CHEMISTRY

Paper 0620/01
Multiple choice

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

General comments

Some 12 741 candidates sat the examination. They achieved a mean mark of 26.8. The marks were well spread with a standard deviation of 7.9. The reliability coefficient was also very good.

The comments below tend to draw attention to the performance of the lower-scoring candidates.

Comments on individual questions

Question 5

The facility index was good with very good discrimination. This latter was probably a consequence of the fact that more of the lower-scoring candidates chose response A than the key (C). This indicates that such candidates did not read the question with sufficient care. The stem of the question refers to “atoms or ions” so that the number of protons, not electron structure, was the issue.

Question 6

A similar comment applies here in that response A was more popular with the lower-scoring candidates than the key (D). In this case, however, the misunderstanding relates to what is meant by 'nucleon number'.

Question 7

The lower-scoring candidates seem merely to have guessed between responses A, B and C.

Question 10

Another question in which the lower-scoring candidates favoured responses other than the key, i.e. responses A and D, rather than B. Simple lack of knowledge seems to be the explanation here.

Question 11 and **21** were both found rather easy and did not discriminate well.

Question 13 was found marginally hard but with excellent discrimination, probably due to the fact that the lower-scoring candidates seem to have guessed between all four responses.

Question 19 proved to be decidedly hard. The key (D) was the least popular choice amongst the lower-scoring candidates and some 28% of the higher-scoring candidates opted for response B. The (VI)'s in the equation indicate that the oxidation state of chromium does not change and, with an excess of alkali being added, the pH increases.

Question 20

A third of the lower-scoring candidates chose A – possibly misunderstanding the question.

Question 22 was disappointingly hard across the ability range. More than 50% chose response C, rather than the key (D). Zinc is not a very reactive metal and neither its carbonate nor its hydroxide is soluble in water.

Question 25

The majority of the lower-scoring candidates seem merely to have guessed between response B, C and D. This was a simple question of recall of trends in the Group 1 metals.

Question 28 was found slightly hard with 70% of the lower-scoring candidates and 20% of the higher-scoring candidates choosing response B rather than the key (A). In diagram B, the different particles are arranged regularly, implying the definite stoichiometry of a compound whereas, in diagram A, there is a random arrangement of the different particles, typical of an alloy.

Question 30

The lower-scoring candidates seem to have guessed across all of the responses.

Question 32 was found quite hard, with response A being unduly popular across the ability range. However, the syllabus refers to mild steel being used for car bodies.

Question 34

Once again, the lower-scoring candidates were divided between responses A, B and C.

Question 39 and 40

Lower-scoring candidates also found these two questions difficult, giving answers across all 4 responses in **Question 39** and responses A, B and C in **Question 40**).

CHEMISTRY

Paper 0620/02

Core Theory

General comments

Many candidates tackled the paper well and good answers were seen in many parts of the paper, e.g. **Questions 1**, **3** and **7**. The range of marks obtained by the candidates was very wide and most were entered at the appropriate level. There were, however, more very high scoring candidates compared with the past few sessions. 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 ionic structures, few were able to write the structure of a chlorine molecule correctly, and many were found to have a poor knowledge of inorganic reactions and tests for specific ions or molecules. For example, many could not remember the bromine water test for an unsaturated hydrocarbon or the test for aluminium ions. A surprising number of candidates had difficulty with writing word equations correctly: the arrow was often omitted and colour changes, rather than products, were sometimes given on the right hand side of the equation. Many candidates insisted on writing symbol equations where word equations were asked for and in consequence wrote incorrect symbols or formulae. The apparatus for chromatography was often badly drawn and many lost marks because of poor or non-existent labelling. There were only a few instances where candidates disadvantaged themselves by giving multiple answers. For example, a small number of candidates gave multiple answers to **Question 1(d)** where a box was required to be ticked. It was encouraging to note that many candidates were able to explain the environmental effects of acid rain in **Question 2(b)**, an area which in previous Papers has not been well answered. In more extended questions, candidates often disadvantaged themselves by sloppy and non-specific writing. It was encouraging to note, that many candidates' appreciated the correct method to do the calculations in **Questions 5(e)** and **5(f)**, although in the latter, many chose to calculate the percentage impurity rather than the percentage purity. This may partly reflect the fact that a recent Paper 2 required the percentage impurity to be calculated. A general point may be made about the use of the word 'substance'. candidates should be advised to use this only as a very general term when they cannot use others such as 'atoms', 'molecules' or compounds. The use of 'substance' indiscriminately can lead to failure to gain marks e.g. when defining terms such as 'isotope' or 'compound'.

Comments on specific questions

Question 1

This was the best answered question on the Paper with most candidates scoring well over half marks. The major errors arose from a lack of knowledge of the test for an unsaturated hydrocarbon. The most encouraging feature of the candidates' answers in this session was the improved ability to write a suitable definition of a compound.

(a) (i) This was the least well answered of questions in **(a)**, with F (graphite) often being incorrectly selected as being ionic. This was perhaps because some candidates recognised it as a giant structure but could not make the distinction between covalent and molecular forms of these structures.

(ii) This was generally correct, the commonest incorrect answer being A or D.

(iii) Almost all candidates gained this mark.

(iv) This was generally correct, with the commonest incorrect answer being A – a result of the misunderstanding of the word 'unsaturated'.

(b) The test for an unsaturated hydrocarbon was not well known, despite the fact that most candidates had answered **Question (a)(iv)** correctly. A common error was to give the limewater test for carbon dioxide. Other common mistakes included 'add water' (without the bromine) or add acid. Most of the candidates who gained the mark for the test, also got the mark for the result. The commonest error for the latter was to suggest that the bromine remained brown.

(c) Most candidates could identify calcium carbonate. Many gave the formula rather than the name but on this occasion they were not penalised as long as the formula was correct. A minority, however, penalised themselves by writing incorrect formulae such as $CaCO_2$.

(d) This part was well answered, the commonest error being to suggest that graphite is used for cutting metals. This presumably arose because candidates identified the incorrect allotrope of carbon, thinking that F was diamond rather than graphite or simply not knowing the difference in uses. A not inconsiderable number of candidates disadvantaged themselves by selecting two boxes, when the question stated that only one use was required.

(e) It is encouraging to note that most candidates were able to define the term *compound*. Although a few failed to refer to bonding or joining of the different atoms, most candidates gave a satisfactory description. Other common errors were to suggest that 'two or more atoms are combined' (which could also apply to a molecule) or that 'it is a combination of metals' (which would be an alloy). Another common error was to suggest that a compound is a mixture of elements.

(f) This was generally answered correctly. The commonest errors were to suggest that the bonding is ionic or single.

Question 2

This question was fairly well answered and it was encouraging to note that many candidates scored 3 or 4 marks on the extended writing in **(b)**. **Part (d)(ii)** was surprisingly poorly answered by many candidates who just put down numbers without any charges or left the table blank. Most candidates understood the term isotope but fewer could distinguish between industrial and medical uses in **(e)**.

(a) Just over half the candidates scored this mark. Many failed to write the name of the chemical present in limestone and were content to write the formula, often incorrectly. Common errors included (i) calcium chloride, (ii) to write calcium without the carbonate and (iii) to write the individual elements present i.e. calcium + carbon + oxygen.

(b) Although many candidates scored at least two marks, there are still many misconceptions about acid rain: (i) carbon dioxide was often held, incorrectly, to be responsible (usually in addition to sulfur dioxide), (ii) vague statements about air and water eroding the limestone were often seen and (iii) the sun's rays and heat were often stated to be responsible. Although the last of these errors is a possible mechanism, albeit over a long time period, the question clearly refers to atmospheric pollutants. Candidates should be advised to read the question carefully and stick to what is on the syllabus rather then go down geological byways.

(c) Almost all candidates gained the mark for this part, usually for mentioning rusting or corrosion.

(d) (i) Many candidates understood the meaning of the word isotope, even if they did not express it in a very exact form. Candidates should be advised that it is better to suggest that there are different numbers of neutrons or a different mass number rather than 'different (relative) atomic masses', since the latter often refers to a mixture of isotopes.

(ii) Many candidates had difficulty with this part, either because they failed to put charges in the table or because they muddled up the charges of the proton and electron.

(iii) The correct answer for the number of nucleons (56) was rarely seen. Common errors were (i) to mistake the term nucleon for neutron, giving an answer of 30, (ii) to add the number of all the particles, giving an answer of 82 and (iii) 54, through incorrect addition.

(e) Many candidates gave medical uses rather than industrial uses for radioactive isotopes and so failed to gain the mark here. The commonest correct answers were related to production of nuclear power or for measuring the thickness of paper.

(f) Few candidates recognised nitric acid. Many suggested hydrogen nitrate, but more exotic answers included 'hydronitrate oxide' or nitrogen hydroxide'. Most candidates who used oxidation numbers, described iron nitrate correctly as iron(II) nitrate. It should be noted, however, that in the core Paper, candidates are not expected to know the oxidation numbers of specific compounds and that the use of these can lead to problems such as metallic iron being described as iron(II).

Question 3

This question was well done by most candidates, the exception being **(f)(ii)**, where a common error was to draw the electronic structure of a chlorine atom rather than a chlorine molecule. **Parts (a)**, **(c)** and **(f)(i)** were almost invariably correct but a wide variety of incorrect answers were seen in the other parts.

(a) Nearly all candidates scored the mark for chloride, although a few put chlorine and a small number put calcium, perhaps through a mis-scanning of the table.

(b) Although many candidates gave the correct answer, sulphate, there were a variety of incorrect answers, including sulphide, sulphur oxide and even sulphur itself.

(c) Most candidates gained this mark. The usual error was to suggest that calcium is in Group I.

(d) Sodium chloride was chosen as the compound most often found in seawater by about one-third of the candidates. Many just wrote 'salt', which was just about acceptable, but others failed to get the mark by just focussing on one of the ions e.g. chloride. Calcium sulphate was also often seen. Another common error was the answer 'water'. Although water is obviously the compound present in the greatest quantity in seawater, the question asked for the most likely compound to be found after the water has been evaporated.

(e) A wide variety of answers were given. The commonest errors were (i) to put down sodium plus chlorine (perhaps the candidates were still thinking of sodium chloride from the last part) and (ii) chloride and bromide (where the term cathode had not been understood).

(f) (i) The majority of candidates suggested, correctly, that chlorine is in Period three of the Periodic Table. The two commonest errors were (i) Period 2 (forgetting that Period one contained just two elements) and (ii) Period 7 (selected by those who mistook Groups for Periods)

(ii) Few candidates drew a correct diagram of the chlorine molecule. Those who realised that the molecule is diatomic obtained both marks. Only a few left out the bonding electrons. Most candidates made a correct drawing of a chlorine atom but no credit was given for this.

(g) Candidates who specified that sodium chloride is soluble in water were most likely to obtain at least one of the marks available. Many candidates failed to get any marks because their answers were far too vague and did not focus in on the specific case in hand. Answers such as 'filtration removes solids' or 'distillation separates two liquids' cannot be given credit in a question which is context based. Many candidates gave even vaguer answers such as 'filtration would not work' or 'filtration removes less salt than distillation'.

Question 4

Most candidates scored at least half the marks available in this question. It was encouraging to note that even poor candidates were able to explain the electron transfer when sodium reacts with chlorine. The test for aluminium ions was better known than when asked in a previous session but few gained all three marks for this section. The equation and explanation in **(e)** were not done as well as expected considering that questions similar to this are often asked.

(a) As in **Question 2(e)**, the majority of the candidates failed to distinguish between an industrial use and a general use. Many gave a use in the home such as 'for cooking' or 'for washing' (often followed by 'dishes or 'clothes'). Many candidates also suggested that 'to drink' was an industrial use, although if they specified something along the lines of 'to make bottled drinks', which had an industrial connotation, they were given credit.

(b) Few candidates could explain convincingly, how and why the water is filtered. The best answers included using the idea of small spaces between the sand and the relative sizes of the particles. Many candidates wrote about filtering off large stones, rocks and branches. These would have been removed in the sedimentation tank (or by screens beforehand).

(c) Although many candidates are still poor at remembering the tests for ions, there has been a slight improvement over previous years. Many candidates realised that sodium hydroxide produced a white precipitate, but less than half realised that the precipitate is soluble in excess sodium hydroxide. Many candidates did not mention what happened when excess sodium hydroxide was added, despite the fact that there are three marks for the question. The colour plus the word 'precipitate' usually only gains one mark in this sort of question.

(d) Most candidates realised that chlorine kills bacteria in the water, although a few wrote rather vaguely that 'it removes bacteria'. Vague statements such as 'it purifies the water' or it 'cleans the water' are not acceptable. A small number of candidates suggested that chlorine neutralises the water.

(e) (i) The word equation was written correctly by only about half the candidates. Common errors were to omit one of the products, (ii) to write potassium chlorine rather than chloride, or (iii) to write the colour of the bromine as the product rather than the name bromine. A considerable minority of the candidates suggested that chlorine bromide plus potassium were the products.

(ii) Although many candidates realised that bromine was more reactive than iodine, many made the wrong comparison by comparing iodine with potassium bromide or with metallic potassium. It was not uncommon to see a 'comparison' which was far too vague e.g. 'iodine is less reactive'. This does not tell us what iodine is being compared with – and this is necessary given the sort of incorrect answers stated above.

(f) (i) This was almost invariably correct. The most common error was to suggest neutralisation.

(ii) About two thirds of the candidates realised that the bonding in sodium chloride is ionic. There were few incorrect answers other than 'covalent'.

(iii) This was well answered by nearly all candidates. The commonest errors were either to suggest that the electrons were shared between the sodium and chlorine or to use the word 'atom' in place of 'electron'.

Question 5

Many candidates scored fewer than half marks on this question, and although the calculations in **(e)** and **(f)** were often correct, the scoring in the other parts appeared rather 'hit and miss'.

(a) The correct answer (hydrogen) was given by a minority of candidates and this often appeared to be Centre-specific. Incorrect answers included sulphur dioxide, carbon dioxide and oxygen in equal measure. A variety of solids such as magnesium oxide were also seen as an answer.

(b) (i) Few candidates gave the correct answer. A common error was to suggest that the excess magnesium 'kept the reaction going' or 'made it react quickly' – both alluding to rates rather than extent of reaction. Some answers such as 'because the magnesium reacts with the sulphuric acid' were not given credit as they were held to be not specific enough.

(ii) About half the candidates gave the correct answer 'filtration'. Incorrect answers included 'distillation', 'crystallisation' and 'adding water'.

(c) Many candidates failed to obtain a mark here through inaccuracy in writing. Many wrote about the magnesium sulphate being evaporated. Some even went as far to suggest that the crystals evaporated. Good answers to this question involved the evaporation of water from the solution. Very few candidates gained the mark for drying the crystals – this was also very Centre-dependent.

(d) (i) Many candidates ignored the word 'other' in the stem of the question and merely repeated the reaction between magnesium and sulphuric acid. Very few gave a correct answer: 'the reaction of magnesium oxide with the acid' or 'the reaction between magnesium and copper sulphate' were the ones most commonly seen. Other incorrect answers included (i) magnesium + sulphate (ii) magnesium + sulphur (iii) magnesium + sulphur dioxide. Some candidates realised that magnesium could react with a metal sulphate, but many did not use their knowledge of the reactivity series and gave unacceptable answers such as magnesium + calcium sulphate.

(ii) Those candidates who chose a correct combination of reactants in **(d)(i)** almost invariably gained a mark for this part.

(iii) Although many candidates realised that the impurities may be harmful, some failed to gain the mark because they went as far as to suggest that the impurities would kill the patient or that the medicine would contain bacteria or cause a disease.

(e) It was encouraging to note that most candidates could do the calculation (answer = 6 g). A common error was to multiply 1.2 by 4.8 then divide by 24.

(f) Although a large proportion of the candidates were able to do this calculation (answer = 97.5%), many ended up by writing down the percentage impurity (i.e. 2.5%) and then stating that it was the percentage purity. A minority of candidates gave the incorrect answer 3.9, by multiplying 19.5 by 20 then dividing by 100.

Question 6

Although many candidates scored just over half marks for this question, most had difficulty in describing how fractional distillation works and even fewer could adequately describe the meaning of the term 'fraction' as applied to distillation. Most candidates scored full marks in **(b)** but it was surprising to note how many failed to respond correctly to **(c)(iii)** (what is the function of the catalyst) compared with the responses to a similar question in previous sessions. **Part (c)(iv)** was also not answered as well as expected.

(a) (i) Very few candidates were able to describe the meaning of the term 'fraction'. Many gave a general non-contextual meaning of the word e.g. 'dividing an object into portions', whilst others merely described the process of fractional distillation. Very few focused on the fact that it was a <u>group</u> of molecules / hydrocarbons.

(ii) The term *fuel gas* was not seen as often as expected. Many candidates thought, incorrectly, that the temperature was lowest at the bottom of the column and put the answer 'bitumen'. Lack of logical thinking was often demonstrated, in that many candidates went on to write, in **(iii)**, that 'the boiling points were higher at the top of the column'. It was also surprising to note that many candidates suggested that petrol or the lubricating fraction had the lowest boiling points. Presumably such candidates were concentrating only on the pipes which came out from the side of the column.

(iii) This was poorly answered, with few candidates obtaining both marks. The commonest mark awarded was for the suggestion that different fractions had different boiling points. Fewer candidates mentioned the temperature gradient in the column and hardly any accessed any of the other marking points.

(iv) Just under half the candidates scored both the marks. The commonest errors were to suggest that paraffin was used for cars or candles (unfortunately muddling with paraffin <u>wax</u>) and that bitumen was used for fuel. Some candidates disadvantaged themselves by giving vague answers such as 'for fuel'.

(b) (i) Most candidates could explain cracking in simple terms of breakdown of large molecules / hydrocarbons into smaller ones. The few candidates who failed to gain this mark usually did so because they referred to breakdown of polymers or referred to distillation e.g. 'separating different sized molecules'. Some candidates disadvantaged themselves by vague writing about 'substances' rather than molecules or hydrocarbons.

(ii) The formula completion was generally worked out correctly as $C_{12}H_{26}$. The major errors were mathematical slips such as $C_{12}H_{28}$ or $C_{12}H_{24}$. A few candidates put 2 C_6H_{13}.

(c) (i) Although many candidates gained the mark, fewer than expected realised that a catalyst speeds up a reaction. The commonest errors were to suggest that a catalyst starts a reaction or that it joins ethene to steam.

(ii) Most candidates understood the meaning of *reversible reaction*. The commonest errors were to suggest that the symbol means just 'reaction' or 'equals'.

(iii) Most candidates recognised fermentation. The commonest error was to choose 'combustion'.

(iv) The colour change of litmus was invariably correctly identified. Many candidates, however, failed to gain the second mark because they did not write down an observation e.g. bubbles/ effervescence. Instead, many wrote about neutralisation or carbon dioxide (or other gases) being given off, which are inferences not observations. Several candidates, still thinking about litmus, suggested that the solution went blue.

Question 7

Many candidates scored over half the marks available for this question. **Part (c)** was poorly done, with many candidates being unable to draw a simple apparatus for chromatography. As in previous years, candidates found the question about diffusion in **(a)** difficult. Although the word diffusion often appeared, explanations for this process were often unconvincing. Many candidates had difficulty with **(b)**, once again emphasising that particle theory is not well understood.

(a) Most candidates scored one of the marks available, usually either by using the words 'dissolve' or 'diffuse' in a correct context. Very few candidates specified the particles that were moving i.e. water molecules or copper or sulphate ions. Common misconceptions included (i) the suggestion that the crystals move to hit the water particles, (ii) that the copper sulphate reacted with the water, or (iii) that copper particles move in between the spaces in the water molecules. The last of these reflects the common misconception that the water molecules somehow stay in position and that the solute particles merely move between them.

(b) Although many candidates realised that there was some sort of regular arrangement in crystals, many others though that the particles 'slide past each other' or are 'scattered evenly', the latter suggesting that they are wide apart, which is incorrect. Just over half the candidates suggested that the motion in crystals was 'moving very slowly' or there is 'only a little movement'. This is not sufficient to gain a mark, since movement implies motion from place to place.

(c) Few candidates scored both marks for the diagram. Some candidates disadvantaged themselves by not labelling their diagrams. This was an important part of this question, for without the labels it is unclear whether the candidate can or cannot distinguish where the solvent goes and where the spot of solution goes. Judging by the labelled diagrams seen, many candidates believe incorrectly, that the solution of copper ions goes in the beaker and the solvent is somehow already on the filter paper. Other common errors were to draw the starting / datum line below or on the solvent level or to fail to draw a beaker or other receptacle for the solvent and have the solvent mysteriously on the paper.

(d) (i) Most candidates correctly selected the cathode from the list. The commonest errors were to select either the anode or the cation.

(ii) About half the candidates scored both marks here. Common errors were (i) to suggest that the pure copper foil deceased in size/ mass, (ii) to write that copper was attracted to the cathode without suggesting that it was deposited and (iii) to suggest that sulphate was deposited on the impure foil. The last error in this list was generally given by those candidates gaining only one mark.

Location Entry Codes

UNIVERSITY *of* CAMBRIDGE
International Examinations

As part of CIE's continual commitment to maintaining best practice in assessment, CIE has begun to use different variants of some question papers for our most popular assessments with extremely large and widespread candidature, The question papers are closely related and the relationships between them have been thoroughly established using our assessment expertise. All versions of the paper give assessment of equal standard.

The content assessed by the examination papers and the type of questions are unchanged.

This change means that for this component there are now two variant Question Papers, Mark Schemes and Principal Examiner's Reports where previously there was only one. For any individual country, it is intended that only one variant is used. This document contains both variants which will give all Centres access to even more past examination material than is usually the case.

The diagram shows the relationship between the Question Papers, Mark Schemes and Principal Examiner's Reports.

Question Paper	**Mark Scheme**	**Principal Examiner's Report**
Introduction	Introduction	Introduction
First variant Question Paper	First variant Mark Scheme	First variant Principal Examiner's Report
Second variant Question Paper	Second variant Mark Scheme	Second variant Principal Examiner's Report

Who can I contact for further information on these changes?
Please direct any questions about this to CIE's Customer Services team at: international@cie.org.uk

CHEMISTRY

Paper 0620/31

Extended Theory

General Comments

The majority of candidates attempted most questions, with many candidates giving good answers. In particular, questions **1**, **2(b)** and parts of **3**, **4** and **5** were all generally answered well. However, there were some issues of clarity that need to be addressed as these made it difficult for the Examiners to find the intended answer. For example, it is essential that when a candidate continues a question later in the paper, usually on the blank page, that this is indicated in the space allocated for the question. Similarly when the answer needs to be rewritten this ought to be referenced in the original space. Examiners always mark answers that go outside the space provided, but as a general rule, candidates should be discouraged from doing so, since it frequently generates ambiguities or contradictions.

Similarly, the practice of drafting the response in pencil and then going over it in ink is not ideal, since it not only uses up valuable examination time, it also greatly reduces legibility for the Examiners. Erasures should be complete; if this is not possible the material ought to be deleted and rewritten.

Candidates should be advised that they should not offer more than the required number of answers in the hope that the Examiner will select the correct response(s). Candidates rarely gain credit from this.

Individual Questions

Question 1

(a) to (g) Many candidates scored high marks. Those who used symbols correctly were not penalised, although giving the name would have been a better option. For example 'fe' was not accepted as the symbol for iron. The major reason for error was slipping into another period, typically in **(d)** giving argon not krypton.

Question 2

(a) It is unfortunate that many candidates had not learnt the basic information needed to complete this table. Typical errors were:

- relative charges given as + and – not 1+ and 1-
- the relative mass of an electron thought to be 1(amu) or an incorrect fraction
- neutron assigned a charge
- the symbol for a proton written as Z

(b) (i) The required explanation is that there are equal numbers of electrons and protons and their charges balance, or the electron has a negative charge and the proton a positive one. The particles had to be named rather than just state that there are equal numbers of positively charged particles and negatively charged ones. Candidates should be advised that repeating comments from the question does not usually gain the mark – 'they are electrically neutral' or 'they have no overall charge' did not gain the second mark. Some thought that the presence of neutrons conferred neutrality upon the atom.

(ii) The formation of positive ions was well answered – by losing electron(s). However, this was not always followed by stating that the particle has more protons(+) than electrons (–). Some candidates were under the misconception that atoms can gain protons.

(iii) This question had to be answered in terms of particles so atomic number and mass number were not accepted. The response has to be: different number of neutrons, same number of protons or electrons.

(iv) There were a number of acceptable suggestions given in this slightly unusual question:
- there are no gaps in the sequence of proton number 1 to 103
- two elements cannot have the same Z
- the proton numbers of the elements are consecutive
- all the elements from Z = 1 to Z = 103 are known

The question cannot be answered in terms of the mass numbers of the elements.

This question is a prime example of where a bit of initial thought would have been highly beneficial. It would have eliminated unacceptable explanations such as 'the proton numbers are in increasing order' - this does not necessarily mean that consecutive numbers differ by 1.

Question 3

(a) The Examiners were looking for (respectively): impure copper; (pure) copper; any (soluble) copper salt or the presence of Cu^{2+} (usually copper sulphate was suggested but the chloride and nitrate were also given). However, the most common mistakes were the reversal of pure and impure, the use of graphite electrodes and the electrolyte was sometimes thought to be copper oxide, sulphuric acid or copper hydroxide.

(b) Usually answered correctly, the most common errors were to write the equation either for the cathode reaction or for the discharge of OH^- or for the discharge of Cl^-.

(c) Malleable and ductile are essentially the same property, the ability of a material to plastically deform, that is change its shape without breaking. Malleability or ductility was accepted once in the four properties. It was necessary to state that copper is a <u>good</u> conductor of electricity/heat. Copper is neither cheap, which would not been accepted as a property even if it had been true, nor does it have a low density. 'Copper does not rust' was not credited, since only ferrous materials can rust, but 'copper is resistant to corrosion' was accepted. Candidates need to be aware that corrosion and corrosive have different meanings.

However, in general, this was a well answered question.

(d) The uses of copper were very well known. One unusual use, that was credited, was copper nails (they are used in roofing).

Question 4

(a) The two word equations were usually correct as was the symbol equation for the reaction of lithium oxide with sulphuric acid. The symbol equation for the reaction between CuO with H^+ was rarely correct and usually included H_2 not an acid.

(b) Bases were recognised as species that are proton or hydrogen ion acceptors. A minority thought that water was a base because it could split to form OH^-.

(c) The candidates had to discuss the extent of ionisation/dissociation or the balance between ions and molecules. Most were able to explain the difference using the following ideas: Sulphuric acid is fully ionised, ethanoic acid is partially ionised; in solution sulphuric acid is mainly ions and a few molecules but ethanoic acid is mainly molecules and a few ions.

The comment that sulphuric acid is fully ionised and ethanoic acid is not was awarded 1 mark.

Question 5

(a) (i) The correct answer was that the concentration of reactants increased and that of products decreases. A widespread mistaken belief was that both concentrations would increase or decrease.

(ii) The explanation of why a decrease in pressure moved the position of equilibrium to the left proved elusive, with most candidates attempting to explain the movement in the position of equilibrium in terms of reaction rates. However there were some excellent answers of the type 'a decrease in pressure favours the side with more moles of gas or the bigger volume'.

(b) There is no direct evidence in the question that energy is given off by the forward reaction but there is evidence that the forward reaction is favoured by low temperatures or by cooling. The forward reaction is exothermic. The most frequent error was that the forward reaction is bond forming so it must be an exothermic reaction. It is bond forming (C-C*l*), but it is also bond breaking (C*l*-C*l*) and the carbon-oxygen triple bond changes into a double bond. No conclusion can be drawn about the thermicity of the reaction unless the bond energies are known.

(c) Generally the acidic compounds were correctly named as carbon dioxide or carbonic acid and hydrogen chloride or hydrochloric acid. A minority thought that they were a carboxylic acid and carbon monoxide.

(d) It is strongly recommended that candidates use the notation given in the question, with the electron pairs arranged symmetrically around the atom, rather than curved or straight lines, in these formulae. Well presented and neat diagrams are essential in this type of question. The major mistakes were to put too many or too few electrons in the outer levels of the oxygen and carbon atoms.

Question 6

(a) (i) Candidates found this question difficult and the two available marks were rarely awarded together. The Examiners were looking for mention of large surface area and high collision rate. The increased collision rate was variously attributed to energy from the explosion, heating the flour and light.

(ii) The word equation involved anything from carbohydrate and flour, both acceptable, to glucose, sugar, carbon and methane. The products ranged from flour oxide to heat and an explosion. All that was required was:
carbohydrate + oxygen = carbon dioxide + water

(b) The marking points were: rate of reaction depends on light; more light, more silver; or blacker/thicker card less light. The first mark was rarely awarded.
On some papers the account was both clear and succinct and fitted into the space allocated but on others it was written in spaces over several pages. This question highlighted the need to plan the response before starting to write and not to have to resort to an evolutionary style of writing which almost always results in contradictions. Some of these extended accounts did not even mention light, with the result that no marks could be awarded.
In contrast there were some excellent answers, of which the following is an example:
'The rate depends on light; more light the reaction goes faster. The uncovered section received the most light, it went black (or all the silver bromide changed into silver). The paper stopped some of the light, it went grey (or some of the silver bromide changed into silver). The thick card blocked all the light, it stayed white (or no silver was formed)'.

(c) (i) Many candidates said that an enzyme is just a catalyst rather than a biological catalyst.

(ii) Respiration was incorrectly described as being the exchange of gases. However most realised that it is the release of energy (from food) but far fewer added by living organisms or in cells.

(iii) It was thought that the fermenting mixture had to be cooled:

- to condense the ethanol
- to increase the yield by moving the position of an equilibrium
- because ethanol is inflammable
- to avoid an explosion

These misconceptions were more popular than the correct explanation that is a high temperature would kill the yeast or denature the enzymes. There was some confusion both in this part and in **(iv)** about "killing" and "denaturing". When these terms are applied to yeast and enzymes, yeast can be killed, enzymes are denatured.

(iv) To gain the first marking point - all the glucose is used up - the word *glucose* was specifically required. 'Reactant', 'sugar' and 'yeast' were not credited. For the second mark, candidates needed to state that either that the yeast is killed or that the enzymes are denatured by ethanol.

(v) The techniques were: filtration or centrifuging or decanting, to remove the cloudiness; and fractional distillation to separate the ethanol/water mixture.

Question 7

(a) This question provided a perfect example of why excessively lengthy descriptions simply serve to confuse. A simple description was needed, such as: repeat the experiment without using the indicator; partially evaporate solution; allow to crystallise; dry crystals using filter paper.

Typical errors seen were:

- filter the solution without adding carbon
- evaporate to dryness
- add excess acid
- use fractional distillation
- filter before evaporation
- evaporate to dryness then add 10 H_2O
- evaporate then add water and dry crystals
- dry crystals and then add water

(b) The solution to this calculation is given below.
Number of moles of NaOH used = 0.025 × 2.24 = 0.056
Maximum number of moles of $Na_2SO_4.10H_2O$ that could be formed = 0.028

Mass of one mole of $Na_2SO_4.10H_2O$ = 322g
Maximum yield of sodium sulphate-10-water = 9.02g
Percentage yield = 42.8%

The most common error was to give the number of moles of $Na_2SO_4.10H_2O$ as 0.112 not 0.028. Some candidates seemed to be unfamiliar with this type of calculation and the mole concept; their mistakes did not show any pattern just a random manipulation of the figures in the question, for example 'percentage yield = 3.86/322 = 1.2%'.

Question 8

(a) The majority of candidates discussed either the combustion of wood or that there would be less photosynthesis causing higher levels of carbon dioxide, but not both, despite the question being worth two marks. There were two main issues:
Some candidates talked about burning hydrocarbons, fossil fuels or merely specified that burning produces carbon dioxide;
Trees can respire and photosynthesise but these processes are not identical, one absorbs carbon dioxide and the other produces it. The comment 'when trees are cut down there is less respiration' is a true statement, but it does not answer the question.

(b) (i) The third food group was correctly identified as fat by the vast majority of the candidates, with just a few suggesting either fibre or vitamins.

(ii) The diagram for the structure of starch was generally well drawn.

(iii) This first part of this question was well answered by most of the candidates; they knew that it is the amide linkage in both polymers. Identifying two differences between proteins and synthetic polyamides proved more difficult. Two of the following were needed:
Synthetic polyamide usually two monomers;
Protein many monomers;
Protein monomers are amino acids, or proteins hydrolyse to amino acids, or a protein monomer has one $–NH_2$ and one –COOH group;
Synthetic polyamide each monomer has 2 $–NH_2$ or 2COOH groups, or monomers are dioic acid and diamine.

CHEMISTRY

Paper 0620/32

Extended Theory

General Comments

The majority of candidates attempted most questions, with many candidates giving good answers. In particular, questions **1**, **2(b)** and parts of **3**, **4** and **5** were all generally answered well. However, there were some issues of clarity that need to be addressed as these made it difficult for the Examiners to find the intended answer. For example, it is essential that when a candidate continues a question later in the paper, usually on the blank page, that this is indicated in the space allocated for the question. Similarly when the answer needs to be rewritten this ought to be referenced in the original space. Examiners always mark answers that go outside the space provided, but as a general rule, candidates should be discouraged from doing so, since it frequently generates ambiguities or contradictions.

Similarly, the practice of drafting the response in pencil and then going over it in ink is not ideal, since it not only uses up valuable examination time, it also greatly reduces legibility for the Examiners. Erasures should be complete; if this is not possible the material ought to be deleted and rewritten.

Candidates should be advised that they should not offer more than the required number of answers in the hope that the Examiner will select the correct response(s). Candidates rarely gain credit from this.

Individual Questions

Question 1

(a) to **(g)** Many candidates scored high marks. Those who used symbols correctly were not penalised, although giving the name would have been a better option. For example 'fe' was not accepted as the symbol for iron. The major reason for error was slipping into another period, typically in **(d)** giving argon not krypton.

Question 2

(a) It is unfortunate that many candidates had not learnt the basic information needed to complete this table. Typical errors were:

- relative charges given as + and – not 1+ and 1-
- the relative mass of an electron thought to be 1(amu) or an incorrect fraction
- neutron assigned a charge
- the symbol for a proton written as Z

(b) (i) The required explanation is that there are equal numbers of electrons and protons and their charges balance, or the electron has a negative charge and the proton a positive one. The particles had to be named rather than just state that there are equal numbers of positively charged particles and negatively charged ones. Candidates should be advised that repeating comments from the question does not usually gain the mark – 'they are electrically neutral' or 'they have no overall charge' did not gain the second mark. Some thought that the presence of neutrons conferred neutrality upon the atom.

(ii) The formation of negative ions was well answered – by gaining electron(s). However, this was not always followed by stating that the particle has fewer protons (+) than electrons (-). Some candidates were under the misconception that atoms can lose protons.

(iii) This question had to be answered in terms of particles so atomic number and mass number were not accepted. The response has to be: different number of neutrons, same number of protons or electrons.

(iv) There were a number of acceptable suggestions given in this slightly unusual question:

- there are no gaps in the sequence of proton number 1 to 103
- two elements cannot have the same Z
- the proton numbers of the elements are consecutive
- all the elements from Z = 1 to Z = 103 are known

The question cannot be answered in terms of the mass numbers of the elements.

This question is a prime example of where a bit of initial thought would have been highly beneficial. It would have eliminated unacceptable explanations such as 'the proton numbers are in increasing order' - this does not necessarily mean that consecutive numbers differ by 1.

Question 3

(a) The Examiners were looking for (respectively): impure copper; (pure) copper; any (soluble) copper salt or the presence of Cu^{2+} (usually copper sulphate was suggested but the chloride and nitrate were also given). However, the most common mistakes were the reversal of pure and impure, the use of graphite electrodes and the electrolyte was sometimes thought to be copper oxide, sulphuric acid or copper hydroxide.

(b) Usually answered correctly, the most common errors were to write the equation for the cathode reaction, or for the discharge of OH^- or for the discharge of Cl^-.

(c) Malleable and ductile are essentially the same property, the ability of a material to plastically deform, that is change its shape without breaking. Malleability or ductility was accepted once in the four properties. It was necessary to state that copper is a <u>good</u> conductor of electricity/heat. Copper is neither cheap, which would not been accepted as a property even if it had been true, nor does it have a low density. 'Copper does not rust' was not credited, since only ferrous materials can rust, but 'copper is resistant to corrosion' was accepted. Candidates need to be aware that corrosion and corrosive have different meanings.

Despite the above comments this was a well answered question.

(d) The uses of copper were very well known. One unusual use, that was credited, was copper nails (they are used in roofing).

Question 4

(a) The two word equations were usually correct as was the symbol equation for the reaction of lithium oxide with sulphuric acid. The symbol equation for the reaction between $CuCO_3$ with H^+ was rarely correct and often included H_2 not an acid. The usual version was the following:
$CuCO_3 + H_2 = Cu + H_2O + CO_2$

(b) Bases were recognised as species that are proton or hydrogen ion acceptors. A minority thought that water was a base because it could split to form OH^-.

(c) The candidates had to specify a method and give a valid comparison between the two acids. For example:

method	electrical conductivity
comparison	sulphuric acid is the bett<u>er</u> conductor;
method	rate of reaction with a named metal or carbonate
comparison	sulphuric acid gives the faster reaction;
method	add a soluble barium salt
comparison	only sulphuric acid forms a white precipitate.

Common errors seen were:

- not specifying the metal, or suggesting an unsuitable one e.g. sodium
- giving the result for only one acid, sulphuric acid is a good conductor
- using universal indicator or even litmus
- explaining the difference between them in terms of the extent of ionisation - sulphuric acid is fully ionised, ethanoic acid is partially ionised or in solution sulphuric acid is mainly ions and a few molecules, but ethanoic acid is mainly molecules and a few ions. These ideas are correct but do not answer the question.

Question 5

(a) (i) The correct answer was that the concentration of reactants decreased and that of products increased. A widespread mistaken belief was that both concentrations would increase or decrease.

(ii) The explanation of why an increase in pressure moved position of equilibrium to the right proved elusive, with most candidates attempting to explain the movement in the position of equilibrium in terms of reaction rates. However there were some excellent answers of the type 'an increase in pressure favours the side with fewer moles of gas or the smaller volume'.

(b) There is no direct evidence in the question that energy is given off by the forward reaction but there is evidence that the forward reaction is favoured by low temperatures or by cooling. The forward reaction is exothermic. The most frequent error was that the forward reaction is bond forming so it must be an exothermic reaction. It is bond forming (C-C*l*), but it is also bond breaking (C*l*-C*l*) breaks and the carbon-oxygen triple bond changes into a double bond. No conclusion can be drawn about the thermicity of the reaction unless the bond energies are known.

(c) Generally the acidic compounds were correctly named as carbon dioxide or carbonic acid and hydrogen chloride or hydrochloric acid. A minority thought that they were a carboxylic acid and carbon monoxide.

(d) It is strongly recommended that candidates use the notation given in the question, with the electron pairs arranged symmetrically around the atom, rather than curved or straight lines, in these formulae. Well presented and neat diagrams are essential in this type of question. The major mistakes were to put too many or too few electrons in the outer levels of the oxygen and carbon atoms.

Question 6

(a) (i) Candidates found this question difficult and the two available marks were rarely awarded together. The Examiners were looking for mention of large surface area and high collision rate. The increased collision rate was variously attributed to energy from the explosion, heating the flour and light.

(ii) The word equation involved anything from carbohydrate and flour, both acceptable, to glucose, sugar, carbon and methane. The products ranged from flour oxide to heat and an explosion. All that was required was:
carbohydrate + oxygen = carbon dioxide + water

(b) The marking points were: rate of reaction depends on light; more light, more silver; or blacker/thicker card less light. The first mark was rarely awarded.
On some papers the account was both clear and succinct and fitted into the space allocated but on others it was written in spaces over several pages. This question highlighted the need to plan the response before starting to write and not to have to resort to an evolutionary style of writing which almost always results in contradictions. Some of these extended accounts did not even mention light, with the result that no marks could be awarded.
In contrast there were some excellent answers, of which the following is an example:
'The rate depends on light; more light the reaction goes faster. The uncovered section received the most light, it went black (or all the silver bromide changed into silver). The paper stopped some of the light, it went grey (or some of the silver bromide changed into silver). The thick card blocked all the light, it stayed white (or no silver was formed)'.

(c) (i) Many candidates said that an enzyme is just a catalyst rather than a biological catalyst.

(ii) Respiration was incorrectly described as being the exchange of gases. However most realised that it is the release of energy (from food) but far fewer added by living organisms or in cells.

(iii) It was thought that the fermenting mixture had to be cooled:

- to condense the ethanol
- to increase the yield by moving the position of an equilibrium
- because ethanol is inflammable
- to avoid an explosion

These misconceptions were more popular than the correct explanation that is a high temperature would kill the yeast or denature the enzymes. There was some confusion both in this part and in **(iv)** about "killing" and "denaturing". When these terms are applied to yeast and enzymes, yeast can be killed, enzymes are denatured.

(iv) To gain the first marking point - all the glucose is used up - the word *glucose* was specifically required. 'Reactant', 'sugar' and 'yeast' were not credited. For the second mark, candidates needed to state that either that the yeast is killed or that the enzymes are denatured by ethanol.

(v) The techniques were: filtration or centrifuging or decanting, to remove the cloudiness; and fractional distillation to separate the ethanol/water mixture.

Question 7

(a) This question provided a perfect example of why excessively lengthy descriptions simply serve to confuse. A simple description was needed, such as: repeat the experiment without using the indicator; partially evaporate solution; allow to crystallise; dry crystals using filter paper.

Typical errors seen were:

- filter the solution without adding carbon
- evaporate to dryness
- add excess acid
- use fractional distillation
- filter before evaporation
- evaporate to dryness then add 10 H_2O
- evaporate then add water and dry crystals
- dry crystals and then add water

(b) The solution to this calculation is given below.
Number of moles of NaOH used = 0.025 × 2.64 = 0.066
Maximum number of moles of $Na_2SO_4.10H_2O$ that could be formed = 0.033

Mass of one mole of $Na_2SO_4.10H_2O$ = 322g
Maximum yield of sodium sulphate-10-water = 10.63g
Percentage yield = 37.2%

The most common error was to give the number of moles of $Na_2SO_4.10H_2O$ as 0.132 not 0.033. Some candidates seemed to be unfamiliar with this type of calculation and the mole concept; their mistakes did not show any pattern just a random manipulation of the figures in the question, for example 'percentage yield = 3.86/322 = 1.2%'.

Question 8

(a) The majority of candidates discussed either the combustion of wood or that there would be less photosynthesis causing higher levels of carbon dioxide, but not both, despite the question being worth two marks. There were two main issues:
Some candidates talked about burning hydrocarbons, fossil fuels or merely specified that burning produces carbon dioxide;
Trees can respire and photosynthesise but these processes are not identical, one absorbs carbon dioxide and the other produces it. The comment 'when trees are cut down there is less respiration' is a true statement, but it does not answer the question.

(b) (i) The third food group was correctly identified as fat by the vast majority of the candidates, with just a few suggesting either fibre or vitamins.

(ii) The diagram for the structure of starch was generally well drawn.

(iii) This first part of this question was well answered by most of the candidates; they knew that it is the amide linkage in both polymers. Identifying two differences between proteins and synthetic polyamides proved more difficult. Two of the following were needed:
Synthetic polyamide usually two monomers;
Protein many monomers;
Protein monomers are amino acids, or proteins hydrolyse to amino acids, or a protein monomer has one $–NH_2$ and one –COOH group;
Synthetic polyamide each monomer has 2 $–NH_2$ or 2COOH groups, or monomers are dioic acid and diamine.

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Paper 0620/04

Coursework

General comments

Centres are thanked for all the hard work that went into the preparation of the samples submitted for moderation. In all cases, the samples conformed to the criteria laid out in the syllabus.

Many Centres have been assessing their candidates' practical skills for many years and these Centres presented few problems.

It was pleasing to note that some of the Centres which presented problems last year had read the guidance in the Moderator's report and had adapted their exercises appropriately. This was, however, not always the case.

Very few Centres needed to have their marks scaled but where this was necessary it was due, not to the ability of the candidates, but to the nature of the tasks set by the Centre. If candidates are to receive the marks that their ability merits, it is essential that the tasks set allow them to demonstrate the skills listed in the syllabus.

Comments linked to each skill follow.

Skill C1

This skill has to do with following instructions. It is, therefore, essential that there are instructions to follow. Verbal instructions are not good enough; a copy of the work sheets used should be included with the sample to enable the Moderator to assess the level of skill required.

To gain the higher marks there should be an opportunity, somewhere in the task, for the candidate to make a decision on how to proceed. Statements such as if A happens then do B otherwise do C make it quite clear to the candidate that such a decision should be made.

This is not the same as asking the candidate to make a written amendment to the method for reasons of improving the accuracy.

It is easiest to assess this skill by using a tick list showing how each candidate coped with the instructions given. A copy, of any such 'tick lists', should be included with the sample.

Skill C2

This skill has to do with the obtaining and recording of results. It is essential, for the higher marks, that candidates design their own method of recording (whether it be in a table or some other method). An instruction sheet which supplies a table or blanks to be filled, automatically denies a candidate these higher marks.

Centres should note that there are two aspects to this skill; the recording of numerical data and the recording of observations. The exercise set should allow candidates to demonstrate both of these skills.

Skill C3

This skill includes the drawing of graphs (a skill often mistakenly included in C2) and the interpretation of the data or observations obtained.

Graphs should be of a sufficient size, have a title, labelled axes and an appropriate straight line or curve to gain the higher marks.
In addition, the observations should be explained using appropriate and correct science. The answering of simple questions on a work sheet is often not sufficient to gain higher marks.

Centres are reminded once more that both numerical and observational data are appropriate and that both should be tested.

Skill C4

This skill involves the candidate planning their own investigation. This is, perhaps, the most difficult skill to score high marks on.

One of the key skills which must be demonstrated to achieve the higher marks is the control of variables. Simple tasks, which do not involve the control of a number of variables are, thus, not appropriate.

Candidates should always carry out the investigation which they have planned. If they do not then it is impossible for them to point out sources of error and suggest improvements.

It is not appropriate to assess skill C1 in an investigation the candidate has planned themselves since they have not been given any instructions to follow.

If the investigation does not go well, this can also affect the marks in skills C2 and C3 if they are assessed in the same exercise.

The difficulty of tasks used by different Centres varies widely. Sometimes they are too straightforward and do not allow access to the full range of marks. Sometimes they are very complex and penalise weaker candidates who may well have scored higher on a more straightforward task.

Centres are encouraged to use the criteria provided in designing their marks schemes. Do not assume that your best candidate is worth six marks or that your weakest deserves two. Some Centres have very good candidates, all of whom deserve high marks others have weaker candidates who may not achieve the highest marks available.

It is the job of a Moderator to ensure that Centres have allocated marks based on the criteria provided not on their own view of the candidates' relative ability.

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Paper 0620/05

Practical

General comments

All candidates attempted both questions. The majority of Centres included Supervisors' reports. Despite comments in previous reports there are still a minority of Centres, which failed to submit a copy of the Supervisor's results with the candidates' scripts. When marking the scripts, the Examiners check comparability using the Supervisors' results. Particular attention is paid to the titration values in **Question 1** and some of the observations in **Question 2**.

Some samples of the salts used in **Question 2** were of a dubious nature. Some Centres reported that their sample of copper(**II**) ethanoate dissolved in water to form a solution of pH 11-14. The colours obtained when Universal Indicator was added to solutions of salts **T** and **V** varied widely among candidates from the same Centre. New bottles of salts involved in the practical should be purchased, if possible, for use in the Practical Test, especially if existing stock is old. The use of Universal Indicator solution was specified in the Confidential Instructions. The use of pH sticks by a few Centres caused problems.

Comments on specific questions

Question 1

Reference to precipitates was often missing in **(a)** and **(d)**. The table of results was generally fully completed. Marks were awarded for volume readings similar to those reported by the Supervisor (+/- 5 cm^3). Common error was to write the initial and final volume readings in the wrong boxes. Some candidates did not specify the volumes to one decimal place, e.g. 0 instead of 0.0, and were penalised.

(e) 'Pink' and 'purple' were common incorrect observations.

(g) (i) Generally well answered.

(ii) Figures were often quoted without any comparison given in words.

(iii) A good discriminating question which only the more able candidates managed to successfully attempt. Answers were frequently confused. A common error was to deduce that solution **B** was stronger/more concentrated than solution **A**. In fact solution **A** was twice the concentration of solution **B**. Vague references to 'solutions were of different concentrations' scored no credit. References to the different reactivity of the solutions showed a lack of knowledge and understanding.

(h) Guesses were prevalent and the unit cm^3 was often omitted.

(i) Quality of answers varied according to the Centre. Good answers suggested the use of a burette/pipette instead of a measuring cylinder. A minority suggested using a pipette instead of a burette, which showed a lack of understanding.

The idea of repeating the experiments was given credit. However, the second mark was only awarded if reference to average was given. Many candidates just repeated the stem of the question 'to get more accurate results'.

Question 2

(a) The majority of candidates scored the mark for giving the correct colour.

(b) A good discriminating question. Many candidates did not refer to the formation of condensation or a change in the colour of the solid. Failure to heat the solid strongly, as directed, resulted in a negative test with the lighted splint. A minority of candidates detected a flammable gas. Some guessed that the splint popped which was incorrect while others got the splint to relight. Vague statements were common such as 'puts the splint off'.

(c) Colours and observations were often well described.

(e) Credit was given for the formation of a brown gas or solid.

(f) Colours and observations were often correct. The colour and pH of the solution varied widely between Centres and candidates within the same Centre.

(g) Zinc, aluminium and iron were common incorrect answers.

(h) Few candidates deduced the identity of ethanoic acid/ethanoate ions despite noting a vinegary smell in **(f)**. Copper carbonate or copper sulphate were common answers. Credit was given for the mention of copper even though, strictly speaking, copper ions were present.

CHEMISTRY

Paper 0620/06
Alternative to Practical

General comments

The majority of candidates successfully attempted all of the questions. Examiners thought that the paper was comparable in difficulty with previous years apart from **Questions 4** and **7**. **Question 4** proved difficult to candidates from some Centres whereas **Question 7** was more accessible. **Question 7** was of a different style from previous years being less open-ended and more structured. Some Centres had not covered all sections of the syllabus. As in previous years most candidates had a good knowledge of basic practical techniques. The majority of candidates are able to complete tables of results from readings on diagrams e.g. **Question 6**, and plot the points successfully on a grid.

Comments on specific questions

Question 1

(a) Generally well answered. Incorrect answers referred to measuring jar, stand or Bunsen burner instead of tripod and descriptions of spoons.

(b) Often well attempted. Ambiguous or careless wording sometimes lost the mark.

(c) Most candidates correctly identified the filtration process. Omission of either paper or funnel or a clear label lost a mark.

Question 2

(a) (i) Generally the electrodes were correctly labelled. Some candidates put the labels by the cell.

(ii) Copper was the most common incorrect answer.

(b) Many candidates referred to gas or lead or bromine and confused names of products with observations.

(c) A good discriminating question. Two different safety precautions were required. Often two items of protective clothing were given which only scored one mark. The idea of precautions, as opposed to safety points, was not realised by some candidates. Responses such as 'handle with care', 'do not breathe in the fumes', do not touch the hot tube/use a test-tube holder' etc. are not safety precautions. Use of a 'mask' scored no credit.

Question 3

(a) Generally correct. A few candidates used sulphate or sulphide instead of sulphite.

(b) Most candidates scored credit though a significant number of heated test-tubes were seen.

(c) Solubility and density of sulphur dioxide were often identified as the two problems. Marks were often lost giving the correct description/explanation of the problem. A number of 'tubes the wrong way round in the water' and 'a bung/cover is needed for the inverted container' showed a lack of understanding.

Question 4

(d) Rarely was the table of results completed to give the burette readings to one decimal place and incorrect readings were common.

(e) A good discriminator. Only the better candidates scored full marks on **(ii)** and **(iii)**. In **(ii)** comparing the volumes was not well understood. Numbers without any explanation were common and few realised that twice as much solution **A** was used. In **(iii)** reference to' different concentrations' or different reactivity of the solutions was common. Many candidates were confused and gave solution **B** as being the more concentrated.

(f) Most candidates got the unit mark, but incorrect values were common.

(g) Generally scored credit. The idea of repeating the experiment was often unexplained. The idea of average was required while many candidates just vaguely restated the question 'is more accurate'.

(h) Generally well answered. A minority had the oxidation states reversed and some identified copper.

Question 5

(b) Quality of answers was Centre-dependent. Some candidates clearly did not know or had learned the tests.

(e) Generally well answered though 'slightly' or 'not very strong' descriptions of acids were penalised. The idea of weak acids was needed for both marks.

(f) Copper was often given but few candidates identified the organic nature of the salt. The ethanoic acid/ ethanoate ion was only recognised by the more able candidates.

Question 6

(a) The table of results was generally correctly completed.

(b) The points were normally plotted correctly, but despite being able to identify the inaccurate point in **(d)**, they still drew a line through it. A significant number of candidates did not plot (0, 0).

(c) The most common error was in stating that the magnesium had all been used up or that the reactants had all been used up.

(d) Most candidates identified the inaccurate point but some gave a range such as 3-4.

(e) The sketch was often above the original graph. Only the better candidates scored the second mark with the curve levelling off at about 31-32 cm^3.

Question 7

The standard of answers varied widely, though almost all candidates showed familiarity with the subject matter, even if they scored few marks.

(a) Omission of 'red' with litmus was common. Vague references to paper or indicator were penalised.

(b) 'Fractional' was often missing while long descriptions of the process, rather than naming the process, was a frequent mistake.

(c) Anhydrous copper sulphate and cobalt chloride paper were often cited. Common errors were the omission of 'anhydrous' or 'paper' and incorrect colour changes. The use of a physical test such as boiling point scored no credit.

(d) Most candidates recognised that the alcohol would burn. Errors focused on the splint burning/relighting or gave the result of the test for hydrogen - a pop or small explosion.