CHEMISTRY

Paper 0620/01

Paper 1 (Core)

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

General comments

Candidates for this paper achieved a mean mark of 28.5 with a standard deviation of 6.4. These parameters are satisfactory. The mark distribution was slightly skewed to higher marks but this no doubt reflects the fact that candidates of all abilities offer this paper which is, however, limited to the core of the syllabus.

The easiest questions were **Questions 1**, **2**, **10**, **11**, **16** and **25**. On the other hand, **Questions 3**, **6**, **12** (especially), **14** and **31** were found to be relatively hard. The comments below concentrate on these latter questions although one or two others are mentioned.

Comments on specific questions

Question 3

The more able candidates coped satisfactorily (as shown by the very good discrimination statistic) but many of the less able chose **C**. Lead(II) iodide is indeed yellow - when solid - but it is the residue and not in the filtrate. Did such candidates misread the question (by ignoring the column presentation) and merely respond to the three consecutive words “yellow”, “lead(II) iodide”?

Questions 5 and 9

These were found quite easy but this is encouraging.

Question 6

As for **Question 3**, the more able candidates coped satisfactorily. Overall, however, only a third of the candidates answered correctly and most went for response **C**. This is so despite the fact that the words "atom" and "ion" were printed in heavy type: It cannot be sufficiently emphasised that candidates read and think about the questions carefully.

Question 12

This was found very hard with most candidates choosing **C** instead of **A** - although the question directly relates to the syllabus. The popularity of **C** is understandable but candidates might have wondered about an insulator being quite as thick as layer 1 shown in the diagram.

Question 14

This was hard but discriminated between candidates satisfactorily. Half of the candidates went for **B**. This perhaps hints at a language difficulty rather than a lack of understanding.

Question 26

This was found to be slightly harder than anticipated. Some of the less able candidates chose **A**. It seems curious that candidates are reluctant to accept that copper is low in the activity series.

Question 31

This was another question that discriminated well but proved to be surprisingly, and disappointingly, hard. Only a third of candidates chose the key, **D**, and another third chose **C**. Hydrogen as an atmospheric gas is a well-established mistake but did candidates not recognise helium as one of the 'rare' gases?

Paper 0620/02

Paper 2 (Core)

General comments

Although many candidates were well prepared for this paper, there were a large number who found difficulties with some of the questions requiring more extended answers. Many candidates scored about two thirds of the marks available but a significant number scored in a range of 20 to 40 marks out of the 80 available. Most candidates attempted every part of each question, and the standard of English continues to be good. There were many good answers showing a thorough grasp of the subject matter. Most candidates seemed to have a good knowledge of practical procedures, and could answer questions relating to chemical apparatus to a high standard. However, questions concerning tests for ions continue to pose some difficulties.

In general, the rubric was well interpreted, but a few candidates still insist in putting more than one answer to questions which clearly state that only one answer is required, for example, **Question 2** parts **(a)** to **(d)**. There were few other instances in this particular paper where candidates disadvantaged themselves by giving multiple answers. Many candidates, even high scoring ones, did not look at the number of marks available in questions such as **Questions 4 (b)** and **7 (a)(i)** and so disadvantaged themselves.

A fairly large number of candidates have difficulty in explaining the meaning of the basic chemical terms which were asked for in **Questions 2 (e)** and **3 (e)**. Explanations of the meanings of the terms compound and molecule were very poor. It was encouraging to note that the majority of the candidates were able to write correct formulae in the appropriate places and showed a good ability at balancing equations. As stated in previous Examiner's Reports, many candidates did not appear to know the uses of many of the chemicals as stated in the syllabus. This was especially apparent in **Questions 4 (f)** and **5 (d)**.

Comments on specific questions

Question 1

Most candidates scored fairly well on this question but full marks were rare.

(a) About 20% of the candidates listed metallic properties rather than properties confined to the transition metals. A significant number of candidates implied that the transition metals themselves were highly coloured. One or two candidates muddled variable valency with amphoteric character, or mentioned uses rather than properties.

(b)(i) Few candidates scored both marks in this part of the question. Many candidates assumed, incorrectly, that litmus could be used to test for the pH, or did not refer to a colour change of the Universal Indicator. Candidates should be reminded what is meant by a test 'result' not just referring to a number.

(ii) This part was generally well answered, the most common incorrect responses being pH 2 and pH 8.

(iii) This part was reasonably well answered by most candidates, although some referred to losses of protons or merely referred to 'charged particles such as electrons'. 'Charged elements' was also a commonly seen incorrect response.

(iv) Most candidates obtained the mark for this part.

(c) About 20% of the candidates failed to use the data given. From the comprehensive lists of reactivity series written on the paper, many candidates appeared to be relying on their learnt knowledge rather that using the information. Candidates will not usually be expected to learn the exact order of the reactivity series, which is, in any case, arbitrary unless based on electrode potentials. Zinc and iron were often misplaced.

(d) The answers were very Centre dependent but many candidates scored 2 of the 3 marks available. The most difficult mark to obtain was the one relating to the precipitate re-dissolving. Some candidates had obviously learnt their tests for ions very well but other candidates had no idea. Common errors were to suggest that hydrochloric acid alone or hydrochloric acid plus sodium hydroxide should be added, or to use a flame test. Several candidates should be advised to be careful with the way they write their answers. For example, statements such as 'a white soluble precipitate' are contradictory.

Question 2

Most candidates scored fairly well on this question but few obtained full marks on parts **(d)** and **(e)**.

(a) This part was generally correctly answered.

(b) Many candidates chose response E instead of B, obviously recognising a giant structure, but being less sure of how to distinguish one of an ionic nature.

(c) This part was generally correctly answered.

(d)(i) Response A was the most common incorrect response for this question, a clear case of not looking at all the data.

(ii) This part was poorly answered in terms of the arrangement, many candidates merely referring to the fact that the particles in a gas are far apart. Most candidates, however, could describe the movement of gas particles adequately.

(e) As in previous years, this sort of question was poorly answered by most candidates. Although a few clearly confused a compound with a mixture, many candidates inadvertently used the term mixture in their otherwise good answers and therefore forfeited the marks. The idea of substances formed by merely reacting them together is not a sufficiently rigorous definition.

(f)(i) It was encouraging to see so many good answers to the electron transfer question in this part. Most candidates scored 3 of the 4 marks available, the idea of complete outer electron shells being the mark which was least easily gained.

(ii) Most candidates obtained both marks for the calculation in this part [58.5]. A few candidates rounded down the answer to 58. If the calculation were to be done to 2 significant figures, the correct answer would be 59. A few candidates multiplied the numbers instead of adding them or used atomic numbers.

Question 3

About 60% of the candidates obtained at least 5 marks. All but the best candidates found the definitions in part **(e)** difficult.

(a) Many candidates seemed to be confused between groups and periods in the Periodic Table. A common incorrect answer to this part was therefore 6.

(b) The idea of the atomic/proton number determining the order of the elements in the Periodic Table was accessed by most candidates. The most common incorrect answers included writing about mass numbers or numbers of protons and neutrons, the mention of neutrons negating the positive point.

(c) This part was poorly answered, with only about 40% of the candidates recognising that there were 6 outer electrons in a group 6 element. It is clear that many candidates are not using the Periodic Table as a source of information when answering such questions. The incorrect answer, 2, was not uncommon, the candidates presumably relating the number of electrons to the charge on the ion rather than the position in the Periodic Table, or making the assumption that all electron shells have 8 electrons as a maximum.

(d) The most common error was to regard polonium as a period 5 element. This again highlighted the candidates' misconceptions about the arrangement of the Periodic Table.

(e)(i) About 60% of the candidates understood the term diatomic, but few could explain the nature of molecular structures. Common misconceptions about diatomicity included the idea of two molecules being joined. Many candidates did not realise the important distinction between molecular structures and giant structures in terms of size (albeit large for molecules such as proteins), or that molecules are covalently bonded. Many candidates defined molecules as 'the smallest particles joined together naturally'. Such an answer is too vague, the particles not being defined.

(ii) This part was generally correctly done.

Question 4

Most candidates scored fairly well on this question but full marks were rare.

(a) Most candidates correctly identified carbon dioxide as being given off during fermentation. Common incorrect answers included oxygen and hydrogen.

(b) This part was generally well answered, with the point about enzymes being catalysts being generally accessed. The idea that catalysts are enzymes or present in living material was less well realised, incorrect answers implying that enzymes are bacteria or yeasts themselves.

(c) This part gave candidates most problems in this question. Many candidates realised that distillation would separate ethanol and water, but few could explain the process of boiling and condensing well enough to gain the second mark. Many candidates did not mention condensing at all, although they mentioned evaporation or boiling. A few of the candidates mentioned the difference in boiling points, but the majority were content with vague statements such as 'the alcohol comes off, then the water'.

(d) Many candidates drew the correct structure for ethanol but a significant number did not draw in the O-H bond. This is a common mistake, which has been commented on in previous Examiner's Reports. When requested to draw a displayed or graphical formula <u>all</u> bonds must be shown.

(e) Most candidates scored all four marks available for this part.

(i) Combustion was the most common incorrect answer in this part, followed by polymerisation.

(ii) Answers to this part were invariably correct and it is encouraging to see fewer answers just stating that 'catalysts change the rate of a reaction'.

(iii) The most common incorrect response was ethane, but more general terms such as hydrocarbon were not infrequently seen.

(iv) Apart from one or two cases, this part was answered correctly with the correct units. A small number of candidates, however, wrote the answer as + or −100ºC, which did not give them credit.

(f) Uses of ethanol ranged from fuels to use in solvents and its presence in (alcoholic) drinks. However, candidates should note that it is not sufficient to say 'for drinking' (since this implies drinking neat alcohol) or 'for making alcohol'.

(g) This part was surprisingly poorly done. Carbon dioxide was often seen as a correct answer, but the second product of burning ranged from oxygen and hydrogen to various hydrocarbons such as ethane.

Question 5

This question proved to be a good discriminator. Although some candidates appeared not to be confident enough in their knowledge of carbon allotropes to tackle a question such as this, set in unfamiliar terms, the most disappointing part of the question was in the straightforward naming and use of graphite and diamond in part **(d)**.

(a) Many candidates gave good answers, but a few contradicted themselves by claiming that the substance was a compound because it had only one type of atom.

(b) Most candidates recognised the bonding as being covalent.

(c) This was generally correctly calculated [25 atoms].

(d) The idea of molecular formula was not always well known and there were many permutations of various carbons, hydrogens and nitrogens. A significant minority of candidates calculated the molar mass of the compound rather than writing the formula.

(e) Only about 20% of the candidates obtained the correct answer [14], most not reading the question properly, which referred to a molecule of nitrogen rather than an atom.

Question 6

This was the best answered question on the paper and many candidates obtained full marks.

(a) Nearly all candidates correctly wrote 'oxidised' for the first space. Fewer candidates realised that removal of oxygen is reduction.

(b)(i) This part was not always well answered, with the observation of 'bubbles' being the most common correct answer. A significant proportion of candidates, however, did not put down observations but rather focused on processes that are not descriptions. For example, 'a gas is given off' or 'the iron changes to iron chloride'.

(ii) Most candidates scored at least 3 marks of the 4 available for this part. Drawings were often good and most candidates correctly identified the aluminium oxide on the filter paper and the solution of iron(II) chloride as filtrate. The most common mistake in the drawings was not to show the filter paper.

(c) Most candidates recognised the reaction as being exothermic, although a few put down the incorrect answer 'combustion'.

(d) The majority of candidates recognised a correct use of acetylene. A significant number of candidates suggested, incorrectly, that its main use was to produce light or be used in the blast furnace.

Question 7

Most candidates scored at least half marks on this question.

(a) A high proportion of candidates calculated the percentage of sodium chloride correctly [2.8%]. A not uncommon error was not including 5.6 (the mass of sodium chloride) in the total. Some candidates miscalculated and gave answers as 2.88%.

(b) The general idea of evaporation was commented on by about 50% of the candidates.

(c) This was generally well answered, but some candidates failed to understand what was happening to the sodium chloride during the electrolysis, and focused their attention on the ions moving towards the electrodes rather than mentioning concentration changes.

(d) Most candidates understood that the chloride ion moved towards the anode.

(e) Most candidates realised that the electrodes must conduct electricity but there were a variety of incorrect answers, mostly focusing on hardness of the electrode.

(f) About 70% of candidates realised that the circulation of the mercury can only take place if it is liquid.

(g) Many candidates realised that sodium hydroxide was a product of the reaction of sodium with water, but only about 40% of them put hydrogen as the second product. In its place, oxygen was a common incorrect answer. A minority of candidates suggested, incorrectly, that sodium oxide was formed.

(h) This was answered correctly by the majority of candidates but a few disadvantaged themselves by putting only one of the years.

(i) Most candidates realised that the reaction was either a polymerisation or an addition reaction, but less than 20% wrote both words. The attention of candidates should be drawn to the fact that the number of marks for a question is related to the number of points needing to be written about.

(ii) Most candidates could define an electrical insulator in this part.

Paper 0620/03
Paper 3

General comments

Candidates need to be advised that the requirements of the question are to be taken literally. If the question asks for the name of a substance, the name and not a formula should be given. Similarly, the request for an equation cannot be interpreted as being for a word equation. The word ‘use’ on Chemistry papers has the connotation of commerce, for example, respiration is not considered to be a use of oxygen, yet oxygen in artificial atmospheres would be accepted. Similar considerations relate to the term ‘application’. Following the same theme, a specific request, for example, for a reaction condition, must be met, otherwise not only that mark cannot be awarded but neither can subsequent ones. One cannot explain the choice or give a reason, if the choice has not been made. Candidates must follow the demands of the question.

There is an abundance of evidence that the preparation of some of the candidates for this examination was inadequate. They could not recall basic facts and obviously had spent little or no time revising either knowledge or skills. In common with most examinations, a secure foundation of basic knowledge is an essential requisite otherwise there is not the slightest chance of attaining a respectable grade.

In general, the standard was higher for **Questions 1** and **2** than for the remainder of the paper.

Comments on specific questions

Question 1

(a)(i) Most correctly attributed the formation of carbon monoxide by vehicles to the incomplete combustion of the carbon in the fuel. A typical error was to suggest that it was formed by the incomplete combustion of carbon dioxide. Another problem was to identify the fuel as coal.

(ii) There was a general awareness that carbon monoxide was converted into carbon dioxide. This was one of the marking points. However the explanation was not usually extended to include the role of the oxides of nitrogen. Candidates did not realise that the following reaction

$2NO + 2CO \rightarrow 2CO_2 + N_2$

occurred in the exhaust and not in the engine. Some of those who knew that the oxides of nitrogen were involved thought that the reaction was of the following type.

$NO + CO \rightarrow C + NO_2$.

(iii) To be awarded both marks, the answer had to include reduction, and either the gain of electrons, or a decrease in oxidation number. Redox did not suffice. Predictably many of the responses were the exact opposite of the correct one. A considerable proportion of the candidates thought that Pd was the symbol for lead, if the rest of the Chemistry was correct, this was ignored.

(iv) The majority of the entry gave a correct test, either with bromine water or with potassium manganate(VII), and then described an appropriate observation for the positive result of the test.

The most common difficulty was to believe that the test was for carbon monoxide, either combustion followed by limewater or more usually just limewater. The question made it clear that 'this gas' is ethene. Quite prevalent was the belief that ethene could reduce acidified potassium dichromate(VI).

(b)(i) The answer had to include a reaction condition that favoured the back reaction, followed by an explanation. To comment that the back reaction was endothermic would not gain marks but commenting that the temperature should be increased because the back reaction is endothermic would be awarded both marks. In this particular reaction, the idea that the back reaction solely involves bond breaking is of merit.

(ii) Electrolysis or electroplating were the only possible answers.

Distillation, filtration, heat with carbon and heat with oxygen were the usual mistakes. Most of the candidates offered the correct technique.

(c)(i) The answers lacked clarity and precision. An example of a model response is 'a saturated compound contains only carbon-carbon single bonds but an unsaturated compound contains at least one double (or triple) bond'. An alternative explanation could involve reaction types such as addition and substitution.

The diagram defined the context of the question so answers based on solubility were not accepted.

(ii) The name 'ester' was required. Many candidates could not recall this fact and they gave strange formulae and a variety of functional groups – alcohols, amides, carboxylic acids.

(iii) The comment 'heat with sodium hydroxide', was the easiest route to both marks. Other acceptable terms were alkaline hydrolysis and saponification. The latter was usually spelt as 'soaponification'. Most of the candidates had some idea of how to obtain soap from a fat. In fact, some displayed a very detailed knowledge and discussed triglycerides, glycerol and sodium stearate. This depth of knowledge is not required by the syllabus but obviously was given full credit.

The most frequent mistake was to suggest alcohol instead of alkali.

Question 2

(a)(i) This part was very well answered. A few forgot to mention 'liquid air'.

(ii) The vast majority gave an acceptable use, such as welding, production of steel, artificial atmospheres and medical uses. A few stated 'respiration', but this was not considered to be a use.

(b)(i) Most could give the right word equation. The usual error was to give the equation for respiration with glucose as a reactant and not as a product.

(ii) Light, which is the energy source for this endothermic reaction, was at least as common as chlorophyll.

(iii) If the candidate recognised that a clear deduction from the results of this experiment was required, and not general comments derived from other studies, then a pleasing answer ensued. An example of which is 'if the intensity of the light increases, so does the rate of photosynthesis'.

(iv) A good standard of answers, the new graph was drawn with a bigger slope but still passing through the origin.

(v) Two popular examples were photography, and the preparation of chloroalkanes from an alkane and chlorine. The reaction did not have to be defined by an equation. For photography, any one of the following would have been awarded the two marks for specifying the reaction.
Silver ions are changed into silver atoms.
Ag^+ becomes Ag
$Ag^+ + e \rightarrow Ag$
A silver compound forms silver metal.
$2AgCl \rightarrow 2Ag + Cl_2$

All that was needed for the application was some reference to photography, such as making films.

This question proved to be quite testing. The candidates needed a clear understanding of what constituted a photochemical reaction and then the ability to define the reaction in chemical terms. It was not acceptable to repeat photosynthesis. The addition reactions of alkenes and halogens are not photochemical and neither is the thermal decomposition of mercury(II) oxide.

(c) Number of moles of KCl = 1.49/74.5 = 0.02
Number of moles of oxygen molecules = 0.72/24 = 0.03
Number of moles of oxygen atoms = 0.06
Mole ratio KCl : O is 0.02 : 0.06
n = 3

Most of the candidates correctly calculated moles of KCl, but then calculated moles of O_2 as 0.72/32 = 0.0225 or 0.72/16 = 0.045. An additional complication was that the number of moles of molecules were divided by 2, rather than multiplied, to find the number of moles of atoms. At this point some candidates multiplied by Avogadro's Number in an attempt to calculate the number of moles of atoms. Only those candidates, who were familiar with this type of calculation, arrived at the correct result. Even then, many who had the correct ratio for KCl : O did not give the consequent value of n. The Examiners allocated the final mark if either the ratio or the value of n was correct.

A few candidates used their own rather elegant route to n.
Number of moles of KCl = 1.49/74.5 = 0.02
Number of moles of $KClO_4$ = 0.02
Mass of one mole of $KClO_4$ = 2.45/0.02 = 122.5
Mass of oxygen in one mole of $KClO_4$ = 122.5 − 74.5 = 48
n = 48/16 = 3

Question 3

(a) Candidates did not seem to be familiar with this type of calculation and were unable to offer 5cm^3 and 25 cm^3 respectively. The calculation would have been simple if they were aware of the basic idea that the volume ratio is the same as mole ratio.

(b)(i) The most frequent responses were as follows.
$2C_3H_8 + Cl_2 \rightarrow 2C_3H_7Cl$
$2C_3H_8 + Cl_2 \rightarrow 2C_3H_7Cl + H_2$
Rather than the correct version:
$C_3H_8 + Cl_2 \rightarrow C_3H_7Cl + HCl$

(ii) A popular, but incorrect, answer was addition. The reaction was not universally recognised as substitution.

(c)(i) Candidates continue to lack a clear comprehension of the concept of isomerism, that is, different compounds that have the same molecular formula but different structural formulae. They do not have to possess the same functional group, and neither are they different forms of the same compound. The phrase 'molecular formula', is essential, and 'chemical formula' is not acceptable.

This explanation of isomerism had to relate to the two propanols before three marks could be awarded. Many of the attempts to draw the two structures represented rotations of the structure of propan-1-ol.

(ii) 'They have different boiling points' is a complete answer. There is no need to qualify it with comments such as 'boiling points close together' or 'less than 40ºC apart'.

(iii) Few candidates could recall either potassium dichromate(VI) or potassium manganate(VII).

(iv) Most could name an ester, ethyl ethanoate and propyl propanoate being the favourite choices. The difficulties were to draw the structure of the named ester or the representation of the ester linkage.

(d)(i) Cracking and one other valid point were required. This could be selected from the following.

- heat
- catalyst or silica or aluminium oxide
- details of chemistry, such as forms shorter alkane and alkene.

Candidates tended to repeat the information given in the question without addressing the technique of cracking i.e. 'remove hydrogen by heating with sulphur'.

(ii) Alkenes do not ferment to form alcohols, and hydrolysis and hydration are not the same. The comment that propene was hydrated by heating with steam/water in the presence of a catalyst, represents a pleasing answer. Many candidates gave the precise reaction conditions, i.e. 300ºC, 60 atmospheres and phosphoric acid as a catalyst. The standard was higher in this part than in **(i)**.

Question 4

(a)(i) Burn, heat in air and add acid were frequent, but inappropriate, suggestions of how to obtain zinc oxide from calamine.

(ii) A proportion of candidates gave precise and accurate descriptions of the type 'heat zinc blende in air to make zinc oxide, this could be reduced by carbon or carbon monoxide to zinc'. Others were distracted by unnecessary detail and described the concentration of the ore by flotation or the use of a blast furnace. Other errors were to suggest that carbon could reduce zinc blende or that molten zinc blende could be electrolysed.

(b) The marking points were as follows:

- hydrochloric acid
- excess zinc oxide
- filter to remove excess zinc oxide

Incorrect methods included the following:

- the use of any chloride
- react zinc oxide with chlorine
- electrolysis of zinc oxide
- titration with a burette and indicator

(c)(i) This was well answered. The most popular response was brass, closely followed by bronze. The latter contains up to 2.5% of zinc, so it was accepted.

(ii) Having chosen a correct alloy in **(i)**, the majority could then name the second metal in the alloy.

(d) The following misconceptions still persist. Steel does not rust because it is an alloy, the carbon content protects it. Zinc can rust; it cannot, only ferrous materials can rust, others corrode. The steel had been painted or it was stainless steel.

There were many pleasing explanations. The most basic of these included the three points.

- Zinc is more reactive than iron.
- It will react with water and oxygen.
- It will react with water and oxygen in preference to iron.

They progressed in sophistication up to those based on electron transfer, redox and cell Chemistry. A significant proportion of the candidates are to be commended on their grasp of the underlying concepts. The following is a high level explanation of sacrificial protection.

- Zinc is the anode.
- Electrons move from zinc to iron.
- Iron cannot be oxidised by electron loss as it is receiving electrons.

(e)(i) The required equation was as follows:
$Zn - 2e \rightarrow Zn^{2+}$ or $Zn \rightarrow Zn^{2+} + 2e$
Incorrect versions were at least as common as the correct one.
$Zn^{2+} + 2e \rightarrow Zn$
$4OH^{-} - 4e \rightarrow O_2 + 2H_2O$
$2H^{+} + 2e \rightarrow H_2$
$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

(ii) The obvious and correct idea is to increase the separation of the two metals in the reactivity series by using a copper electrode instead of an iron one, or magnesium instead of zinc. It was essential to be precise, for example, 'use a copper electrode', was not awarded the mark. Sensible predictions were accepted, such as 'increase concentration of acid' or 'use a higher temperature'.

(f)(i) The name, not the formula, of the ion was required. There were many fictitious ions and compounds involving iron.

(ii) The equation is as follows:
$O_2 + 2H_2O + 4e \rightarrow 4OH^{-}$
Strictly the above is the only correct answer, but the following had sufficient merit to be accepted.
$O_2 + 2H_2O + 2Fe \rightarrow 2Fe(OH)_2$

Question 5

(a) There was a good standard of answers and most candidates could identify the properties that related to the uses.

(b)(i) The most frequent mistake was to repeat that the bond is covalent, and not to add that it is a double bond.

(ii) There was widespread confusion between atoms and electrons – oxygen atoms are not shared. Another misconception was that oxygen did not share electrons. It does share electrons, but it does not contribute any bonding electrons.

(c) There has been a significant drop in the standard of drawing this type of diagram. More often than not, a covalent structure was represented and the charges omitted. Candidates should be advised that diagrams that show the transfer as arrows can act to their disadvantage. A variety of anomalies can arise, such as a magnesium atom still with two valency electrons, yet showing a positive charge.

One diagram that included the following points was needed:

- 2+ on Mg.
- 2− and 8e on sulphur.
- 1Mg:1S.

(d)(i) The alternatives for both marks were either 'a good proton donor' or 'completely ionised to give H^{+}'. Many of the explanations had not been given sufficient thought, such as hydrogen atoms or molecules instead of ions, and giving the characteristics of a strong acid rather than a definition.

(ii) This part was poorly answered. Water was missed out, sulphide was given instead of sulphate and carbonic acid rather than carbon dioxide and water. In this part, a symbol equation was accepted provide it was correct, but inevitably many were not.

(iii) $NaOH + H_2SO_4 \rightarrow NaSO_4 + H_2O$
This equation featured more frequently than the correct one. Word equations are not considered to be a substitute for the symbol equation.

(iv) Most of the candidates could not write this ionic equation.
$Mg + 2H^+ \rightarrow Mg^{2+} + H_2$

Many offered the molecular version, which, if correct, gained partial credit. The word equation was not awarded any marks, and neither were the following.
$Mg^{2+} + SO_4^{2-} \rightarrow MgSO_4$
$Mg^{2+} + H_2SO_4 \rightarrow MgSO_4 + H_2$

Paper 0620/04
Coursework

General comments

Coursework samples from three Centres were received.

The samples were well organised and many good and interesting examples of tasks were in evidence. Students generally had good opportunities to demonstrate their skills over the range of levels, and clear marking criteria together with clearly annotated work made moderation straightforward in the majority of cases.

As in previous years, it was noticed that in a minority of examples inappropriate marking criteria were used, and elements of C2 and C3 criteria cropped up in C4 tasks and some C2 criteria were included in a C1 task.

There were examples this year of students' work which showed no signs of marking and tasks for which no mark scheme had been provided. This makes the job of moderation virtually impossible without some form of remarking by the Moderator. This process is likely to disadvantage students.

Some of the tasks used this season are listed:

C1
destructive distillation of wood
making esters
qualitative analysis
rate of reaction

C2
rate of reaction
simple ebulliometry
qualitative analysis

C3
reaction rate studies
thermochemistry
simple ebulliometry

C4
factors affecting electrolysis
reaction rate studies
factors affecting rusting
ease of decomposition of carbonates

Paper 0620/05

Practical Test

General comments

The majority of the candidates successfully completed both questions. Candidates scoring low marks did not follow the instructions. A few Centres did not include Supervisor's results.

Comments on specific questions

Question 1

The observations from Experiment 1 were often correctly given.

(a) The main errors in this part were incorrect reading of the *y* scale, and joining the points rather than drawing a best fit straight line. The completion of the table of results was correctly completed by the majority of candidates.

(b) This part was generally answered well.

(c) Some candidates were confused and used the term 'endothermic' in this part.

(d) A common error in this part was to give the experiment in which the temperature increase was greatest over the last result, which was usually Experiment 2.

(e) This was a good discriminating question. Many vague answers lacking details were evident. The commonest correct answers referred to insulation.

Question 2

(a) Some candidates described the crystals as blue, and some described the solution.

(b)(ii) The pH indicator paper needs to be damp to correctly perform the test in this question. Some candidates used litmus paper.

(c) The answer 'clear' was often given, instead of 'colourless'.

(d)-(f) These parts were generally answered well.

(g) Copper and iron(**III**) were common incorrect answers to this question.

(h) The quality of answers to this question varied from Centre to Centre, and thus it was a good discriminating question. In part (i), nitrate was a common incorrect answer.

Paper 0620/06

Alternative to Practical

General comments

The majority of candidates attempted all of the questions. The complete range of marks was seen. There was evidence that some candidates had not done sufficient practical work to be prepared for this essentially practical paper.

<u>Comments on specific questions</u>

Question 1

The burette was often labelled as a measuring cylinder. The use of a named indicator and reference to colour change in **(b)** was a good discriminating question.

Question 2

The quality of the answers depended on the Centre. Some candidates guessed the answers and referred to copper throughout the question. Silver chloride was a common answer in **(c)**.

Question 3

Part **(a)** was generally well done. Spoon was a common answer in **(c)** and lack of factual information was common in **(d)**. The purpose of the airlock in **(e)** was not well known. “To prevent gas escaping” was a common incorrect answer. Part **(f)** was a good discriminating question. In **(f)(i)** 0 to 3 days was a common answer.

Question 4

The table was generally correctly completed. A straight line graph was rare in **(b)** and endothermic was common in **(d)**. In **(e)(ii)** reference to more magnesium with an explanation was rare. Vague answers lacking detail were common in **(f)**.

Question 5

The quality of answers varied widely according to the Centre. Well-prepared candidates scored full marks while others guessed observations and scored little credit.

Question 6

A good discriminating question. Many candidates did not read the stem of the question, which asked the candidates to ‘plan tests’. A lot of candidates just guessed answers to the questions. For example, in **(a)** candidates gave a number between 0 and 14 instead of mentioning the use of universal indicator paper and a colour chart to record the pH.

In **(b)** chromatographic methods were often correctly described. In **(c)** only the better candidates used a method involving displacement of water in e.g. a measuring cylinder. Numerous methods that would not work involving gas syringes received no credit.

In **(d)** methods involving lighted splints were penalised.