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CHEMISTRY

Paper 0620/01
Multiple Choice

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20	**C**	40	**B**

General comments

Candidates achieved a mean mark of 28.3, with a standard deviation of 6.5. These statistics are satisfactory as also is the reliability coefficient. There was some skew towards higher marks: this probably reflects the fact that, although the paper is intended to discriminate between candidates likely to achieve grades C to G, candidates who achieve the highest grades also take this paper. It is probably also true that the most able candidates offer this syllabus rather than the companion 'mixed' syllabuses such as Physical Science and Combined Science.

Comments on specific questions

Question 7

This question was found marginally hard: this may be accounted for by the fact that the lower-scoring candidates found response **C** rather attractive (49%). Presumably they overlooked the fact that graphite is used as a lubricant. The question discriminated very well across the ability range.

Question 11

Similar comments apply to this question as for **Question 7**. In this case, 62% of the lower candidates chose **A**. Why?

Question 15

This was found quite hard by all candidates: only 63% of the higher-scoring candidates answered correctly. A third of the lower-scoring candidates each went for either **B** or **C**. This suggests that either they were confused about endo-versus exo-thermic or about the neutrality of solution of a salt such as potassium nitrate.

Question 20

As for **Questions 7** and **11**, the question was found marginally hard but discriminated very well. Responses **A** and **B** each attracted about a third of the lower-scoring candidates but there seems to be no obvious reason for this.

Question 30

Another slightly hard question with very good discrimination. The percentages of the lower-scoring candidates choosing **A**, **B** and **C** were somewhat similar but with **C** the most popular. Perhaps these candidates were guessing. On the other hand, it is also possible that they did not fully appreciate the significance of each fuel producing both carbon dioxide and water.

Question 32

This seemed the second hardest question but still discriminated effectively. Of the lower-scoring candidates, 40% chose **D**. This seems rather curious since it implies that more gas is being produced.

Question 36

This was also found to be a difficult question but, as for **Question 32**, a good discriminator. Response **C** was the most popular with the lower-scoring candidates. Did they not recognise $-CO_2H$ as the acid group?

Paper 0620/02

Paper 2

General comments

Many of the candidates tackled the paper well and there were many good answers showing a thorough grasp of the subject matter. In general, the rubric was generally well interpreted and most candidates attempted all parts of each question. However, many candidates failed to distinguish the difference between a word equation and a symbol equation, presumably through too rapid scanning of the relevant questions. This led to some candidates losing marks – see comments on **Questions 3 (d)** and **4 (c)(ii)** below. The standard of English was generally good. Methods of purification, atomic structure and general inorganic reactions were generally well known and although some candidates found it difficult to explain what an isotope is, there seemed to be a general improvement in the candidates' understanding of this term. There were fewer 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 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 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. The tests for hydrogen, carbon dioxide and ammonia were well known, although many candidates disadvantaged themselves by careless writing or muddling similar tests. As in previous examinations, few candidates explained the effects of acid rain in a convincing way. It was encouraging to note, however, that answers to questions on metals (**Questions 2 (e)** and **6 (j)**) 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 11 ma on this question, the lowest scoring parts usually being **(c)(i)** and **(e)**.

(a) Most of the candidates achieved 4 marks on this question. The commonest mistakes were to reverse the answers to parts **(ii)** and **(iii)** or parts **(i)** and **(iv)**.

(b) Many candidates achieved full marks for this part. The process of chromatography was less well known than distillation. The commonest mistakes were to mention condensation rather than distillation in part **(i)** and to maintain, incorrectly, that diagram **B** showed filtration. The latter mistake was presumably due to the fact that the filter paper was labelled – candidates should be encouraged to look at the apparatus as a whole rather than its component parts.

(c)(i) Fewer candidates than expected chose fuel gas as the correct answer here. This was presumably related to the fact that their knowledge of distillation using a fractionating column was rudimentary. The commonest incorrect answers were 'bitumen' (understandable if the candidate misunderstood the direction of the temperature gradient in the fractionating column) and petrol (presumably related to the fact that this was the top fraction shown coming from the *side* of the column). The diagram was a standard one however, and candidates should make sure that they read such a diagram correctly.

(ii) Although the majority of candidates stated a correct use for paraffin, a few failed to write down sufficient detail to gain a mark: the answer 'for aircraft' does not give any indication of fuel. Compared with previous years, a correct use for bitumen was not as well known. Incorrect answers included 'for petrol', 'for lamps' etc. The answer 'for roofs' was sometimes seen. This was held to be too vague: roofing tar is, however, acceptable.

(d) Most candidates gave the correct answer (hydrocarbons), the most common incorrect response being 'carbohydrates', presumably because this word sounds as if carbon and hydrogen are present. Candidates should be encouraged to think about the meaning of parts of words e.g. hydrate, referring to water.

(e) The dot and cross diagram for methane was generally well known. The commonest mistake was to put a single cross in the middle and then four dots around the outside. This was seen in scripts from diverse Centres.

(f) This part was answered correctly by at least three-quarters of the candidates, the most common incorrect responses being 'hydrocarbons'. Candidates should realise that 'hydrocarbons' is a more general term, and homologous series refer to compounds with specific functional groups.

Question 2

This appeared to be a fairly accessible question, most candidates performing well in parts **(d)** and **(e)**. The tests for hydrogen and ammonia were not known as well as expected and the correct structure of ethanoic acid was rarely seen.

(a) The description of respiration was not well known by many candidates, the most common incorrect description being 'decomposition'. This answer may have arisen through not reading the question sufficiently deeply, in other words focusing on the breaking down of the organic material rather than on the oxidation of food. Photosynthesis was another common incorrect answer.

(b)(i) The test for hydrogen seemed to be confused with the test for oxygen in many candidate's minds. There were numerous instances of 'glowing splints' being reignited.

(ii) Although many candidates gave a correct answer for a hazard associated with hydrogen, many wrote vague statements about water being formed or combination of hydrogen with nitrogen to form ammonia. The latter response must have been due to referral back to the stem of the question rather than to the question itself.

(iii) The test for ammonia given in the syllabus was fairly well known, but som... disadvantaged themselves by referring to the addition of sodium hydroxide and then t... solution?) for ammonia. This confusion with the ammonium salts test could not always b... credit where the candidate did not explain fully that it was the gas which was under test. A... minority of the candidates suggested incorrectly that ammonia bleached the litmus or t... hydrochloric acid had to be added first.

(c) As in previous years, the drawing of the full structure of more complex organic compounds provided a good discriminator. Few candidates were able to draw the structure with all bonds shown (including the O – H bond). Common errors were to draw two oxygen atoms in line with each other, to draw propanoic acid or to draw ethanol.

(d)(i) This was, on the whole, poorly done. Many candidates, could balance the equation but failed to realise that the hydrogen molecule is H_2. 4H or H_4 were therefore common incorrect answers. A not inconsiderable number of candidates failed to balance the equation even though they realised that hydrogen is diatomic.

(ii) The use of methane as a fuel was well known by most candidates although a few gave vague answers such as 'for burning' or 'natural gas' (which is not a use).

(iii) The characteristics of the gaseous state were well known by nearly all candidates.

(e) Most candidates obtained full marks on this part. A few candidates disadvantaged themselves by not choosing chemicals from the list. The most common error in part **(i)** was to suggest that magnesium is used to galvanize iron. The least well answered of this set of questions was part **(ii)**, where aluminium was occasionally claimed to be a transition element. Sodium sulphate was an infrequently seen incorrect answer for part **(iv)** and iron or even lead appeared as suggestions for aircraft bodies!

Question 3

This question was generally well answered, candidates from many Centres gaining more than 10 marks although part **(f)(ii)** proved to be a stumbling block for many candidates. The distinction between word equations and symbol equations was not often made and this disadvantaged some candidates in part **(d)**.

(a) Although many candidates referred to iron extraction or making buildings, there were many incorrect references to uses such as blackboard chalk or vague references to adding limestone to the soil (rather than being used to treat acidic soil).

(b) This was generally well answered, correct equations for complete or incomplete combustion being accepted. In contradistinction to the case of hydrogen, most candidates realised that oxygen molecules are diatomic. A minority of candidates, tried to include iron or calcium carbonate in the equation, rather than focusing on carbon.

(c) That exothermic reactions release heat was well known by practically all the candidates.

(d) A word equation was necessary to gain the marks for this question because the left hand side had been given in words rather than symbols. Word equations examine a different thing from symbol equations and candidates must be made aware of this. The fact that 'quicklime' was often written in place of the proper chemical name (calcium oxide) emphasises the difference. Candidates who wrote the correct formula, CaO, as well as a name did not always provide a correct name – calcium dioxide was occasionally seen. Some candidates put water as well as carbon dioxide on the right hand side of the equation.

(e)(i) Most candidates were able to balance the equation by placing a 2 in front of the HC*l*.

(ii) The test for carbon dioxide was generally well known but a considerable minority of candidates opted for the suggestion that a glowing splint would be extinguished, which was not considered correct, as quite a number of gases will blanket out the oxygen. A few candidates referred to bicarbonate indicator, which is commonly used in biological experiments in respiration. However, since any acidic gas will change the colour of the indicator, it cannot be held to be as good as the standard limewater test.

(f)(i) Although most candidates realised that an oxidation was taking place, some did not ... reaction in hand (C → CO_2) and wrote vague or rambling statements which included ... oxide (including the incorrect idea that calcium oxide was being oxidised). Candidates ... focus on the reaction indicated and not give vague answers if an explanation of what is happ... is required.

(ii) Few candidates realised that acetylene is used in welding. There was a wide range of incorrect answers including lubricant, solvent, nail polish and 'in perfumes'. It should be noted that hardly any plastics are made nowadays using acetylene and this answer was not accepted unless a correct reaction was suggested.

Question 4

Most candidates were able to work out the numbers of electrons, neutrons and protons in the bromine isotopes even though they could not score marks for the definition of an isotope. This highlights the difficulty candidates have with formal definitions, a fact which has been commented on in previous Examiner's Reports. Parts **(d)** and **(e)**, although straightforward, were less well done than expected.

(a) Most candidates realised that the halogens are the group VII elements, but a few made the mistake of referring to theses elements as halides. A minority of candidates suggested that group VII elements were alkali metals.

(b)(i) The definition of an isotope made by many candidates was not always accurate. Candidates should be advised not to quote differences in atomic mass (rather than mass number). Some candidates also refer to numbers of neutrons in molecules or elements rather than atoms.

(ii) It is encouraging to note that the majority of the candidates were able to obtain all 4 marks in this part even if they failed to get the mark for part **(i)**. Nearly all candidates obtained the mark for the correct proton number, but some muddled the neutrons with the protons and hence put 45 for the number of electrons and 34 and 36 for the number of neutrons.

(c)(i) Most candidates realised that chlorine was more reactive than bromine but a few failed to make the comparison: it is not sufficient to write that chlorine is reactive.

(ii) Some candidates disadvantaged themselves by writing an incorrect symbol equation. For a mark to be scored, a symbol equation in place of a word equation must be absolutely correct. Since there is no left hand side written down as in **Question 3 (d)**, symbol equations were accepted. In any case, few candidates were able to write a balanced equation e.g. potassium chloride often appeared as KCl_2 and the halogens were not shown diatomically.

(d)(i) Many candidates made a rough guess at the pH. Those who used a ruler and pencil invariably obtained the correct answer. Quite a few candidates failed to read the word 'highest' in the question and hence chose pH 0.

(ii) Although most candidates realised that the lowest pH, was the most acidic, a considerable minority chose pH 11, presumably under the mistaken impression that the higher the pH, the more acidic the solution. The response to the pH of a neutral solution was practically always answered correctly.

(e) Although this is a regular question in one form or another, it is surprising how few candidates produce a good answer. The word 'observe' is apparently not always understood: many candidates concentrate on what is happening to the ethene molecule e.g. 'becoming saturated' or 'bromine adds on to the ethene to form one molecule'. Candidates should be encouraged to concentrate on what they see.

Question 5

This question provided many candidates with some difficulties especially in parts **(a)**, **(b)** and **(e)(iii)** and **(iv)**. The explanations in part **(d)** were not always convincing.

(a) Only about half the candidates were able to balance the equation correctly, common incorrect answers being 2 or 7/2 i.e. 3 ½ .

(b) Although the test using anhydrous copper sulphate was the commonest correct answ[illegible] of candidates opted to use cobalt chloride. However, many of the answers using the la[illegible] confused the tests and gave the wrong colour change (pink to blue). Many candidates [illegible] gain a mark by referring to the boiling point of water - a physical test rather than a chemica[illegible] Quite a number of candidates merely opted for cobalt or copper without the negative ion. Th[illegible] could not be given credit.

(c) Most candidates ticked the first two boxes. The commonest incorrect answer was to tick the last box rather than the first. This suggests that these candidates are focusing on the acid rather than on the carbon compound.

(d)(i) Most candidates identified carbon monoxide as being the product of incomplete combustion of carbon containing fuels. However a sizeable minority opted, incorrectly, for carbon dioxide, methane (presumably from the unburnt gas) or sulphur dioxide (from ideas about burning fossil fuels).

(ii) This question was poorly answered by many candidates but proved a good discriminator. Many candidates talked about the fuel burning in the absence of oxygen (rather than in a reduced amount) or carbon reacting with carbon dioxide. Yet others wrote vague statements including water or acid rain.

(e)(i) Most candidates identified gas as being the least polluting fuel.

(ii) Many candidates did not appear to realise the connection between sulphur dioxide and acid rain, a common incorrect answer being 'oil'. A large number of candidates did not use the information in the table and wrote down the names of specific gases.

(iii) Only about one fifth of the candidates scored 2 marks here through inaccurate answers. It is not sufficient to say that the acid erodes buildings. Some idea if the type of stone present in the building is necessary e.g. limestone/buildings made from calcium carbonate etc. A mention of 'harm to animals' was similarly seen as a vague answer. For the answer to be correct some mention of lakes/rivers was necessary, since terrestrial animals are little affected by acid rain.

(iv) Although many candidates were able to suggest that a white precipitate would be formed, a large minority were content to give the name of the product rather than to write down the observations. This has already been commented on in relation to **Question 4 (e)**. Many candidates were content to suggest that bubbles would be formed or that 'nothing happens because aluminium is lower in the reactivity series than sodium'. This last incorrect response was fairly common and highlights a misconception in the candidates' minds by confusing precipitation and redox reactions.

Question 6

This was the lowest scoring question on the paper. Most candidates found the contextual nature of parts **(a)**, **(e)** and **(f)** difficult and although it was a straightforward question, only about a third of the candidates scored all 3 marks in part **(j)**.

(a) Only a small proportion of the candidates referred to the relative reactivity of aluminium and carbon. Many referred in a vague manner to an oxide layer protecting the aluminium.

(b) Only a small proportion of the candidates referred to electrical heating. Many thought, incorrectly, that the steel case was heated from the outside.

(c) The conduction of electricity was the answer given by most candidates although a minority referred to the high melting point of graphite. A significant number of candidates maintained that graphite was used because it was unreactive. In the light of part **(f)** below this is clearly incorrect.

(d) The majority of candidates realised that the cathode was the negative electrode, although quite a few were content to put the answer 'graphite' even though this was given in the diagram.

(e) This question proved to be a good discriminator. Some candidates realised that the steel case would melt at temperatures above 1500°C, but many were content to mention the high melting point of the molten aluminium oxide and not make any comparison. There were many incorrect answers based on aluminium itself. Many candidates understood that the high temperatures were a problem but came up with incorrect ideas such as 'it will explode' or 'you can't get to that temperature' rather than the idea that it is expensive to maintain a high temperature.

(f) This part was also a good discriminator, quite a few candidates gaining 1 mark, bu both marks. Many of the higher scoring candidates accessed all 3 marking poi candidates hinted that the oxygen would react with the graphite but failed to state this Answers such as 'an oxide layer is formed' or 'the oxygen sticks on the graphite' are no enough for a mark. The mark for the decrease in size of the electrode was the one most freque given.

(g) About half the candidates obtained a mark for balancing the equation, but many had incorrect combinations of 3 and 'e' e.g. -3e (unacceptable because electrons are being added not removed) or e^{-3}.

(h) Most candidates realised that opposite charges attract although a few penalised themselves by suggesting that the aluminium was the electrode.

(i) This was correctly calculated by the majority of candidates. Answer = 60%.

(j) Many candidates were unsure of the properties of metals and a considerable number thought that the question referred to transition metals and so answered along the lines of high melting point, coloured compounds etc. Properties such as malleability, ductility and lustre were well known, but fewer candidates than expected obtained all 3 marks.

Paper 0620/03

Paper 3

General comments

Candidates would be well advised to try to analyse the exact demands of the question, what is the required response to gain all of the marks? In general marks are not awarded for simply repeating the information given in the question, there has to be some input from the candidate. If more than one mark is allocated to the part of the question, then usually two pieces of information are needed.

In the last two Reports there have been extensive comments written about candidates for whom this paper is an inappropriate test and consequently their level of attainment is extremely low. The situation still persists, there is a significant fraction of the entry in this category.

The time allocated to the examination is adequate and candidates would benefit from checking their answers. Even the most superficial perusal would eliminate obvious errors and if the candidate reread the question and their answer, this might highlight those situations where they have not answered the question but offered peripheral Chemistry that relates to that in the question.

Comments on specific questions

Question 1

(a)(i) This part was usually answered correctly with the comment – fractional distillation.

(ii) Candidates were not as familiar with the large scale manufacture of hydrogen. Laboratory methods were described such as metal and acid or reactive metals with cold water. Quite popular was the suggestion that air or even ammonia were suitable raw materials.

Acceptable ideas were:

- methane and water
- electrolysis of brine
- alkanes by cracking.

(b)(i) Very few gave an explanation based on the position of equilibrium and its rela[illegible] pressure. Most discussed rates of reaction.

(ii) Once again the discussion centred on rates. However there were some excellent responses [illegible] type – the percentage of ammonia would increase because the forward reaction is exothermic. [illegible] increase in temperature moves position of equilibrium to the right, that is more ammonia.

(iii) Many answered this question with generalities – high pressure, high temperature and a catalyst. These were not considered to be adequate. The marking scheme required specified temperature and pressure and a named catalyst.

(c)(i) The syllabus defines acids and bases in terms of the transfer of protons. Hydrogen ion was awarded partial credit but hydrogen, hydrogen atom and hydrogen molecule did not score.

(ii) Any equation, ionic or molecular, that showed ammonia acting as a base was acceptable.

$NH_3 + H^+ = NH_4^+$

$NH_3 + HCl = NH_4Cl$

$NH_3 + H_2O = NH_4OH$

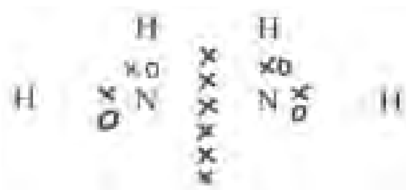
The question proved to be difficult with some strange formulae – NH_3SO_4 and NH_2Cl.

(d) In this type of question not only should the test be described but so should the expected results. The pH was measured, ammonia would have the lower pH. Universal indicator was added it went green in ammonia and blue in sodium hydroxide. Sodium hydroxide would have the better electrical conductivity.

Typical misconceptions were that the weaker base would react more slowly with acids or that it would require more of the weaker base to neutralise an acid.

(e)(i) Despite the information given in the question about the number of bonds per atom, correct structural formulae were quite rare, structures with nitrogen – nitrogen multiple bonds were far more common.

(ii) By far the most popular, but incorrect, response is drawn below.



Most of those who realised that the nitrogen – nitrogen bond was single omitted the non-bonding pairs. Even those who had drawn the right structural formula in **(i)** suggested a different structure for **(ii)**.

Question 2

(a)(i) The answers in table order are:

$1 mol/dm^3$

40s and 80 or 40s

The concentration of acid and the time for the 4M acid to react were usually correct. The right answer for the time of reaction of two pieces of carbonate in 2M acid is 80s. The reaction goes twice as fast since double the surface area but twice the mass of carbonate has to react. The reason for accepting the second answer, 40s, was that is was felt that the way the question was phrased might direct some candidates to concentrate on rate and ignore the mass of carbonate. By far the most popular suggestion was 120s – presumably by considerations of symmetry – 40s 80s? 160s.

(ii) In general an excellent standard of answers based on the speed or energy of the part... collision rate.

(iii) Very well answered, a widespread appreciation of surface area.

(iv) The risk is associated with combustible powders in air – coal mining, milling flour and gunpowder. A surprising number thought that the industrial process was either the Haber Process or the Contact Process.

(b)(i) Volume of oxygen or mass of solution should be monitored with respect to time. Many used the vague term –amount. Others discussed intensity of light and time.

(ii) A model answer would be the lower the intensity of the light the slower the rate or in the dark there is no reaction. There were many explanations of the term photochemical but no discussion of how the experimental results would show that the reaction is photochemical.

(c)(i) Good standard of answers from the majority.

(ii) Very variable in response, for some the word "polymer" triggered the idea of polyesters and polyamides. A common mistake was to retain hydrogen, obviously divalent, in the chain.

Question 3

(a)(i) Very well answered.

(ii) The majority offered one of the following equations:

$ZnO + C = Zn + CO$

$2ZnO + C = 2\ Zn + CO_2$

Carbon monoxide was not accepted as a reductant, the question specified carbon.

(iii) The boiling point of zinc is below 1400°C so it will have evaporated. The boiling point of lead is above 1400°C so it will remain as a liquid. The above is an example of a quality explanation given by some of the candidates.

There were a variety of errors – melting instead of boiling, trying to involve the reactivity series, believing that carbon was involved in the distillation and that the boiling point of carbon was 1400°C.

(b)(i) Virtually everyone knew a use of zinc.

(ii) The marking points for the description of a metallic structure were:

- lattice or layers of cations
- mobile or free or sea of electrons
- layers/cations can slip or the forces are non-directional.

Protons, atoms, molecules or nuclei are not equivalent to cations. Many just described typical metallic properties and did not mention structure.

(iii) The best explanation is that the different sized ion prevents slippage of the layers. Explanations of why alloys are used in preference to the pure metal and the erroneous concept that an alloy adopts the properties of its strongest constituent metal were frequently encountered instead of an explanation of why it is stronger.

(c)(i) Change two, either because the lead ions have gained electrons or because there has been a decrease in oxidation number. Most recognised that the lead ions were reduced, fewer gave the correct reason.

(ii) $Zn + 2Ag^{+} = Zn^{2+} + 2Ag$

The above is the correct version of the equation. The most frequent error was to write:

$Zn + Ag^{+} = Zn^{2+} + Ag$

The next most popular mistake was:

$Zn + Ag^{2+} = Zn^{2+} + Ag$

Equations that involved Au, Pb and A*l* were offered.

Question 4

(a)(i) All that was needed was the idea that a solvent could dissolve other substances. The question was well answered.

(ii) Drawing the correct formula for ethyl ethanoate proved to be quite difficult. Methyl propanoate was a frequent error.

(iii) Candidates often gave the right reagent but did not add additional information to gain the second mark. For the reaction ethene to ethanol the marking scheme required the reagent, water, and at least one reaction condition. Similarly for the change ethanol to ethanoic acid- the comment that the reaction is oxidation and the name of an appropriate oxidant, oxygen, potassium dichromate(VI) or potassium manganate(VII) were both needed.

(iv) The correct response, ethanoic acid and butanol, was comparatively infrequent. Incorrect reagents were:

ethanol and butanoic acid

butanol and butanoic acid

ethanoic acid and butene.

(b)(i) The majority correctly chose glycerol as the alcohol. In this type of question candidates should realise that it is pointless to underline more than one chemical, even if the selection includes the right answer.

(ii) A popular misconception was to think that the compound ,$C_{17}H_{35}COONa$, was an ester and that it was used in perfumes or for flavouring food. The simple response- soap or detergent, was needed. Comments such as – they are used to clean clothes were not accepted, clothes can be dry cleaned using a solvent.

(c)(i) Polyester. The prefix “poly” was deemed to be essential and the names of specific polyesters, e.g. *Terylene*, were not accepted.

(ii) The most common mistake was to omit the hydrogen atoms from both the alcohol and the acid.

(d)(i) The natural macromolecule is a protein or polyamide, not ester or polyester as was suggested by a significant minority.

(ii) Provided **(i)** was correct then amide was usually offered for this part.

(iii) There were many good explanations – amino acids are colourless, spraying with a locating agent makes them visible.

(iv) There was a tendency to repeat the answer given in **(iii)** and discuss the role of locating agents. A mark was awarded for simple comments about the position of the sample or its colour. Both marks were awarded for comparison with a standard chromatogram of known amino acids or for discussing Rf values.

Question 5

(a)(i)(ii) The uses of sulphur dioxide were known by most of the candidates.

(b)(i) The conversion of sulphur dioxide to sulphur trioxide was recognised as being the Contact Pro[cess] or equivalently the manufacture of sulphuric acid. A few were aware of the role of sulphur dioxi[de] in Acid Rain and thought that the reaction would reduce this form of pollution.

(ii) The only systematic mistake was to include vanadium(V) oxide instead of oxygen in the word equation.

(iii) As stated earlier in this report the description of reaction conditions has to be specific – 450°C, pressure 1 to 10 atm, vanadium(V) oxide as a catalyst. High temperature or even optimum temperature will not suffice.

(c)(i) Orange or yellow to green, the change for dichromate(VI) was more prevalent than purple to colourless, which is the change for potassium manganate(VII).

(ii) A difficult question, the marking points were:

- barium sulphate
- sulphur dioxide to sulphate ion
- sulphur dioxide reacted with or oxidised by bromine.

Very few candidates gained all three marks, recognising that the precipitate was barium sulphate proved relatively easy but gaining the other two marks proved to be challenging. It was generally believed that bromine had displaced chlorine and that the precipitate was barium bromide.

(d) The correct solution to this calculation is as follows:

the number of moles of SO_2 in the mixture = 0.125

the number of moles of Cl_2 in the mixture = 0.2

reagent was not in excess? SO_2

moles of SO_2Cl_2 formed = 0.125

the mass of sulphuryl chloride formed = 16.9g.

Most of the candidates earned at least partial credit on this calculation. In fact candidates who had struggled with the rest of the paper often showed some understanding of this type of calculation.

The most frequent errors were:

the number of moles of Cl_2 in the mixture = 0.4 (14.2/35.5)

moles of SO_2Cl_2 formed = 0.325 (0.2 + 0.125)

or moles of SO_2Cl_2 formed = 0.164 (8.0 + 14.2 = 22.2, 22.2/135 = 0.164).

Paper 0620/04

Coursework

General comments

Only a small number of Centres submitted coursework for moderation in the November session and, of these, only one had a significant number of candidates.

The work submitted by Centres conformed with the syllabus criteria and in the largest especially there was a good standard of performance coupled with a range of marks as would be expected.

Centres who regularly submit coursework for moderation are becoming good at organising their samples of work and at getting the best from their candidates. Examiners look forward to further improvement in candidate performance over coming years

Paper 0620/05
Practical Test

General comments

The majority of candidates successfully completed both questions. Some Centres experienced problems with the preparation of solutions for **Question 1**. Supervisor's results were submitted by the majority of Centres – only a few did not enclose supervisor's results. These results were taken into consideration when marking the work of candidates from a particular Centre. A minority of Centres used iron (II) ammonium sulphate in **Question 2** instead of iron (III) ammonium sulphate.

Comments on specific questions

Question 1

The majority of candidates successfully completed the five experiments and thus the table of results. Times were sometimes not recorded in seconds e.g. 1.13 minutes was the type of common mistake which was prevalent.

In **(a)** results were often correctly plotted on the grid. However, a minority of candidates chose an inappropriate scale for time axis. Smooth line graphs were rare – joined up medical charts and multiple lines were common.

Part **(c)** was a good discriminator. Weaker candidates were unable to grasp the idea that experiment number 3.5 would give the required answer.

Part **(d)(ii)** required reference to the concentration of the potassium bromate. Only the better candidates referred to collision theory.

The sources of error in **(e)** were often very vague e.g. references to inaccurate stop clock/readings and parallax errors often cited with regard to the measuring cylinders. Only the better candidates were able to give meaningful errors and improvements e.g. use a burette instead of a measuring cylinder/repeat the experiments and take the average time.

Question 2

Part **(b)** was a good discriminator. Reference to insoluble brown precipitate scored full marks. Few candidates referred to the smell of the gas in **(ii)**.

Part **(d)** required reference to gas evolution and the description of the test. Incorrect tests were "glowing splint pops". Only the better candidates spotted the white precipitate in **(e)**.

Conclusions to the nature of **X** often referred incorrectly to nitrate ions – candidates did not realise that aluminium was not present in test **(b)**. Iron (II) ions ammonia and iodide ions were also common incorrect answers.

Paper 0620/06
Alternative to Practical

General comments

The vast majority of candidates attempted all of the questions. Examiners noted that there appeared to be fewer very poor scripts but also fewer very good scripts.

Question 4, the analysis question was answered less well than in previous papers. **Question 2**, parts **(b)** to **(e)** were poorly answered despite testing basic knowledge of practical chemistry.

Comments on specific questions

Question 1

Generally well-answered apart from the fractionating column which was often wrongly labelled. Sim[illegible] rather than fractional distillation was common in **(c)**.

Question 2

In **(b)** mention of ethanol was rare – many candidates referred to smells or dangerous gases.

Gloves was the answer given by a large number of candidates in **(c)**. Only the better candidates referred to the flammability of the ethanol.

In **(d)** the majority of candidates thought a watch glass was a glass you could watch or see the reaction through or a stop watch!

In part **(e)** decant was confused with filtration and the solid settling.

Part **(f)** was well-answered, though a significant number of candidates stood the paper in the orange solution.

Question 3

The table was generally correctly completed apart from *Experiment 5* – 1 minute 22 seconds was common instead of 82 seconds. Parts **(a)** and **(b)** were well-answered. In part **(c)** reference to collision theory was rare. Possible sources of error in **(d)** were often vague as were suggested improvements. A significant minority of candidates thought that the varying amounts of different solutions was an error, and suggested they be kept constant. The suggestion to use 'a more accurate measuring cylinder' was common.

Question 4

The quality of answers was Centre dependent. In part **(f)(ii)** only the better candidates realised that iron(III) ions had been reduced to iron(II) ions.

Part **(g)** was poorly answered. Anions and cations were confused and few candidates deduced the presence of the ammonium ion. Nitrate was a common incorrect answer.

Question 5

Parts **(a)** to **(d)** were generally well-answered. In **(e)** some candidates lost 2 marks by giving the two tubes in the central flask as separate mistakes. Vague answers referred to the lack of a lid on the gas jar and missed the point with regard to upward delivery.

Question 6

Some very poor answers indicated that the question was not carefully read. A large number of answers referred to *heating* the coal instead of *burning* it.

A large number of candidates added acidified potassium dichromate solution directly to the coal samples with consequent lengthy description of the colour changes.