use of a measuring cylinder to measure the acid – use a burette instead
- variability in the marble chips-weigh them before the experiment
- Doing all five experiments at the same time/difficulty in judging when the graph paper lines could be clearly observed etc., with ideas to improve the procedure.

Vague answers included 'measuring volume is not accurate' and reference to parallax.

Question 2

Generally well answered. Good descriptions of observations of changes. There is a tendency to record one change then go no further. For example in **(b)** 'damp pH paper turns red' scores 1 mark, but no reference to bleaching or colour of gas or liquid formed etc. was given.

In **(a)** reference to colour was required.

In **(c)** only the weaker candidates failed to describe the formation of white precipitates. Some candidates are confused between the meaning of the terms soluble, insoluble and dissolves.

In **(iii)** and **(iv)** reference to no reaction/change was expected leading to the deduction in **(d)** that sulphate ions and halide or named halide ions were not present. The absence of carbonate was also given credit when mentioned as an alternative answer.

The conclusions in **(e)** about solid **X** varied from poor to excellent. Only a minority of candidates referred to the water given off when **X** was heated. Reference to chlorine and chloride ions was common. Some confusion between the test's results for zinc and aluminium was evident. The better candidates correctly identified **X** as aluminium nitrate.

Paper 0620/06
Alternative to Practical

General comments

The vast majority completed this accessible paper in the time allocated. A wide range was seen in the standard of the scripts marked. The questions effectively discriminated between candidates of different ability. A minority of Centres appeared not to have covered certain sections of the syllabus.

Comments on specific questions

Question 1

The majority of candidates scored high marks on this question.

(a) Common incorrect answers referred to spoon instead of spatula and some measuring jars were seen.

(b) This was generally well answered.

(c) Most candidates mentioned the idea of heating/evaporating the solution. A common mistake was to heat the solution to dryness or 'remove all of the water'. The method of heating to the point of crystallisation, e.g. using a stirring rod to observe crystal formation was rarely mentioned.

Question 2

(a) Some candidates missed this out. Others labelled the wires, the tubes or the battery.

(b) Credit was given for reference to the bulb lighting, a green gas or bubbles/fizz/effervescence. 'Gas made or gas given off' is not an observation. Some answers referred to 'seeing the ions moving'.

(c) Many candidates gave the correct test for hydrogen.

(d) However, some used glowing splints-this was often Centre dependent. A significant number gave the test for chlorine.

Question 3

(a) Lots of wrong answers and very few correctly spelt right answers! Many references to 'grinders/crushers', etc. The names pestle and mortar were not well known though some candidates scored credit for drawing the apparatus.

(b) A good discriminating question. Weaker candidates referred to the grass dissolving instead of the chlorophyll and 'saturation' was commonly mentioned.

(c) This was generally well answered. Incorrect answers were chromatography and distillation.

(d) A good labelled diagram was given full credit. The two main errors were to have water or the solution as the solvent or to have the solvent too deep. A minority of candidates described fractional distillation.

Question 4

Most candidates completed the table of results correctly.

(a) Most candidates plotted the points correctly. However, many then failed to draw a straight line graph as requested. Even many of those who missed out the error point for Experiment 2 still joined the rest of the points up with a bent straight line.

(b) This was generally well answered.

(c) Some answers referred to point 3 with the reason that the line was the steepest. Those candidates that gave the correct answer, 5, often failed to give a possible reason for it being faster. Many said 'because it makes more gas'.

(d) A good discriminating question. Many answers lacked detail and waffle was prevalent. Reference to the continued presence of the chips or testing the pH of the solution were the basis of the better answers.

(e) A significant number of candidates failed to spot any sources of error. Lots of vague references to inaccurate measuring, 'parallax errors' lacked depth. Some candidates decided that using different concentrations of acid was a problem, although this was the independent variable.

Question 5

(b) Often fully correct but some candidates got the dissolving/not dissolving the wrong way round.

(c) This was generally well answered, most got the idea that the gas was acidic.

(d) The negative results caused some problems, with some candidates thinking it must be a sulphate because it was tested for a sulphate.

(e) Common incorrect answers were ammonium and chlorine.

(f) Many candidates worked out that **X** was a nitrate but failed to note that the question was worth 2 marks. Only the better candidates referred to the hydrated nature of the salt/water of crystallisation. A minority identified the presence of chloride ion despite the negative test in **(b)(iv)**.

Question 6

(a) This was missed out by some candidates. Lots gave only one arrow, some heated different parts of the apparatus randomly. A few excellent answers indicated the relative strengths of the heat required.

(b) Some confusion between barium and bromine here. Most who mentioned bromine/bromine water got the correct result, though a significant number used the word clear instead of colourless. Some Centres appeared not to have covered this section of the syllabus.

(c) A number of candidates thought that ethene would get sucked back. Some thought that the ethene would react with the water and form ethanol. Only the more able candidates got the idea of the water being sucked back and the resultant effect on the tube.

Question 7

(a) Most candidates scored marks on this discriminating question. Many candidates did not add water to the soil and failed to mix/shake the mixture and then filter. A common answer resorted to 'use indicator to find the pH' which is what the question told them to do. Adding universal indicator directly to the soil scored a maximum of 2 marks.

(b) Credit was given to answers referring to the testing of soil from different parts of the field, different fields and experiments to work out which plants grow in soils of certain pHs.