CHEMISTRY

Paper 0620/11
Multiple choice 11

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

Candidates performed quite well on this paper. The mean mark was 27.7 with a standard deviation of 7.7.

Questions 2, 7 and **10** proved particularly straightforward with more than 90% of candidates selecting the correct answer.

Questions 22 and **32** proved to be the most difficult with less than half of the candidates selecting the correct answer.

The following responses were popular wrong answers to the questions listed:

Question 4 Response D. Some candidates had the impression that it is the numbers of electrons which defines the identity of an element.

Question 6 Response B. Some candidates did not have a clear definition of an isotope.

Question 8 Response A. Candidates read “gained two electrons” and selected the response without reading further to discover the error in the statement.

Question 13 Response A. Candidates did not realise that hydrogen not sodium is produced when sodium chloride solution is electrolysed.

Question 14 Response B. Candidates had the correct link between the energy change and the type of change but perhaps mistook the upward arrows to indicate energy being given out.

Question 15 Response D. Candidates realised that both A and C were exothermic and picked the wrong one of two reactions with which they were, perhaps, not familiar

Question 22 Responses A and B. Candidates did not think the problem through or perhaps had not experienced the practical concerned.

Question 26 Responses A and B. Candidates knew that bromine was coloured but took no notice of the displacement reaction taking place.

Question 30 Response A. Candidates thought of the gas coming out of the reaction vessel rather than the gas going in.

Question 32 Response A. Candidates thought only of the uses, which is not what was asked in the question.

Question 34 Response A. Candidates did not notice the word liquid in alternative A.

Question 36 Response C. Candidates either did not know what galvanising was or did not realise the reactivity of zinc.

Question 37 Response B. Candidates chose the least familiar formula not noticing the five bonded carbons in alternative C.

Question 40 Response A. Candidates did not know what bitumen was used for and so chose the first answer.

CHEMISTRY

Paper 0620/12
Multiple choice 12

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

Candidates performed quite well on this paper. The mean mark was 28.7 with a standard deviation of 7.7.

Questions 5, 12 and **13** proved particularly straightforward with more than 90% of candidates selecting the correct answer.

Questions 20 and **34** proved to be the most difficult with less than half of the candidates selecting the correct answer.

The following responses were popular wrong answers to the questions listed:

Question 2 Response D. Some candidates had the impression that it is the numbers of electrons which defines the identity of an element.

Question 3 Response B. Some candidates did not have a clear definition of an isotope.

Question 7 Response A. Candidates did not realise that hydrogen not sodium is produced when sodium chloride solution is electrolysed.

Question 11 Response A. Candidates read "gained two electrons" and selected the response without reading further to discover the error in the statement.

Question 16 Response B. Candidates had the correct link between the energy change and the type of change but perhaps mistook the upward arrows to indicate energy being given out.

Question 17 Response D. Candidates realised that both A and C were exothermic and picked the wrong one of two reactions with which they were, perhaps, not familiar.

Question 20 Responses A and B. Candidates did not think the problem through or perhaps had not experienced the practical concerned.

Question 25 Response A. Candidates thought of the gas coming out of the reaction vessel rather than the gas going in.

Question 29 Responses A and B. Candidates knew that bromine was coloured but took no notice of the displacement reaction taking place.

Question 31 Response C. Candidates either did not know what galvanising was or did not realise the reactivity of zinc.

Question 34 Response A. Candidates thought only of the uses, which is not what was asked in the question.

Question 35 Response A. Candidates did not notice the word liquid in alternative A.

Question 37 Response A. Candidates did not know what bitumen was used for and so chose the first answer.

Question 40 Response B. Candidates chose the least familiar formula not noticing the five bonded carbons in the alternative C.

CHEMISTRY

Paper 0620/13

Multiple choice 13

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

The following responses were popular wrong answers to the questions listed:

Question 2 Response D. Some candidates had the impression that it is the numbers of electrons which defines the identity of an element.

Question 3 Response B. Some candidates did not have a clear definition of an isotope.

Question 7 Response A. Candidates did not realise that hydrogen not sodium is produced when sodium chloride solution is electrolysed.

Question 11 Response A. Candidates read “gained two electrons” and selected the response without reading further to discover the error in the statement.

Question 16 Response B. Candidates had the correct link between the energy change and the type of change but perhaps mistook the upward arrows to indicate energy being given out.

Question 17 Response D. Candidates realised that both A and C were exothermic and picked the wrong one of two reactions with which they were, perhaps, not familiar.

Question 20 Responses A and B. Candidates did not think the problem through or perhaps had not experienced the practical concerned.

Question 25 Response A. Candidates thought of the gas coming out of the reaction vessel rather than the gas going in.

Question 29 Responses A and B. Candidates knew that bromine was coloured but took no notice of the displacement reaction taking place.

Question 31 Response C. Candidates either did not know what galvanising was or did not realise the reactivity of zinc.

Question 34 Response A. Candidates thought only of the uses, which is not what was asked in the question.

Question 35 Response A. Candidates did not notice the word liquid in alternative A.

Question 37 Response A. Candidates did not know what bitumen was used for and so chose the first answer.

Question 40 Response B. Candidates chose the least familiar formula not noticing the five bonded carbons in the alternative C.

CHEMISTRY

Paper 0620/21
Core Theory 21

General comments

Many candidates tackled the paper well and good answers were seen to **Questions 1, 2** and **7**. The range of marks obtained by the candidates was very wide but most were entered at the appropriate level. There were, however, quite a few very high scoring candidates who may well have been able to improve their grades by being entered for Paper 3. In general, the rubric was well interpreted and most candidates attempted all parts of each question. The standard of English was generally good. Precise definitions were rarely known. For example, in **Question 2(c)(i)** few candidates could successfully define an isotope. Although most candidates had a good knowledge of characteristics of the structure of materials and many could interpret formulae correctly, few were able to write the structure of a hydrogen molecule correctly. Many also had difficulty in distinguishing between the physical and chemical characteristics of metals. Many candidates were found to have a poor knowledge of inorganic reactions and tests for specific ions. For example, many could not remember the test for iodide ions. Compared with previous sessions many candidates in this session were able to write word equations correctly. However, a number of candidates still insist on writing symbol equations where word equations are asked for. A pleasingly high number of candidates were able to interpret information from tables and diagrams. The labelling of the blast furnace in **Question 6(b)(iii)**, did, however, cause problems for many. There were some instances where candidates disadvantaged themselves by giving multiple answers. Multiple answers to **Question 3(b)** and **3(c)** were especially common. A few ticked two boxes in **Question 5(c)(ii)** and / or **7(a)(ii)** which led to the forfeit of a mark. It was encouraging to note that many candidates were able to draw the correct structure of ethene, which in previous sessions 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 the candidates' knowledge of electrolysis **(Question 8)** appeared better than in previous sessions.

Comments on specific questions

Question 1

Few candidates obtained full marks on this question. Very few seemed to know that methane is a greenhouse gas. Parts **(b)** and **(d)** were particularly well done.

(a) This was the least well answered part of **Question 1**. Nitrogen dioxide was the commonest answer here even though it was incorrect. Carbon monoxide was also a common incorrect answer. This reflects the difficulty that candidates have with disentangling the various effects of chemical pollutants in the atmosphere.

(b) Most candidates could select a correct alkane, many writing both. Ethene was a common error, the candidates presumably reading this as ethane.

(c) A variety of answers were seen here. The commonest errors were to suggest that chlorine or nitrogen would react with sulfuric acid.

(d) This part was well answered, the commonest errors being to suggest that nitrogen forms 20 % of the air. A large minority suggested carbon monoxide as the answer. This presumably arose because candidates were thinking of carbon dioxide and the publicity given to its effect on global warming, despite the fact that the concentration of the latter is very low.

(e) A surprisingly large number of candidates could not identify chlorine as a halogen. Nitrogen was commonly incorrectly suggested.

(f) This was not very well answered. Although the commonest error was to suggest methane, a wide variety of the other compounds in the list were also suggested.

Question 2

This question was the best answered on the Paper despite the fact that very few candidates answered parts **(b)** and **(c)(i)** correctly. A large number of candidates scored all 4 marks in part **(c)(ii)** and the other parts were generally correctly answered.

(a) About three quarters of the candidates scored both marks for this question and most scored at least one mark. The commonest reason for not scoring was to write too vaguely about the arrangement of the particles.

(b) This was poorly done. Most candidates drew a hydrogen atom rather than a hydrogen molecule. Some had no idea of electronic structure and just drew diagrams showing bonding, sometimes with four hydrogen atoms in a cross shape. This seemed to be a confusion with the geometric formula for methane.

(c) (i) Very few candidates understood the precise meaning of the word isotope. Candidates should be advised that it is better to focus on the word atom as well as different numbers of neutrons. Many suggested that an isotope was an substance or an element containing different numbers of neutrons. This is not precise enough. A not inconsiderable minority suggested incorrectly, that isotopes have different numbers of atoms or protons or different atomic masses. The last of these is not sufficient because atomic masses are calculated from mixtures of isotopes.

(ii) Many candidates scored 3 or 4 marks for this question. The commonest error was to suggest that hydrogen-1 has a single neutron. The second most common error was to suggest that hydrogen-3 has 3 neutrons.

(d) Most candidates recognised that an exothermic reaction gives out energy. The two most common errors were ‘endothermic’ and ‘respiration’. The latter was presumably being given as an example of an exothermic reaction. A few candidates wrote other examples of exothermic reactions – a misreading of the question.

(e) (i) This was the best answered question on the Paper. Most candidates were able to use the information in the table to rank the reactivity of the elements. Very few completely reversed the correct order. The commonest error was to reverse cobalt and iron.

(ii) This was reasonably well done and many candidates scored two marks. Few, however, scored all three marks. Carbon dioxide was the commonest mark gained. The mark for calcium chloride was less commonly given because many candidates just wrote ‘salt’ or ‘calcium salt’. The commonest error of all was to suggest that hydrogen was formed instead of water. Very often water was omitted altogether. Those gaining all three marks often wrote out the whole word equation.

Question 3

This question was not particularly well done. Few candidates scored over half marks. Parts **(a)(i), (b)** and **(c)** all posed particular problems. Few candidates could really distinguish between physical and chemical properties and there were many instances of candidates giving more than the required number of answers. This sometimes led to the loss of marks if the ‘extra’ answers were definitely incorrect.

(a) (i) Few candidates recognised the reaction of dehydration and then hydration as being an example of a reversible reaction. Many suggested dehydration or hydration. A large minority suggested exothermic or addition.

(ii) Many candidates gained both marks for ‘hydrated’ and ’water’. The commonest error was to suggest dehydrated for the first marking point. A variety of different incorrect answers were seen for the second marking point.

(b) (i) Many candidates failed to understand the meaning of the words 'physical properties'. Chemical properties such as 'unreactive' or 'react with oxygen' were often seen. Even when physical properties were mentioned, many candidates wrote rather vague statements about boiling points and strength and there were many references to cobalt itself rather than to metals in general. For example, 'very dense' was a not uncommon answer that was not given credit. The best answers referred to conduction of electricity and heat, shiny surface and malleability.

(ii) Many candidates simply repeated their answers to **(b)(i)** here. Few seemed to write about the physical properties of transition elements. It was, however, encouraging to note that a large minority of candidates gave good answers relating to formation of coloured compounds, variable valency etc.

(c) Few candidates approached this question from the point of view of the chemical properties of basic oxides. Most simply gave incorrect statement implying that cobalt oxide dissolved and turned litmus blue or some statement about the pH. Many gave vague statements about alkalis.

Question 4

This proved to be the most difficult question on the Paper for most candidates. Most candidates scored well under half marks. Parts **(c)**, **(d)** and **(e)** proved to be especially demanding.

(a) This was fairly well answered, many candidates correctly identifying the chloride ion. It was encouraging to note that only a few identified a positive ions rather than a negative one. The commonest errors were to suggest sodium chloride or to write chlorine ion instead of chloride ion. Those candidates who wrote the symbol were the most likely to avoid the latter mistake because they tended to write Cl^- from the table rather than just Cl. Very few selected other ions such as sulfate ions.

(b) Most candidates selected at least one of the ions correctly. Common incorrect answers included (1) lack of charges on the ions (2) writing sodium ions in place of bromide ions (3) writing K^{2+}. A common reason for not obtaining the Br^- mark was the formulation of a lower case b rather than upper case.

(c) Only about one third of the candidates could do this calculation correctly. There was a lot of 'random' working.

(d) This part was poorly answered. Less than 20 % of the candidates knew the silver nitrate test for iodide ions. Two errors were very common: (1) the suggestion of sodium hydroxide as a reagent (presumably because of its extensive use in the quantitative analysis in the syllabus) (2) the suggestion that starch solution should be used (an error arising for the starch test for iodine <u>molecules</u>, which in any case is not on the syllabus).

(e) (i) About one third of the candidates were able to balance the equation by insertion of I_2. It is encouraging to note that this is an improvement on similar questions in recent sessions. Single iodine atoms or combinations of different atoms were often seen.

(ii) Many candidates thought that the solution should go colourless even if they had correctly identified iodine as a product in part **(i)**.

(iii) This was particularly badly done in comparison with a similar question from last summer's Paper. Many candidates suggested bromide was more reactive than iodine or iodide was less reactive than bromine rather than comparing the reactivity of the two halogens. The reactivity was often incorrectly compared with potassium. Another series of incorrect answers focused on Group similarities and similarities in the number of electrons.

(f) About half the candidates calculated the relative formula mass correctly. Some used the atomic numbers in the calculation rather than the atomic masses. A large minority of candidates appeared to put down the correct atomic masses and multiply Cl by 2 but then failed to add up the figures correctly.

Question 5

This question was fairly well answered with most candidates being able to explain the term 'soluble' and identify the number of different types of atoms in ammonium sulfate correctly. Many candidates, however, wrote rather vague statements in an attempt to explain the use of fertilisers and the control of soil acidity.

(a) Fewer than half the candidates could identify all three elements correctly. Nitrogen was the most commonly identified element present in most fertilisers and potassium was the least well identified. A large minority of answers suggested rather improbable elements such as silicon or arsenic. Magnesium and sulfur were also common incorrect answers.

(b) Most candidates scored one mark, for suggesting better yield or increased plant growth. However a second mark was rarely given. A large number of candidates seemed to think that fertilisers act to kill insects or have fungicidal properties.

(c) (i) Most candidates gave a suitable explanation of the word 'soluble'. Those who failed to gain the mark usually gave some answer relating to mixtures.

(ii) Many candidates had difficulty with this part. Precipitation and reaction of acid with a metal were the commonest incorrect answers.

(d) Just under half the candidates gave the correct answer 'ammonia'. Common incorrect answers included (1) ammonium (2) nitrogen (3) oxygen (4) sodium.

(e) (i) Few candidates gained the mark for calcium oxide or calcium carbonate. The commonest error was to suggest that water should be added. Ammonia or sodium hydroxide were commonly seen answers which, while understandable, were not acceptable.

(ii) Many candidates gained at least one of the two marks available, usually for relating the control of acidity to plant growth. Many candidates failed to gain the first mark by just stating that 'plants can not grow in acidic soils'. This is not exactly true – most plants do grow better in slightly acidic soils e.g. pH 5.5-6.5. The words very acid or too acid were needed in order to gain the mark.

(f) (i) Most candidates identified the correct number of elements present.

(ii) In comparison with part **(i)** far fewer candidates could identify the total number of atoms present. Incorrect answers tended to be below 15: often 10 or 12.

Question 6

This question was generally poorly answered, parts **(b)(i)** and **(b)(iii)** causing particular problems for the candidates.

(a) Just under half the candidates scored this mark. A variety of phonetic spellings were accepted. The commonest error was to suggest bauxite.

(b) (i) Only about one quarter of the candidates recognised the raw materials used for extracting iron. Many candidates did not seem to realise what a raw material is. Common answers included oxygen and carbon but such answers were not sufficient to gain a mark. Limestone was the mark most often awarded. Many other suggestions such as sand, slag and carbon dioxide were seen. Some candidates wrote haematite through not reading the word 'other' in the question.

(ii) Many candidates were able to construct the correct word equation. The commonest errors were (1) to write iron(**II**) as a product (2) to write carbon dioxide or carbon oxide instead of carbon monoxide.

(iii) Although many candidates scored 2 marks very few gained all 4. The commonest errors were (1) labelling the air blast where the waste gases exit (2) placing the iron ore charge where the waste gases exit (3) putting the iron on top of the slag (4) labelling multiple exits the same e.g. slag out of two exits.

(c) Many candidates could write the correct formula for ZnS. Common errors included (1) write incorrect charges on the ions (2) putting numbers in front of the ZnS (3) writing ZnS_2.

Question 7

This question was one of the best answered on the Paper. It was encouraging to note that many candidates could draw the displayed formula of ethene correctly and relate oil fractions to their use. Only about one quarter of the candidates, however, could describe the conditions for cracking.

(a) Just over half the candidates scored this mark. Many chose melting point instead of boiling point. It was encouraging that few chose the other possibilities.

(b) Many candidates scored all four marks. There were no consistent errors made by those scoring 1, 2 or 3 marks.

(c) (i) Few candidates scored both marks here. High temperature was seen more often than catalyst. Many candidates were simply satisfied to write 'heat' or 'warm'. These were not sufficient to gain a mark. Many suggested that oxygen was required. Many candidates wrote vague answers about other organic reactions which were not related to cracking.

(ii) Many candidates gained this mark. Those who failed to do so generally wrote $C_{12}H_{24}$.

(iii) Many candidates were able to write a displayed formula for ethene. Common errors included (1) lack of double bond (2) structure of methane.

(d) Only about one third of the candidates were able to name the polymer obtained from ethene. A wide range of incorrect answers were seen from 'polymer' to 'plastic'. Some candidates wrote 'polyethane' which could not be given a mark.

(e) (i) About one third of the candidates could identify that steam was the other reactant required to make ethanol from ethene. The commonest incorrect answer was hydrogen although a large minority of candidates suggested oxygen.

(ii) Most candidates gained this mark. Amongst definitions, that of a catalyst is always likely to produce the best answers.

Question 8

This question was generally well answered and it was encouraging to note that many candidates scored fairly well on the electrolysis questions – a traditionally difficult area for the core syllabus.

(a) Most candidates scored 2 or 3 marks. The commonest incorrect suggestion for an electrical conductor was sodium chloride crystals. This was clearly related to the fact that sodium chloride does conduct when molten or in aqueous solution.

(b) Many candidates did not appear to know the word 'insulator'. Most were content to write down examples such as 'wood' or plastic' or to merely suggest 'non-conductors' or 'bad conductors'.

(c) (i) Most candidates correctly selected the word 'anode'.

(ii) About half the candidates could identify the correct products from the electrolysis of molten zinc chloride. Incorrect responses included (1) zinc ions and chloride ions (2) hydrogen and / or oxygen.

(iii) About half the candidates were able to name graphite or carbon. A considerable minority failed to read the question properly and wrote 'platinum'. Those candidates who tended to score lower marks overall gave illogical responses such as oxygen or bromine.

CHEMISTRY

Paper 0620/22

Core Theory 22

General comments

Many candidates tackled the paper well and good answers were seen in many parts of the paper e.g. **Questions 1, 2** and **6**. The range of marks obtained by the candidates was very wide and most were entered at the appropriate level. 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 chemical structures (ionic, giant covalent and molecular), few were able to define the term polymer satisfactorily. Most had difficulty interpreting the structures of diamond, graphite and buckminsterfullerene even though diagrams were given. As in previous sessions the tests for specific substances were not well known. Most candidates had some difficulties with **Question 8** (decomposition of calcium carbonate) – it seemed that this reaction was not well known.
There were only a few instances where candidates disadvantaged themselves by giving multiple answers. A small number of candidates, however, gave multiple answers to **Question 6(e)(ii)** where one box was required to be ticked.
Many candidates had difficulty with the questions on environmental effects such as global warming and acid rain, these effects more often than not being muddled up. Despite it not being on the syllabus, many candidates thought that sulfur dioxide and carbon dioxide were responsible for the depletion of the ozone layer. As in previous years, many candidates had difficulty explaining diffusion. It was, however, encouraging to note that the chromatography section of **Question 5** was well attempted. It was also encouraging to note that more candidates than in previous sessions were able to balance simple chemical equations.
In more extended questions, candidates often disadvantaged themselves by inaccurate and non-specific writing.

Comments on specific questions

Question 1

This was generally well answered with most candidates scoring well over half marks. The major errors arose from a lack of knowledge of the Periodic Table in terms of Groups and Periods and the trends in these. The most encouraging feature of the candidates' answers in this session was the improved ability of candidates to complete simple chemical equations.

(a) (i) This was well answered although a few candidates chose elements which were not shown on the diagram. Magnesium and calcium were the commonest errors.

(ii) This was the most poorly done part of **Question 1**. Many candidates did not realise that H and He comprise the first Period or mistook Period for Group.

(iii) Most candidates gained the mark. The commonest error was to suggest potassium rather than sodium.

(iv) Just under half the candidates gained this mark. The commonest incorrect answer was to suggest lithium.

(v) Many candidates mistook the 23 protons for the relative atomic mass so sodium was often seen as an incorrect answer.

(b) The equation was balanced correctly by the majority of candidates. The commonest error was to write 2O rather than O_2.

Question 2

This was the best answered question on the Paper with most candidates scoring well over two thirds of the marks available. Part **(b)** was particularly well done. The most encouraging feature was the candidates' ability to identify chemical structures correctly.

(a) (i) Many candidates scored at least 2 marks. Some candidates regarded the ionic and metallic structures as giant covalent structures. Another common error was to suggest that **A** (ionic) was a metal and **D** (metal) was ionic. A few candidates also suggested that chlorine was a giant structure.

(ii) This was generally well answered, the commonest error being to suggest that **A** and **D** (giant structures) had low melting points.

(b) Most candidates scored both marks.

Question 3

This question was poorly answered, few candidates gaining more than half marks. It was encouraging to note that many could balance the equation in part **(d)(i)** correctly.

(a) Many candidates gained a mark by suggesting that water could be used as a coolant or (more rarely) gave a specific chemical reaction. Those who failed to gain the mark often did so because they gave a domestic rather than an industrial use for water.

(b) The test for water was not well known. Common errors were (1) to suggest boiling the liquid and taking its boiling point (2) using the incorrect reagent e.g. sodium hydroxide or copper oxide (3) using blue / hydrated copper sulfate. The colour change was not well known, often being put the incorrect way round.

(c) (i) The test for hydrogen was not well known. Many candidates seemed not to recognise the gas in the equation and gave a test for carbon dioxide. The commonest errors, however, were to suggest that a glowing splint should be used or just a splint without any reference to it being lit.

(ii) Few candidates realised that potassium hydroxide was strongly alkaline. The commonest error was to suggest pH 8. A considerable number of candidates chose pH 7.

(d) (i) This was encouragingly well answered. Most candidates gained at least one mark.

(ii) Just over half of the candidates chose combustion. The commonest incorrect answer was hydrogenation, followed closely by dehydration (presumably because water was being given off).

(iii) Just over half of the candidates carried out the calculation correctly. 36 was the commonest incorrect answer. Many candidates did not attempt this or made seemingly random combinations of figures.

Question 4

Most candidates found this question the most demanding on the Paper. Few explained the diffusion experiment with confidence and there were many vague answers despite the fact that this sort of question has appeared on the Core Paper many times. Many candidates have difficulty with definitions. In this case, the word 'mixture' was poorly described and few candidates obtained the mark.

(a) Many candidates failed to score a mark here even though they wrote a lot. The answers tended to be too vague. Those who obtained the marks generally wrote the word diffusion and implied some movement of the particles. Many candidates were content to just describe what happened in terms of the bulk movement of the ink rather than choosing to use the word particles.

(b) Very few candidates gave a convincing definition of a mixture. The idea that the substances could be separated again seemed lost on many. Most seemed to want to define the word compound.

(c) (i) Most candidates could identify a correct solvent from the list. The commonest error was to suggest water despite the fact that it appeared in the stem of the question and was not on the list.

(ii) Many candidates identified oxidation state as the correct answer. The commonest incorrect answer was 'type of isotope'.

(iii) Few candidates could describe the meaning of the word 'polymer'. Few wrote about the length / size of the molecule and few wrote about the units used to make up the polymer. The commonest errors were (1) to give an example of a polymer e.g. polyethene (2) to write generally about plastics (3) to focus just on the monomers and not mention them joining together.

(d) (i) About half of the candidates could recognise the carboxylic acid group. Common errors included (1) putting a ring around the C=O group (2) omitting the H. It was encouraging to note that only a few chose to circle incorrectly one of the bottom –OH groups.

(ii) Over half of the candidates could define reduction in terms of oxygen loss, hydrogen gain or electron gain. Those who failed to gain the mark often suggested hydrogen loss or electron loss.

Question 5

This question was fairly well answered with most candidates scoring over half the marks available. Part **(d)** proved to be the most difficult. This is understandable because, traditionally, core candidates have often had difficulty in dealing with organic chemistry.

(a) Most candidates scored the mark for 'filtration'. The commonest error was to suggest distillation.

(b) Nearly all candidates correctly identified the dropping pipette.

(c) (i) Most candidates scored two marks for this question. The commonest errors were (1) to fail to place the origin spot vertically below the other 4 spots (2) to label the lowest spot on the diagram. The chromatography paper was almost always correctly labelled. The solvent was generally labelled correctly, the commonest error being to place it somewhere on the chromatography paper. A few candidates failed to respond to this question, seemingly not knowing what to do.

(ii) This was generally correct, the commonest incorrect answer being 3.

(d) (i) Most candidates could identify an unsaturated hydrocarbon. The commonest errors were to suggest **B** or **D**.

(ii) Fewer candidates than expected knew the bromine water test for unsaturated hydrocarbons. This may suggest that the term unsaturated is not well known. Common errors were to suggest limewater or to use a lighted splint.

(iii) Only about one third of the candidates scored this mark. The main problem was the lack of the important word 'only'. This small word is essential in the definition of a hydrocarbon. If a candidate wrote it contains hydrogen and carbon it could also refer to alcohols, carboxylic acids etc.

(iv) Many candidates could not name ethanoic acid, despite the fact that they could identify the carboxylic acid group in **Question 4(d)**. Ethanol or ethane were often given so it is not the prefix which appear to be the problem.

(v) Many candidates had difficulty in identifying the homologous series to which ethanol belongs. Alkane was the commonest incorrect answer.

Question 6

This was one of the best answered questions on the Paper with most candidates scoring well over half marks. The major errors arose from a poor knowledge of atomic structure and a lack of knowledge about carbon monoxide.

(a) This was fairly well answered but many candidates chose properties that were not characteristic of all metals e.g. high boiling point. Candidates should be encouraged to stick to properties such as conduction of electricity and heat, shiny surface, malleability and ductility in order to gain the mark.

(b) Most candidates could identify the Group to which lead belongs.

(c) This was not done as well as expected. The commonest errors were (1) to put the incorrect number of neutrons (2) to use the atomic mass of lead rather than the atomic number to calculate the number of protons and / or electrons.

(d) It was encouraging to note that many candidates could construct the correct word equation. The commonest error was to write lead(II) as a reactant.

(e) (i) Most candidates realised that carbon had become oxidised.

(ii) Many candidates thought that carbon monoxide forms 1% of the atmosphere.

Question 7

This question provided most candidates with considerable difficulties. Many failed to use the information in the diagrams in part **(a)** to elicit differences in the structures between the allotropes. This may have been partly related to the deficiencies of core candidates explaining facts clearly in English. It should be noted, however, that candidates can always gain marks in such as situation by showing diagrammatically what they mean, even if they cannot explain it adequately in words. As in previous sessions, questions about the chemistry of the atmosphere (parts **(e)** and **(f)**) always prove to be a challenge.

(a) (i) Many candidates failed to score a mark because they did not compare the two structures and wrote rather vaguely and non-specifically. A few compared graphite and diamond, so could not be awarded the mark.

(ii) Again, many candidates failed to score a mark because they did not compare the two structures and wrote rather vaguely and non-specifically.

(b) Over half the candidates correctly described the bonding as being covalent. The commonest incorrect suggestion was ionic. It was encouraging to note that very few put 'weak', 'strong' or 'chemical' which have been favourites in the past.

(c) Few candidates had the idea of the layers sliding or weak forces between the layers. Many failed to gain the mark because they did not refer to the layers as instructed in the question. For example, a common incorrect answer referred to atoms moving rather than layers moving.

(d) Most candidates could suggest a correct use for diamonds.

(e) This was poorly done. Many scored a mark for the term global warming or (less commonly) greenhouse effect. Surprisingly few, however, gave suitable examples of the effects of global warming. Common errors were caused by candidates muddling up global warming, ozone layer, acid rain, infra-red and ultraviolet radiation.

(f) Many candidates provided weak responses here. Many suggested that sulfur is vaporised in the air and causes acid rain. Sulfur dioxide was not often mentioned. Most did not know that sulfur oxides dissolve in / react with water to form acids containing sulfur. Yet again, there was confusion with the ozone layer.

(g) (i) Surprisingly few candidates identified the correct source of methane. The commonest error was to suggest from waste gas from respiration in plants.

(ii) Only about one third of the candidates could write the correct structure for methane. Many candidates used bond lines for the structure rather than dots and crosses.

(iii) Most candidates could write the name of another alkane.

Question 8

This question also provided a mixture of challenges for many candidates, parts **(b)** and **(d)** being the most difficult but **(e)** and **(f)** relatively easy. Few candidates seemed to have a firm grasp of the chemical reaction involved in the decomposition of limestone. It was encouraging to note, however, that many candidates could extract information correctly from a graph.

(a) Surprisingly few candidates could supply the chemical name for lime, especially in view of the fact that this has been generally well-answered in previous sessions. The commonest error was to suggest limestone or calcium carbonate.

(b) Very few candidates realised that the reaction was an example of (thermal) decomposition. The commonest errors were to suggest exothermic or oxidation. The latter probably arose in candidates' minds from the fact that hot air is blown into the kiln for heating purposes.

(c) Only about one quarter of the candidates realised that the carbon dioxide came from the reaction itself. Many thought that it came from the air blown in.

(d) Few candidates could supply a correct use of lime. Common errors included (1) statues and buildings, the latter being too vague (2) food (by confusion with the name of the fruit).

(e) This was well answered, most candidates being able to state a factor which must be kept constant. The heat source was the commonest thing referred to.

(f) (i) Most candidates interpreted the graph correctly.

(ii) Most candidates read the graph correctly.

(iii) Few of the candidates could relate the speed of reaction to the position of the metal in the Group and few gained the mark for mentioning the order of rate with respect to each other.

(g) Although many candidates scored the marks for 'limewater goes milky', the context of the question seemed to confuse some. Many suggested that limewater, hydrochloric acid and carbonate should all be mixed together at the same time. They did not appreciate that the gas given off should be tested with limewater.

CHEMISTRY

Paper 0620/31
Extended Theory 31

General Comments

Candidates should be cautious of unnecessary embellishment of their responses. It seems that candidates attempted to improve their answers by adding extra material. Frequently this contradicted a correct point in the initial response and consequently no marks were awarded. A typical example would be - the position of equilibrium moves to the left (one mark awarded) but in the additional material there was the contradictory statement- this favoured the formation of the products (no marks).

It is the responsibility of the candidate to ensure that all their work is both readily accessible and legible. If answers are repeated elsewhere in the paper then the original attempt should be deleted and a clear reference given to the location of the re-draft.

Diagrams should not be drawn with a very hard pencil, the image is very faint and causes considerable difficulties when marked.

Individual Questions

Question 1

This was well answered, with only a few candidates giving the names or formulae of compounds rather than the name or symbol of the element as required by the question. Parts **(ii)** and **(iv)** were the weakest. Many students were not aware that iodine is a black solid which gives a purple vapour and variously suggested astatine, fluorine and potassium. A frequent error in part **(iv)** was to name the metal oxide, typically CaO. The question asks which element has a basic oxide which is used to treat acidic soils - not name this basic oxide.

Question 2

(i) The majority of candidates correctly gave chloromethane as the chemical which diffused the slowest but the reason for their choice often referred to biggest or heaviest gas rather than the gas with the largest M_r or the biggest mass of one mole or the highest density.

(ii) Many answers to this question were illogical. Students seemed to ignore the fact that the question related to seaweed and it asked from which compounds in the environment might seaweed have obtained the constituent elements in chloromethane. Most correctly gave carbon dioxide as a source of carbon and water for hydrogen but then gave hydrochloric acid for chlorine. A minority inappropriately suggested electrolysis for both hydrogen and chlorine.

(iii) Less than 50 % of answers gave the correct reagent to make chloromethane from methane - which is chlorine. Hydrochloric acid, chloride ions, chorine water or even chlorine atoms were frequently seen. The reaction condition mark was conditional on the correct reagent and so was often not scored. In many instances the students gave a list of possible conditions including heat, pressure and catalysts, this approach might negate a correct answer if the list included an incorrect reaction condition.

(iv) The formation of oxides of nitrogen is a question that is frequently asked. The marking points were that (1) nitrogen reacts with oxygen (2) at high temperatures or lightning or in an engine.

(v) The equation for the decomposition of ozone was usually correct but a significant minority of the candidates altered the equation so that oxides of nitrogen or carbon appeared on both sides of it.

Question 3

(a) (i) Many candidates thought that when magnesium reacts and decreases in mass, its density also decreases. The answer had to include more than the idea that hydrogen was formed and should be extended to explain why the presence of hydrogen caused the magnesium to rise to the surface – metal coated with bubbles of hydrogen or the gas pushes or lifts the metal to the surface.

(ii) Since water was mentioned in the question, candidates usually assumed that the question referred to the reaction of a metal with water. Few stated that copper does not react with acid or that zinc and iron react with dilute acid. Most answers usually referred to copper being less reactive than iron and zinc but not to the relevance of that in this experiment.

(b) (i) The majority of candidates knew that the experiment with copper holding the magnesium down was the faster.

(ii) Unacceptable reasons for the above usually involved the idea that a greater surface area was exposed or that copper is a better conductor of heat or even that copper did react with the acid. A more thoughtful minority realised that copper might be a catalyst because it is a transition element.

(c) (i) The question asked how would the graph with propanoic acid differ from the one with hydrochloric acid. The answer had to refer to the shape of the graph not the reaction rate – smaller gradient/slope rather than the rate was slower.

(ii) The similarities between the two graphs which would be obtained if propanoic acid was used as well as hydrochloric acid varied in accuracy. The majority of the candidates mistakenly concentrated on how the conditions could be changed to make the two graphs the same, particularly with respect to reaction rate. The usual suggestions were to add a catalyst, use more concentrated propanoic acid or increase the temperature. Consequently they failed to mention that the same volume of hydrogen was produced or that the graphs finished on the same level (y axis).

(d) Some excellent responses were seen explaining two factors which could alter the rate of this reaction. The required responses were temperature and surface area of the metal.

Question 4

(a) (i) A high proportion of the candidates were able to give the names and formulae of the two compounds formed by hydrolysis of the ester but on occasions the answers were spoilt by missing hydrogen atoms or –HO rather than –OH being shown in structures. The most frequent error was to suggest that ethanoic acid and propanol were the products.

(ii) The question required a type of compound rather than the name of a specific compound. Most of the answers correctly suggested a use of the salt as soap or in soap making.

(iii) Terylene was the usual polymer correctly named as an example of a polyester although just as many candidates believed that nylon was a polyester.

(b) (i) The amide linkage was well known. Acceptable alternatives were polyamide, peptide and polypeptide.

(ii) Drawings of a man-made polymer often did not show enough of the polymer to ensure that the required linkages were present. Nylon 6 or 6,6 nylon structures were both acceptable answers providing that the correct amide linkages and monomer 'blocks' were shown.
The structure of nylon 6 is not required by the syllabus. The reason for its inclusion in this report is that it is obviously being taught in some Centres.
Candidates should always include at least three monomer units unless the question states otherwise.

(iii) To gain the marks it was not necessary to describe the process of producing a chromatogram.

Question 5

(a) (i) The incorrect use of terminology plagued the descriptions of the structure of diamond. The terms macromolecular or giant covalent were rarely encountered but incorrect ideas were prevalent – intermolecular forces, tetrahedral shape instead of tetrahedral structure and molecules bonded together.

(ii) Uses of diamond were very well known.

(iii) The majority of the candidates could explain why graphite is soft in that it has a layer structure with weak bonds between the layers which allows the layers to slip/slide past each other.

(iv) Uses of graphite were very well known.

(b) (i) The diagrams of the bonding in a molecule of carbon dioxide were usually correct and many candidates scored full marks.

(ii) Many did not heed the instruction in the question to use the diagram to explain why the formula is SiO_2, not SiO_4, and based their argument on valency or electron distribution. There are two acceptable arguments.
Each Si atom is bonded to 4 O atoms.
Each O atom is bonded to 2 Si atoms.
Therefore, there are twice as many O atoms as Si atoms, formula SiO_2.

A less common argument was:
In the unit Si---O---O, each Si atom has ½ O atom
Each Si atom is surrounded by 4O atoms and it has 4 x ½ O
Formula SiO_2

(iii) This question, concerning the differences in physical properties between carbon dioxide and silicon(IV) oxide, was confusing to some candidates who thought that the question referred to SiO_2 and the non-existent SiO_4. Those who did refer to the correct oxides often failed to give comparative answers.

Question 6

(a) Definitions of equilibrium were poor and rarely mentioned the fact that the concentrations of reactants and products were constant. Answers often stated that concentrations were the same or equal.

(b) A minority of candidates had a clear understanding of the principles of equilibria, they correctly stated that the reverse reaction was endothermic because it was favoured by an increase in temperature. Frequently the correct choice was contradicted by superfluous and unnecessary embellishment of the answer, no marks could be awarded.

(c) (i) Succinct and correct responses were forthcoming from some candidates – the equilibrium moved to the left as a decrease in pressure favours the side with the greater volume or with more molecules, that is the reactant/left side. Candidates should be discouraged from using the converse argument that is when the pressure is increased the position of equilibrium moves to the right etc. Obviously if the argument is correct then the marks are awarded but the usual effect of this tactic is to increase the confusion which seems to be generated by this type of question.

(ii) For those who had demonstrated a creditable understanding of this topic, this question was easy.

Question 7

(a) The explanation of why it is necessary to include a number in the names of transition metal compounds should have been attributed to the fact that transition elements have more than one oxidation state or valency not because they had varying numbers of valency electrons. Comments such as transition metals have different oxidation states could not be accepted, this comment is equally valid for nitrogen and oxygen.

(b) Many answers stated that coke was needed to produce heat and that it reacted to form carbon monoxide which is a good reductant. An alternative, but erroneous explanation, was that the heat moved the position of equilibrium favouring the formation of titanium(IV) chloride. Happily some candidates were able to give good, logical explanations of it removing oxygen, the equilibrium moving to the right to replace the oxygen with the consequent increase in the concentration of the metal chloride. An alternative explanation was that the decrease in the concentration of oxygen reduced the rate of the back reaction so increasing the concentration of titanium(IV) chloride.

(**c)** Most answers were correct, the oxidation state of titanium decreased (from +4 to 0) or that there was electron gain (by the titanium ion). However, some said that there was a loss of oxygen which is impossible as it the chloride which is being reduced.

(d) The table was usually filled in appropriately with low density/light and building ships/submarines/cathodic protection/surgical implants etc.

(e) This calculation was well done with many candidates scoring full marks. Mistakes were made by using the wrong atomic masses or incorrect rounding of numbers. The correct solution to this numerical problem is given below.

(i) The percentage of oxygen = 31.6%

(ii) Calculate the number of moles of atoms for each element.
number of moles of Ti = 31.6/48 = 0.66
number of moles of O = 31.6/16 = 1.98 (2 was accepted)

(iii) The simplest <u>whole number ratio</u> for moles of atoms had to be quoted for the mark:
Fe : T : O
1 1 3

(iv) Formula is $FeTiO_3$ or $TiFeO_3$
a formula based on the whole number ratio in **(iii)** gained the mark that is ecf marking.

Question 8

(a) The concept of a homologous series was familiar to most of the candidates.
Acceptable characteristics are:
same general formula;
same chemical properties;
same functional group;
physical properties vary in predictable way;
common methods of preparation;
consecutive members differ by CH_2.
The common errors were:
they had the same structural formula;
they had the same molecular formula;
the same physical properties;
they all react with the same reagent (this is not the same as they have the same Chemistry, for instance, members of different homologous series react with sodium hydroxide).

(b) (i) Most were able to complete the equation by the insertion of carbon dioxide and water, the balancing of this equation proved more of a challenge. Frequently an extra C or CH_2 was added in front of the methanoic acid formula, both marks were consequently lost.

(ii) The reaction between zinc and methanoic was not generally understood as a standard metal/acid reaction and there were some unusual answers. The products included water, methanol and carbon dioxide rather than hydrogen.

(iii) The reason that aluminium kettles do not react with methanoic acid was generally correct - the metal is protected by an oxide layer.

(c) The fourth acid was almost always named correctly – butanoic acid. The molecular formula of pentanoic acid, $C_5H_{10}O_2$ was frequently given rather than that of butanoic acid. Most candidates gave the structural formula, CH_3-CH_2-CH_2-COOH, rather than the molecular formula, $C_4H_8O_2$, this was not penalised and either was accepted. Empirical formulae were poorly understood and the usual response was to repeat the molecular formula.

CHEMISTRY

Paper 0620/32
Extended Theory 32

General Comments

There was much evidence that candidates did not read the questions carefully enough nor think about the questions sufficiently. This is referred to in several individual instances below.

Legible handwriting is crucial to success in Chemistry examinations. Candidates should be aware that substituting one letter for another, for example in the case of butane or butene, refers to a completely different substance. Examiners always give candidates the benefit of doubt on such occasions, but if a response genuinely cannot be read, then it cannot be credited. Formulae should also be written accurately. In particular capital and small letters should be used as appropriate. Candidates do have the advantage of a Periodic Table to consult if they are in any doubt.

Individual Questions

Question 1

This question was based on the candidates knowledge of the periodic table, specifically groups I, VII and the transition elements. Candidates were expected to extrapolate their knowledge of common elements in these areas of the periodic table to elements that were less familiar or unfamiliar. There was a great deal of confusion over the differences between chemical and physical properties.

(a) and **(b)** were the best answered. It was often known that Group I elements were soft and that they reacted with cold water. There was some confusion regarding the fact that compounds of transition elements were coloured, rather than the elements themselves.

(c) This was not answered well. Most did not comment on the fact that fluorine was gaseous, which they should have realised on the basis of trends in boiling points and physical states of the other halogens. Fluorine was often regarded as being unreactive.

Question 2

(a) (i) Many knew that enzymes were biological but this was often confused with being 'living'. (see also **(c)(ii)**)

(ii) It was not known very often that carbohydrates had a ratio of hydrogen atoms to oxygen atoms of 2:1.

(b) There was a wide variety of answers here. All that was required was the same drawing of a complex carbohydrate as is shown on the syllabus.

(c) (i) There were some very good answers to this question that scored full marks. Common errors included the misunderstanding that the reason for the decrease in colour intensity was that the iodine was being used up and not the starch. There was also a feeling that the enzymes were being denatured. Some merely repeated the colour changes, with no explanation.

(ii) Most realised that the enzymes were being denatured, but a few thought that the enzymes were being 'killed'. Some thought that the blue colour meant that the reaction had proceeded faster at the higher temperature.

Question 3

(a) (i) Many tried to give explanations of what was happening in terms of redox or electron transfer. 'Describe what you would observe' means that observations are required. Those who attempted to give observations often missed out the original colour of the bromine or failed to refer to the precipitate of sulfur or to describe its colour adequately.

(ii) There was a wide variety of responses here, including many correct answers.

(iii) Many referred to the bromine gaining electrons, but fewer mentioned that the electrons came from the sulfur, which was required for the second mark.

(b) (i) The correct answer, oxidation, was often seen as was reduction and other types of reaction such as decomposition or exothermic.

(ii) Hydrogen was not seen very often. Oxygen was very common, as were other gases as well as non-gaseous iron compounds.

(iii) Candidates should realise that the names of transition metal compounds should always be accompanied by an oxidation state. There were many iron hydroxides or oxides as well as many correct answers.

(iv) Quite often answered correctly.

(v) Loss of electrons or increase in oxidation state was very often accompanied by gain of oxygen, which meant that the mark did not score. This was one of the most common misconceptions on the whole paper. Candidates should realise that the concept of oxygen/hydrogen transfer is very limited in explaining oxidation/reduction.

(vi) Most realised that zinc is more reactive than iron which scored one mark in the majority of cases. Several comments regarding zinc being oxidised, or losing electrons, or being oxidised in preference to iron also scored marks as did the mention of sacrificial protection. However it was not uncommon to see references to zinc rusting in preference to iron. Some candidates did not realise what electrical contact referred to and described zinc protecting iron from rusting by forming an impervious layer which air and water could not penetrate.

Question 4

(a) (i) There was confusion regarding the definition of isotopes. The mark for structural formula usually scored but molecular formula scored less often. Chemical formula is not an acceptable alternative.

(ii) There were a number of correct drawings of but-2-ene, but it was common to see but-1-ene drawn differently to the way it was drawn in the stem of the question.

(iii) This was usually answered very well, but the colour of bromine had to be given to score all three marks

(b) Cracking was often referred to correctly as were conditions of high temperature/catalyst.

(c) The first part was not often correct, but the other two responses scored fairly highly. Common errors were bromobutane instead of dibromobutane. But-1-ol and buta-1-anol were other common errors.

Question 5

(a) This was usually answered correctly, scoring both marks. Electrolysis was occasionally seen as an incorrect answer.

(b) An indication of bonds being broken between oxygen atoms or hydrogen atoms in part **(i)** and bonds being formed between oxygen and hydrogen atoms in part **(ii)**. Candidates were usually not specific enough in their answers. Some gave inappropriate formulae usually H_2, O_2 and H_2O without any further explanation. Many of the responses in part **(i)** could have referred to intermolecular bonds between oxygen molecules or hydrogen molecules and therefore could not be given credit. In general, the Examiners were left to carry out too much interpretation to award a mark to candidates.

(iii) Responses were evenly split between exothermic and endothermic. Candidates were supposed to realise that bond breaking is endothermic.

(c) (i) Many candidates are mistakenly of the opinion that hydrogen can be obtained from the air. Hydrogen does not cause pollution was the point that often scored, but a second mark proved more difficult to come by. Hydrogen produces water when it undergoes combustion, but so do fossil fuels. The important factor concerning the combustion of hydrogen is that the **only** product is water, a point that was referred to by a small number of candidates.

(ii) It is a common misconception that because hydrogen is highly reactive/explosive in air it is not suitable as a fuel. Fuels must be made from flammable materials. Hydrogen is not widely used at the moment for a variety of reasons, including that its manufacture from fossil fuels or water requires energy and also that there are problems concerning storage and transport of hydrogen.

Question 6

(a) The most common errors in writing formulae was to assume that the oxidation state of thallium represented the number of thallium atoms. Roman numerals should not be included in formulae. Capital and small letters were sometimes used incorrectly. However there were a considerable number of correct answers.

(b) This caused a large number of problems. What was required is that the precipitate was filtered, washed (preferably with distilled water) and dried. However, after filtration the majority of candidates turned their attention to the filtrate and described the process of crystallisation, which usually led to no marks being scored for the whole response. This represents a good example of candidates not reading the question carefully.

(c) (i) Quite a number were aware of silver bromide being used in photographic film, even in these days of digital photography.

(ii) This was another example of candidates not reading the question carefully or thinking sufficiently about what the question was asking. Very large numbers gave ways of **decreasing** the time by bringing the lamp closer to the paper or increasing the intensity of the light, both of which would increase the rate but decrease the time, rather than increasing the time as required by the question.

(d) (i) This was often correct. Incorrect answers included ammonium instead of ammonia, and also other incorrect substances such as oxygen and hydrogen.

(ii) It was nice to see a correct formula for thallium(I) sulfate quite often. Some equations were unbalanced.

(iii) Quite a number of candidates scored both marks here. The precipitates were often a variety of incorrect colours.

Question 7

(a) The reason that aluminium was expensive was that sodium had to be extracted first. Any mention of sodium being expensive scored the mark, but this was seen very infrequently. Gold, which has nothing to do with the question, was mentioned very often as was electrolysis, which is also irrelevant.

(b) (i) Large numbers knew that cryolite lowered the operating temperature, but when temperatures were quoted they were often too low. The increase in conductivity was less well known. Protective layer of aluminium oxide was incorrectly referred to here on several occasions. There were also several incorrect references to lowering the **boiling** point of the electrolyte and lowering the melting point of **aluminium**.

(ii) and **(iii)** These were both often well answered.

(c) Hydrogen was mentioned very infrequently in the first part, but the second part scored more highly. Some said that carbon will not reduce aluminium instead of aluminium oxide. Protective layer of aluminium oxide was incorrectly referred to here on several occasions.

Question 8

(a) (i) This usually scored, a large number of metals being acceptable.

(ii) Nitr**ide** was seen on occasions, instead of the correct answer which was nitr**ite**.

(b) (i) Exothermic scored a mark, but this was often fortuitous, with no coherent explanation. The second mark required an indication that an increase in temperature favoured the reverse reaction or a decrease in temperature favoured the forward reaction, either of which could be deduced from the evidence given.

(ii) This was more commonly correct than part **(i)**.

(c) Any final answer between 86-89 % was awarded all four marks. Consequential, marks were allowed based on correct method. There were a number who scored all four marks. Some divided 0.16 by 32 (the M_r) rather than by 24, but could then go on to score three marks. 0.00667 was occasionally wrongly approximated to 0.006. Candidates who achieved a mass of lead(**II**) nitrate of more than 5.00 g should have realised that this was impossible, and then gone back to check their work. This did not usually happen.

The expected calculation is given below

Moles of O_2 formed = 0.16/24 = 0.00667

Moles of lead(**II**) nitrate = 0.00667 X 2 = 0.0133

Mass of lead(**II**) nitrate in the sample = 0.0133 X 331 = 4.41 g

Percentage = 4.41/5.00 X 100 = 88.3 %

CHEMISTRY

Paper 0620/33
Extended Theory 33

General Comments

There was much evidence that candidates did not read the questions carefully enough nor think about the questions sufficiently. This is referred to in several individual instances below.

Legible handwriting is crucial to success in Chemistry examinations. Candidates should be aware that substituting one letter for another, for example in the case of butane or butene, refers to a completely different substance. Examiners always give candidates the benefit of doubt on such occasions, but if a response genuinely cannot be read, then it cannot be credited. Formulae should also be written accurately. In particular capital and small letters should be used as appropriate. Candidates do have the advantage of a Periodic Table to consult if they are in any doubt.

Individual Questions

Question 1

This question was based on the candidates knowledge of the periodic table, specifically groups I, VII and the transition elements. Candidates were expected to extrapolate their knowledge of common elements in these areas of the periodic table to elements that were less familiar or unfamiliar. There was a great deal of confusion over the differences between chemical and physical properties.

(a) and **(b)** were the best answered. It was often known that Group I elements were soft and that they reacted with cold water. There was some confusion regarding the fact that compounds of transition elements were coloured, rather than the elements themselves.

(c) This was not answered well. Most did not comment on the fact that fluorine was gaseous, which they should have realised on the basis of trends in boiling points and physical states of the other halogens. Fluorine was often regarded as being unreactive.

Question 2

(a) (i) Many knew that enzymes were biological but this was often confused with being ‘living’. (see also **(c)(ii)**)

(ii) It was not known very often that carbohydrates had a ratio of hydrogen atoms to oxygen atoms of 2:1.

(b) There was a wide variety of answers here. All that was required was the same drawing of a complex carbohydrate as is shown on the syllabus.

(c) (i) There were some very good answers to this question that scored full marks. Common errors included the misunderstanding that the reason for the decrease in colour intensity was that the iodine was being used up and not the starch. There was also a feeling that the enzymes were being denatured. Some merely repeated the colour changes, with no explanation.

(ii) Most realised that the enzymes were being denatured, but a few thought that the enzymes were being ‘killed’. Some thought that the blue colour meant that the reaction had proceeded faster at the higher temperature.

Question 3

(a) (i) Many tried to give explanations of what was happening in terms of redox or electron transfer. 'Describe what you would observe' means that observations are required. Those who attempted to give observations often missed out the original colour of the bromine or failed to refer to the precipitate of sulfur or to describe its colour adequately.

(ii) There was a wide variety of responses here, including many correct answers.

(iii) Many referred to the bromine gaining electrons, but fewer mentioned that the electrons came from the sulfur, which was required for the second mark.

(b) (i) The correct answer, oxidation, was often seen as was reduction and other types of reaction such as decomposition or exothermic.

(ii) Hydrogen was not seen very often. Oxygen was very common, as were other gases as well as non-gaseous iron compounds.

(iii) Candidates should realise that the names of transition metal compounds should always be accompanied by an oxidation state. There were many iron hydroxides or oxides as well as many correct answers.

(iv) Quite often answered correctly.

(v) Loss of electrons or increase in oxidation state was very often accompanied by gain of oxygen, which meant that the mark did not score. This was one of the most common misconceptions on the whole paper. Candidates should realise that the concept of oxygen/hydrogen transfer is very limited in explaining oxidation/reduction.

(vi) Most realised that zinc is more reactive than iron which scored one mark in the majority of cases. Several comments regarding zinc being oxidised, or losing electrons, or being oxidised in preference to iron also scored marks as did the mention of sacrificial protection. However it was not uncommon to see references to zinc rusting in preference to iron. Some candidates did not realise what electrical contact referred to and described zinc protecting iron from rusting by forming an impervious layer which air and water could not penetrate.

Question 4

(a) (i) There was confusion regarding the definition of isotopes. The mark for structural formula usually scored but molecular formula scored less often. Chemical formula is not an acceptable alternative.

(ii) There were a number of correct drawings of but-2-ene, but it was common to see but-1-ene drawn differently to the way it was drawn in the stem of the question.

(iii) This was usually answered very well, but the colour of bromine had to be given to score all three marks

(b) Cracking was often referred to correctly as were conditions of high temperature/catalyst.

(c) The first part was not often correct, but the other two responses scored fairly highly. Common errors were bromobutane instead of dibromobutane. But-1-ol and buta-1-anol were other common errors.

Question 5

(a) This was usually answered correctly, scoring both marks. Electrolysis was occasionally seen as an incorrect answer.

(b) An indication of bonds being broken between oxygen atoms or hydrogen atoms in part **(i)** and bonds being formed between oxygen and hydrogen atoms in part **(ii)**. Candidates were usually not specific enough in their answers. Some gave inappropriate formulae usually H_2, O_2 and H_2O without any further explanation. Many of the responses in part **(i)** could have referred to intermolecular bonds between oxygen molecules or hydrogen molecules and therefore could not be given credit. In general, the Examiners were left to carry out too much interpretation to award a mark to candidates.

(iii) Responses were evenly split between exothermic and endothermic. Candidates were supposed to realise that bond breaking is endothermic.

(c) (i) Many candidates are mistakenly of the opinion that hydrogen can be obtained from the air. Hydrogen does not cause pollution was the point that often scored, but a second mark proved more difficult to come by. Hydrogen produces water when it undergoes combustion, but so do fossil fuels. The important factor concerning the combustion of hydrogen is that the **only** product is water, a point that was referred to by a small number of candidates.

(ii) It is a common misconception that because hydrogen is highly reactive/explosive in air it is not suitable as a fuel. Fuels must be made from flammable materials. Hydrogen is not widely used at the moment for a variety of reasons, including that its manufacture from fossil fuels or water requires energy and also that there are problems concerning storage and transport of hydrogen.

Question 6

(a) The most common errors in writing formulae was to assume that the oxidation state of thallium represented the number of thallium atoms. Roman numerals should not be included in formulae. Capital and small letters were sometimes used incorrectly. However there were a considerable number of correct answers.

(b) This caused a large number of problems. What was required is that the precipitate was filtered, washed (preferably with distilled water) and dried. However, after filtration the majority of candidates turned their attention to the filtrate and described the process of crystallisation, which usually led to no marks being scored for the whole response. This represents a good example of candidates not reading the question carefully.

(c) (i) Quite a number were aware of silver bromide being used in photographic film, even in these days of digital photography.

(ii) This was another example of candidates not reading the question carefully or thinking sufficiently about what the question was asking. Very large numbers gave ways of **decreasing** the time by bringing the lamp closer to the paper or increasing the intensity of the light, both of which would increase the rate but decrease the time, rather than increasing the time as required by the question.

(d) (i) This was often correct. Incorrect answers included ammonium instead of ammonia, and also other incorrect substances such as oxygen and hydrogen.

(ii) It was nice to see a correct formula for thallium(I) sulfate quite often. Some equations were unbalanced.

(iii) Quite a number of candidates scored both marks here. The precipitates were often a variety of incorrect colours.

Question 7

(a) The reason that aluminium was expensive was that sodium had to be extracted first. Any mention of sodium being expensive scored the mark, but this was seen very infrequently. Gold, which has nothing to do with the question, was mentioned very often as was electrolysis, which is also irrelevant.

(b) (i) Large numbers knew that cryolite lowered the operating temperature, but when temperatures were quoted they were often too low. The increase in conductivity was less well known. Protective layer of aluminium oxide was incorrectly referred to here on several occasions. There were also several incorrect references to lowering the **boiling** point of the electrolyte and lowering the melting point of **aluminium**.

(ii) and **(iii)** These were both often well answered.

(c) Hydrogen was mentioned very infrequently in the first part, but the second part scored more highly. Some said that carbon will not reduce aluminium instead of aluminium oxide. Protective layer of aluminium oxide was incorrectly referred to here on several occasions.

Question 8

(a) (i) This usually scored, a large number of metals being acceptable.

(ii) Nitr**ide** was seen on occasions, instead of the correct answer which was nitr**ite**.

(b) (i) Exothermic scored a mark, but this was often fortuitous, with no coherent explanation. The second mark required an indication that an increase in temperature favoured the reverse reaction or a decrease in temperature favoured the forward reaction, either of which could be deduced from the evidence given.

(ii) This was more commonly correct than part **(i)**.

(c) Any final answer between 86-89 % was awarded all four marks. Consequential, marks were allowed based on correct method. There were a number who scored all four marks. Some divided 0.16 by 32 (the M_r) rather than by 24, but could then go on to score three marks. 0.00667 was occasionally wrongly approximated to 0.006. Candidates who achieved a mass of lead(**II**) nitrate of more than 5.00 g should have realised that this was impossible, and then gone back to check their work. This did not usually happen.

The expected calculation is given below

Moles of O_2 formed = 0.16/24 = 0.00667

Moles of lead(**II**) nitrate = 0.00667 X 2 = 0.0133

Mass of lead(**II**) nitrate in the sample = 0.0133 X 331 = 4.41 g

Percentage = 4.41/5.00 X 100 = 88.3 %

CHEMISTRY

Paper 0620/04
Coursework

General comments

The vast majority of Centres which entered for the coursework alternative were Centres which had entered previously and there were few problems with the standards applied by the staff concerned.

This year was the first year of the new sampling arrangements and most Centres submitted sample selected according to the new procedures. Those who used the old system were not disadvantaged in any way but it is important that Centres do start using the new system in November 2010 and June 2011.

Centres are reminded that they should still send details of the investigations used together with the candidate instruction sheets and mark schemes.

The only general comment that requires making is regarding the difficulty of the tasks set. This does vary between Centres and candidates set more difficult tasks do not necessarily get higher marks. Marks are given according to how well candidates fulfil the criteria specified in the syllabus. Provided that tasks provide the opportunity to do so, full marks are available on any task based on the Chemistry syllabus. For details of the requirements in each skill please see the comments below.

Some Centres have successfully used the same tasks over a number of years and there is, clearly, no need to change these. However, if you are considering introducing a new task the comments below may help.

Comments on specific skills

Skill C1 Using and Organising Techniques, Apparatus and Materials.

To gain maximum marks here candidates need to follow instructions successfully. The task needs to have a number of steps which need to be followed in sequence. At some point there must be a situation where a candidate has to make a choice between two alternative courses of action (this could be as simple as whether or not to stop heating).

Candidates are not required to modify the method they are using this is part of skill C4.

Skill C2 Observing Measuring and Recording.

The tasks set should allow candidates both to take measurements and to make other observations, though not necessarily in the same task.

Visual observation should be detailed and complete. Measurements should be as accurate as is feasible using the apparatus available to the candidate.

Observations and measurements should be recorded appropriately (usually in a table) in a manner designed by the candidate. The provision of an outline table or detailed instruction on how to record results limits the maximum mark available.

Skill C3 Handling Experimental Observations and Data.

The processing part of this skill refers to data and the most common form of processing is a graph. Graphs should be of sufficient size, ideally A4, and should occupy most of the grid. Small graphs are less accurate and are not deserving of the highest marks. Computer drawn graphs are acceptable but they must be to the same standard as hand drawn ones with a best-fit line or curve. For the highest marks there should be no plotting errors and axes should be labelled with quantities and units.

Where calculations are involved (e.g. in titration exercises) any assistance given decreases the mark available.

Conclusions given in answer to leading questions are rarely worth high marks although a question prompting the candidate to give a conclusion is fair.

At the highest level conclusions should describe and explain patterns/trends found in the results and should comment on any results which do not fit the pattern.

Skill C4 Planning, Carrying Out and Evaluating Investigations.

This is the skill where the selection of an appropriate task is most important. To gain access to the higher marks it is essential that a number of variables are involved. Very simple investigations are, thus, unlikely to give access to the highest marks.

The most obvious examples are concerned with rate of reaction where a number of variables could affect the rate. Explaining how these variables will be controlled, varied or measured is key to performing well. Another good example would be comparing the amount of heat produced by different fuels.

It is also essential that candidates perform the investigation which they have planned as indicated in the title for this skill. A candidate who does not carry out the investigation has not fully complied with even the criteria for 2 marks.

This is the most difficult skill to score well on. It is not recommended that C4 tasks should be the only way of assessing C2 and C3 as a poor plan can adversely affect these marks.

It is impossible to assess C1 and C4 on the same task since one involves following instructions and the other involves writing them.

CHEMISTRY

Paper 0620/51
Practical 51

General comments

The majority of candidates successfully completed both questions and there was no evidence that candidates were short of time. Centres reported very few problems with the requirements of the examination. However, results showed that some of the aqueous acid solutions for **Question 1** were not made to the specified concentrations. Candidates were not penalised as Supervisors' results were considered when marking the scripts.

There were still a minority of Centres, which failed to submit a copy of the Supervisor's results with the candidates' scripts. The Examiners use Supervisors' results when marking the scripts to check comparability.

Comments on specific questions

Question 1

The majority of candidates correctly recorded the volume of acid required to change the colour of the indicator in both experiments.

The majority of candidates carried out the two experiments.

The tables of results were generally, fully and successfully completed. A minority of candidates recorded increasing temperatures with no maximum and some candidates had results, which were not remotely comparable to the Supervisor's results.

(a) The points were often plotted correctly on the grid. A significant number of candidates were unable to draw smooth line graphs and joined the points randomly, Thick lines and multiple lines were penalised. A number of candidates did not label the graphs.

(b) Experiment 2 was incorrectly chosen by some candidates and the scale on the x-axis read wrongly by others.

(c) Surprisingly, only the minority of candidates scored credit for the correct colour change i.e. pink to colourless. The majority reversed the colour change and many incorrect answers referred to the original colour as clear or purple.

(d) (i) The vast majority of candidates successfully identified the experiment with the greater temperature change.

(ii) A good discriminating question. Good candidates referred to the greater concentration / strength of the acid solution C and discussed more collisions between particles. A number of candidates mistakenly wrote at length about the increased kinetic energy of the particles.

Vague answers mentioned the different reactivity or acidity of the acid solutions.

(e) Credit was scored for realising that the reaction was finished and that the reaction mixture would return to room temperature or the initial temperature in the table of results. A common vague answer was 'the temperature of the mixture would decrease / drop'.

Question 2

(a) Some candidates failed to describe the colour of the solid. White or colourless scored credit while references to clear or transparent did not.

(b) A good discriminating question. Detailed answers listed the 'melting' of the solid and the evolution of an acidic gas. Some candidates tested the gas, which bleached indicator paper but failed to record its acidic nature. A number of candidates recorded that the indicator paper turned blue or purple.

(c)(i) and **(ii)** The formation of white precipitates and the effect of adding excess reagent was recorded accurately by most candidates. Poor attempts referred to observations such as cloudy or milky appearances.

(iii) A surprising number of candidates obtained a white precipitate when hydrochloric acid and barium chloride was added to the solution. No reaction / change was the expected observation here as the substance being analysed was a nitrate and not a sulfate.

(iv) Many answers referred to a lighted splint popping which was irrelevant. Credit was awarded for reference to effervescence and the formation of an alkaline gas with a pH > 7 or the indicator paper turning blue / purple.

(d) Some candidates did not read the question and failed to refer to test **(c)(iii)**. Only the more able candidates realised that a sulfate was absent.

(e) A number of candidates used their test from **(c)(iv)** to identify hydrogen. These candidates failed to recognise the nitrate test and the formation of ammonia.

(f) The answers to this question were Centre dependent. Only the more able candidates recognised the presence of a hydrated salt. Many candidates ignored the mark allocation for the question and concluded that aluminium or nitrate ions were present but not both. Some candidates concluded wrongly that solid E was zinc / calcium sulfate.

CHEMISTRY

Paper 0620/52
Practical 52

General comments

Virtually all candidates were able to complete all practical tasks in the allotted time. Very few difficulties were reported by Centres and this was reflected by the consistency of the results gained by candidates. A very small minority of Centres failed to submit a set of Supervisor's results; in these cases the candidates' results were compared to the median values of the Supervisors' results form other Centres

Comments on specific questions

Question 1

Almost all candidates recorded a complete set of results in the table. A small minority recorded an increasing temperature as the volume of the solution increased rather than the expected decreasing temperature; even in these cases candidates often scored one of the two marks available for comparability to the Supervisor's results.

(a) Some candidates chose to use difficult graph scales (such as 3 cm = 10 °C); in these cases marks were often lost due to incorrect plotting. Despite the instruction to draw a straight line graph, both best fit and "point to point" graph lines were seen.

(b) Most candidates were able to describe how they knew when all the salt had dissolved, although a small number misunderstood the question and described how they knew when crystals had started to reappear.

(c) Most candidates successfully extrapolated their graph line and read a correct temperature from the graph, however, some candidates tried to read the temperature without first extrapolating the line. Full marks could be gained even where the extrapolated line went beyond the printed grid.

(d) Correct sketch lines for salt **B** were often seen, but candidates should note that there is no need to make up data points and then plot them when a sketch line has been asked for.

(e) This question part proved to be a good discriminator. A number of candidates focused on time (which was not measured in the experiment) and tried to explain why the reaction (although no reaction was occurring) would be slower.

(f) In common with **(e)**, some candidates suggested that time should be measured. If candidates suggest repeating the experiment, they should go onto explain why – simply "to find an average" will suffice for the explanation in this case. Some candidates seem to be answering questions from previous examination papers – making suggestions such as "use a burette rather than a measuring cylinder" despite having used a burette in the experiment.

Question 2

(a) Some candidates described the yellow precipitate as white while others missed the fact that a precipitate had been formed (claiming a yellow solution was seen).

(b) (i) Almost all candidates could describe solution **X**. Although the vast majority gave an acceptable value for the pH, some gave a value which was too high.

(ii) Most candidates accurately described the formation of the blue precipitate. It should be noted that terms such as "cloudy" or "milky" are not acceptable alternatives to the term "precipitate".

(iii) Some candidates had difficulty in recording their results clearly for this two part test. It was evident that some candidates ignored the instruction to add the ammonia drop by drop since they recorded an immediate change to a dark blue solution.

(iv) It was rare for full marks to be awarded for this part. The failure by many candidates to note that the precipitate formed is white (or cream) probably stemmed from not following the instructions carefully and so not leaving the reaction mixture to stand for 5 minutes (which lets the precipitate settle out).

(c) Most candidates scored full marks, but a surprising number recorded pH values that would suggest solution **Y** (sulfuric acid) was a weak alkali.

(d) Candidates should have used the result of **(a)** to conclude that **W** was an iodide. However, many candidates thought that **W** (or **X** in **(e)**) contained iron(III) ions – presumably confusing the brown solution (of iodine) formed in **(b)(iv)** with the formation of a precipitate of iron(III) hydroxide.

(e) While most candidates correctly concluded that **X** contained Cu^{2+} ions, many missed the fact it was acidic (as shown by the test in **(b)(i)**).

(f) Most candidates identified **Y** as sulfuric acid.

CHEMISTRY

Paper 0620/61

Alternative to Practical 61

General comments

The vast majority of candidates successfully attempted all of the questions. The full range of marks was seen. The paper discriminated successfully between candidates of different abilities but was accessible to all.

Candidates found **Questions 2** and **7** to be the most demanding. Some Centres had not covered all sections of the syllabus e.g. qualitative analysis.

The majority of candidates were able to complete tables of results from readings on diagrams and plot points successfully on a grid as in **Questions 3** and **4**.

Comments on specific questions

Question 1

(a) Most candidates scored credit on this question. The most common error was to identify the separating/tap funnel as a burette or thistle funnel. Most candidates recognised the flask though some mistakenly thought it was a beaker. Gas jar or measuring cylinder was allowed for the container collecting the gas. This container was sometimes labelled as a collecting tube, glass jar or cylinder.

(b) Generally well answered. The collection of the gas by upward delivery was recognised by most candidates.

(c) Only the more able candidates realised that the passage of the gas through the acid would dry it or remove impurities. Some vague answers referred to observing bubbles and acidifying the gas.

Question 2

A good discriminating question. The use of silver/lead nitrate to identify iodide ions was common. Many candidates used bromine to test for the alkene. A variety of methods were used to identify nitric acid. Named indicators were common as was the use of carbonates with the subsequent evolution of carbon dioxide gas – both scored full marks. A common correct answer was to describe the nitrate test with sodium hydroxide/aluminium and a description/test for the ammonia gas formed.

Question 3

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

(b) Most candidates successfully plotted the results and drew a smooth curve. A minority of candidates omitted the origin and then drew a distorted graph through the inaccurate point.

(c) Vague descriptions such as ‘the second one’ were penalised. Some candidates drew the curve through the two minute point and then identified the one minute point as inaccurate – this was penalised.

(d) The sketches were generally steeper than the original curve as required. However, many sketches did not level out at the same level as the original curve.

Question 4

(a) and **(b)** The tables of results were usually completed correctly.

(c) Some candidates misread the scale on the y-axis. Many smooth line graphs were not smooth. Thick, wobbly and multiple lines were common.

(d) A minority of candidates used experiment 2 instead of experiment 1. Some answers showed no indication as to how the answer had been obtained and some misread the scale on the x-axis.

(e) Vague references to the reactivity of the acids and different acidity were prevalent. Good answers included the idea of more particle collisions.

(f) Generally well answered.

(g) Credit was given for realising that the reaction had finished and that the temperature would return to room temperature/23 °C.

Poor answers lacked detail and discussed either the temperature remaining constant or decreasing to 0 °C.

Question 5

(c) The formation of white precipitates and their soluble or insoluble nature was recognised by most candidates.

(d) The formation of water or recognition of a hydrated or hydrous(sic) salt was only understood by a minority of candidates.

(e) Generally well answered.

(f) A good discriminating question. Credit was given for the identification of the nitrate ion and realising that the salt was hydrated. Too many candidates referred to the presence of ammonia or ammonium instead of the nitrate ion.

A significant number of candidates identified the presence of a sulfate even though the tests showed that a sulfate was absent.

Question 6

(a) Some candidates placed the arrow beneath the tube in the beaker of ice. The arrow was expected to be drawn below the solid in the horizontally placed tube. Frequently this question was not attempted.

(b) The common incorrect answers were blue to pink or confusion with hydrated copper sulfate i.e. blue to white.

(c) Generally well answered, though some candidates described the cooling/condensing of crystals/solid.

(d) References to gases/air entering the tube scored no credit. The idea of relieving pressure or allowing gases to escape scored credit. Named incorrect gases, e.g. chlorine/hydrogen. escaping from the apparatus were penalised.

Question 7

A good discriminating question. Marks were awarded for recognising that the large lumps of malachite should be crushed or broken into smaller pieces using a mortar and pestle.

Various methods could be used to obtain copper from copper carbonate. Those chosen involved adding a dilute acid to the malachite to form a copper salt solution. This solution could then be electrolysed or have a more reactive metal, e.g. magnesium or zinc, added to displace the copper. The use of sodium or potassium as the reactive metal was common and was penalised. Other methods involved heating the malachite and then reduction with carbon, carbon monoxide or hydrogen. Reaction conditions were often missing or incorrect.

Correct chemistry with appropriate conditions scored credit. Many answers scored no credit. Some examples of these are listed below:

- reference to molten malachite;
- dissolving copper carbonate or copper oxide in water;
- adding sodium hydroxide to malachite to form copper;
- adding acid to malachite and filtering off copper metal.

Answers using malachite as an anode and describing the purification of copper by electrolysis received partial credit.

CHEMISTRY

Paper 0620/62
Alternative to Practical 62

General comments

The vast majority of candidates successfully attempted all of the questions. The full range of marks was seen. The paper discriminated successfully between candidates of different abilities but was accessible to all.

Candidates found **Questions 5** and **7** to be the most demanding.

The majority of candidates were able to complete tables of results from readings on diagrams and plot points successfully on a grid as in **Questions 3** and **4**.

Comments on specific questions

Question 1

(a) Most candidates scored full marks on this section. The Bunsen burner and tripod were recognised by nearly all candidates. The condenser caused most, but still only a few, problems. Answers such as distillation tube and delivery tube were the most common incorrect responses. Condensing tube was accepted.

(b) Generally well answered, although a few thought that crystals of salt could be obtained by distillation using apparatus **H**.

Question 2

(a) Most candidates knew that a mortar and/or pestle should be used to crush the grass; many could not remember the correct name. Common answers included grinder, crusher and muncher. A suitable diagram was accepted.

(b) The term "decant" was not well known. Although a significant minority did get the idea of pouring a liquid away from a solid, the most common answer was filtering.

(c) This was well answered although water was often used as the solvent; or the chromatography paper was dipped in the solution. A lot of candidates inappropriately used control 'spots' or a spray to develop the colours.

Question 3

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

(b) Most candidates successfully plotted the results and drew a smooth curve. A minority of candidates omitted the origin or drew a distorted graph through the inaccurate point.

(c) Vague descriptions such as 'the second one' were penalised. Some candidates drew the curve through the two minute point and then identified the one minute point as inaccurate; this was penalised.

(d) The sketches were generally steeper than the original curve as required. However, many sketches did not level out at the same level as the original curve.

Question 4

(a) and (b) The tables of results were usually completed correctly.

(c) Some candidates misread the scale on the y-axis, losing three plotting marks. Many smooth line graphs were not smooth. Thick, wobbly and multiple lines were common. Labels were often omitted.

(d) A minority of candidates used experiment 2 instead of experiment 1. Some answers showed no indication as to how the answer had been obtained and some misread the scale on the x-axis.

(e) Vague references to the reactivity of the acids and different acidity were prevalent. Good answers included the idea of more particle collisions.

(f) Generally well answered.

(g) Credit was given for realising that the reaction had finished and that the temperature would return to room temperature/23 °C. Some candidates thought that all the acid had been used up, when, in fact, the acid was in excess. Poor answers lacked detail and discussed either the temperature remaining constant or decreasing to 0 °C.

Question 5

(c) The formation of white precipitates and their soluble or insoluble nature was recognised by most.

(d) The formation of water or recognition of a hydrated or hydrous(sic) salt was only understood by a minority of candidates.

(e) Generally well answered.

(f) Ammonia was recognised by most candidates.

(g) A good discriminating question. Credit was given for the identification of the nitrate ion and realising that the salt was hydrated. Too many candidates referred to the presence of ammonia or ammonium instead of the nitrate ion. A significant number of candidates identified the presence of a sulfate even though the tests showed that a sulfate was absent.

Question 6

(a) Electrolysis was well known.

(b) Most answers correctly gave carbon or graphite as the electrode material, although a variety of metals were specified.

(c) Generally well answered.

(d) The test for hydrogen was well known.

Question 7

A good discriminating question. Few candidates scored full marks or failed to score, most got about half marks.

Marks were awarded for:

- testing both metals;
- using a suitable reagent (acid, water or other 'cooking' liquids);
- stating a suitable period of time;
- heating (they are for saucepans);
- suggesting the expected result, e.g. corrosion, gas evolved;
- explaining the basis for choice, e.g. least corrosion.

Some credit was given for answers that just compared the thermal conductivity of the metals.

CHEMISTRY

Paper 0620/63
Alternative to Practical 63

General comments

The vast majority of candidates successfully attempted all of the questions. The full range of marks was seen. The paper discriminated successfully between candidates of different abilities but was accessible to all.

Candidates found **Questions 5** and **7** to be the most demanding.

The majority of candidates were able to complete tables of results from readings on diagrams and plot points successfully on a grid as in **Questions 3** and **4**.

Comments on specific questions

Question 1

(a) Most candidates scored full marks on this section. The Bunsen burner and tripod were recognised by nearly all candidates. The condenser caused most, but still only a few, problems. Answers such as distillation tube and delivery tube were the most common incorrect responses. Condensing tube was accepted.

(b) Generally well answered, although a few thought that crystals of salt could be obtained by distillation using apparatus **H**.

Question 2

(a) Most candidates knew that a mortar and/or pestle should be used to crush the grass; many could not remember the correct name. Common answers included grinder, crusher and muncher. A suitable diagram was accepted.

(b) The term “decant” was not well known. Although a significant minority did get the idea of pouring a liquid away from a solid, the most common answer was filtering.

(c) This was well answered although water was often used as the solvent; or the chromatography paper was dipped in the solution. A lot of candidates inappropriately used control ‘spots’ or a spray to develop the colours.

Question 3

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

(b) Most candidates successfully plotted the results and drew a smooth curve. A minority of candidates omitted the origin or drew a distorted graph through the inaccurate point.

(c) Vague descriptions such as ‘the second one’ were penalised. Some candidates drew the curve through the two minute point and then identified the one minute point as inaccurate; this was penalised.

(d) The sketches were generally steeper than the original curve as required. However, many sketches did not level out at the same level as the original curve.

Question 4

(a) and (b) The tables of results were usually completed correctly.

(c) Some candidates misread the scale on the y-axis, losing three plotting marks. Many smooth line graphs were not smooth. Thick, wobbly and multiple lines were common. Labels were often omitted.

(d) A minority of candidates used experiment 2 instead of experiment 1. Some answers showed no indication as to how the answer had been obtained and some misread the scale on the x-axis.

(e) Vague references to the reactivity of the acids and different acidity were prevalent. Good answers included the idea of more particle collisions.

(f) Generally well answered.

(g) Credit was given for realising that the reaction had finished and that the temperature would return to room temperature/23 °C. Some candidates thought that all the acid had been used up, when, in fact, the acid was in excess. Poor answers lacked detail and discussed either the temperature remaining constant or decreasing to 0 °C.

Question 5

(c) The formation of white precipitates and their soluble or insoluble nature was recognised by most.

(d) The formation of water or recognition of a hydrated or hydrous(sic) salt was only understood by a minority of candidates.

(e) Generally well answered.

(f) Ammonia was recognised by most candidates.

(g) A good discriminating question. Credit was given for the identification of the nitrate ion and realising that the salt was hydrated. Too many candidates referred to the presence of ammonia or ammonium instead of the nitrate ion. A significant number of candidates identified the presence of a sulfate even though the tests showed that a sulfate was absent.

Question 6

(a) Electrolysis was well known.

(b) Most answers correctly gave carbon or graphite as the electrode material, although a variety of metals were specified.

(c) Generally well answered.

(d) The test for hydrogen was well known.

Question 7

A good discriminating question. Few candidates scored full marks or failed to score, most got about half marks.

Marks were awarded for:

- testing both metals;
- using a suitable reagent (acid, water or other 'cooking' liquids);
- stating a suitable period of time;
- heating (they are for saucepans);
- suggesting the expected result, e.g. corrosion, gas evolved;
- explaining the basis for choice, e.g. least corrosion.

Some credit was given for answers that just compared the thermal conductivity of the metals.