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CHEMISTRY

Paper 0620/01
Multiple Choice

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General comments

The candidates achieved a mean mark of 28.0 with a standard deviation of 6.59. These values are satisfactory. The Paper is intended, primarily, to discriminate between candidates in the grade C to grade G range. However, the Paper is also taken by candidates who achieve higher than grade C. As a consequence, the mark distribution tends to be skewed towards higher marks. This report concentrates more on the responses made by the grade C to G candidates. Similarly, there were several questions, e.g. **Questions 5**, **6**, **7**, **15**, **24**, **30**, **36** and **38**, that were found, overall, to be on the easy side but yet discriminated very well across the ability range.

Questions 26 and **27** also had relatively high facilities: they discriminated well but not as well as the 8 questions just mentioned.

Comments on specific questions

Question 4

A relatively hard question that discriminated well. Response **B** was relatively popular amongst the lower scoring candidates, the implication being that these candidates did not realise that a soluble impurity affects the m.p. and b.p, of the solvent in opposite directions.

Question 6

Perhaps because it was presented in numerical form rather than diagrammatic form, this question proved to be an 'either or' question with very few takers for responses **A** and **D**.

Question 8

The higher scoring candidates found this question quite easy but their lower scoring colleagues favoured response **B**. There seems to be no obvious reason for this.

Question 9

As for **Question 8**, the higher scorers thought their way through the details but response **C** attracted nearly 60% of the lower scorers. Did they forget that the oxygen molecule is diatomic?

Question 16

Nearly a third of the lower scorers chose **A** - slightly more than those in this group who answered correctly. Presumably this is due to simple misremembering of the colours of hydrated and anhydrous copper(II) sulphate.

Question 18

Half of the lower scorers chose **A** rather than the key, **C**. It is not good practice to have a sealed reaction vessel with a gaseous product involved. Quite apart from that pragmatic point, there would be no change in reading of the balance. These candidates needed to be a little more thoughtful.

Question 19

The popularities of all four responses were very roughly equal amongst the lower scoring candidates with **B** slightly the most popular. It seems almost impossible to convince the majority of candidates that copper does not react with dilute acids.

Question 25

Only half of the candidates answered correctly. Amongst the lower scoring candidates, responses **A** and **B** together accounted for 60% of their choices. This seems to be a somewhat surprising lack of recall.

Question 29

This question was found hard across the ability range. The relative popularities of responses **B** and **C** were fairly equal for both the lower scoring and the higher scoring groups. This suggests that there was much guessing. It seems that candidates did not take on board the reference in the question to "economic" and the fact that the water does not need to be very pure.

Question 32

Disregard for practicalities was also evident in the response to this question. All of the techniques mentioned in the question can be used to prevent rusting but neither coating with grease nor electroplating are very realistic in respect of a large object such as a girder for a bridge.

Paper 0620/02

Paper 2 (Core)

General comments

Many of the candidates tackled the Paper well and there were many good answers showing a thorough grasp of the subject matter. Many candidates scored over three-quarters of the marks available. In general, the rubric was generally well interpreted and most candidates attempted all parts of each question. The standard of English was generally good. Atomic structure and general inorganic reactions were well known but, as in previous years, many of the candidates found it difficult to explain terms such as thermal decomposition, compound and element convincingly. There were few instances in this particular Paper where candidates disadvantaged themselves by giving multiple answers and it is encouraging to note that most candidates confined themselves to a single answer when requested. It was also encouraging to note that the majority of the candidates were able to write correct formulae in the appropriate places and showed a good ability at balancing equations. A considerable number of candidates appeared to have difficulty in explaining the results from graphs and interpolating data e.g. **Question 6 (c)(i)**. The general properties of elements as tested in **Question 3 (d)** and tests for particular groups e.g. **Question 5 (a)** proved a stumbling block for many candidates. It was encouraging to note, however, that answers to questions on changes of state and the Periodic Table showed an improvement over those set in previous years.

Comments on specific questions

Question 1

This appeared to be the most accessible question on the Paper. Most candidates achieved at least 10 marks on this question, the lowest scoring part usually being **(c)** where the idea of moving ions transferring the charge in molten sodium chloride is still not well appreciated.

(a) At least three quarters of the candidates achieved 5 marks on this question. Parts **(i)**, **(iii)**, **(v)** and **(vi)** were practically always correct. Many candidates however, suggested, incorrectly, that metals formed acidic oxides (part **(ii)**), with potassium or sodium being the most often seen mistakes. A variety of answers were seen for part **(ii)** with bromine and oxygen often being seen as incorrect answers. It is clear that many candidates ignored or did not appreciate the meaning of the word ‘giant’ in the question.

(b) Practically all candidates achieved full marks for this part. It is encouraging that candidates seem to have a better knowledge of the uses of chemical elements than in previous years.

(c)(i) Most candidates realised that the bonding was covalent and hardly any gave foolish answers.

(ii) Although the majority of candidates put the correct formula BrF_5, a few failed to read the letters correctly and put $NaCl$ (for compound B) or failed to count the correct number of fluorine atoms. BrF and BrF_4 were the commonest incorrect answers.

(iii) The commonest error here, which has been commented on in previous Examiner’s Reports, was to suggest that electrons are responsible for the conduction in a molten ionic substance. This may arise from the fact that electrons are responsible for metallic conduction where they may learn about ions in a sea of electrons. A minority of candidates also suggested that the ions dissolved in water and were then able to move. This is perhaps a misinterpretation of the meaning of the term ‘molten’.

Question 2

This question was surprisingly poorly attempted even by some fairly high scoring candidates, and full marks were rarely recorded for parts **(a)(iii)** and **(e)**.

(a) Many candidates wrote rather vague answers here such as ‘heat it’ or ‘pull the string’.

(b)(i) Most candidates plotted the points well, but a significant minority failed to plot the 0-0 point (or even to draw the line between 0 and 23).

(ii) Most candidates were able to draw a suitable curve as a line of best fit missing one of the points at either 2 or 3 minutes. However, a considerable number of candidates drew straight lines from point to point and this could not be given credit. A few candidates drew a straight line from 0 to 55, even though the points clearly fell on a curve.

(iii) This was not always well done and many candidates only scored one mark, usually for suggesting that the reaction was finished. Many candidates failed to gain the mark for suggesting that the zinc had all been used up because they suggested that the reactants or reactant had been used up. Candidates should be encouraged to refer back to the stem of a question. In this case, the clue lies in the fact that the hydrochloric acid is in excess.

(c) Most candidates realised that the reaction went faster at a higher temperature but many failed to realise that the final volume of gas remains more or less the same. Even accounting for expansion, many candidates made the final volume of gas far too high.

(d)(i) Nearly all candidates obtained the mark for the balancing of the equation.

(ii) Most candidates correctly added the atomic mass of zinc and two chlorines together to get an answer of 136. A few candidates, however either used a mass of chlorine of 35 rather than the 35.5 from the Periodic Table and calculated the incorrect answer of 135.

(iii) This was poorly attempted, even by a number of high-scoring candidates. Many answers were too vague and referred to 'pure substances', 'chemicals in the Periodic Table' or 'the smallest unit of a substance'. Candidates who wrote along the lines of 'a substance which cannot be broken down' had to put the rider 'by chemical means' to gain the mark.

Question 3

This was reasonably well done by the majority of candidates, but it was disappointing to note that few could identify the type of chemical reaction occurring between ammonia and hydrochloric acid or could explain part **(g)(ii)** adequately.

(a) This was reasonably well done by most candidates but at least 20% of the candidates reversed steps B and C, perhaps by reading the diagram round in a clockwise direction without taking note of the letters. Cooling was sometimes seen as an incorrect answer for both parts **(ii)** and **(iii)**.

(b) Most candidates correctly identified a liquid state as involving molecules sliding over each other. The most common error was to suggest that the molecules were moving completely freely from each other.

(c) Although there were a variety of responses for which letter represented an endothermic change, more candidates could describe that an endothermic change involved absorbing heat or taking in heat. Although it was marked correct on this occasion the idea of the reaction 'needing heat' is deemed to be rather vague.

(d)(i) The incorrect answer, bromine, was not uncommon, presumably because many candidates had seen bromine vapour in diffusion experiments. Sulphur was also not uncommonly thought to be a gas, presumably because it is below oxygen in the Periodic Table and next to chlorine.

(ii) The incorrect answer 'chlorine' was often seen here.

(iii) A surprisingly large number of candidates failed to recognise sodium chloride as the correct answer. Iron was often given as an answer. Presumably these candidates did not recognise or act on the word 'compound' in the question.

(e)(i) Many candidates wrote Brownian Motion in place of diffusion. This cannot be accepted as correct because ammonia and hydrogen chloride are of the same order of size.

(ii) Although ammonium chloride was written by most candidates, a considerable minority suggested either nitrogen trichloride or another nitrogen compound. Quite a few candidates penalised themselves through inaccuracy by putting ammonia chloride.

(iii) The commonest incorrect response referred merely to higher concentrations at one end compared with the other. It was encouraging to note that many candidates were able to work out the correct reason in terms of either differences in mass or differences in speed.

(f) The responses to this question were more often than not incorrect. Many candidates failed to recognise the key word 'chemical' in the question and wrote exothermic as an incorrect answer. A considerable number of candidates thought, incorrectly, that the reaction was an example of a redox reaction.

(g)(i) Nearly all candidates recognised the thermometer, the commonest incorrect answer being 'a measuring tube/cylinder'.

(ii) Many candidates failed to gain a mark for this part because they did not refer at all to the solid. The answer required more than just reference to the boiling point of water. Some candidates referred, incorrectly to the dissolving of the solid rather than melting or to the boiling point of the solid.

(iii) This was answered well by the majority of candidates, the commonest errors being to suggest that rates of reaction were involved or that the solid needed to dissolve in the water.

Question 4

This question was reasonably well attempted by many candidates, but the sections involving definitions were often poorly written.

(a)(i) Many candidates understood that thermal decomposition involved heat, but fewer explained the meaning of decomposition. Candidates should realise that words in italics in the Exam Paper need full explanation. In this case the meaning of decomposition needs to be explained as well as the word thermal. Answers just suggesting 'decomposing' were held to be too close to the word 'decomposition' to merit the mark.

(ii) Most candidates could explain that a catalyst speeds up the rate of a reaction. The idea that a catalyst just alters the rate of reaction is regarded as rather too vague and this has been commented on in previous Examiner's Reports.

(b) Most candidates suggested that ethene was the unsaturated compound and only a few put ethane.

(c)(i) Many candidates failed to give the correct answer to this question through not using the information in the table and gave one of the products rather than the name of a fraction. Petrol or diesel were not uncommon incorrect answers, given through not reading the question thoroughly enough.

(ii) 90g was a not uncommon incorrect answer but about two-thirds of the candidates gave the correct answer of 4000g. Only a few candidates penalised themselves by giving the incorrect units.

(iii) The equation was completed correctly by most candidates, although a large minority put methane down as one of the products or tried to put a number in front of the C_2H_6.

(d)(i) In previous years, candidates have often found the writing of formulae for polymers difficult. Although, the polymer in this case is very simple, and it is encouraging that a large number of candidates succeeded in gaining the mark here, the Examiners are still finding a great number of mistakes in the writing of the formulae. Common errors included, writing the formulae out but not joining them together, the inclusion of the double bonds still and the lack of 'continuation bonds'. Formulae showing cycloalkanes were not uncommon as were formulae with hydrogen atoms terminating either end of the chain.

(ii) This was only answered correctly by about half the candidates. Apart from the incorrect answer 'condensation polymer', other incorrect answers often seen referred to names of chemicals rather than a type of polymerisation e.g. plastic, polythene, butane.

Question 5

This was one of the most poorly answered questions on the Paper for many candidates. The tests for ions were often not known and the definition of the word compound given by most candidates was often extremely vague.

(a) Although many candidates had learnt the tests for ions and gained full marks for this section, a considerable minority failed to gain any marks through not knowing the correct solutions to be added. It is to be noted that, although many candidates know tests for gases such as carbon dioxide and hydrogen, when it comes to learning the tests for specific ions, the lower scoring candidates are overwhelmed by the number of tests required. Many candidates merely put down sodium hydroxide as a test for all the ions in the left hand column. Sodium chloride was sometimes seen as an incorrect test for iron(II) ions and starch was often reported to be a test for iodide ions, presumably through mistaken identification with the test for iodine. A number of candidates lost marks through suggesting adding the wrong acid for dissolving a presumed precipitate, although the acid was not essential in this case because the ions were already in solution. Adding hydrochloric acid for testing for chloride ions or sulphuric acid for testing for sulphate ions can hardly be given credit, although this does not negate the mark for the colour of the precipitate.

(b) Most candidates scored at least 2 of the 3 marks available for this part. The two most common errors were to either not make clear that the filtrate was sodium chloride solution or the omission of the crystallisation step. Those candidates who drew annotated diagrams, generally scored more marks. Candidates should be reminded, however, that it is essential to annotate the diagrams, since it is not obvious that the filtrate is sodium chloride, as evinced by the fact that a number of candidates labelled the precipitate on the filter paper as being sodium chloride.

(c) As in previous examinations, where a similar question has been asked, candidates find it difficult to explain the meaning of chemical terms and this question proved to be a good discriminator. Many candidates are still under the impression that a compound is a mixture of elements or do not mention that the different elements/atoms are bonded.

(d)(i) This was well answered by most candidates, the only error being to confuse the electrode products by putting sodium here. Chloride was another incorrect answer, because it is not a final product.

(ii) This was less well answered than part **(i)** with the most common incorrect response being hydrogen. This is a common error arising from the candidates' misunderstanding of the term molten (as also commented on in **Question 1**).

Question 6

This question proved to be fairly low scoring for many candidates especially in part **(b)** and **(c)(i)**, where an interpretation of the properties in the table was required.

(a) Most candidates gave a correct response. The most common incorrect response was zinc or copper, the candidates presumably confusing extraction with purification.

(b) Many candidates referred to the activity series, reactivity of the elements or the formation of an oxide layer, rather than focusing on the need for electricity to extract aluminium.

(c)(i) Many candidates failed to gain full marks here because they did not read the information in the table carefully enough and did not give responses indicating a gradation between magnesium and zinc. Candidates were most likely to obtain the marks if they made clear statements along the lines of 'less .... than magnesium but more ....than zinc'. Some candidates failed to use the information in the table at all and wrote answers to do with radioactivity. Repeating statements in the observation boxes for magnesium or zinc did not gain any credit. Some candidates failed to gain a mark because they referred to magnesium in the central box rather than uranium.

(ii) This was answered well by most candidates, although a small number used the term relative atomic mass rather than mass number.

(iii) Most candidates referred to nuclear energy or nuclear bombs but a significant minority of candidates failed to obtain the mark because they merely referred to a fuel without any further clarification.

(d) This mark was obtained by most candidates. A minority suggested, incorrectly, that magnesium hydroxide would be formed.

(e)(i) Although most candidates realised that an alloy was a mixture of metals, some wrote rather vaguely about it being just a mixture of elements or non-metals or mentioned compounds and forming covalent bonds between metals. These latter ideas were not given credit.

(ii) Many candidates tended to give a long list of properties of metals without making any comparison with the metals alone. Some of these properties such as increase in melting point are not valid. There were many vague answers such as 'it improves the properties of the metal' or 'makes it better for a particular job'. Candidates should be encouraged to write an answer with a specific correct property in mind.

(f) This part was poorly answered because many candidates did not refer to carbon as the reducing agent and only mentioned the zinc oxide. Candidates should also be encouraged to be more accurate with their wording. There were many vague statements and many candidates opting for an answer based on oxidation numbers or electrons failed to gain the mark through incorrect statements such as 'the carbon gains electrons'. At foundation level, candidates should be encouraged to choose the simplest method of expression e.g. 'the carbon removes the oxygen from the zinc oxide'.

(g)(i) Most candidates realised that the double headed arrow referred to a reversible reaction.

(ii) Although most candidates gave a good approximation of the percentage of nitrogen in the air, common errors were 70% (rounding down from 78%?) and 20% (mistaken for oxygen?).

(h)(i) About 90% of the candidates drew a correct diagram of the electronic structure of magnesium. Of those who did not, the most common errors appeared to be the addition of another shell of 8 electrons below the valency shell or 4 electrons in the outer shell.

(ii) About one third of the candidates obtained only a single mark because they did not refer to the number of electrons transferred or the electrons in the valency shell being transferred.

Paper 0620/03

Paper 3 (Extended)

General comments

There remains the perennial problem of the candidates for whom this Paper is far too challenging and consequently their level of attainment is predictably extremely low. This issue was discussed in the Report for November 2002 and these comments are increasing germane to the entry of candidates in future examinations. As has been said before:-

For some candidates who have been entered for Paper 3, it presents an inappropriate test of their skill and knowledge and they attain very low marks or hand in blank scripts. This Paper is not one that inspires them to make full use of whatever knowledge and aptitude they may possess. From 2004, candidates can only be entered for Paper 2 or Paper 3 and not both as in the past. In the future, candidates should be entered for Paper 3 if they expect to achieve grade D or higher. Being entered for this higher and more demanding Paper could reduce an individual's chances of attaining their optimum grade, as Paper 2 is designed to allow candidates expected to gain a C or below to show their skills better and to concentrate on core concepts. Candidates who are correctly entered should find preparing for and sitting the examination a more positive and rewarding experience that best allows them to demonstrate their abilities to the full.

At the other end of the attainment range, there a significant cohort of candidates who displayed a most creditable knowledge and understanding of Chemistry. They deserve the highest praise and commendation for their undoubted diligence and achievement.

Candidates continue to persist in trying to write symbol equations when the less demanding word equation has been requested.

There was ample evidence that candidates are not considering exactly what is required to answer the question and offering irrelevant or incorrect answers.

The quality of the diagrams this year was disappointing and future entrants might well profit by practising this essential skill.

<u>Comments on specific questions</u>

Question 1

(a) The major difficulty was the balancing of the equations. The equation with carbon dioxide as a product proved to be more challenging than the alternative with carbon monoxide as a product. Typical errors were as follows.

$Fe_2O_3 + C = 2Fe + 3CO$

$Fe_2O_3 + C = 2Fe + 3CO_2$

$Fe_2O_3 + 3C = 2\,Fe + 3CO_2$

$Fe_2O_3 + C = 2\,Fe + CO_3$

$Fe_2O_3 + 3C = Fe_2 + 3CO_2$

$Fe_2O_3 + C = 2\,FeO + CO$

(b)(i) The equation for the reduction of iron(III) oxide by carbon monoxide was given on many scripts as was the equation for the formation of carbon monoxide. $2C + O_2 = 2CO$. Inevitably, despite comments in a number of these reports, word equations featured on many scripts. When a word equation is required, it is specifically requested. The highly exothermic reaction in this process is: $C + O_2 = CO_2$.

(ii) A number of explanations were accepted. These ranged from the incomplete combustion of carbon, carbon dioxide reduced by coke and higher in the furnace, most of the oxygen had been used up so the reaction that occurred was: $2C + O_2 = 2CO$. The most frequent errors were to give a discussion of the role of carbon monoxide as a reductant for the iron(III) oxide and to correctly state that carbon reacted with oxygen to form carbon dioxide, which was then wrongly thought to be reduced by oxygen to carbon monoxide.

(c) A wide range of word equations was accepted, the use of trivial names was permitted. The following examples illustrate the diversity of the equations that were credited with both marks.

lime + sand = slag

limestone + silica = slag + carbon dioxide

calcium oxide + silicon(IV) oxide = calcium silicate

A correct symbol equation also gained the marks.

A common mistake was to believe that the impurity was silicon not its oxide.

(d)(i) Almost all the entry could state a use of stainless steel ranging from garden tools to kitchen equipment.

(ii) Nickel or chromium were the usual and correct responses. Errors were to suggest aluminium, zinc, carbon, copper or tin.

(iii) The most serious and unfortunately quite common mistake was to describe the blast furnace and not the Basic Oxygen Process. Another difficulty was that some candidates were not clear about the role of the reagents, did they reduce the ore or the amount of carbon in the impure iron or remove the oxides of silicon etc?

However there were many excellent answers of the type:

Oxygen was blown through the impure iron, it oxidised the impurities to their oxides. Carbon dioxide escaped as a gas. Lime was added, this removed the silicon(IV) oxide as slag.

The marking scheme was sufficiently flexible to acknowledge a wide range of appropriate comments.

(e) In general many candidates understood the concept of plating metal on metal by electrolysis, this question was well answered. The response that caused the most difficulty was the identification of the electrolyte, errors were – molten tin, solution of tin, an iron salt, sulphuric acid or sodium hydroxide. A named tin salt, a tin salt or tin ions were the correct answers. Another difficulty was to reverse the tin and the iron, that is the anode made of iron and the cathode made of tin.

Question 2

(a)(i) Very well answered, a small minority gave the electron distribution instead of the valency.

(ii) The marking points were any two from the following:

- high melting *or* boiling point
- hard
- poor conductor of electricity *or* heat
- brittle.

Insoluble, dull, or not malleable were not accepted.

(iii) Many did not heed the request – an element with a macromolecular structure and then a macromolecular compound and gave two elements.

(iv) Useful advice that might be offered to future candidates – do not make the diagram too complicated, for example the structure of diamond can be illustrated with five carbon atoms and that of silicon(IV) oxide by one silicon and four oxygen atoms. Some of the more artistic candidates drew quite complex and accurate diagrams and for those with the necessary skills it is to be encouraged but for the majority of candidates simplicity is the best option.

For carbon or silicon(IV) oxide the Examiners were looking for 1:4 co-ordination, a suggestion of tetrahedral geometry or evidence of continuation.

The link between parts **(iii)** and **(iv)** was not insisted upon and any correct macromolecular structure was accepted in **(iv)**. This extended the range of possible answers to include organic macromolecules, nylon 66, poly(ethene) and starch were all given.

(b)(i)(ii) Probably due to the influence of practical work, most of the candidates had some knowledge of these reactions. Many answers were spoilt by the inappropriate phrasing of the responses. It is essential the two parts are kept separate: addition of aqueous sodium hydroxide - a white precipitate forms: excess sodium hydroxide - this dissolves or it is soluble in excess (to give a colourless solution)

Careless use of the words “soluble” and “insoluble” completely negated some potentially correct descriptions.

(c) The correct solution to this problem is:

(i) number of moles CO_2 = 0.24/24 = 0.01

number of moles of $CaCO_3$ and $MgCO_3$ = 0.01

number of moles of $CaCO_3$ = 0.005

(ii) Calculate the volume of hydrochloric acid, 1.0 mole/dm^3, needed to react with one tablet.

number of moles of $CaCO_3$ and $MgCO_3$ in one tablet = 0.01

Expect same as answer to **(c)(i)**.

number of moles of HCl needed to react with one tablet = 0.02

volume of hydrochloric acid, 1.0 mole/dm^3, needed to react with one tablet = 0.02 dm^3 *or* 20 cm^3

This question was marked consequentially so that one incorrect answer did not invalidate the whole question. It also relied on an understanding of mole ratios so many candidates earned at least partial credit.

The most typical mistakes were:

number of moles CO_2 = 0.24/24 = 0.01 (correct)

number of moles of $CaCO_3$ and $MgCO_3$ =0.02 (incorrect)

and

number of moles of HCl needed to react with one tablet = 0.02 (correct)

volume of hydrochloric acid needed to react with one tablet = 0.02 x 24 dm^3

= 0.48 dm^3

or = 0.02 x 36.5

= 0.73 g

Question 3

(a)(i) A pleasing standard of answers. Examples of acceptable equations are:

$C_{10}H_{22} = C_2H_4 + C_8H_{18}$

$C_{10}H_{22} = 5C_2H_4 + H_2$

$C_{10}H_{22} = C_5H_{10} + C_5H_{12}$

$C_{10}H_{22} = C_{10}H_{20} + H_2$

(ii) Most realised that the reagent had to be chlorine but there was more of a challenge in specifying the conditions – light or heat or a named catalyst such as lead tetraethyl. A popular, but incorrect, option was to suggest that a high pressure was needed. Many resorted to writing a list of possible conditions in the hope that the Examiner would select the correct one.

(b)(i) The term molecular formula was essential as was the idea that isomers have different structures or structural formulae. The most serious misconception was to think that isomers are different forms of the same compound.

(ii) This part proved to be difficult. The answers were but-2-ene and CH_3-CH=CH-CH_3.

It seemed to be difficult for some candidates to allocate the correct number of bonds on each carbon - CH_3-CH=CH_2-CH_3 or CH_3-C=CH_2-CH_3 and to establish the correct name, for example but-2-ene was named as methylpropene. Many of the suggested isomers were rotations of but-1-ene or methylpropene, very popular was the imaginary but-3-ene.

(c) The additional products butanol and butane were given by most candidates. Dibromobutane was only on a minority of scripts, more usually bromobutane or dibromobutene were suggested.

(d)(i) There was some difficulty in naming the monomer, the term poly was often retained. Its formula proved to be more amenable and featured on many scripts. Semi-structural formulae, as shown below, are acceptable.

CH_3 –CH=CH_2 but molecular formulae are not – C_3H_6.

Those who had the formula of propene wrong usually drew a single rather than a double bond.

CH_3-CH-CH_2 instead of CH_3-CH=CH_2.

(ii) This proved to be a difficult question. The repeat unit had to be correct before the second mark could be awarded for evidence of continuation that implied a macromolecular structure. Candidates from one Centre used a neat device that avoided most of the difficulties in drawing this structure. They represented CH_3CO_2- as X and then it was easily designated as a side group off the chain of the linear polymer, this eliminated the most frequent error that is the chain drawn from ester group and not carbon.

(iii) The vast majority of candidates equated pollution to acid rain, the decrease in the ozone layer or global warming. Polymers are generally non-biodegradable with the consequent problems visual pollution and the availability of landfill sites. The burning of polymers produces some very poisonous gases such as hydrogen chloride, hydrogen cyanide etc. The phrase harmful gases was not accepted.

Question 4

(a)(i) Equations of this type have to be learnt and although there was an indication that a higher proportion of the entry had done so, many did not have the vaguest idea. Even candidates, who were aware of the products, had difficulty balancing the equation. It appeared that the following version was the easiest: $Pb(NO_3)_2 = PbO + 2NO_2 + \frac{1}{2} O_2$.

(ii) Only the word equation was required, candidates lost marks by attempting to write the symbol equation. A common mistake was to write nitride rather than nitrite. Fewer candidates could recall this equation than the one for lead nitrate.

(b)(i) The marking points were:

- order or lattice
- close together
- vibration.

There were very many pleasing answers that were awarded 2 or 3 marks. The major difficulties were to omit order or to discuss the melting process rather than concentrate on the solid state.

(ii) All that was required was the one word – melting. There were all kinds of suggestions relating to changes of state – liquefaction, evaporation etc.

(c)(i) This was well known by the majority of the candidates who gave commendable explanations of the type – because of the high temperatures in the engine, oxygen and nitrogen from the air react to form nitrogen oxides.

The fallacy that there is nitrogen in the fuel is still quite prevalent.

(ii) The knowledge of this topic, catalytic converters, has improved considerably over the last few years. Two of the following marking points were needed:

- catalytic converter
- react with carbon monoxide *or* hydrocarbons
- form nitrogen.

(d) The quality of the descriptions of this salt preparation was poor. Many thought that lead oxide was soluble and the method was titration with an indicator. Others thought that lead nitrate was insoluble and that it would be precipitated. Few mentioned the need to add an excess of lead oxide and then filter to remove the unreacted solid.

Question 5

(a) Most candidates gained three marks.

(b)(i) Once again a good standard of answers. The only common mistake was to include an additional "3" in the equation.

$La^{3+} + 3^{e-} = 3La$

(ii) The three products were hydrogen, bromine and caesium hydroxide. Caesium oxide, caesium metal, hydrogen bromide were incorrectly suggested as products.

(c) Either the products were correctly stated to be the metal hydroxide and hydrogen or the usual mistake was to give the metal oxide instead of the hydroxide.

(d) Compared with recent years the quality of the diagrams was disappointing. It is not necessary or desirable to include the inner electron shells, neither is it profitable to include the electronic structure of the atoms before combination. Obviously neither of these two inclusions is incorrect but they greatly increase the risk of error and ambiguity.

(e) A simple diagram was required that showed the positive and negative ions alternating in a regular arrangement. Candidates are not required to know the actual lattice structure of caesium chloride so a very simple diagram would suffice.

(f)(i) The required response was barium----oxygen. Errors were to quote bond formation in other reactions or to believe that a covalent bond formed.

(ii) The explanation had to refer to bond forming and bond breaking and not be a general discussion on thermicity. A creditable response would be – the energy needed to break the bonds was less than that released when bonds formed. Candidates had to think carefully before starting to write. There was some confusion about the direction of the energy transfer such as - breaking bonds releases energy or the energy is needed to form the bonds. On many scripts, the candidate did not compare energy taken in with energy given out and limited the explanation to – breaking bonds needs energy and forming bonds gives out energy.

Paper 0620/04
Coursework

General comments

It was pleasing to note that most Centres did not require their marks to be changed as marking was to a reasonably consistent standard across the Centres Moderated.

The few Centres which had to have marks adjusted were, for the most part, only changed by one or two marks out of 48. Centres were Moderated both up and down.

There were a number of concerns which arose in one or more Centres some to do with paperwork and some with the actual investigation.

- In assessment for skill C1 investigations must provide candidates with the opportunity to make a choice at some point which affects what they do in the investigation. The fact that the candidates have successfully made this choice must be one of the marking points in the mark scheme.
- In assessment of skill C2 only observations and numerical results and the recording of them must be included. Some Centres have included references to graphs in the mark schemes. If tables are provided the mark is limited, however good the results are. To gain full marks candidates should design their own tables.
- It is not really possible to draw adequate graphs unless graph paper is used. It is not satisfactory for candidates to use lined paper for this task.

- Candidates can be disadvantaged if marks for skills C2 and C3 are based on their own planned investigations. If the plan is poor then the results and the conclusions based on them may also be poor.
- A few Centres are still assessing skills C1 and C4 with the same investigation. This is impossible. Candidates cannot be assessed for following their own instructions.
- Investigations planned for C4 must be carried out to obtain full marks as candidates have to suggest improvements based on problems encountered.
- Exercises set for C4 should allow candidates the opportunity to show that they can allow for the control of variables or marks could be limited.
- All the paperwork required by the board should be included. Items missed by some Centres in this examination session included;
  - a list of all the candidates with their marks in candidate number order.
  - instruction sheets for all investigations used.
  - mark schemes for all investigations used including those for skill C1.
- Most Centres were not guilty of any of these faults and none was guilty of all of them. It is of concern that sometimes errors like those above may result in candidates gaining lower marks than they are capable of. Good candidates should be scoring close to full marks on skills C1 and C2 if good exercises are set.

Paper 0620/05
Practical Test

General comments

The majority of Centres provided Supervisors' results to **Questions 1** and **2** – regrettably some did not. Surprisingly some of the results were unexpected. For example in **1 (b)** when the starch was added a small number of Centres did *not* get the blue/black colouration.

Comments on specific questions

Question 1

The table of results discriminated well. Burette readings were often not given to 1 decimal place. The initial readings were often erroneously given as 50 cm^3. Supervisors' results were used to mark the magnitude of the difference in volumes.

Observations in **(a)** and **(b)** were often correctly stated. There were a large number of incorrect responses to **(c)(i)**. In **(ii)** vague answers such as 'more' were common. Part **(iii)** discriminated well - many said **C** was more reactive than **B** or made vague reference to different concentrations. **(iv)** discriminated well. Catalyst, speed up reaction, test for iodine were common incorrect answers to **(d)**.

Question 2

Responses varied from Centre to Centre. Some candidates gave very detailed answers while others were vague and tests were confused.

In **(b)** the filtrate and residue description were often the wrong way round.

In **(c)(i)** reference to effervescence, colour of solution and the limewater test were required for 3 marks. In **(ii)** some gave vague reference to milky, cloudy etc. instead of precipitate. Confused answers such as the 'blue precipitate dissolved to give a precipitate' were common. **(d)** was often well done, white precipitates soluble in excess were common correct answers. **(e)** and **(f)** were frequently the wrong way round. **D** was soluble in water and therefore was not copper carbonate. Similarly **E** was often given as zinc chloride.

Paper 0620/06
Alternative to Practical

General comments

A wide range of marks was seen. Candidates generally attempted all questions. There were fewer very low scoring scripts due to the accessible nature of the questions.

Comments on specific questions

Question 1

(a) **A** Mortar was not well known and crucible was a common answer.

B Thermometer, and vague answers such as stick or rod were common.

C Stand was a common incorrect answer.

Question 2

(a) Vague references to colour were often given.

(b) Answers were confused and often referred to "variables".

(c) Acid was sometimes added first or second.

(d) Graph plotting was good but lines often not smooth. Part **(ii)** discriminated well.

(e) Discriminated well. Very few candidates linked time with the precipitate being more spread out. Many candidates referred to a change in rate.

Question 3

Burette scales were inverted. Some Centres had changed the scales and these were marked based on the 'new scales'.

(a) Candidates clearly did not understand the table they had filled in, often giving experiment 2 as using the bigger volume. More bizarre were the large numbers of candidates who contradicted their answer in **(i)** when answering **(ii)**. In **(ii)** many just restated the volumes rather than compared them. **(iii)** was rarely correct. Many of those who did identify the iodate concentrations as being different got the concentrations the wrong way round. **(iv)** served to highlight that candidates did not understand **Question 3** – volumes were halved, some tried doubling (or halving) zero (since that was the initial reading in experiment 1).

(b) Most said Starch is a test for iodine. Some said starch is a test for starch, others thought starch was full of enzymes. Of those who did know it was an indicator, virtually no one could pick up the second mark.

Question 4

(a) Most missed out the 'fizzing' mark.

(b) Performance was very Centre dependent. Some excellent answers.

(c) As above.

(f) Some got solids **D** and **E** mixed up. Very few stated the hydrated nature of **D**.

(g) Again, answers very Centre specific for example whole Centres said 'Cu^{2+}' while others just said copper.

Question 5

(a) Many candidates joined all of the points and/or ignored the origin.

(b) A common answer was 0g or none.

(c) Often well answered, but some did not understand the question and thought the hole was the one in the middle of the tube for the gas to pass along.

Question 6

Some very good answers. Most got the marks for weighing sand and adding acid and then filtering. A lot of candidates then weighed the calcium chloride. Those who did focus on the sand left often failed to wash/dry and so found gaining full marks difficult.

Some candidates invented complex methods for no reason. Many wanted to collect the gas and then did nothing with it. A very small minority collected the gas, measured its volume, worked out how many moles of calcium carbonate this related to and so found the mass of calcium carbonate – this was credited.

A few candidates thought the best way was not to use any sand at all (and so could not get any credit since whatever they did it would not work). One or two had special filters which, when a sand/shell mix was poured into them would separate them.