CHEMISTRY

Paper 0620/11
Multiple Choice

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

General comments

Candidates performed quite well on this paper.

Questions 2, 9, 10, 28 and **32** proved particularly straightforward with more than 90% of candidates choosing the correct response.

Questions 17, 29 and **30** proved to be difficult with less than 40% of candidates choosing the correct response.

Comments on Specific Questions

The following responses were popular **wrong** answers to the questions listed.

Question 11

Response C. Candidates related the diagram to an experiment that they had done instead of co
the polarity of the battery.

Question 12

Response A. Candidates knew the correct substances and hastily selected A without considering the correct electrodes.

Question 13

Response A. Chlorine is coloured but sodium is not produced. Candidates needed to read all possible responses then they may have selected the correct one.

Question 17

Response A. This response was more popular than B (the correct response). Candidates knew the correct colour change and either did not read further or confused exothermic and endothermic.

Question 19

Response B. Candidates realised that positive tests for iodide and sulfate were involved but got them the wrong way round.

Question 23

Response C. A significant number chose this alternative. Group I metals are good conductors even if they are not used as such.

Question 30

Response B. This answer was more popular than the correct one. Candidates knew that carbon monoxide was involved in iron production and did not realise that this question involved the conversion of iron to steel.

Question 33

Response C. Candidates did not realise that lead compounds are a fuel additive and therefore constitute part of the fuel.

Question 39

Response B. Candidates knew that ethanol contained an oxygen atom but did not know of the reaction involved in the question.

Question 40

Response B. Candidates knew that bitumen was at the bottom of the tower and did not read to the end of the alternatives.

CHEMISTRY

Paper 0620/12

Multiple Choice

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

General comments

Candidates performed quite well on this paper.

Questions 2, 4, 5, 10, 30, 32, 33 and **40** proved particularly straightforward with more than 90% of candidates choosing the correct response.

Questions 16 and **30** proved to be difficult with less than 40% of candidates choosing the correct response.

Comments on Specific Questions

The following responses were popular **wrong** answers to the questions listed.

Question 11

Response C. Chlorine is coloured but sodium is not produced. Candidates needed to read all responses then they may have selected the correct one.

Question 15

Response B. Candidates realised that positive tests for iodide and sulfate were involved but got them the wrong way round.

Question 16

Response A. This response was more popular than B (the correct response). Candidates knew the correct colour change and either did not read further or confused exothermic and endothermic.

Question 29

Response B. This answer was more popular than the correct one. Candidates knew that carbon monoxide was involved in iron production and did not realise that this question involved the conversion of iron to steel.

Question 31

Response C. Candidates did not realise that lead compounds are a fuel additive and therefore constitute part of the fuel.

Question 37

Response B. Candidates knew that bitumen was at the bottom of the tower and did not read to the end of the alternatives.

CHEMISTRY

Paper 0620/13

Multiple Choice

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

General comments

Candidates performed quite well on this paper.

Questions 1, 2, 3, 4, 5, 6, 8, 29, 32, 33 and **40** proved particularly straightforward with more than 90% of candidates choosing the correct response.

Questions 18 and **28** proved to be difficult with less than 40% of candidates choosing the correct response.

Comments on Specific Questions

The following responses were popular **wrong** answers to the questions listed.

Question 11

Response A. Chlorine is coloured but sodium is not produced. Candidates needed to read all [the] responses then they may have selected the correct one.

Question 18

Response A. This response was more popular than B (the correct response). Candidates knew the correct colour change and either did not read further or confused exothermic and endothermic.

Question 20

Response B. Candidates realised that positive tests for iodide and sulfate were involved but got them the wrong way round.

Question 27

Response C. Candidates did not realise that lead compounds are a fuel additive and therefore constitute part of the fuel.

Question 28

Response B. This answer was more popular than the correct one. Candidates knew that carbon monoxide was involved in iron production and did not realise that this question involved the conversion of iron to steel.

Question 38

Response B. Candidates knew that bitumen was at the bottom of the tower and did not read to the end of the alternatives.

CHEMISTRY

Paper 0620/21

Core Theory

General comments

Some candidates tackled this Paper well, showing a very good knowledge of core Chemistry. Relatively good answers were seen to **Question 1** but all other questions posed particular problems for individual candidates. Nearly all candidates were entered at the appropriate level.

The rubric was occasionally misinterpreted. For example, in **Question 3(b)(ii)** a number of candidates incorrectly ticked two boxes and in **Question 8(c)**, a significant number of candidates ticked only one box rather than two. In **Question 8(e)(ii)** many candidates misinterpreted the word 'number' and just wrote down the types of atom present. In **Question 1(b)**, a few candidates wrote down elements which were absent from the list provided and so could not be awarded credit.

More candidates than usual appeared to leave blank spaces especially when questions required a more structured response e.g. **Questions 2(c)(i)** and **5(d)(ii)**. The standard of English was reasonable but seemed less accurate than in previous November sessions. It was encouraging, however, that a considerable number of candidates wrote their answers in the form of short phrases or bullet points. There is less chance that candidates write vague statements or contradict themselves if this is done.

Although some candidates had a fairly good knowledge of inorganic chemistry and many could interpret formulae correctly, few could give the correct name for the chloride and sulfate ions. Many candidates had a limited knowledge of organic chemistry and tests for specific ions. For example, few could write the structure of ethanol or define a hydrocarbon or unsaturated compound. Many candidates need to revise the test for nitrate ions and for carbon dioxide. As in previous sessions, many candidates had difficulty answering questions on environmental issues such as acid rain and lead pollution with clarity. Many candidates in this session were able to perform a simple calculation in **Question 4(b)**.

Comments on Specific Questions

Question 1

Although many candidates scored fairly well on this question, few candidates were awarded full credit. However, many did gain credit on selected questions in **(b)**.

(a) This was generally fairly well answered, the common error being to suggest that the elements in the diagram belonged to Period 1.

(b)

(i) Most candidates correctly selected oxygen as having 6 electrons in its outer shell. The commonest error was to suggest carbon, presumably because a carbon atom has 6 electrons in total.

(ii) Many candidates correctly identified fluorine as being a halogen but others needed to read the stem of the question properly and instead wrote chlorine, which was absent from the list.

(iii) Fewer than half the candidates realised that lithium was the element on the list which reacted with cold water. The commonest error was to suggest neon. This error presumably arose for muddling up the symbol Ne with that of sodium, Na. B was also a common suggestion.

(iv) Many candidates realised that diamond and graphite were forms of carbon. The commonest error was to suggest boron.

(v) Most candidates correctly identified Be as being in Group II of the Periodic Tabl misinterpreted the stem of the question and wrote magnesium, which was absent list.

(vi) Most candidates erroneously thought that oxygen made up approximately 80% of the ai rather than nitrogen.

(c) Many candidates were awarded at least partial credit for this question. The first gap was often filled correctly by ‘atoms’, but many candidates gave an incorrect response in the second gap. The commonest error here was to suggest electrons. Although the electron number in a neutral atom is equal to the proton number, it is the proton number which determines the position of the element in the Periodic Table. A large minority of candidates wrote ‘molecules’ in the first gap.

Question 2

Many of the seemingly straightforward parts of this question provided a challenge to many candidates. For example, few could describe an alloy, give a use of calcium oxide or identify carbon dioxide as the gas given off when calcium carbonate is heated. It was encouraging to note that many candidates could balance the equation in **(c)(iv)** and write the correct name for $CaCl_2$.

(a) Few candidates could identify thermal decomposition as the type of chemical reaction occurring when calcium carbonate is heated. The commonest errors were to suggest oxidation or hydration.

(b)

(i) A minority of candidates were able to identify carbon dioxide as the gas given off when calcium carbonate is heated. The commonest incorrect suggestions were oxygen, carbon monoxide or calcium oxide. Candidates need to look carefully at all parts of the question to ensure that they get the relevant information - the stem to **(c)** hints that calcium oxide cannot be a gas. A significant minority suggested that hydrogen was formed.

(ii) Although a good proportion of candidates realised that limewater turned milky or white, a few suggested that a purple or blue colour was obtained. This presumably arose because they were thinking of the colour Universal Indicator or litmus changed when added to limewater.

(c)

(i) Few candidates were awarded credit for this part. Common errors were to suggest that the iron/ steel was made stronger or harder by adding calcium oxide or to merely rephrase the question.

(ii) Very few candidates gave a good description of an alloy. Many were content to suggest that you add a substance or a compound or a molecule to a metal. The idea of a mixture was seldom encountered and many did not even mention a metal at all.

(iii) Few candidates were able to suggest a suitable use for calcium oxide. Many candidates thought that calcium oxide was a metal and so chose incorrect answers such as ‘for car bodies’ or ‘in stainless steel’.

(iv) It was encouraging to note that a considerable number of candidates could balance the equation. Common errors included H_2 rather than H_2O on the right or the addition of other compounds on the left.

(v) Most candidates correctly identified calcium chloride.

Question 3

This question was generally fairly well done. Many candidates could state a correct use of helium and name the nucleus but quite a few had mixed success with other sections in **(b)**. Part **(c)** posed particular problems, with few candidates realising that the particles in a liquid are <u>very</u> close together/ touching.

(a) Most candidates gained credit for a correct use of helium, the commonest answer referring to balloons. Some candidates unfortunately suggested that the balloons were hot air balloons and so did not receive credit.

(b)

(i) Most candidates realised that the central part of the atom is the nucleus. A few su… 'nucleons' which was an acceptable alternative. The commonest incorrect answe… protons.

(ii) Although many candidates realised that helium has a complete outer shell of electrons, many thought that the shell was incomplete, presumably forgetting that in the first Period, there can be only a maximum of two electrons in the 1^{st} shell. The second most common error was to suggest that argon's inner electron shell is incomplete.

(iii) The correct answer 18 was given by about half the candidates. 16, 6 or 2 were common incorrect answers.

(iv) A few candidates gave good answers to this question. Others need to improve their knowledge of atomic structure. Common errors were to suggest there are 16 protons, to give the structure 36 nucleons or to mistake argon for helium and give the number of protons and nucleons as 2 and 4 respectively (or incorrectly as 2 and 2).

(c) Few candidates gained credit for drawing the atoms touching or very close to each other. Most candidates drew the atoms randomly but a significant number drew them in rows and so received no further credit.

Question 4

This proved to be one of the most difficult questions on the Paper. A few candidates exhibited a good knowledge of separation techniques, qualitative tests and names of ions. Parts **(a), (c)(i)** and **(d)(ii)** proved to be especially demanding.

(a) Many candidates need more practice at naming ions. For example many candidates incorrectly named the chloride ion as a chlorine ion. Few recognised the correct name of the sulfate ion. The commonest misnaming was sulfur oxide.

(b) The calculation was well carried out by the majority of the candidates.

(c)

(i) A minority of the candidates were able to remember a test for identifying a nitrate. Common errors included the use of sodium hydroxide, the use of barium nitrate, the addition of ammonia, application of heat or add oxygen. Many candidates did not attempt the question.

(ii) Although ammonia was identified as the gas being produced in the test for nitrates, many candidates opted for hydrogen or chlorine.

(d)

(i) Most candidates could label at least two of the pieces of apparatus correctly. The commonest correct label was for the condenser. Some candidates did not look carefully enough at where the arrow pointed to the pure water and wrote 'flask'.

(ii) A few candidates gave good answers and the majority of candidates were awarded partial credit. A significant number of candidates left this part of the question blank. Many candidates merely stated that the water was heated or it evaporated. Although the latter is a slightly better answer, neither of these suggests the idea of boiling or conversion of liquid to gas at a temperature which will allow the particles to gain enough energy to get to the condenser. The commonest valid point made was the idea of condensation/ conversion of vapour/ gas to liquid in the condenser. Many were content just to say that the water was formed in the flask. This is self-evident from the diagram.

(iii) Many candidates were able to suggest a suitable area of everyday life such as foodstuffs, water or medicines where 'purity' in terms of no harmful contaminating substances is important.

Question 5

This question posed many problems for most candidates, especially in **(c)(ii)** and **(d)(ii)**, where e writing was required. Many need to be able to explain a neutralisation reaction, as in **(d)(i),** in more and a significant minority left **(d)(ii)** unanswered. As in previous sessions many candidates had diffic answering the question on acid rain; many candidates failing to even mention sulfur or fossil fuels.

(a) This was the best answered part of this question. Most candidates ringed the correct pH. The commonest incorrect answers were pH 3 and pH 7.

(b) A few candidates realised that the common name for calcium hydroxide is slaked lime. The majority chose either limestone or quicklime.

(c)

(i) Most candidates gave a suitable explanation of why it is important to control soil acidity. There were some good answers, although most candidates restricted themselves to vague answers such as 'the plants might die'.

(ii) Most candidates were awarded limited credit here. Few mentioned sulfur or burning fossil fuels. Most candidates restricted themselves to writing vague statements about car exhausts or pollution from factories. Carbon dioxide was often, incorrectly, thought to contribute to acid rain. Although a solution of carbon dioxide in water is very slightly acidic, this does not contribute to what is defined as acid rain. A few candidates mentioned rainwater but hardly any mentioned the acidic oxides dissolving in rainwater to form an acid.

(d)

(i) A minority of candidates recognised the reaction between a hydroxide and an acid as being an example of neutralisation. Common errors were oxidation and electrolysis. It is difficult to explain why the latter error was so common.

(ii) This question was poorly done compared with similar questions asked in previous sessions. Few candidates did little more than suggest the idea of adding the acid from the burette to the alkali in the flask. Candidates needed to be more conversant with the titration procedure and hardly any mentioned an indicator. Even then, universal indicator seemed to be the one mentioned. Only a handful of candidates mentioned that the alkali was put in the flask and the importance of delivering an accurate volume was rarely seen as an answer.

Question 6

This question was fairly well answered but **(a)(i)** and **(a)(iii)** caused particular problems for the candidates.

(a)

(i) A few candidates could name the ore of aluminium. The commonest error was to suggest 'haematite' or 'aluminium ore'.

(ii) Although many candidates realised that oxygen was removed or that electrons were added, a significant number gave vague answers. A common error was to suggest that electrons were removed.

(iii) Some candidates realised that aluminium was too reactive or high in the activity series. Most gave vague answers such as 'carbon can't react with it' or 'the ore doesn't dissolve'.

(b) Many candidates gained full credit for the correct order of reaction. The commonest error was to completely reverse the order.

(c)

(i) There were a few very good answers to this question. Some candidates gave answers relating to rate of reaction rather than volume of gas (per unit time) and were allowed credit for this. The commonest error was to suggest that there was a bigger surface area with bigger lumps.

(ii) This was generally correctly answered. As in **(i)**, some candidates gave answers relating to rate of reaction rather than volume of gas (per unit time). Once again credit was given.

(d) A minority of candidates were awarded full credit. Most realised that copper is used fo wiring and that aluminium is used for aircraft bodies or car bodies. The commonest erro suggest that mild steel was used for chemical plants and stainless steel for car bodies.

Question 7

Many candidates need to improve their knowledge of organic chemistry. The definitions in **(a)(i)** and **(c)** were infrequently known and only a minority could draw the complete structure of ethanol.

(a)

(i) Some candidates had difficultly in describing a petroleum fraction adequately. Many just suggested that it was 'a fraction/ part of petroleum' or 'things that you can do with petroleum' or merely gave examples of petroleum fractions such as diesel.

(ii) Many candidates were able to deduce the correct formula of the alkane. A few suggested that there were 24 hydrogen atoms.

(b) This was generally well answered, most candidates referring to fuels for cooking and cars.

(c) A few candidates were awarded full credit here. A minority of candidates referred to a double bond when defining an unsaturated compound. The commonest errors were 'not saturated', reference to saturated solutions or suggesting that there were only C-C bonds. The main error in defining a hydrocarbon was to omit the word 'only' in the definition 'has carbon and hydrogen <u>only</u>'. This has been frequently referred to in previous Examiner Reports. A significant minority of candidates compounded this error by suggesting that hydrocarbons were a mixture of carbon and hydrogen.

(d)

(i) A minority of candidates gave the correct reaction. The commonest error was to suggest fermentation. This suggests that candidates omitted to read 'from ethene' or need to be more conversant with this addition reaction.

(ii) Some candidates gave a good answer here and were awarded full credit for the structure of ethanol. Many drew the O – H bond as OH. Common errors were showing a double bond, drawing molecules rather like methanol and omitting a hydrogen atom from the alkyl group.

(e) This was reasonably well done, most candidates correctly selecting and placing 'polymers'. Fewer candidates wrote monomer in the correct position. The commonest errors were to substitute carbohydrate for one of the correct terms or to get the 'monomer' and 'polymer' the wrong way round.

Question 8

This question was reasonably well answered but few candidates could define a precipitate or give a convincing answer as to why lead compounds are harmful to health.

(a) Most candidates gave the correct answer, 'electrodes'. The commonest errors were to suggest cations or insulators.

(b) Many candidates correctly identified the products at the cathode and anode. The commonest errors were to suggest that compounds or ions are formed at the electrodes and to write 'cathode' and 'anode' instead of the names of the products at the electrodes.

(c) A minority of candidates were awarded full credit, although many gained partial credit. The commonest error was to suggest that that solid lead(II) bromide conducts electricity. A large number of candidates only put one tick rather than the two asked for in the stem of the question.

(d) A wide range of answers was seen. Common errors included Pb_2Br, PbBr and Pb_6Br_{12}.

(e)

(i) A few candidates could describe what is meant by the term 'precipitate'. Most ju to a solid without reference to how that solid arose. Common errors included 'solids from a mixture' and 'when it no longer dissolves in water'.

(ii) Although many candidates realised that there were 3 different types of atom, some were content just to write the names of the atoms present.

(iii) Many candidates were able to answer this correctly, although there was a common incorrect answer.

(iv) A minority of candidates gave a convincing argument as to why lead is hazardous to health. Many confused it with the effects of carbon monoxide and stated breathing difficulties or preventing the blood carrying oxygen/ effects on haemoglobin/ respiration etc. Few mentioned the effect of lead on the nervous system or that it was poisonous/ toxic.

CHEMISTRY

Paper 0620/22

Core Theory

General comments

Many candidates tackled the paper well and excellent answers were seen in many parts of the paper especially in **Questions 3** and **5**. It is encouraging to note that fewer candidates than usual scored very little credit or left most of the question paper unanswered.

In general, the rubric was generally well interpreted and most candidates attempted most parts of each question. The exceptions to this were in **Question 2(b)(i)**, where two boxes were ticked rather than one and in **Question 3(a)(iii)** where many candidates gave trends in melting point or boiling point rather than trends in density as instructed in the stem of the question.

The standard of English was generally good. Many candidates had a good knowledge of general inorganic chemistry and were able to balance simple chemical equations and write word equations. Most candidates exhibited a good knowledge of rates of reactions, often giving fuller answers than required. Graphical work was generally accurate. Some candidates showed an excellent understanding of chemical structures and bonding (**Questions 2(a)** and **4(a)**). Others had difficulty interpreting the structures in terms of giant ionic in **Question 2(a)(ii)** and covalency in **Question 4(a)(i)**. More able candidates generally wrote the electronic structure of a chlorine molecule correctly. Others drew the structure of a chlorine atom rather than chlorine molecule or just drew circles of atoms or molecules without any electrons. The tests for specific substances (hydrogen, iodide ions and unsaturation) were well understood by a minority of candidates. Other candidates need to be able to distinguish particular qualitative tests and not muddle them up. There were many good answers to parts of **Question 7** but most candidates had some difficulties with **(a)(i)**, **(a)(iii)** and **(d)**. These parts required specific answers. Many candidates wrote rather vague answers in response to these questions. In more extended questions, candidates often disadvantaged themselves by non-specific writing. For example in **Question 6(c)(ii)**, where candidates are required to explain how a method of rust prevention works, many did not refer to oxygen or water and merely suggested that a layer of another metal on the iron prevented rusting. It is encouraging to note that many candidates were able to extract information from a table and to complete sentences with the correct words (**Question 3(b)**).

Comments on Specific Questions

Question 1

This was generally well answered. The main errors arose in **(a)**, **(d)** and **(e)**. Most candidates were awarded at least partial credit in **(b)** and **(c)**.

(a) More able candidates realised that magnesium oxide is a basic oxide. Many others either suggested carbon dioxide or water.

(b) Most candidates correctly suggested that either sulfur dioxide or nitrogen dioxide is responsible for acid rain. Few candidates gave both correct suggestions. The commonest incorrect answer was carbon dioxide. Although this is an acidic oxide, candidates should realise that acid rain is due to stronger acids than ‘carbonic acid’. A considerable minority of candidates gave the incorrect answer, carbon monoxide.

(c) Carbon dioxide and water were correctly suggested as the products of combustion of a hydrocarbon by more able candidates. Most candidates only gained partial credit. There was no particular common error, nitrogen dioxide and magnesium oxide often being seen in place of either carbon dioxide or water. This suggests that many candidates do not realise that a hydrocarbon contains carbon and hydrogen only and therefore the products should reflect this. Carbon monoxide was not an acceptable answer since the question referred to complete combustion.

(d) About half the candidates realised that water turns anhydrous copper sulfate blue. Th wide range of incorrect answers, nitrogen dioxide and magnesium oxide being pa common.

(e) A minority of candidates realised that carbon dioxide is released when calcium carbonate undergoes thermal decomposition. Common errors were to suggest either carbon monoxide or nitrogen dioxide.

Question 2

More able candidates tended to give excellent answers to all parts of this question. Others need to make sure that they improve on learning definitions (e.g. compound) and qualitative tests as in **(b)(ii)**. A minority of candidates gave a correct explanation of why sodium iodide has a high melting point but a greater number were able to see the relationship between hydrogen chloride and hydrogen iodide. It was encouraging to note that a larger number of candidates than in previous sessions was able to identify a correct statement about the electrical conductivity of sodium iodide, even if they did not recognise its ionic nature in **(a)(ii)**.

(a)

(i) A minority of candidates gave a good explanation of the term ‘compound’. The commonest error was the lack of reference to bond or joining atoms. Some candidates disadvantaged themselves by only referring to atoms joining together, without mentioning that the atoms have to be different.

(ii) Most candidates recognised that compound **B** had a high melting point. Fewer gave a correct explanation in terms of an ionic or giant structure. The commonest error was to suggest compound **D**. The commonest errors in explanation were that it has double bonds or stronger bonds. Strong bonding was not a sufficient answer since the other compounds also have strong bonds. References to reactivity or intermolecular forces were also common incorrect answers.

(iii) This was generally well answered, the commonest error being to suggest that sodium iodide is similar in structure to hydrogen chloride.

(b)

(i) Most candidates realised that sodium iodide conducts electricity when molten. The commonest incorrect answers were to tick the boxes ‘conducts when solid’ and ‘does not conduct in aqueous solution’.

(ii) The best answers referred either to the addition of lead iodide or silver nitrate to the solution. Many candidates need to revise these qualitative tests in more detail. The commonest errors were to suggest that starch or iodine should be used, to suggest the addition of sodium hydroxide, to suggest that a white precipitate is formed or to omit the word ‘precipitate’.

(c) A minority of candidates linked the non-metallic nature of iodine to the fact that its oxide is acidic. An alternative correct answer occasionally seen was ‘it reacts with bases’. The commonest incorrect answers referred to iodine being a metal or iodine being in Group VII. Many simply referred to the fact that it can form iodide ions.

Question 3

This question was generally well answered, many candidates being able to extract information correctly from the table and to write word and symbol equations. It is encouraging to note that many candidates gained at least some of the credit available for understanding the properties of Group I elements in **(b)**. Most candidates also gained at least partial credit for understanding the arrangement and motion of particles in gaseous chlorine. Fewer could draw a convincing electronic structure for a chlorine molecule.

(a)

(i) Most candidates showed an excellent ability to interpret data from the table in order to estimate a value for the boiling point of potassium. Others were often way out in their predictions, often on the lower side e.g. 500 ^{o}C

(ii) Many candidates realised that caesium and rubidium were liquid at 50 ^{o}C. Th errors were to suggest lithium and sodium or sodium and potassium. A co number of candidates disadvantaged themselves by only naming one element. Th two clues in the question that more than one was required: the plural (elements) in the of the question and the number of marks available. Candidates should realise that number of marks available in a question is equal to the number of answer points required.

(iii) Many candidates realised that density increases down Group 1. A considerable minority disadvantaged themselves by writing about trends in melting point or boiling point and not about density.

(b) Most candidates understood the properties of the alkali metals. The commonest error was to suggest that alkali metals are hard. Fewer candidates suggested an incorrect trend in reactivity with water.

(c) The majority of candidates wrote correct word equations for the reaction of sodium with water. The commonest errors were to write sodium oxide as a product instead of sodium hydroxide, to write hydrogen on the left or water on the right and the non-inclusion of an arrow or + signs in the word equation.

(d)

(i) The equation was correctly balanced by nearly all candidates. The commonest error was to suggest 3 NaC*l* or 4 NaC*l* on the right hand side of the equation.

(ii) Many candidates had a vague idea of the meaning of the term ‘diatomic’ but disadvantaged themselves by suggesting that diatomic molecules are always elements or always compounds. Other incorrect answers included vague references to ‘more than one atom’ and reference to diatomic molecules as being ‘atoms made up of two atoms’.

(iii) Some good answers were given to this question. The commonest errors were to suggest that the particles are close together or that particles sliding over each other (this would be an answer for the liquid state rather than the gaseous state).

(iv) A few candidates drew excellent diagrams showing 2 chlorine atoms with the electrons correctly paired. Others just showed a single chlorine atom. When being asked to draw dot and cross diagrams for species such as hydrogen and halogen molecules, candidates should make sure that they read the stem of the question carefully, looking for the word atom or molecule. A considerable minority of candidates drew structures showing no electrons, just randomly arranged circles representing atoms (sometimes in pairs).

Question 4

More able candidates gave some excellent answers to **(a)(v)** and **(b)(i)** which required knowledge of qualitative tests and an appreciation of essential detail respectively. Others need to be able to distinguish the various qualitative tests in the syllabus and to revise the general properties relating to an ‘homologous series’. Parts **(a)(i)**, **(b)(ii)** and **(c)(ii)** were generally well answered but the remaining parts provided a challenge for many candidates.

(a)

(i) Many candidates realised that the bonding was covalent. A minority suggested erroneously that the bonding was ‘ionic’ or ‘chemical’.

(ii) Many candidates chose **C** correctly as the answer. The commonest incorrect answers were to select either **B** or **D**, both of which contained oxygen.

(iii) The majority of candidates correctly identified structure **B** as having acidic characteristics. The commonest incorrect answer was **C**.

(iv) A wide variety of answers was seen in addition to the correct answer ‘ethanol’. Some candidates recognised that **D** was an alcohol, so either wrote ‘alcohol’ or the incorrect alcohol, ‘propanol’ being the commonest incorrect response for a named alcohol.

(v) The best answers involved only a few words. For example 'bromine ... d 'decolourises' was often written by the more able candidates. Other candidates w... bromine but suggested that it was either not decolourised/ remained brown ... 'discolourised'. A significant number of candidates wrote erroneously about lime ... adding hydrogen atoms or boiling points.

(b)

(i) The more able candidates could describe two features of an homologous series precisely. The best answers often mentioned 'the same functional group' and the 'same general formula'. Common errors included reference to arrangement of atoms, suggesting that they have the same formula (rather than general formula), reference to having exactly the same properties, the lack of the word 'same' when referring to a general formula or lack of distinction between physical and chemical properties.

(ii) Many candidates scored at least partial credit here, either for a correct structure or a correct name. Candidates were most likely to gain credit for both structure and name if they selected the simplest alkane, methane. The majority of candidates who selected propane or butane tended to make an error in either the name or the related structure. Those who chose higher alkanes such as hexane or octane often received full credit. Another common error was to draw structures of either alkenes or alcohols.

(c)

(i) Many candidates placed the **X** for the lowest temperature near the top of the column but few gained credit because they put the **X** outside the column. A considerable number of candidates put the **X** at the base of the column. A smaller proportion put the **X** in the middle. Some candidates put the **X** in two places and so could not be awarded credit.

(ii) More candidates scored credit here compared with **(i)**. Common errors included placing the **Y** in the bottom tube on the left hand side, placing **Y** on the right of the second tube from the bottom on the right and placing the **Y** inside the column. Some candidates put the **Y** in two places and so could not be awarded credit.

Question 5

This question was the best answered in the paper. Many carefully-drawn graphs were seen and the 'rate of reaction' questions were particularly well answered. In addition many candidates gave explanations of the reasons for the changes which would have gained credit in Paper 31/32 (supplement). The correct test for hydrogen proved a challenge for many candidates, a high proportion muddling the test with the test for oxygen.

(a)

(i) Most candidates realised that the zinc would decrease in mass. A few candidates disadvantaged themselves by either referring to rates of reaction rather than loss of mass or 'getting smaller' or zinc dissolving.

(ii) This was generally answered correctly, many candidates realising that zinc sulfate is a product rather than a reactant.

(b)

(i) Most candidates plotted good graphs and gained at least partial credit. There were very few occasions where the points were incorrectly plotted. The commonest errors were leaving the 0-0 point unplotted, a lack of a curve joining the points or joining the points by a series of straight lines.

(ii) Most candidates gained credit by reading the correct value from their curve, often to the nearest 0.5 cm^3. Common errors included incorrect reading from the curve – the accuracy expected on this occasion was to the nearest 0.5 cm^{3} - or guessing a value when the curve had not been drawn.

(iii) Many candidates realised that the zinc had been used up or (for a lower level answer) that the reaction had finished. Common errors were to suggest that the hydrogen had been used up, to refer to the sulfuric acid being used up, writing about zinc dissolving rather than reacting or suggesting that the reaction was slowing down.

(iv) Some candidates gave a good explanation of the test for hydrogen. A large candidates gave the test for oxygen rather than the test for hydrogen. A cons number of candidates incorrectly gave other tests such as limewater or pH paper (pe through thinking of hydrogen ions rather than hydrogen gas).

(c)

(i) Most candidates realised that the reaction would go faster and gave reasons why using the kinetic theory.

(ii) Most candidates realised that the reaction would go slower and also gave reasons why. The commonest errors were to suggest that the reaction would stop altogether or that extra sulfuric acid had been added and so made the reaction faster.

(d) Most candidates gave the preferred answer that a catalyst speeds up a reaction. A few gave a vague but acceptable answer that a catalyst changes the rate of a reaction. A greater proportion of candidates compared with previous sessions gave an incorrect answer such as 'allows the reaction to occur' or 'is a substance which starts a reaction'.

Question 6

Some candidates exhibited an excellent appreciation of atomic structure, transition elements and rusting. Others need to develop their understanding of the properties of transition elements and process of rusting considerably. Many candidates wrote vague answer to **(c)(ii)** on explaining rusting prevention and **(e)** on carbon monoxide.

(a) Many candidates could name 2 properties of transition elements not shown by Group I elements. Only in exceptional cases were 3 properties suggested. Many candidates only wrote about general metallic properties or confused the properties of Group I metals with those of transition elements. Other common errors included suggesting that the transition metals themselves are coloured or writing about chemical properties.

(b)

(i) Many candidates realised that the neutron or nucleon number differed. A common error was to suggest that the proton number differed. Many referred, incorrectly, to differences in relative molecular mass. This is not a correct answer because the question refers to atomic <u>structure</u>.

(ii) Many candidates realised that there are 57 nucleons in the isotope iron-57. A large number of candidates misread the question or misunderstood the term 'nucleon' and calculated the number of neutrons. Hence 31 was an incorrect answer which was common. The answer 26 (the number of protons) was also a common incorrect answer as was 28 (the number of neutrons in the <u>other</u> isotope).

(iii) Many candidates used the isotopic symbols to give the correct number of electrons. Some candidates chose the incorrect number 28 (which is the number of neutrons) or 54 (which is the number of nucleons).

(c)

(i) Most candidates could identify at least one condition required for rusting, even though there were many vague answers such as 'moisture'. Common incorrect answers included oxides or lack of water or oxygen.

(ii) Good answers were usually given by candidates who chose sacrificial protection as a method. Many candidates, who chose a method involving covering with paint, plastic or another metal, wrote far too vague statements. Examples such as 'it covers the surface up' or 'stops the iron underneath from rusting' do not address the source of the attacking material. Correct answers referred to the fact that either water or air or both could not get to the iron because of this layer. Many candidates did not mention the nature of the protective layer.

(d) Although many candidates knew that reduction is the removal of oxygen, a signific need to develop their answers so that there are no contradictory points in them. Fo many candidates suggested that oxygen was removed and that electrons were also Common errors included oxygen is reduced, reference to carbon gaining oxygen without refe to iron and reference to the number of oxygen atoms being more on the left of the equation than the right.

(e)

(i) Few candidates gained credit here because they wrote statements which were far too vague. Many wrote about fuels burning or incomplete combustion without mentioning the nature of the fuel i.e. hydrocarbon or carbon-based. This is essential because the increasing number of hydrogen-powered cars means that not all fuels used in car engines cause pollution.

(ii) The more able candidates gave simple, often one or two word answers, such as ‘poisonous’ or ‘prevents haemoglobin binding oxygen’. Many candidates gave vague answers such as ‘harmful’ or ‘reduces the amount of oxygen carried’. A considerable number of candidates muddled the effects of carbon monoxide with other environmental issues such as global warming and effect on ozone. A large number of candidates suggested, incorrectly, that carbon monoxide was responsible for acid rain.

Question 7

More able candidates were generally able to score at least partial credit on this question. This question provided many other candidates with considerable difficulties. There were many vague arguments used to explain **(a)(i), (a)(iii)** and **(a)(iv)**. Many made simple errors in writing the simplest formula for urea and few used the formula for urea to help them identify the important element in fertilisers. Vague descriptions of how to prepare pure, dry crystals of urea from a solution of urea highlighted the need for candidates to improve their knowledge of practical processes. This has been commented on in previous Examiner reports.

(a)

(i) Better answers focused on the idea that the boric acid was dissolving or diffusing to point **A**. Most candidates wrote vague statements about the boric acid being an acid. The commonest error was to suggest that water or urea neutralised the acid and so the pH went down.

(ii) This question was well answered. Most candidates identified the alkaline solution at pH 8. The commonest incorrect error was to suggest pH 6.

(iii) A minority of candidates gave a rigorous definition of diffusion. Most did not refer to the fact that particles can move anywhere or generally become ‘spread out’. Many gave answers referring to osmosis (movement of water from high to low concentration) or Brownian motion. Others just referred to the movement of substances rather than particles.

(iv) Most candidates had some idea of neutralisation. The very best answers referred to the neutralisation of equal quantities of acid and alkali. Many vague or incorrect answers were seen which just referred to the solution returning to pH 7 or the water neutralising the acid.

(b)

(i) The best answer, CON_2H_4, was usually given by candidates who had clearly counted each atom and crossed each off from the formula. The commonest error was to suggest $CO_2N_2H_4$ as the formula. Many tried to simplify the formula to $2CONH_2$ or similar. Others just rewrote the displayed formula in a different way, showing two or more bonds.

(ii) About half the candidates calculated the relative molecular mass of urea correctly. A common error was to use the incorrect answer to **(i)** to calculate the molar mass rather than going back to the original formula. On the other hand, many candidates answering **(i)** incorrectly managed to gain credit here.

(c) **(i)** Many candidates recognised that nitrogen was an important element in fertilisers. Many candidates did not refer back to the formula of urea and gave incorrect answers such as potassium, phosphorus or magnesium. Others gave answers such as nitrate, ammonia and NH_2 which did not relate to the word ‘element’ in the stem of the question.

(ii) Many candidates scored well on this question. The effect of fertilisers in im... growth was most commonly awarded credit.

(d) Some more able candidates gave excellent descriptions of the crystallisation process, inc... making a saturated solution, allowing this to stand and then separating and drying the crystals ... filter paper. Many candidates gave vague and conflicting suggestions. Common errors were suggesting heating until a solid is formed, cooling in a refrigerator (which would minimise further evaporation), pouring a solid through a filter paper without reference to a solution being separated or heating with a Bunsen (without any further reference to a saturated solution being formed).

CHEMISTRY

Paper 0620/23
Core Theory

General comments

Many candidates tackled the paper well and excellent answers were seen in many parts of the paper especially in **Questions 3** and **5**. It is encouraging to note that fewer candidates than usual scored very little credit or left most of the question paper unanswered.

In general, the rubric was generally well interpreted and most candidates attempted most parts of each question. The exceptions to this were in **Question 2(b)(i)**, where two boxes were ticked rather than one and in **Question 3(a)(iii)** where many candidates gave trends in melting point or boiling point rather than trends in density as instructed in the stem of the question.

The standard of English was generally good. Many candidates had a good knowledge of general inorganic chemistry and were able to balance simple chemical equations and write word equations. Most candidates exhibited a good knowledge of rates of reactions, often giving fuller answers than required. Graphical work was generally accurate. Some candidates showed an excellent understanding of chemical structures and bonding (**Questions 2(a)** and **4(a)**). Others had difficulty interpreting the structures in terms of giant ionic in **Question 2(a)(ii)** and covalency in **Question 4(a)(i)**. More able candidates generally wrote the electronic structure of a chlorine molecule correctly. Others drew the structure of a chlorine atom rather than chlorine molecule or just drew circles of atoms or molecules without any electrons. The tests for specific substances (hydrogen, iodide ions and unsaturation) were well understood by a minority of candidates. Other candidates need to be able to distinguish particular qualitative tests and not muddle them up. There were many good answers to parts of **Question 7** but most candidates had some difficulties with **(a)(i)**, **(a)(iii)** and **(d)**. These parts required specific answers. Many candidates wrote rather vague answers in response to these questions. In more extended questions, candidates often disadvantaged themselves by non-specific writing. For example in **Question 6(c)(ii)**, where candidates are required to explain how a method of rust prevention works, many did not refer to oxygen or water and merely suggested that a layer of another metal on the iron prevented rusting. It is encouraging to note that many candidates were able to extract information from a table and to complete sentences with the correct words (**Question 3(b)**).

Comments on Specific Questions

Question 1

This was generally well answered. The main errors arose in **(a)**, **(d)** and **(e)**. Most candidates were awarded at least partial credit in **(b)** and **(c)**.

(a) More able candidates realised that magnesium oxide is a basic oxide. Many others either suggested carbon dioxide or water.

(b) Most candidates correctly suggested that either sulfur dioxide or nitrogen dioxide is responsible for acid rain. Few candidates gave both correct suggestions. The commonest incorrect answer was carbon dioxide. Although this is an acidic oxide, candidates should realise that acid rain is due to stronger acids than ‘carbonic acid’. A considerable minority of candidates gave the incorrect answer, carbon monoxide.

(c) Carbon dioxide and water were correctly suggested as the products of combustion of a hydrocarbon by more able candidates. Most candidates only gained partial credit. There was no particular common error, nitrogen dioxide and magnesium oxide often being seen in place of either carbon dioxide or water. This suggests that many candidates do not realise that a hydrocarbon contains carbon and hydrogen only and therefore the products should reflect this. Carbon monoxide was not an acceptable answer since the question referred to complete combustion.

(d) About half the candidates realised that water turns anhydrous copper sulfate blue. Th wide range of incorrect answers, nitrogen dioxide and magnesium oxide being pa common.

(e) A minority of candidates realised that carbon dioxide is released when calcium carbonate undergoes thermal decomposition. Common errors were to suggest either carbon monoxide or nitrogen dioxide.

Question 2

More able candidates tended to give excellent answers to all parts of this question. Others need to make sure that they improve on learning definitions (e.g. compound) and qualitative tests as in **(b)(ii)**. A minority of candidates gave a correct explanation of why sodium iodide has a high melting point but a greater number were able to see the relationship between hydrogen chloride and hydrogen iodide. It was encouraging to note that a larger number of candidates than in previous sessions was able to identify a correct statement about the electrical conductivity of sodium iodide, even if they did not recognise its ionic nature in **(a)(ii)**.

(a) (i) A minority of candidates gave a good explanation of the term 'compound'. The commonest error was the lack of reference to bond or joining atoms. Some candidates disadvantaged themselves by only referring to atoms joining together, without mentioning that the atoms have to be different.

(ii) Most candidates recognised that compound **B** had a high melting point. Fewer gave a correct explanation in terms of an ionic or giant structure. The commonest error was to suggest compound **D**. The commonest errors in explanation were that it has double bonds or stronger bonds. Strong bonding was not a sufficient answer since the other compounds also have strong bonds. References to reactivity or intermolecular forces were also common incorrect answers.

(iii) This was generally well answered, the commonest error being to suggest that sodium iodide is similar in structure to hydrogen chloride.

(b) (i) Most candidates realised that sodium iodide conducts electricity when molten. The commonest incorrect answers were to tick the boxes 'conducts when solid' and 'does not conduct in aqueous solution'.

(ii) The best answers referred either to the addition of lead iodide or silver nitrate to the solution. Many candidates need to revise these qualitative tests in more detail. The commonest errors were to suggest that starch or iodine should be used, to suggest the addition of sodium hydroxide, to suggest that a white precipitate is formed or to omit the word 'precipitate'.

(c) A minority of candidates linked the non-metallic nature of iodine to the fact that its oxide is acidic. An alternative correct answer occasionally seen was 'it reacts with bases'. The commonest incorrect answers referred to iodine being a metal or iodine being in Group VII. Many simply referred to the fact that it can form iodide ions.

Question 3

This question was generally well answered, many candidates being able to extract information correctly from the table and to write word and symbol equations. It is encouraging to note that many candidates gained at least some of the credit available for understanding the properties of Group I elements in **(b)**. Most candidates also gained at least partial credit for understanding the arrangement and motion of particles in gaseous chlorine. Fewer could draw a convincing electronic structure for a chlorine molecule.

(a) (i) Most candidates showed an excellent ability to interpret data from the table in order to estimate a value for the boiling point of potassium. Others were often way out in their predictions, often on the lower side e.g. 500 ^oC

(ii) Many candidates realised that caesium and rubidium were liquid at 50 ^oC. The commonest errors were to suggest lithium and sodium or sodium and potassium. A considerable number of candidates disadvantaged themselves by only naming one element. There were two clues in the question that more than one was required: the plural (elements) in the stem of the question and the number of marks available. Candidates should realise that the number of marks available in a question is equal to the number of answer points required.

(iii) Many candidates realised that density increases down Group 1. A considerab disadvantaged themselves by writing about trends in melting point or boiling point and n density.

(b) Most candidates understood the properties of the alkali metals. The commonest error was to suggest that alkali metals are hard. Fewer candidates suggested an incorrect trend in reactivity with water.

(c) The majority of candidates wrote correct word equations for the reaction of sodium with water. The commonest errors were to write sodium oxide as a product instead of sodium hydroxide, to write hydrogen on the left or water on the right and the non-inclusion of an arrow or + signs in the word equation.

(d) (i) The equation was correctly balanced by nearly all candidates. The commonest error was to suggest 3 $NaCl$ or 4 $NaCl$ on the right hand side of the equation.

(ii) Many candidates had a vague idea of the meaning of the term 'diatomic' but disadvantaged themselves by suggesting that diatomic molecules are always elements or always compounds. Other incorrect answers included vague references to 'more than one atom' and reference to diatomic molecules as being 'atoms made up of two atoms'.

(iii) Some good answers were given to this question. The commonest errors were to suggest that the particles are close together or that particles sliding over each other (this would be an answer for the liquid state rather than the gaseous state).

(iv) A few candidates drew excellent diagrams showing 2 chlorine atoms with the electrons correctly paired. Others just showed a single chlorine atom. When being asked to draw dot and cross diagrams for species such as hydrogen and halogen molecules, candidates should make sure that they read the stem of the question carefully, looking for the word atom or molecule. A considerable minority of candidates drew structures showing no electrons, just randomly arranged circles representing atoms (sometimes in pairs).

Question 4

More able candidates gave some excellent answers to **(a)(v)** and **(b)(i)** which required knowledge of qualitative tests and an appreciation of essential detail respectively. Others need to be able to distinguish the various qualitative tests in the syllabus and to revise the general properties relating to an 'homologous series'. Parts **(a)(i)**, **(b)(ii)** and **(c)(ii)** were generally well answered but the remaining parts provided a challenge for many candidates.

(a) (i) Many candidates realised that the bonding was covalent. A minority suggested erroneously that the bonding was 'ionic' or 'chemical'.

(ii) Many candidates chose **C** correctly as the answer. The commonest incorrect answers were to select either **B** or **D**, both of which contained oxygen.

(iii) The majority of candidates correctly identified structure **B** as having acidic characteristics. The commonest incorrect answer was **C**.

(iv) A wide variety of answers was seen in addition to the correct answer 'ethanol'. Some candidates recognised that **D** was an alcohol, so either wrote 'alcohol' or the incorrect alcohol, 'propanol' being the commonest incorrect response for a named alcohol.

(v) The best answers involved only a few words. For example 'bromine water' and 'decolourises' was often written by the more able candidates. Other candidates wrote about bromine but suggested that it was either not decolourised/ remained brown or was 'discolourised'. A significant number of candidates wrote erroneously about limewater, adding hydrogen atoms or boiling points.

(b) (i) The more able candidates could describe two features of an homologous series p... best answers often mentioned 'the same functional group' and the 'same genera... Common errors included reference to arrangement of atoms, suggesting that they have t... formula (rather than general formula), reference to having exactly the same properties, the ... the word 'same' when referring to a general formula or lack of distinction between physical a... chemical properties.

(ii) Many candidates scored at least partial credit here, either for a correct structure or a correct name. Candidates were most likely to gain credit for both structure and name if they selected the simplest alkane, methane. The majority of candidates who selected propane or butane tended to make an error in either the name or the related structure. Those who chose higher alkanes such as hexane or octane often received full credit. Another common error was to draw structures of either alkenes or alcohols.

(c) (i) Many candidates placed the **X** for the lowest temperature near the top of the column but few gained credit because they put the **X** outside the column. A considerable number of candidates put the **X** at the base of the column. A smaller proportion put the **X** in the middle. Some candidates put the **X** in two places and so could not be awarded credit.

(ii) More candidates scored credit here compared with **(i)**. Common errors included placing the **Y** in the bottom tube on the left hand side, placing **Y** on the right of the second tube from the bottom on the right and placing the **Y** inside the column. Some candidates put the **Y** in two places and so could not be awarded credit.

Question 5

This question was the best answered in the paper. Many carefully-drawn graphs were seen and the 'rate of reaction' questions were particularly well answered. In addition many candidates gave explanations of the reasons for the changes which would have gained credit in Paper 31/32 (supplement). The correct test for hydrogen proved a challenge for many candidates, a high proportion muddling the test with the test for oxygen.

(a) (i) Most candidates realised that the zinc would decrease in mass. A few candidates disadvantaged themselves by either referring to rates of reaction rather than loss of mass or 'getting smaller' or zinc dissolving.

(ii) This was generally answered correctly, many candidates realising that zinc sulfate is a product rather than a reactant.

(b) (i) Most candidates plotted good graphs and gained at least partial credit. There were very few occasions where the points were incorrectly plotted. The commonest errors were leaving the 0-0 point unplotted, a lack of a curve joining the points or joining the points by a series of straight lines.

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(iv) Some candidates gave a good explanation of the test for hydrogen. A large minority of candidates gave the test for oxygen rather than the test for hydrogen. A considerable number of candidates incorrectly gave other tests such as limewater or pH paper (perhaps through thinking of hydrogen ions rather than hydrogen gas).

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Some candidates exhibited an excellent appreciation of atomic structure, transition elements and rusting. Others need to develop their understanding of the properties of transition elements and process of rusting considerably. Many candidates wrote vague answer to **(c)(ii)** on explaining rusting prevention and **(e)** on carbon monoxide.

(a) Many candidates could name 2 properties of transition elements not shown by Group I elements. Only in exceptional cases were 3 properties suggested. Many candidates only wrote about general metallic properties or confused the properties of Group I metals with those of transition elements. Other common errors included suggesting that the transition metals themselves are coloured or writing about chemical properties.

(b) (i) Many candidates realised that the neutron or nucleon number differed. A common error was to suggest that the proton number differed. Many referred, incorrectly, to differences in relative molecular mass. This is not a correct answer because the question refers to atomic <u>structure</u>.

(ii) Many candidates realised that there are 57 nucleons in the isotope iron-57. A large number of candidates misread the question or misunderstood the term 'nucleon' and calculated the number of neutrons. Hence 31 was an incorrect answer which was common. The answer 26 (the number of protons) was also a common incorrect answer as was 28 (the number of neutrons in the <u>other</u> isotope).

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(d) Although many candidates knew that reduction is the removal of oxygen, a significant proportion need to develop their answers so that there are no contradictory points in them. For example, many candidates suggested that oxygen was removed and that electrons were also removed. Common errors included oxygen is reduced, reference to carbon gaining oxygen without reference to iron and reference to the number of oxygen atoms being more on the left of the equation than on the right.

(e) (i) Few candidates gained credit here because they wrote statements which were fa Many wrote about fuels burning or incomplete combustion without mentioning the nature i.e. hydrocarbon or carbon-based. This is essential because the increasing number of hy powered cars means that not all fuels used in car engines cause pollution.

(ii) The more able candidates gave simple, often one or two word answers, such as 'poisonous' or 'prevents haemoglobin binding oxygen'. Many candidates gave vague answers such as 'harmful' or 'reduces the amount of oxygen carried'. A considerable number of candidates muddled the effects of carbon monoxide with other environmental issues such as global warming and effect on ozone. A large number of candidates suggested, incorrectly, that carbon monoxide was responsible for acid rain.

Question 7

More able candidates were generally able to score at least partial credit on this question. This question provided many other candidates with considerable difficulties. There were many vague arguments used to explain **(a)(i), (a)(iii)** and **(a)(iv)**. Many made simple errors in writing the simplest formula for urea and few used the formula for urea to help them identify the important element in fertilisers. Vague descriptions of how to prepare pure, dry crystals of urea from a solution of urea highlighted the need for candidates to improve their knowledge of practical processes. This has been commented on in previous Examiner reports.

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(ii) This question was well answered. Most candidates identified the alkaline solution at pH 8. The commonest incorrect error was to suggest pH 6.

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(iv) Most candidates had some idea of neutralisation. The very best answers referred to the neutralisation of equal quantities of acid and alkali. Many vague or incorrect answers were seen which just referred to the solution returning to pH 7 or the water neutralising the acid.

(b) (i) The best answer, CON_2H_4, was usually given by candidates who had clearly counted each atom and crossed each off from the formula. The commonest error was to suggest $CO_2N_2H_4$ as the formula. Many tried to simplify the formula to $2CONH_2$ or similar. Others just rewrote the displayed formula in a different way, showing two or more bonds.

(ii) About half the candidates calculated the relative molecular mass of urea correctly. A common error was to use the incorrect answer to **(i)** to calculate the molar mass rather than going back to the original formula. On the other hand, many candidates answering **(i)** incorrectly managed to gain credit here.

(c) (i) Many candidates recognised that nitrogen was an important element in fertilisers. Many candidates did not refer back to the formula of urea and gave incorrect answers such as potassium, phosphorus or magnesium. Others gave answers such as nitrate, ammonia and NH_2 which did not relate to the word 'element' in the stem of the question.

(ii) Many candidates scored well on this question. The effect of fertilisers in improving plant growth was most commonly awarded credit.

(d) Some more able candidates gave excellent descriptions of the crystallisation process, including making a saturated solution, allowing this to stand and then separating and drying the crystals on filter paper. Many candidates gave vague and conflicting suggestions. Common errors were suggesting heating until a solid is formed, cooling in a refrigerator (which would minimise further evaporation), pouring a solid through a filter paper without reference to a solution being separated or heating with a Bunsen (without any further reference to a saturated solution being formed).

CHEMISTRY

Paper 0620/31
Extended Theory

General Comments

The Examiners are aware that candidates are under examination conditions and make the utmost effort to read even the most difficult handwriting, which was prevalent this session. An illegible script cannot be awarded credit and it is the responsibility of the candidate to ensure that the Examiner can read the response.

Adequate and comprehensive preparation for the examination is essential; candidates should be able to recall the requisite information and have practised the basic skills, examples of which are writing equations and solving numerical problems. It was evident from the scripts that the preparation of some of these candidates was inadequate.

It was however pleasing to note that answers written in other than the allocated space were clearly referenced by arrows or comments as to their new location.

Comments on Specific Questions

Question 1

(a) All the parts were generally well answered, the only significant problem was that some of the candidates mixed up the particle names and referred to neutrons when they should have mentioned protons.

(b)

(i) A minority gave an orbital description of the electron structure, $1s^2$ etc., which is unnecessary at this level but, if correct, was awarded credit.

(ii) The valency was accepted as 3 or 5. It is not necessary to include signs and if the valency was stated to be 3e or 5e, this is not acceptable.

(iii) Most realised that the element is a non-metal. This is easily deduced from the information in the rest of the question.

Question 2

(a)

(i) The majority gave a sensible suggestion – the alloy is harder, stronger, cuts better or is more resistant to corrosion.

(ii) The other element in brass was known to be zinc.

(b)

(i) The term “lattice” as a regular array of particles in a crystalline solid needs more emphasis as it is applicable to ionic crystals, metals etc.

(ii) Most of the diagrams would have benefited from a little more care particularly showing the regularity of the predominant atom.

(iii) Any explanation of the term malleable has to include two ideas; a *change of* [illegible] *application of force.*

(iv) Metals are malleable because the layers/rows of particles/ions or even atoms can slid[illegible] each other or better still the metallic bond is non-directional. The particles should not [illegible] referred to as protons, cores or nuclei.

(c)

(i) Candidates should be advised that the oxidation state should not be included for the element in a word equation, only in the names of compounds. In the word equation tin(IV) is wrong.

(ii) Most could deduce the names of the products – water and carbon dioxide.

(iii) The labelling of the apparatus used to refine copper needs to be complete and precise:
anode - impure copper
cathode - pure copper
aqueous - copper sulfate or copper sulfate solution

The most common, but incorrect, choices of electrolyte were copper oxide and copper carbonate.

(iv) The uses of copper were well known.

Question 3

(i) There was general agreement that the required term was chemical or potential.

(ii) Candidates need to be reminded that electrons flow from negative to positive through a metallic conductor not an electrolytic one e.g. salt bridge.

(iii) The key to this part is "colourless" which should suggest Br^- is formed and hence the equation is $Br_2 + 2e^- \rightarrow 2Br^-$.

(iv) The reaction is reduction because it is electron gain.

(v) Only a few realised that Fe^{3+} would be formed. This can be deduced as if there is reduction in the left hand half cell, there has to be oxidation in the right hand half cell. The oxidation number of iron has to increase rather than decrease so Fe(+3) not Fe(0) is formed.

(vi) The pattern is that the more reactive the halogen, the higher the voltage. A similar idea to the more familiar cells involving two metals where the bigger the difference in reactivity between the two metals, the higher the voltage.

Question 4

(a)

(i) Once again orbital descriptions were offered rather than the simpler 2,5.

(ii) Most realised that a nitrogen atom needed three electrons to complete its outer energy level so it forms three covalent bonds.

(b)

(i) The usual answer was that iron was less expensive than platinum. Other sensible suggestions were accepted – iron is the better catalyst.

(ii) Candidates found it difficult to explain why high pressure gave a larger yield. Candidates could be recommended to include the following points;

- high pressure favours the side which has the lower volume (of gases) or the smaller number of molecules (of gas),
- the product side has the smaller volume,
- the products or the forward reaction are favoured / the position of equilibrium moves to the right,

- the yield of ammonia is increased.

(iii) The unused nitrogen and hydrogen is recycled or used again or sent back over the It is not allowed to escape into the air, this was a common suggestion.

(iv) The advantage of using a low temperature is that the yield is high (as the forward reaction is exothermic). The disadvantage is a slow (uneconomic) reaction rate.

Question 5

(a)

(i) Ideas such as 'many simple molecules form one large molecule' or 'many monomer molecules form one polymer molecule' explain the term polymerisation.

(ii) Only a small minority realised that with addition polymerisation there is only one product, the polymer, but with condensation polymerisation there are two products, the polymer and simpler molecules typically water.

(b)

(i) The equation was completed on the majority of scripts.

(ii) Reasons why the ethene route is preferred were not readily forthcoming. They are:

- ethane and chlorine gives a mixture of products,
- ethene is more readily available than ethane,
- ethene is easily made by cracking,
- in the ethane route half the chlorine is lost as hydrogen chloride.

(iii) The industrial method of making chlorine is the electrolysis of aqueous sodium chloride.

(iv) Candidates would benefit from practising the construction of the structural formula of a polymer given the structural formula of the monomer. This would help to eliminate typical errors such as linking through hydrogen atoms, retention of double bonds and changes in carbon skeleton between monomer and polymer.

Question 6

(a)

(i) Most of the candidates were able to explain the significance of an oxidation state of zero.

(ii) Most of the candidates were able to explain why some elements have positive oxidation states and others have negative ones.

(iii) It appeared that not all the candidates appreciate the meaning of the phrase "diatomic molecules" and were not able to select two elements from the list; N_2, O_2 and F_2.

(b)

(i) Other common metals which have an amphoteric hydroxide are zinc, aluminium, tin and lead.

(ii) Candidates did not relate the required observations to the practical work on the reactions of cations. A white precipitate would form which would dissolve in excess sodium hydroxide to form a colourless solution. Some guidance on the difference between colourless and clear might be helpful. The following example might be useful: water is both clear and colourless but copper sulfate solution is clear but not colourless.

(c)

(i) The formulae of the two fluorides were usually correct.

(ii)(iii) These two parts hinged on recognising that one fluoride was ionic and the other covalent and then being able to recall the difference in properties between compounds having these structures. Candidates should be aware that questions of the type - describe the difference

in properties between ionic and covalent compounds - are comparatively ra
designed to assess this part of the syllabus are set in context as illustrated by this

Question 7

(i) Common greenhouse gases, in addition to carbon dioxide, are methane, water vapour, oxides o nitrogen, hydrofluorocarbons, perfluorocarbons and ozone. Sulfur dioxide is not a greenhouse gas.

(ii) The explanations of the term “respiration” were almost invariably incomplete. Most correctly stated that it is the production of energy from food but rarely added ‘by living organisms’.

(iii) The explanations of why the combustion of crop material does not significantly change the percentage of atmospheric carbon dioxide were frequently based on false premises. The same amount of carbon dioxide is released on combustion of the plant material as was taken in during photosynthesis when the plant was growing. This is the correct reason.

(iv) The increase in the percentage of atmospheric carbon dioxide over the last fifty years was wrongly attributed to greater population or more factories and vehicles without mentioning the resulting increase in the consumption of fossil fuels. A minority mentioned deforestation and the consequent decrease in photosynthesis, a valid cause of the increase.

Question 8

(a) The description of the method of preparing the salt had to include the following steps in order;

1 filter or centrifuge or decant,
2 partially evaporate or heat or boil,
3 allow to crystallise or cool or let crystals form,
4 dry crystals or dry crystals between filter paper or leave crystals to dry in a warm place.

Candidates should have been able to recall the preparation of salts by this method from their practical work. Unfortunately this was not invariably the case; the order was confused or a step was omitted or an extraneous step was included, typically add water. A common mistake was to filter and then continue the procedure with the residue not the filtrate.

(b) There is a clear need to practise the type of calculations specified in the syllabus. Many candidates did not seem to be familiar with this type of calculation and did not attempt it. Various errors were made when attempting this calculation, the most common was not realising that moles of $CoCl_2$ is equal to moles of $CoCl_2.6H_2O$.

CHEMISTRY

Paper 0620/32

Extended Theory

General Comments

Adequate and comprehensive preparation for the examination is essential, candidates should be able to recall the requisite information and have practised the basic skills, examples of which are writing equations and solving numerical problems. It was evident from the scripts that the preparation of some of these candidates was inadequate for this extended paper.

Individual Questions

Question 1

Responses to this question were variable. Some candidates were to evaluate the information accurately, whilst others appeared to guess at the answers. They seemed able to deduce that A, C and E were solids at room temperature but often and incorrectly added B to the list. Although room temperature was not specified on the paper, they should be familiar with the idea of r.t.p. so room temperature can be taken to be 25°C. Part **(d)**, identifying which substance was aqueous sodium chloride was probable the most difficult as they looked for the properties of the salt instead of those of an aqueous solution.

Question 2

(a) (i) Most of the candidates were familiar with how to obtain zinc oxide from zinc sulfide by heating the ore in the presence of air or oxygen. There was a definite tendency to include irrelevant information about froth flotation. A few candidates thought that carbon or more reactive metals were involved in this reaction, ZnS to ZnO

(ii) The equation for the reduction of the oxide was usually correct, the only common mistakes were to use carbon monoxide as the reductant or in the balancing of the equation.

$ZnO + C \rightarrow Zn + CO_2$

(iii) The separation of the impurity, cadmium, by fractional distillation was very well known.

(b) (i) The uses of zinc were usually given as galvanising and making alloys. Candidates should be aware that they have to give distinct uses, many of the uses of zinc are essentially sacrificial protection, the obvious example being galvanising.

(ii) The descriptions of metallic bonding were poor, the usual mark was 2/4. The typical account included delocalised electrons and their role in electrical conductivity but few mentioned positive ions and even fewer stated that the metallic bond was the attraction between the positively charged ions and the negatively charged electrons.

Question 3

(a) Most could explain how the mean rate in a 20 second time interval was calculated, the volume of oxygen given off in the interval divided by 20. This gave the mean rate in cm^3/sec.

(b) This part proved more challenging than **(a)**, many omitted the answer in the table or gave values other than the correct one 0.6 cm^3/sec.

(c) If a specific question is asked then the response must relate to the question asked f reaction decreases because the concentration of hydrogen peroxide has decreased, awarded. The concentration of reactant decreased only warrants the award of one mark amount of reactant decreases, no marks.

(d) The rate increases when the amount of catalyst is increased because the surface area of the catalyst has increased and the collision rate between catalyst and hydrogen peroxide is increased. A common misconception was that doubling the mass of the catalyst would decrease the activation energy leading to an increase in rate. Activation energy is not specified in the syllabus however it is a useful concept and if used correctly then obvious full credit would be obtained.

Contrary to popular belief, doubling the mass of the catalyst would not have any effect on the volume of oxygen. Oxygen is derived only from the hydrogen peroxide, if the same number of moles of hydrogen peroxide were used, the same number of moles of oxygen would be formed.

Question 4

(a) (i) and (ii) These parts were poorly answered. Candidates were not clear about the difference between a physical property and a chemical one. This difficulty was further compounded by not describing the differences in properties. Each answer had to relate to both elements, a correct description of a property of one element did not gain the mark.

sodium is a soft element	no marks
sodium is the softer element	one mark
sodium is soft, chromium is hard	one mark

(b) (i) This part was very well answered, usually a comment about appearance and one about preventing the steel from rusting were included.

(ii) Most of the candidates could derive the correct formula from the ionic charges.

(iii) Once again a correct response featured on the majority of the scripts.

Cr^{3+} + 3e → Cr

A common mistake was to offer the following:

Cr^{3+} + 3e → 3Cr

(iv) The gas was recognised as oxygen by most of the entry.

(v) There were some excellent explanations why it was necessary to replenish the chromium sulfate but not the copper sulfate. In essence the copper anode provided a supply of copper ions which maintained the concentration of copper sulfate. This could not occur with chromium sulfate as the anode was lead so the addition of chromium sulfate was necessary. Unfortunately some candidates limited the discussion to only one of the electrolytes.

Question 5

(a) (i) Even those candidates who knew that carbohydrates contained carbon, hydrogen and oxygen failed add that the O:H ratio was 1:2. It was more likely that they stated that carbohydrates contained carbon and water.

(ii) Obtaining energy from food was very well known but few extended the explanation to include the crucial point - in living organisms or cells etc.

(iii) Very few made the obvious link – carbohydrates contain oxygen so there has to be an oxygen-containing product, for example carbon dioxide.

(iv) Most suggested fertiliser or manure, either was acceptable. The solid is not used to make fertilisers or to make ammonia.

(b) (i) This calculation was poorly done with almost every possible permutation of the figur of the question used. Some used V_m and calculated the moles of oxygen used, henc methane and finally the correct value for the volume of methane.

The simplest method is - the mole ratio $CH_4 : O_2$ is 1:2, the volume ratio is the same, so 80 cm oxygen react with 40 cm^3 of methane. Percentage of methane = 40/60x100 = 66.7%

(ii) A range of inappropriate techniques was suggested - titration, use of indicators and fractional distillation. Very few candidates suggested that the carbon dioxide could be absorbed in an alkaline solution and then the volume of methane could be measured. The nearest many got to this procedure was to suggest that water be used to remove the carbon dioxide.

Question 6

(a) The characteristics of a homologous series were not well known, similar chemical and physical properties were given rather than the same chemical reactions and that there is a predictable trend in physical properties. Three of the following were required:

- same general formula
- consecutive members differ by CH_2
- same chemical properties
- same functional group
- physical properties vary in predictable way **or** give trend – mp increases with n etc.
- common methods of preparation

(b) (i) Many realised that isomers have different structures but then added that they have the same general formula or the same chemical formula, neither of which was acceptable.

(ii) Most of the attempts at drawing the structural formula of another isomer resulted in a repeat of one of the isomers given in the question. The structural formula of butan-2-ol or 2-methylpropan-2-ol was required.

(c) (i) Other oxidants are oxygen/air or (acidified) potassium dichromate(VI) or (acidified) potassium manganate(VII). Candidates should be advised that it is necessary to include the oxidation numbers.

(ii) The question asked what type of compound was formed, most answered the question - what is the name of the compound formed. They gave butanoic acid rather than carboxylic acid or alkanoic acid.

(d) (i) To measure the rate of the reaction, it is necessary to measure the volume, not amount, of carbon dioxide at known intervals of time. Almost every one recognised the necessity of the time measurement, fewer specifically mentioned volume as required by the mark scheme.

(ii) The reasons why the rate of this reaction initially increased were that the reaction was exothermic so the temperature increased and the yeast multiplied so there would be an increase in the number of yeast cells respiring. Candidates suggested explanations in terms of the concentration of glucose but this would decrease with time and the rate would decrease rather than increase.

(iii) The rate would eventually decrease because the concentration of glucose had decreased and because the enzymes were denatured by the high concentration of ethanol or yeast was killed or poisoned by the ethanol. These effects were not caused by an increase in temperature.

(iv) Acceptable reasons for conducting fermentation in the absence of air are:

- to prevent aerobic respiration
- **or** ethanol would be oxidised
- **or** ethanoic acid/acid formed
- **or** lactic acid formed
- **or** carbon dioxide and water formed

Many of the answers were not sufficiently specific.

Question 7

(a) (i) and (ii) The role of sulfur dioxide in food preservation and the manufacture of wood pulp w known.

(iii) The same cannot be said about the manufacture of sulfur dioxide by burning sulfur in air. It was thought it was made by the Contact Process.

(b) The majority had learnt the Contact Process and marks 3/4 and 4/4 were common.

(c) (i) Many gave an Arrhenius definition of an acid rather than the required Bronsted-Lowry one – an acid is a proton donor.

(ii) The unacceptable or incomplete methods of distinguishing between a strong acid and a weak acid included:

- add a metal but not stating which metal
- stating that the stronger acid gave off more gas instead it gave off the gas faster
- specified an inappropriate indicator e.g. litmus or phenolphthalein
- suggesting a method which had no obvious observation
- stating that sulfuric acid dissolved in water is fully ionised and that ethanedioic acid dissolved in water is partially ionised. This is a true statement but does not constitute a test.

(d) This question proved to be rather challenging. The correct solution is given below. The marking instructions are included to illustrate that one error does not mean that all subsequent marks are lost. ecf stands for "error carried forward", the error is penalised but the marking continues from that point using the incorrect value. It is effectively marking the method so that one error means only one mark is lost and not all marks subsequent to the error.

(i) How many moles of H_2SO_4 were added = $0.02 \times 0.3 = 0.006$ [1]

(ii) How many moles of NaOH were used = $0.04 \times 0.2 = 0.008$ [1]

(iii) reagent in excess sulfuric acid [1]
only mark ecf if in accord with 1:2 ratio and with values from **(i)** and **(ii)**.
reason 0.006> 0.008/2 [1]
for ecf mark **candidate** must use 1:2 ratio in answer

(iv) Is the pH of the final mixture less than 7, equal to 7 **or** more than 7?
less than 7 [1]
mark ecf to **(iii)** that is reagent stated to be in excess which in this case is the acid.

CHEMISTRY

Paper 0620/33

Extended Theory

General comments

The handwriting of the majority of candidates was perfectly legible, although a minority still produce work that is difficult to read. It is still necessary to point out that Examiners always make every effort to decipher the candidate's handwriting, but if this is not possible, credit cannot be awarded. If candidates decide to change an answer they would be advised to cross out and rewrite the answer rather than try to alter what they have already written as this can lead to answers becoming illegible.

If candidates write two answers on the same line, such as V_2O_4 and VO_2 (see **Question 2(c)(i)**) it is impossible to award credit. It is the responsibility of the candidate to make it clear which answer they want the Examiner to mark rather than leaving it to the Examiner to make the choice.

Question 1

(a) The majority were awarded credit here. Some did not make it clear that they were referring to the **outer** shell when discussing the stability of the oxygen atom.

(b) This scored very highly. Candidates were precise in referring to **one** electron being lost.

(c) Many thought that the transfer of electrons represented the bond as opposed to the *attraction* between oppositely charged ions.

(d) There were probably more candidates who referred incorrectly to movement of *electrons* instead of the correct answer which was movement of *ions* in the liquid phase/lack of movement of *ions* in the solid phase. *Movement* in the liquid phase/lack of *movement* in the solid phase was another key part to the correct answer which was not always present.

Question 2

(a) This question was answered very well with very few candidates making any mistakes whatsoever. The middle horizontal row did not always score.

(b)

(i) Very few referred to iron and therefore did not score. A common answer was that steel is alloyed with another metal, which makes no sense. In large numbers of cases there was a very strong implication that steel was an element.

(ii) It is in the candidate's interest to learn about the types of steel which are mentioned on the syllabus, namely mild steel and stainless steel. Many did this and gained full credit, whereas others tried to invent their own steel alloys, with varying amounts of success. Brass and bronze, neither of which are steel alloys, were both seen frequently.

(c)

(i) Many chose V_2O_4 as the formula for vanadium(III) oxide, not realising that formulae should use the lowest possible whole number ratio.

(ii) Fractional distillation was commonly incorrectly mentioned. Candidates should be aware that all metallic compounds, even unfamiliar ones, are solids at room temperature, and that fractional distillation is a method of separation of liquids.

Question 3

(a)

(i) There was a clue in the question which used the wording ‘as far as possible’. It was not possible to decide what the order was as far as cobalt and magnesium were concerned which very few candidates realised. Some of those who realised that there was insufficient evidence to put cobalt and magnesium in order merely left out cobalt and magnesium instead of saying that they were both more reactive than silver and tin, but it was impossible to put them in order without more evidence. Some did not read the instruction ‘Write the least reactive first’ and gave the metals in reverse order. Very few were awarded full credit.

(ii) This was meant to lead on from **(i)** and candidates were meant to realise that in order to put magnesium and cobalt in the correct order, a reaction between magnesium and a cobalt salt or cobalt and a magnesium salt was necessary.

(iii) A lot of candidates did not realise that tin became tin(II) ions. The intention was that they deduce this from the information in the table that refers to tin(II) nitrate. Quite a number chose tin(IV) as the oxidation product of tin.

(b) The first part was answered very well, the majority of candidates realising that NaOH does not decompose when heated. However whilst the majority realised that $Mg(OH)_2$ does decompose, not many knew that the products were MgO and H_2O.

(c)

(i) Candidates found this quite difficult. Those who referred to formation of ions did not always make it clear that they were talking about *positive* ions.

(ii) ‘How can you deduce’ means how can you use the information provided to draw a conclusion, not how can you carry out another investigation. This was not clear to a lot of candidates. Some candidates may have known the correct answer but were unable to express it correctly. Three cells were shown, and it was up to the candidate to make it clear that they were referring to the zinc/copper cell having a higher voltage than the copper/tin cell. Both cells had to be clearly referred to.

(iii) Too many candidates stated that zinc should be replaced with a more reactive metal or that copper should be replaced with a less reactive metal. The metals should have been named to score credit.

(iv) Most candidates realised that tin was positive relative to zinc, but there were very few correct calculations of the cell voltage, the most common answer being 1.6V.

Question 4

(a)

(i) This was answered quite well.

(ii) A large number of candidates knew that H^+ was being removed but they thought that this automatically led to the concentration of OH^- increasing, and did not refer to the equilibrium moving to the right.

(iii) Many knew that oxygen was the gas evolved, although some other gases were occasionally seen.

(iv) Some candidates gave noble (or what they think of as inert) gases. Gases are not used as electrodes because they are non-conductors as well as being gaseous.

(b)

(i) Production of water or alkanes were seen occasionally. Naturally occurring substances such as water or alkanes do not need to be manufactured. Manufacture of ammonia was the most common correct answer and scored very often.

(ii) Most candidates knew that chlorine kills bacteria in drinking water. This response scored very highly.

(c)

(i) Volume was very rarely referred to. The question referred to the apparatus describ question and not to any other method that the candidate may choose to devise, su measuring loss of mass. 'Amount' is not good enough, because a gas syringe is specific designed to measure volume.

(ii) A lot of candidates correctly mentioned or inferred strongly that it would be necessary to carry out two different experiments, but only a few realised that to fully answer the question there had to be a statement which said that the reaction would be faster when light was present.

Question 5

(a)

(i) The formula of magnesium ethanoate proved to be quite difficult for candidates. Some thought that hydrogen was evolved in the second reaction.

(ii) There were quite a lot of correct answers, including well drawn fully displayed formulae, to a fairly difficult question.

(b)

(i) 'How do you know' means how can you use the information provided to draw a conclusion. Many said that carboxylic acids contain only carbon, hydrogen and oxygen, but this was not using the information provided.

(ii) Large numbers of candidates were successful in calculating the correct numbers of moles of atoms and transforming these into a correct empirical formula. Some calculated the correct number of moles in all three cases, but then wrote another number in the answer space, which meant that no credit was awarded. The question asked for the numbers of moles.

(iii) 116 /5.8 = 20 therefore CHO x 20 = $C_{20}H_{20}O_{20}$ was a very common incorrect response.

(iv) This proved to be one of the most difficult questions on the paper. Some who achieved the correct molecular formula in **(iii)** found it impossible to write a correct structural formula. Many left this blank. Some outstanding fully displayed diagrams were seen and their authors are to be congratulated.

Question 6

(a)

(i) Many candidates achieved full credit for their response. It would be to the general benefit of candidates if they made it absolutely clear in their diagrams which electrons are shared and which ones are not. Using at least half (and preferably more) of the available space to draw diagrams would also be helpful for all concerned. Similarly candidates should ensure that they draw dots and crosses in such a way that it is easy for Examiners to count them. Large numbers of candidates did exactly this.

(ii) Many candidates only referred to the solid without offering any comparison with the gas and therefore did not gain any credit. Only the very able candidates were awarded full credit.

Movement in the gaseous state and lack of movement in the solid state was the point which scored most often, but points which referred to the pattern and distance were less commonly achieved. Fixed does not mean arranged in a regular pattern or lattice. It does mean not moving, and as such duplicates the marking point that often scored by referring to particles vibrating or not moving.

(b) All parts to this question required mention of faster movement of *particles* or *molecules* to gain full credit. This was not always the case.

(i) Full credit awarded quite often.

(ii) There were some very good answers. ‘Nitrogen is lighter’ (without reference) was a common error. Many candidates knew that molecules move faste temperatures and were awarded partial credit.

Question 7

(a)

(i) At least partial credit was invariably awarded for this response.

(ii) Clothing and ropes were very popular correct answers. Uses stated which were general purpose uses for polymers/plastics were but not necessarily specific uses of man-made fibres did not always receive credit.

(iii) There was some confusion between non-biodegradable and biodegradable.

(b)

(i) Methyl ethene was quite a common incorrect answer, because the methyl group was seen as a branch rather than part of the longest chain.

(ii) This was answered quite well.

(c)

(i) This was answered quite well.

(ii) Amino acids were occasionally seen instead of proteins or polypeptides. Many other types of molecule, both biological and non-biological were seen here as well.

(iii) Although some candidates knew what the functional groups in the monomers were, they did not achieve any credit because they represented the middle parts of the molecules by boxes instead of the CH_2 groups shown in the question. Alkenes were occasionally drawn.

CHEMISTRY

Paper 0620/04

IGCSE Chemistry Coursework

General comments

The few Centres who submitted work or moderation this November were all Centres which have previously submitted well and accurately marked work.

Many candidates deservedly scored high marks through their own efforts with the expert guidance of their Centres.

The Centres each use a set of tried and tested investigations which have been used successfully over a number of years.

Candidates clearly understand what is required of them in order to gain good marks and the staff are efficient in administering the system.

CHEMISTRY

Paper 0620/51

Practical Test

General comments

The majority of candidates successfully completed both questions and there was little evidence that candidates were short of time. Centres reported very few problems with the requirements of the examination. The grid supplied for **Question 1(c)** caused a few problems as the final temperatures for Experiment 2 were slightly higher than anticipated and exceeded the values on the *y*-axis scale. Candidates who extrapolated the graph off the grid and estimated the answer to **(d)(i)** received appropriate credit.

Results showed that some of the solid mixtures for **Question 2** were not made as specified in the confidential instructions. Candidates were not penalised as Supervisors' results were considered when marking the scripts.

There was 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 carried out the two experiments.

The tables of results were generally fully and successfully completed. The majority of candidates correctly recorded the initial temperatures of the water in both experiments.

A minority of candidates had results which were not comparable to the Supervisor's results.

(a) Credit was given for recording the initial and final temperatures. The final temperatures were expected to decrease as the mass of solid **A** increased.

(b) Similar to **(a)** but the final temperatures were expected to increase as the mass of solid **B** increased.

(c) The points were often plotted correctly on the grid but a significant number of candidates were unable to read the scale correctly on the *y*-axis.

Some candidates did not follow the instruction to draw straight-line graphs and were penalised for not using a ruler. Thick lines and multiple lines were penalised. A number of candidates did not label the graphs.

(d)

(i) The vast majority of candidates successfully extrapolated their graph to work out the answer. Estimated answers with no evidence of using the graph received no credit.

(ii) The instruction 'show clearly **on the graph** how you worked out your answer' was not followed by some candidates. Tie lines, crosses, arrows, circles etc. indicating the temperature of the reaction mixture when 5 g of solid **A** were added all scored credit.

(e) There was some confusion and some candidates thought that decreasing temperatures indicated an exothermic process.

(f) Credit was scored for realising that the temperature changes would decrease or reference to just 'temperatures' was not penalised. A common vague answer was 'the t of the mixture would decrease and increase'. Only the more able candidates explained t temperature changes in terms of more water.

(g) The effect on the rate of the dissolving of the solid in terms of a smaller surface area was required. Confused answers referred to the dissolving being slower because of a larger surface area and increased temperature changes.

(h) This was a good discriminating question. Many answers did not refer to the apparatus. Common incorrect answers which received no credit included;

- keeping the temperature constant,
- using a thinner/more accurate burette,
- repeating and averaging the measurements,
- using lumps of the solids,
- references to parallax errors.

Answers which received credit referred to using a pipette instead of a measuring cylinder and lagging the apparatus.

Question 2

(a) This was generally well answered.

(b) Vague answers mentioned cloudy or milky white without recording the formation of a white precipitate.

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

(c) Many answers referred to a lighted splint popping which was irrelevant. Credit was awarded for reference to effervescence/bubbles. Many answers such as 'ammonia gas is formed' received no credit, as this comment is a conclusion and not an observation.

The presence of an alkaline gas with a pH > 7 or the indicator paper turning blue/purple also received credit. Good candidates also noted the smell of the gas.

(d) This was a good discriminating question. Many candidates mistakenly discussed the formation of a gas instead of describing any colour changes. The majority of candidates failed to describe the appearance of the contents of the test-tube after it had cooled.

(e) A significant number of candidates successfully tested the gas but failed to record the effervescence when the hydrochloric acid was added to the residue. 'Carbon dioxide given off' is not an observation.

(f) The formation of a white precipitate was expected in both parts of this question. The addition of excess reagent was expected to dissolve the precipitate in both parts of the question. However, in **(f)(ii),** candidates from some Centres noted that the precipitate did not dissolve in excess aqueous ammonia probably due to the presence of lead ions remaining the residue. Candidates from these Centres were marked according to the Supervisor's results- see also **(i)**.

(g) 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.

(h) Credit was given for recognising that solid **C** was lead or silver nitrate. A few candidates confused solid **C** and solid **D**.

(i) Only the more able candidates recorded the formation of carbon dioxide from test **(e).** Many candidates ignored the mark allocation for the question and concluded that zinc or carbonate ions were present but not both. Aluminium was given credit depending on the result to test **(f)(ii).** Some candidates concluded wrongly that solid **D** was zinc chloride or calcium sulfate.

CHEMISTRY

Paper 0620/52

Practical Test

General comments

The majority of candidates successfully completed both questions and there was little evidence that candidates were short of time. Centres reported very few problems with the requirements of the examination. The grid supplied for **Question 1(c)** caused a few problems as the final temperatures for Experiment 2 were slightly higher than anticipated and exceeded the values on the *y*-axis scale. Candidates who extrapolated the graph off the grid and estimated the answer to **(d)(i)** received appropriate credit.

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(b) Similar to **(a)** but the final temperatures were expected to increase as the mass of solid **B** increased.

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(f) Credit was scored for realising that the temperature changes would decrease or reference to just 'temperatures' was not penalised. A common vague answer was 'the t of the mixture would decrease and increase'. Only the more able candidates explained t temperature changes in terms of more water.

(g) The effect on the rate of the dissolving of the solid in terms of a smaller surface area was required. Confused answers referred to the dissolving being slower because of a larger surface area and increased temperature changes.

(h) This was a good discriminating question. Many answers did not refer to the apparatus. Common incorrect answers which received no credit included;

- keeping the temperature constant,
- using a thinner/more accurate burette,
- repeating and averaging the measurements,
- using lumps of the solids,
- references to parallax errors.

Answers which received credit referred to using a pipette instead of a measuring cylinder and lagging the apparatus.

Question 2

(a) This was generally well answered.

(b) Vague answers mentioned cloudy or milky white without recording the formation of a white precipitate.

(c) Many answers referred to a lighted splint popping which was irrelevant. Credit was awarded for reference to effervescence/bubbles. Many answers such as 'ammonia gas is formed' received no credit, as this comment is a conclusion and not an observation.

The presence of an alkaline gas with a pH > 7 or the indicator paper turning blue/purple also received credit. Good candidates also noted the smell of the gas.

(d) This was a good discriminating question. Many candidates mistakenly discussed the formation of a gas instead of describing any colour changes. The majority of candidates failed to describe the appearance of the contents of the test-tube after it had cooled.

(e) A significant number of candidates successfully tested the gas but failed to record the effervescence when the hydrochloric acid was added to the residue. 'Carbon dioxide given off' is not an observation.

(f) The formation of a white precipitate was expected in both parts of this question. The addition of excess reagent was expected to dissolve the precipitate in both parts of the question. However, in **(f)(ii),** candidates from some Centres noted that the precipitate did not dissolve in excess aqueous ammonia probably due to the presence of lead ions remaining the residue. Candidates from these Centres were marked according to the Supervisor's results- see also **(i)**.

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

(h) Credit was given for recognising that solid **C** was lead or silver nitrate. A few candidates confused solid **C** and solid **D**.

(i) Only the more able candidates recorded the formation of carbon dioxide from test **(e).** Many candidates ignored the mark allocation for the question and concluded that zinc or carbonate ions were present but not both. Aluminium was given credit depending on the result to test **(f)(ii).** Some candidates concluded wrongly that solid **D** was zinc chloride or calcium sulfate.

CHEMISTRY

Paper 0620/53
Practical Test

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 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 was 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

(a) (b) The majority of candidates carried out the two experiments.

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

The table of results was generally fully and successfully completed though a significant number of candidates did not record the volumes to one decimal place.

Some candidates had results which were not comparable to the Supervisor's results.

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

(d)

(i) The vast majority of candidates successfully identified the hydroxide ion, but H^+ was a common incorrect answer.

(ii) The majority of candidates successfully identified the reaction as a neutralisation. A number of candidates referred to the redox nature of the reaction. Vague references to acid-base, displacement and exothermic also received no credit.

(e)

(i) This was generally well answered.

(ii) **"**More acid used in Experiment 2" was not sufficient as this was essentially the answer to **(i)**. More able candidates realised that the volume of acid used was twice that used in Experiment 1.

(iii) This was a good discriminating question. More able candidates referred to the greater concentration/strength of the alkaline solution **G** and discussed the fact that **G** was twice as concentrated as **F**. A large number of candidates mistakenly confused the alkaline solutions and thought that **F** was stronger than **G**. Vague answers concerned the misconception of the different reactivity of the alkaline solutions. Others discussed the different concentrations of the solution without specifying which one e.g. 'the solutions are of different st... of the solutions is more concentrated'.

(f) This was generally well answered. Poor answers referred to no change in the results or mista... that the volume of acid used would be greater.

(g) Most answers were too vague. Common examples of these types of answer were;

- reference to parallax and measurement errors that were unqualified,
- ideas regarding that the volume of the indicator used should be more specific than 4-6 drops,
- problems with mixing the solutions,
- use of a thinner or more accurate burette,
- use of a pipette instead of a burette.

Good answers discussed using a pipette instead of a measuring cylinder and repeating the experiment and taking an average of the results.

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) This was a good discriminating question. Detailed answers listed the formation of a liquid or noise produced by the solid and the evolution of an alkaline gas. Some candidates tested the gas with litmus indicator paper instead of pH indicator paper but were still able to receive credit for a correct colour change. A number of candidates recorded that the pH indicator paper turned blue or purple without stating a pH number and were not penalised. A minority scored credit for describing the smell of the gas.

(c)

(i) The formation of a white precipitate was recorded accurately by most candidates. Poor attempts referred to observations such as cloudy or milky appearances.

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

(iii) Credit was awarded for reference to the formation of an alkaline gas with a pH > 7 or the indicator paper turning blue/purple. The best answers also described the pungent smell of the gas formed.

(d) Some candidates did not read the question and failed to carry out test **(f)**. Only the more able candidates noticed that the solid changed colour and the formation of condensation/drops of liquid in the cooler parts of the test-tube.

(e)

(i) Most responses correctly mentioned the formation of a green precipitate. A surprising number of candidates observed a blue precipitate. Grey suspensions were common and received no credit.

(ii) 'White precipitate' was needed to receive the credit. References to white solutions/suspensions received no credit.

(iii) The colour change was expected to be recorded. References to colourless, yellow or brown scored credit.

(f) The formation of a green or brown colouration was given credit. A large number of candidates referred to the formation of a precipitate when the solid was already present to start with.

(g) The majority of candidates successfully identified the formation of ammonia. Chlorine and carbon dioxide were common incorrect answers.

(h) Many candidates ignored the mark allocation for the question and concluded that … sulfate ions were present but not both. Some candidates concluded wrongly that sol… chloride.

(i) This was a good discriminating question. Despite correct observations in tests **(e)** so… candidates were unable to identify solid **X** as iron(II) sulfate. Iron chloride (sic) was a common response and iron(III) and copper were sometimes given as the cation present.

CHEMISTRY

Paper 0620/61
Alternative to Practical

General comments

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

Candidates found **Questions 2** and **6** 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(c)** and **4**.

Comments on Specific Questions

Question 1

(a) A surprisingly small number of candidates were awarded credit here. Answers indicated that candidates had not read the question because answers such as test-tube, cotton wool and hot beads were common incorrect responses. Incorrect chemicals were prevalent e.g. aluminium, ethene and alkanes. Some candidates did not attempt the question.

(b) This was generally not well answered. Often only one arrow or two arrows in the same position were drawn. Arrows were not accurately positioned and many were inserted underneath the trough of water showing a lack of understanding.

(c) This was a good discriminating question. Only the more able could describe the 'suck-back' effect and the possible consequences. Many answers referred to problems involving air, oxygen, gases (sic) entering the tube or ethene escaping.

Question 2

(a) This was a good discriminating question. Common misconceptions involved the acid being warmed to remove impurities. Vague answers such as 'to make it more reactive' and 'so that magnesium oxide dissolves more' received no credit.

(b) The idea that a solid would be seen scored credit. Common incorrect answers discussed bubbles, the formation of precipitates and that 'all the acid was used up'.

(c) This was generally well answered and filtration successfully described. A few candidates thought the method used was evaporation or distillation.

(d) Most candidates missed the clue in the stem of the question showing the salt to be hydrated. Many answers did not relate to the possible dehydration of the crystals. The idea that the crystals would melt or break received no credit. A large number of answers incorrectly discussed the hazardous nature of the crystals being hot and burning your hand.

(e) Many candidates did not read the question, which asked 'how the method would differ..'. The fact that carbonates react at room temperature and that the acid would not need warming was not realised. Most answers discussed the formation of a gas/carbon dioxide but could not relate this to Step 2. A minority of candidates thought that magnesium carbonate would not react with sulfuric acid.

Question 3

(a) Vague answers relating to the accuracy of the experiment were frequent. Good answers to the idea of a fair test

(b) Only the more able candidates were successful in identifying the nitric acid. A large number thought that the water should be added last without realising that the reaction would be happening between the thiosulfate solution and the acid before the timer was started.

(c)

(i) Most candidates successfully plotted the results. A minority of candidates successfully drew a smooth curve. Many curves were very thick or of multiple lines and not smooth.

(ii) Some answers showed confusion where the times taken for 55 cm^3 and 45 cm^3 of sodium thiosulfate solution were read from the *x*-axis resulting in 2 answers. The question asked for the time taken when 55 cm^3 of thiosulfate solution and 45 cm^3 of water were used. This showed a lack of understanding.

(d) The majority of candidates realised that increasing the temperature would speed up the reaction though an explanation in terms of increased energy or particle collisions was rare. As in previous years there was some confusion between time and speed of reaction e.g. 'the time got quicker'.

Question 4

The table of results was usually completed correctly.

(a) Most candidates plotted the points on the grid correctly. Some candidates did not receive full credit due to the use of an inappropriate scale on the *y*-axis. Many straight-line graphs were not straight as a ruler had not been used. Thick, wobbly and multiple lines were common. Labels were often omitted

(b) The idea of the solid not being visible or the solution clear was realised by the more able candidates. Vague answers discussed precipitation and cloudiness.

(c) Many graphs were clearly extrapolated and the value at 9.0 cm^3 correctly recorded.

(d) Candidates did not read the question which asked 'how the results would differ… '. The results obtained were temperatures at which crystals first appeared but many responses were concerned with time for the crystals to appear or different types of reactions.

(e) This was often not attempted. A straight line beneath the original was required. Many lines were above the original and a few started at the same temperature and then went below the original graph. The label was sometimes omitted.

(f) This was generally not well answered. The use of a pipette instead of a burette was common. Credit was given for repeating the experiments, using a digital thermometer and a consistent method of cooling the solution for all five experiments e.g. in a beaker of cold water.

Question 5

Some candidates did not attempt this question.

(a)

(i) The blue colour of copper sulfate solution was recognised by most. Some random guesses were evident. Blue-green received no credit.

(ii) The formation of a blue precipitate was recognised by the majority of candidates.

(iii) The effect of excess aqueous ammonia solution on the blue precipitate was poorly described by some candidates. Answers such as 'insoluble and dissolves to form a solution' showed a lack of understanding.

(c) This was a good discriminating question. Credit was given for the identification of t
and realising that solution **Y** was acidic. The most able candidates correctly deduced t
Y was sulfuric acid.

Question 6

(a) The observation of bubbles at both electrodes was not well known. 'Gas given off' is not an observation and received no credit. Many answers referred to colours and the material the electrodes were made of.

(b) Credit was given for the presence of an alkali, base or sodium hydroxide. Many blank answers were seen and some thought an acid was indicated.

(c)

(i) This was a good discriminator with chlorine being the correct answer. Many references to chloride were seen. Wild guesses giving hydrogen chloride, sodium hydroxide and hydrogen were common.

(ii) The test for chlorine was not well known. The bleaching effect of the gas was often not recognised. Those candidates who successfully identified chlorine often gave the test as turning litmus/indicator paper red or pink.

Question 7

This was a good discriminating question. Few candidates were awarded full or no credit; most were awarded partial credit.

(a) Litmus was commonly used to test for weak acid. Some type of pH indicator e.g. Universal Indicator was required to score credit. A correct colour change was allowed.

(b) Sodium hydroxide, sodium carbonate and sodium oxide were good responses. Common answers, which received no credit, were sodium, sodium chloride and sodium nitrate.

(c) This was generally well answered though there were some candidates who did not attempt the question.

Credit was awarded for;

- chromatography,
- a suitable solvent should be used – not dipping the paper in the solution,
- application of the food colouring/sunset yellow to the paper,
- expected result, e.g. a description of the chromatogram obtained.

Many candidates failed to mention the comparison of E110 with the food colouring despite giving a good description of the chromatographic process. Common incorrect answers were 'observe the (sunset) yellow spot' or 'see a yellow colour'.

No credit was given for answers that used acid-base indicators.

CHEMISTRY

Paper 0620/62

Alternative to Practical

General comments

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

Candidates found **Questions 2**, **3**, **4(f)** and **4(g)** to be the most demanding. It was apparent that some candidates struggled with some 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 pipette as a teat pipette and to confuse the burette and pipette. A few candidates mistook the burette for a tap funnel.

(b) Most candidates wrote about a colour change but forgot to mention the use of a named indicator. Many candidates who correctly named an indicator gave wrong colour changes thus only a few were awarded full credit. A minority of answers stated that effervescence would be observed.

Question 2

This was a good discriminating question. The use of silver/lead nitrate to identify chloride ions was well known. Many candidates wrongly used bromine to test the ethanol. Ester formation and oxidation of ethanol by potassium manganate/dichromate scored credit.

A variety of methods were used to identify sodium hydroxide. Named indicators were common and the use of metal cations with the subsequent formation of a coloured precipitate was awarded full credit. Some candidates were penalised for adding a metal and expecting a precipitate. A common correct answer was to describe the reaction with ammonium ions and the ammonia gas formed.

Question 3

(a) A significant number of candidates did not attempt the graph. Most candidates who did attempt it plotted the points correctly but it was not uncommon for the straight line to have a bend in the middle or to be done freehand instead of with a ruler.

(b) A common misconception was that as reagents get used up the mass must be less. Only the more able candidates referred to a gas or carbon dioxide being evolved.

(c) Despite similar questions being asked in previous papers this caused most candidates problems. The commonest answers discussed the cotton wool stopping air or carbon dioxide leaving or entering the flask. Some mentioned the retaining of heat. References to prevention of loss of the acid were rare.

(d) This question was well answered.

(e) Some candidates extrapolated the graph correctly and then failed to record the time. … t number of candidates misread the scale.

(f) The sketches were generally steeper than the original curve as required. However, many ske… started at a different mass compared to the line for Experiment 1.

Question 4

(a) (b) The tables of results were usually completed correctly. A few candidates managed to write down different starting temperatures even though the thermometer diagrams were identical for each solid.

(c) Many good straight-line graphs were seen. The most common errors were not to label the lines or to plot the last point in Experiment 1 at 5 g rather than 6 g.

(d) The majority of candidates extrapolated correctly and were awarded full credit. Some answers in **(ii)** showed no indication as to how the answer had been obtained.

(e) Most candidates correctly gave endothermic but a significant number of candidates gave the reaction as exothermic.

(f) This was a good discriminating question. Many candidates wrote vague answers referring to lower and higher or different temperatures while others discussed the rate of dissolving/reaction at great length. The more able candidates realised that the temperature changes would be less as more water was involved.

(g) Credit was given for realising the effect on the increase or decrease in the rate of the dissolving of the solid **B** in terms of surface area. The original state of solid **B** was not given and could have been powdered or one large lump.

Question 5

(a) The formation of a yellow precipitate was recognised by most candidates. A minority of candidates incorrectly stated that the precipitate would be white.

(b) Only a minority of candidates scored full credit. Most candidates correctly recorded the indicator colour but references to bubbles and the smell of the gas were only mentioned by more able candidates. Examiners ignored the formation of a white precipitate as this reaction was testing for the presence of nitrate ions.

(d) Generally well answered as the test for carbon dioxide using limewater is very familiar to candidates. However, some references to chlorine and ammonia were seen.

(e) This was a good discriminating question. Credit was given for the identification of zinc carbonate however too many candidates referred to the presence of calcium instead of the zinc ion.

Question 6

(a) Generally well answered with electroplating being the required response. Many vague answers referred to electrolysis. Galvanisation was a common incorrect answer.

(b)

(i) The majority of answers were correct. Common incorrect answers were nickel and silver.

(ii) This was a good discriminator. More able candidates scored credit for a named chromium salt. Many incorrect responses included sodium chloride, which showed a lack of understanding and potassium dichromate, which would not work.

(c) Generally well answered, with most candidates scoring at least partial credit. Some candidates thought that 'to prevent corrosion' was a different answer from 'preventing rusting'. Further credit was awarded for some idea that the chromium would make the knife shiny or more attractive. Some answers focused on making the knife hard so that it would stay sharp.

Question 7

This was a good discriminating question. Credit was awarded for the ideas concerning a fair test e measured amounts of the three samples of water and same number of nails. Some candidates d describe any practical procedure and instead discussed the rusting of iron at great length.

Correct chemistry with appropriate conditions scored credit. Most answers scored some credit.

Some examples of common errors are listed below;

- reference to leaving the investigation for an inappropriate amount of time, often in minutes or a few hours instead of days or weeks,
- using iron filings/powder instead of iron nails,
- having the iron nails somehow remaining at the top of test-tubes which were described as being inverted in troughs of the different water samples.

Answers were expected to include some detail of observing and or recording the observations and comparing these to draw an appropriate conclusion.

CHEMISTRY

Paper 0620/63

Alternative to Practical

General comments

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

Candidates found **Questions 4** and **5** 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 **Question 3**.

Comments on Specific Questions

Question 1

(a) Most candidates were awarded full credit on this section. Nearly all candidates recognised that the process was distillation, although a significant number omitted the “fractional”. The flask was recognised by nearly all candidates. The condenser caused most, but still only a few, problems. Answers such as distillation tube and condensing column were the most common incorrect responses. Condensing tube was accepted.

(b) The majority of candidates thought that electrical heating was used because it gave better control or could achieve higher temperatures. Few mentioned the flammability of alkanes.

(c) Nearly all candidates identified octane as the first alkane to be distilled over.

(d) There were a variety of correct responses here, ranging from a pause in the collection of liquid alkane to a temperature rise to 174 ^{o}C. Incorrect answers often assumed two layers or a different colour.

Question 2

(a)

(i) Most candidates knew that a measuring cylinder should be used here, as the nickel carbonate was going to be added in excess. Burettes and pipettes were common incorrect responses.

(ii)

(b) The majority of answers correctly referred to the solid no longer dissolving or no more fizzing, although a few misused the word ‘precipitate’.

(c) This was well answered with some really excellent diagrams. Pleasingly many diagrams were clearly labelled even though not required by the question.

(d) Very few answers gained full credit, as the more able candidates focused on either evaporating to crystallisation point or avoiding losing the water of crystallisation, but rarely both. Most candidates failed to gain any credit despite the formula of the hydrated nickel nitrate being given in the stem of the question.

Question 3

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

(b) Most candidates successfully plotted the results and drew two straight lines, using a ruler.

(c)

(i) Most graphs were successfully extrapolated to answer this question. Credit was given for extrapolating the straight line or for extrapolating it to the origin and for using either a straight line or a curve.

(ii) The reason for the same temperature rise in the last two experiments was usually correctly given as the zinc being in excess by then.

(d) The sketches were generally to the left of and steeper than the original line and continuing to a higher temperature, as required.

Question 4

(a) The table of results was usually completed correctly, the commonest error by far being the omission of a decimal place, i.e. it should have been "8.0" rather than "8".

(b) Correctly, the hydroxide ion was the most common answer, although a lot of hydrogen ions were seen.

(c) In **(i)**, most candidates realised that Experiment 2 used the greatest volume, although in **(ii)** some did not realise that it was double. Similarly, in **(iii)** most realised that the alkali **G** was the most concentrated, but not that it was double the concentration. Some candidates showed a lack of understanding and thought that solution **F** was twice as concentrated.

(d) This was very well answered, most candidates receiving full credit.

(e) Candidates found it difficult to identify two errors in the experimental procedure and then to suggest improvements. Often the answers to **(ii)** bore no relationship to the answers to **(i)**. Common incorrect responses involved parallax, washing the burette between experiments and not measuring the exact amount of indicator used. More able candidates did realise that a measuring cylinder should not be used and that it would be wise to repeat the titration.

Question 5

(c) Most candidates realised that **X** would be green, although brown and white were often seen.

(d) The formation of a green precipitate in **(i)** and a white precipitate in **(ii)** was well known by all but the weakest candidates.

(e) This was generally well answered with nearly everyone identifying ammonia.

(f) Only the more able candidates gained full credit. Many omitted any reference to the halide test. Others confused aluminium with ammonium.

Question 6

(a) The explanation of the use of a powder was very well known. Many good answers referred to the increase in rate of reaction in terms of increased surface area.

(b) Although there were a lot of correct colours, blue and white were common incorrect responses. Orange scored no credit.

(c) This was generally well answered, although a small minority referred to the formation of water as a product of the reaction in the combustion tube. Reference to the role of the ice or condensation was required.

(d) The chemical tests for water are well known, although some used its physical properties such as boiling point and pH, which did not answer the question.

Question 7

(a) In **(i)** the majority of candidates knew that the pH of an orange juice drink would be below 7, although in **(ii)** many thought that pH indicator paper was more reliable because it was more accurate. More able candidates realised that the colour of the drink would cause confusion with the colour of Universal Indicator solution.

(b) The chromatography experiment was well described by all but the weakest candidates. Only the final marking point caused problems, where a comparison to natural and/or artificial additives was required. Many candidates assumed that the appearance alone of the chromatogram would indicate whether or not artificial colouring had been added. In some cases it was stated that artificial (or natural) colours would not separate. As in previous years, some weaker candidates dipped the chromatography paper directly into the drink.

Some more able candidates assumed that carotenes were alkenes and used bromine water to test for them.