CONTENTS

CHEMISTRY

Paper 0620/01
Multiple Choice

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

General comments

The candidates achieved a mean mark of 28.3 with a standard deviation of 7.3. This latter is a little higher than has commonly been the case. The reliability coefficient was also very good. These statistics show that the paper was very successful in spreading candidates across the mark range. Indeed, because the individual questions also performed well, relatively little comment is called for on them. Where such comment is made, attention is focused on the performance of lower-scoring candidates.

<u>Comments on specific questions</u>

Question 6

This proved to be marginally hard overall but with very good discrimination. Response **D** was the most popular choice amongst the lower-scoring candidates. Perhaps such candidates did not fully appreciate the fact that the question relates to ions and not atoms so that they needed to identify the nearest noble gas configuration.

Question 9

This was found quite easy but the relative popularity of each of responses **A**, **B** and **C** amongst the lower-scoring candidates suggests that about a quarter of them merely guessed.

Question 17

This was found easy with a slightly weak discrimination. Even so, it is somewhat surprising that as many as 10% of the lower-scoring candidates chose response **D** – apparently ignoring that the acid was cold.

Question 18

This also had a slightly weak discrimination. Across the ability range, response **A** was rather popular despite the bromide ion being colourless. Some 10% of the lower-scoring candidates chose **D**, which suggests they may have been confused between bromine and chlorine.

Question 22

This proved to be on the demanding side. Over half of the lower-scoring candidates – and even a quarter of their higher-scoring co-examinees – chose response **B**. The syllabus refers to the precipitation of barium sulphate as the test for sulphate ions so that this aspect was the part of the question that candidates needed to think about more fully.

Question 27

This had a facility a little on the low side. This is accounted for by the fact that the lower-scoring candidates found responses **B** and **D** equally attractive. The syllabus refers to the use of mild steel in making car bodies and cars do rust!

Question 28

This was answered correctly by only a third of the candidates. In essence the question was testing understanding of the reactivity series and it is surprising that two fifths of the lower-scoring candidates chose sodium!

Question 30

This proved to be the hardest question on the paper although the question is not thought to be intrinsically at all difficult. Nevertheless, response **C** was overly popular across the ability range. This may be an example of insufficiently careful reading of the question.

Question 35

This was found to be slightly hard but with very good discrimination. Over half of the lower-scoring candidates chose response **B** – but where does the hydrogen for the alleged product water come from?

Question 40

This was marginally hard and had a relatively weak discrimination. It seems that, amongst the lower-scoring candidates, some merely guessed if they did not know the correct answer. On the other hand, it is surprising that 16% of the higher-scoring candidates chose response **A**. The two major products of cracking are explicitly mentioned in the syllabus.

Paper 0620/02

Paper 2 (Core)

General comments

It is encouraging to note that the standard of answers seen by the Examiners showed a slight general improvement over those seen in last May's examination. Many candidates tackled the paper well and many good answers were seen, especially at the beginning of the paper. There were fewer blank spaces compared with previous sessions and nearly all the candidates tackled each part of every question. However, many candidates exhibited a less than thorough grasp of the subject matter. Some quite straightforward questions e.g. the test for hydrogen and the products of combustion of hydrocarbons, proved difficult for candidates. This has been commented on in previous Principal Examiner Reports. In general, the rubric was well interpreted but a few candidates still failed to distinguish the difference between a word equation and a symbol equation. A small number of candidates also failed to respond to the questions involving drawing molecular arrangements or where the request was to put a ring around the correct answer. It seems that many of these candidates fail to respond because they rush through the paper looking for the next available space to write an answer. Another mistake in reading the rubric was in **Question 5 (b)**, where a minority of candidates responded by inserting the temperatures in the table rather than the state. The standard of English was generally good. Although most candidates had a good knowledge of basic chemical structures many were found to have a poor knowledge of organic chemistry (**Question 4**). There were fewer instances in this particular paper where candidates disadvantaged themselves by giving multiple answers and it is encouraging to note that most candidates confined themselves to a single answer when requested. It was encouraging to note that the majority of the candidates showed a good ability at balancing equations especially when the formulae were given. A considerable number of candidates appeared to have difficulty in explaining electrical conduction in ionic solutions (**Question 5 (e)(iii)** and **6 (b)(ii)**). This follows the general pattern from Paper 2 in previous years. Tests for gases and ions were not particularly well known, the test for copper ions proving a stumbling block for some candidates. Candidates often disadvantaged themselves by sloppy and non-specific writing. For example, it is not good enough to write that a use of petrol is 'cars' (**Question 4 (e)(iii)**). Some idea of its use as a fuel (in cars) was necessary. As in previous examinations, few candidates explained terms such as compound or cracking in a convincing way. It was encouraging to note, however, that the candidates' answers to questions about molecular movement showed an improvement compared with previous sessions.

Comments on specific questions

Question 1

This question was one of the best answered in the paper, most candidates scoring at least six marks. The definition of the word 'compound', however, was poorly understood. This has been noted in previous Principal Examiner Reports.

(a)(i) Most candidates correctly identified methane, the most common error being to give response C, which was a different hydrocarbon.

(ii) This was generally answered correctly but a common mistake was to give the answer E and A. A few candidates wrote down E only and did not identify the ionic structure as being a giant structure.

(iii) This part was invariably answered correctly.

(iv) Most candidates identified B as being an ionic structure.

(v) This was the least well answered in part **(a)**. The incorrect combinations E and A or E and C were those most commonly seen. This reinforces the comment in part **(ii)** above about candidates not appreciating the properties of ionic structures.

(b)(i) Most candidates responded correctly to this question. Carbide was the commonest error seen. Few candidates put lead or poly(hexane).

(ii) Many candidates gave a correct response. Carbon monoxide and coke were the most frequent incorrect responses.

(c) About 60% of the candidates responded correctly to this part. Common errors were to just count up the number of ions and give the answer $Na_{10}I_{10}$, to put 10 in front of NaI, to show the ions being separated (e.g. $Na^+ + I^-$) or even to write Na*Cl*.

(d) This was very poorly answered, the necessary but not sufficient condition of two elements being as far as most candidates could get. The idea of bonding or joining the elements together was usually absent. Many candidates disadvantaged themselves by stating that a compound was a mixture of elements.

Question 2

Many candidates scored well in this question, marks of 8 or 9 out of 12 being common. However part **(g)(i)** proved difficult for most candidates and a wide variety of incorrect answers were seen here. In part **(d)** surprisingly few candidates knew that methane was the main constituent of natural gas.

(a) Most candidates realised that the water needed to be filtered. Only a few suggested decanting the water or distilling it. The latter would also remove the soluble salts from the water.

(b) Although the correct answer of 'litmus turns red' was given by most candidates, answers such as goes orange or yellow were not infrequently seen. This suggests that these candidates are confusing Universal Indicator paper with litmus paper.

(c)(i) Most candidates obtained the mark here but iron or copper were not infrequent incorrect answers.

(ii) Most candidates obtained the mark here, the most common error being 'steam'.

(iii) This was invariably correct.

(iv) Although most candidates identified natural gas correctly, a few did not read the question properly and wrote the first fuel that came into their head. Thus 'hydrogen' was occasionally seen.

(d) The correct answer, 'methane' was usually given, although a small proportion of candidates insisted on 'hydrogen'. The responses 'butane' and 'hydrocarbon' were also seen.

(e) The boiling point of water was usually correctly identified but a few candidates were penalised because they omitted the Celsius symbol.

(f)(i) Although many candidates obtained the mark for 'calcium' here, the response 'carbonate' was often seen through a misreading of the question.

(ii) Few candidates gained the mark for balancing the equation with a single electron. Common errors were to put the symbol e^+ or to balance with two electrons. Many failed to grasp that electrons were required for the balance and wrote Na^- or other strange combinations in the space provided.

(g)(i) The products of combustion of hydrocarbons was not well known. This is surprising, since it is a fairly straightforward idea that carbon burns to carbon dioxide and hydrogen burns to water. The most common error was to write carbon dioxide and hydrogen. The answer 'carbon and hydrogen' was not infrequently seen. All this suggests that some candidates do not understand the meaning of the word 'combustion'. Many candidates also seem to think that the word heat should be included in a chemical equation. This was not marked incorrect on this paper but candidates should be reminded that heat is not a substance and hence cannot be balanced as part of the equation.

(ii) Most candidates realised that carbon monoxide was formed by incomplete combustion of hydrocarbons. This was despite the fact that many of them gave incorrect answers to part **(g)(i)**.

Question 3

This question proved to be a good discriminator. As expected, many candidates had difficulty in explaining the process of diffusion in part **(e)** and the other questions provided a wide range of answers.

(a) The diagram of the gaseous state was well drawn by most candidates. Only a few candidates drew the liquid state. Candidates should also be advised to draw molecules in the gaseous state well apart i.e. not nearly touching. The most common loss of marks however, was the inability of some candidates to understand what the question was asking: diagrams of the *structure* of ammonia were sometimes seen.

(b) Although the correct answer (pH9) was generally seen, many candidates thought, incorrectly, that ammonia was a weak acid. Hence pH6 was a common error.

(c)(i) The correct formula for ammonia was invariably seen. Incorrect responses included N3H and 3NH.

(ii) Many candidates knew that the bonding in ammonia was covalent. The variety of spellings of this word, however, was legion. Although the Examiners accepted a wide variety of spellings, candidates should be advised that Examiners in the future may not always accept incorrect spellings of specific chemical terms such a 'covalent'. Common errors included 'bonding between non-metals' and 'ionic bonding'. The latter shows that such candidates do not understand the meaning of the bonding lines.

(iii) Few candidates gained this mark. The answer 'ammonia has weak bonding' was frequently seen but this was not accepted because it implies that the weak bonds are between the atoms in ammonia rather than between the molecules. The Examiners suggested that many candidates had an idea about the correct answer but could not express themselves well enough. Typical incorrect answers were: 'there is weak bonding between the nitrogen and hydrogen atoms', 'because it is a gas and gases have low boiling points' and 'ammonia is less dense than air'.

(d)(i) Most candidates chose sulphuric acid as the correct acid to make ammonium sulphate. The commonest error was to choose hydrochloric acid.

(ii) Although many candidates gained the mark for the third important element in fertilisers, a common error was to suggest sodium instead of nitrogen. Some candidates inverted the answers, putting 'soil' in the first space and 'nitrogen' in the second. A common incorrect response instead of 'soil' was 'water'.

(e) Most candidates scored a mark for the word 'diffusion'. However, few could explain diffusion adequately in terms of movement of molecules. Many candidates were content to suggest that the ammonia molecules moved from high to low concentration. This is incorrect Science: it suggests that the molecules only move in that direction rather than randomly. The former answer is only correct in the context of bulk flow. It was encouraging to note that many candidates gained the mark for 'random movement of molecules'. Fewer gained the mark for an understanding of evaporation. A considerable number of candidates suggested, incorrectly, that ammonia reacted with the air molecules or that the air molecules helped their movement in some way.

(f)(i) Nearly all candidates gained the mark for 'from the air'. Of those who failed to gain this mark, the commonest response was 'from the ammonia'.

(ii) The equation was invariably balanced correctly, the commonest error being to balance with 4 (NO_2).

(iii) Most of the candidates recognised a reversible reaction, although a few suggested merely that the symbol was an 'equals sign'.

(iv) Only about half the candidates gained the mark for recognising the signs of an exothermic reaction. Common errors were to suggest that the glowing spiral shows that 'oxidation is happening', 'the reaction goes very fast' or that 'the catalyst speeds up the reaction'.

Question 4

This was the lowest scoring question on the paper by far. Many candidates struggled to gain four marks. Previous Principal Examiner Reports have commented on the lack of knowledge of many candidates in terms of organic chemistry. This is clearly an area which candidates need to revise more thoroughly. In part **(d)** cracking was often confused with changing polymers to monomers and in part **(e)** many candidates had no idea of the theory behind petroleum distillation. It was often confused with cracking, simple distillation or even the blast furnace!

(a) Few candidates selected the correct answer (monomers). This may have been because this sort of question usually focuses on the product of the reaction rather than the reactants. Most candidates drew the circle round the word 'polymer'. The response 'alkanes' was also often seen.

(b) Many candidates failed to give sufficient details to obtain a mark. The response 'contains a single bond' is not sufficient. Ethene also contains single (C–H) bonds. The correct response must include reference to the C–C bond or imply it e.g. 'all the bonds are single bonds'/'does not have a double bond'.

(c) Many candidates drew ethane rather than ethene. Even when a C=C double bond was present, many candidates penalised themselves by putting 3 hydrogen atoms on each carbon atom or 3 on one and one on the other.

(d)(i) This was poorly answered. Common errors were to suggest that *elements* were broken up, that separate fractions were formed or that polymers were changed to monomers.

(ii) Although many candidates realised that heat was required, there were many vague answers involving pressure on its own, the 'right' temperature or the presence of a catalyst alone.

(iii) This was the best scoring part of this question, about two-thirds of the candidates gaining the mark. The most common incorrect additions resulted in either C_6H_{14} or C_8H_{20}.

(e)(i) This was very poorly done compared with part **(d)(iii)**. This was surprising because the process is similar. The most common mistake was to write CH_2 rather than H_2. Other incorrect variation included C_2H_6 and 2H, the latter being more understandable.

(ii) This was poorly done, few candidates scoring more than a single mark. The most commonly scored point was mentioning the different boiling points of the various fractions. The process was often confused with cracking, simple distillation or even the blast furnace! Many candidates suggested that the highest temperatures were at the top of the column. Few candidates mentioned temperatures at which the fractions condensed or only loosely implied a temperature gradient in the column.

(iii) The use of petrol was usually known, although many candidates lost the mark through giving too vague an answer such as 'cars' rather than 'a fuel for cars'. The use of the lubricating fraction was less well known. Many candidates muddled it with bitumen and suggested that it was used for road surfaces.

Question 5

This was a reasonably high-scoring question, with many candidates scoring at least half of the marks. A considerable number of candidates performed badly on part **(b)**, sometimes through not reading the question properly.

(a)(i) Not many candidates scored the mark for 'diatomic', many answers being spoiled by 'contains more than one atom'.

(ii) Most of the candidates gained the mark for explaining the word 'state'. A considerable minority however, failed to gain the mark by merely stating one or two of the states.

(b)(i) The states of the halogens at room temperature were not particularly well known. Many candidates only got one of the three different states correct and hence failed to get the marks. Common errors were to suggest that bromine is a gas and iodine is a liquid. These errors may arise through: the candidates seeing bromine in vapour form and the common use of solutions of iodine in the laboratory. A considerable number of candidates put figures in the last column even though they answered part **(a)(ii)** correctly. The figures did not often seem to relate to anything in particular but some seemed to match the boiling points even though these were shown in the third column. This seems to be a case of these candidates not reading the question carefully enough.

(ii) A majority of the candidates wrote an acceptable red or brown as the colour of bromine. A few thought that bromine was green or blue in colour. Combinations such as reddish-green are unacceptable. Purple was also often seen – muddled with iodine vapour?

(iii) Boiling points below $100^{o}C$ were the common type of error here. Most candidates could suggest a possible figure within the quoted range. A number of candidates stated that iodine sublimes (at standard pressure). This is not true – it only appears to if the rate of heating is too great. The melting point of iodine is 387K and boiling point is 457K.

(c) Only about half the candidates could complete the equation. Typical mistakes were 'iodide' in place of 'iodine', 'potassium chlorine' instead of potassium chloride and breakdown into the various elements. Many candidates thought that hydrogen gas was given off, even though there was no hydrogen in the reactants!

(d)(i) Very few candidates scored the marks here. This was because they did not read the question properly. Most of them drew a chlorine atom rather than a chlorine molecule.

(ii) The use of chlorine in swimming pools or for water purification was generally well known.

(e)(i) This was surprisingly badly done, many candidates opting for the incorrect response 'B', perhaps because, being a giant structure, it looks different from the other three.

(ii) Most candidates gained the mark for H–C*l*.

(iii) Many candidates mentioned ions but fewer referred to their movement. It is encouraging to note however, that fewer candidates than usual referred to electrons, molecules or particles. Note that, in this type of question, reference to electrons moving negates any reference to ions moving.

(f)(i) Although the correct answer of Period 6 was often seen, many candidates fell into the trap of confusing Groups with Periods and opted for 7 (or the name halogens). Another incorrect response which was commonly seen was 'Period 5'. This may arise from the fact that the candidates count down the Periods from fluorine, forgetting that H and He form Period 1.

(ii) The proton number of astatine was invariably correct.

(iii) The responses to the definition of an isotope did not seem to be as accurate as in previous examination sessions. Many candidates muddled isotopes with isomers or thought that it was the number of electrons which differed. Some candidates failed to gain the mark because they suggested that 'the number of neutrons *and* protons is different'. This may reflect a problem with these candidates' English. Neutrons plus protons would be marked correct because this is the same as the mass number but the former may suggest that the number of protons differs as well as the number of neutrons. The Examiners cannot guess what is in the candidates' minds.

(iv) About two-thirds of the candidates gained the mark for the number of neutrons (125) but a surprising number wrote down other numbers even though they responded correctly to part **(f)(iii)**. The number 2.5 was occasionally seen (obtained through dividing the atomic mass by the atomic number?).

Question 6

This proved to be a low scoring question with few candidates obtaining more than 5 marks of the thirteen available. The test for copper ions was not well known and even the comparatively easy test for hydrogen proved to be a stumbling block for many.

(a)(i) The equation was very badly done with hydrogen sulphate being the norm for one of the reactants despite the name sulphuric acid appearing in the stem of the question. Water was commonly seen as a product in place of hydrogen. This must be due to candidates not looking at the equation but thinking of some other perceived pattern for acid + metal oxide. The other incorrect product often seen was iron sulphide in place of iron sulphate. Candidates often mistake –ates for –ides and this is something that needs to be addressed, especially with lower ability candidates.

(ii) As commented on in previous Principal Examiner Reports many candidates think that the test involves a glowing splint or that the splint is relit.

(b)(i) All four possibilities were chosen by the candidates with the correct answer (cathode) being chosen by about half.

(ii) The question on the purpose of the copper sulphate in electroplating proved to be a good discriminator. Many candidates gave vague answers relating to electrons rather than ions. A large number of candidates gave answers relating to rates of reaction e.g. 'speeds up the reaction'. This may be due to the fact that the candidates have taken the question out of context. They knew that copper ions are catalysts for some reactions and hence gave this answer here as well.

(iii) Many candidates thought that the size of the iron electrode decreased and the copper increased. Candidates should be advised to look at the information in the diagrams as well as use their knowledge of positive and negative charges attracting. Some just mentioned electrons and ions out of context and the incorrect answer 'copper is coated with iron' was commonly seen.

(iv) Many candidates referred to electrolysis, rather than giving a chemical test. The mark most often missed was for the observation with excess hydroxide or aqueous ammonia. Many of those candidates who used the aqueous ammonia test thought that the precipitate did not re-dissolve. The most common error in the description of the colour of the precipitate was to suggest that it was orange or brown. This is clearly an indication that these candidates were thinking of the colour of copper.

(c) This was poorly done with many candidates just referring to the properties of chromium such as 'conducts electricity' or 'is hard' or general properties of transition metals. The point that the metal was being *plated* with chromium was lost on many. Many candidates thought that chromium was cheap. The answer 'chromium does not react' was frequently seen. This is despite the fact that part **(d)** indicates that it does react. The answers 'less reactive than…' or 'less easily oxidised' were acceptable answers.

(d) About 60% of the candidates were able to put the three metals in the correct order of reactivity. The most common errors were to invert the order completely and to put chromium below copper. The latter was often given by candidates who gave the answer 'chromium does not react' for part **(c)**.

Paper 0620/03

Paper 3 (Extended)

General comments

The comments about specific questions include most of the pertinent points. In general terms, **Questions 4** and **6** were very well answered – many candidates achieved full marks for the latter. The pleasing performance in these questions was clear evidence that the preparation for this examination by some candidates was of a commendable standard. **Question 2** proved to be the most demanding, in particular the parts that focused on the analysis of the graphs and the ionic equation were very severe hurdles.

There were fewer cases of illegible writing or very untidy work, still future candidates might be advised – what cannot be read cannot be marked. It was pleasing to note that candidates who used the blank pages at the end of the paper usually gave a clear reference in the question to this extra work.

No matter how many times the comment has been made in these reports, candidates persist in trying to improve the answer by offering additional comments. If these are correct – no problem, but if incorrect they may prevent the award of the mark.

Comments on specific questions

Question 1

(a)(i) Darker or actual colours were required for the mark. Deeper was not accepted, it does not necessarily mean a different colour, for example – deeper red is still red.

(ii) All three physical states were needed – gas, liquid, solid. The most frequent error was to omit "liquid".

(iii) Most knew that fluorine was a colourless or pale yellow gas. Some candidates described fluorine as white.

(b) A wide range of reagents was suggested – silver nitrate, lead nitrate, bromine, potassium dichromate, potassium manganate(VII) etc. Electrolysis was a sensible suggestion, the colour at the anode would identify the halide. Easily the most popular reagent was silver nitrate and many candidates gained all three marks. Silver bromide is not white, off-white, cream or very pale yellow are all acceptable. Lead(II) nitrate was offered by some candidates, the award was usually 2/3, they were not familiar with the colour of lead(II) bromide, not surprisingly as only the iodide is specified in the syllabus. Finally bromine featured on a number of scripts with correct comments of the type – with bromide it stayed brown and with iodide it turned a much darker brown or grey/black crystals of iodine formed.

There was some confusion between halide and halogen and consequently an alkene was incorrectly believed to be a suitable reagent.

(c) The equation is: $I_2 + 3Cl_2 = 2ICl_3$.

The majority of those who realised that there were 3 moles of Cl_2 and 2 moles of the product could not deduce its formula. The usual award was either 0/2 or 1/2. The most common incorrect equations were: $I_2 + 3Cl_2 = 2ICl$ and $I_2 + 2Cl_2 = 2ICl_2$.

(d) The mark allocated to this question was changed from 2 to 3 to reflect the differing quality of the candidates' responses. The marks were awarded as follows:

chlorine		[1]
reason	it is the lighter gas or using A_r instead of M_r	[1]
better reason	it has the lower M_r or lower density or lighter molecules or its molecules move faster	[2]

The usual errors persist – chlorine molecules are smaller without adding "in mass" and the completely erroneous "sieve theory" of diffusion.

Question 2

(a) This ionic equation proved to be a very severe challenge. It was very rare to find the correct answer: $Zn + I_2 = Zn^{2+} + 2I^-$.

A sample of the failed attempts would include the following:

$Zn + 2I^- = ZnI_2$

$Zn + 2I^- = Zn^{2+} + I_2$

$Zn^{2+} + 2I^- = Zn + I_2$.

(b) Generally very well answered. The observations with sodium hydroxide are:

white precipitate

dissolves in excess.

The same results are given by aqueous ammonia and zinc ions.

Most of the candidates were awarded 2/3 or better.

(c)(i) Zinc was usually named as the reagent in excess but the award of the mark required a valid reason for the choice – the mass of the zinc does not fall to zero. The mass of the zinc falls to a constant value was a popular but incorrect reason. This would happen if the iodine was in excess and the mass of zinc would then have a constant value of zero.

(ii) The comment had to relate to the shape of graph 1. The final mass of zinc would be bigger or less zinc was used up.

For the second mark, the gradient was less steep, a longer time was taken for the mass to change or the mass falls more slowly.

There was a widespread belief that $0.05 mol/dm^3$ iodine was more concentrated than $0.1 mol/dm^3$ iodine.

(iii) The sketch had to show a steeper gradient and same loss of mass of zinc. It was not necessary to show that at the higher temperature the reaction would be complete in less time.

Despite the clear instruction in the question to sketch on graph 2, many answered the question in the blank space at the bottom of the page.

There could not be a comparison between the two graphs so 0/2 was the usual outcome.

Question 3

(a)(i) CH_3-CH=CH_2.

Errors were:

- omitting the hydrogen atoms
- giving the formula of either ethene or butene
- CH_3-CH_2=CH_2
- including silver atoms in the structure.

(ii) The marking points were the correct repeat unit and evidence of continuation.

$–CH_2–CH(CH_3)$ –

The most common mistake was to draw the following structure: $–CH_2–CH_2–CH_2–$.

Those who included silver in the monomer usually incorporated it in the polymer.

(iii) Well answered. The monomer reacted with bromine water because it has a double bond, it is unsaturated or it is an alkene.

(b)(i) The mixture was filtered to remove the fibres or to remove the solid but not to remove unreacted silver, the precipitate or impurities.

(ii) A pleasing standard of explanations – because silver atoms have lost electrons or the oxidation number of silver has increased.

(iii) Silver chloride is the correct name of the precipitate. Silver nitrate, sodium nitrate and sodium chloride were all given.

(c)(i) To be awarded both marks the correct name and formula had to be given. Popular choices were ethyl ethanoate, methyl methanoate, methyl ethanoate and terylene. Creditably some higher esters, propyl propanoate and propyl butanoate were correctly named and their structures drawn.

The names "fats" and "polyesters" were not accepted but the formula mark was still available.

(ii) To complete the word equation – alcohol or alkanol was needed. A named alcohol, ethanol, was not awarded the mark. Common wrong suggestions – hydrogen and fats.

(d)(i) The marking points were:

an acid loses a proton [2]

a base accepts a proton [1]

or a similar explanation – an acid loses a hydrogen ion [1]

and base gains hydrogen ion [1]

There were many errors mainly as a result of inadequate or incorrect terminology:

an acid is a hydrogen donor

an acid donates a hydrogen atom

a base gives OH^- ions

an acid contains hydrogen ions – it does not, in the acid there are hydrogen atoms covalently bonded, the acid loses H^+ when the base donates a non-bonding pair. It is not anticipated that this is taught. All that is needed is that an acid loses (or gives) to base, preferably a proton or failing that a hydrogen ion.

(ii) Weak acids are partially ionised or poor proton donors. This featured on about half of the scripts, equally as common was a mistaken perception that only weak acids can have a high, but still, acidic pH, for example a solution of a weak acid will have a pH = 5 or 6. Another variation on this theme is that weak acids do not form many hydrogen ions when dissolved in water or that the $[H^+]$ in an aqueous weak acid is low. Obviously these statements can be true but they can also be true for a strong acid e.g. 0.00001M HC*l*.

Question 4

(a)(i) The majority gave a correct word equation.

(ii) Usually answered correctly. The mistakes were lead(II) nitrate or silver nitrate instead of a soluble barium salt. Some descriptions were spoilt by acidifying with sulphuric acid.

(iii) The marking point was that the water has low pH or universal indicator turns red. The most common response was to describe the test for hydrogen gas. Other errors were to suggest the use of litmus paper or simply to state that the pH was less than 7. This was one of the lowest scoring questions on the paper.

(b)(i) $H_2S + 2O_2 = H_2SO_4$.

The above equation was on most scripts.

(ii) The following range of explanations was accepted:

- unpleasant smell
- it is poisonous
- when burnt forms acid rain
- a specific effect of acid rain
- forms sulphur dioxide or trioxide
- forms sulphuric acid.

Candidates confused hydrogen sulphide with the element hydrogen – "it would explode".

(iii) A very high standard of diagrams, no doubt assisted because the molecular formula was given on the previous page.

(c)(i)(ii) Both parts were well answered.

(iii) The perennial mistake – add sulphur trioxide to water. Some offered two versions the water route then concentrated sulphuric acid followed by reaction with water method. They would be well advised to give just the latter.

(d) moles of $CaSO_4$ in 79.1g = 0.58

moles of H_2O in 20.9 g = 1.16

$x = 2$ *x* given as an integer

Usually this calculation was correct. A few could not determine *x* from the number of moles and quoted 0.5.

Question 5

(a)(i) A is glutamic acid

B is alanine

Mistakes appeared to be caused by taking measurements from the initial level of the solvent. This explains why glycine, $R_f = 0.5$, featured on some scripts.

(ii) All that was required was one of the following:

- the acids are colourless
- to make them visible
- to show positions of the samples
- to show the distance travelled by the sample.

To measure the R_f values merely repeated the question. The samples were referred to as proteins, sugars and dyes.

(iii) Very few could give an appropriate suggestion that is to compare with known acids or from the colours of samples. In reality the colours would be very similar but this was accepted as a sensible suggestion.

(iv) Many good answers were seen. The structural formulae were marked as follows:

amide linkage [1]

different monomers [1]

continuation [1]

(accept hydrocarbon part of chain as boxes as shown in the syllabus)

If nylon 6 then only one monomer *not* different monomers.

(b) The structure was usually correct that is as in the syllabus (box representation):

correct linkage --O--

continuation

The most frequent errors were not to indicate continuation, draw a polyester and draw a peroxide linkage –O-O-.

(c)(i) $C_6H_{12}O_6 = 2C_2H_5OH + 2CO_2$

Many gave the above, others did not balance it and omitted the final "2".

The following appeared on a number of scripts:

$C_6H_{12}O_6 = C_5H_{12}O_4 + CO_2$.

(ii) Usually correct. The essential idea is that the reaction gives out energy.

(iii) Either of the two marking points was accepted:

- all the glucose used up
- yeast "killed" by ethanol.

The following were not accepted either because they are wrong or lacking detail:

- yeast is used up
- yeast and glucose are used up
- the reagents used up
- the yeast is "killed"
- high temperature denatures the enzymes
- the concentration of the glucose is reduced.

(iv) When oxygen is present yeast will respire aerobically to form ultimately carbon dioxide and water not ethanol. It can oxidise any ethanol formed to ethanoic acid. Anaerobic respiration will only occur in the absence of oxygen. The award of the mark depended on the inclusion of one of the above ideas.

(v) "Fractional distillation" was rare. Distillation, add more glucose, evaporation, dehydration and adding more ethanol were the typical mistakes.

Question 6

(a)(i) Bauxite was given on most scripts, errors were haematite, alumina and cryolite.

(ii) To reduce melting point, to improve conductivity, as a solvent or to reduce the working temperature are the reasons for the inclusion of cryolite. Prevalent errors – to reduce the melting point of aluminium and to reduce the boiling point of the ore.

(iii) The gases are carbon dioxide, monoxide and fluorine. Hydrogen was mentioned frequently.

(b)(i) Aluminium is the more reactive. Some candidates misunderstood the question and referred to the list at the top of the page.

(ii) Generally a pleasing standard of responses from the candidates who emphasised what would be observed. Candidates should not expect to be awarded the mark for stating – copper formed, see equation above on the paper.

(iii) Most realised that aluminium is covered with an oxide layer. Others attributed the low reactivity to a small difference in reactivity or that aluminium had to lose three electrons.

(c) Well answered.

(d)(i) $2Al(OH)_3 = Al_2O_3 + 3H_2O$.

Incorrect versions were:

$2Al(OH)_3 = Al_2O_3 + 3H_2$

$2Al(OH)_3 = 2Al + 3H_2O$

$Al(OH)_3 = Al_2O_3 + 3H_2O$

(ii) Aluminium nitrate = aluminium oxide + nitrogen dioxide + oxygen

There has been a significant improvement compared with the last time a similar question was asked.

Paper 0620/04

Coursework

General comments

This year again few Centres required adjustments to their marks. Where marks were occasionally moderated downwards it was due to Centres failing to follow the instructions in the syllabus. Where marks were moderated upwards it was due to assessment exercises making higher demands of the candidates than is normal in most Centres. In these cases, to be fair to the candidates, their marks were increased slightly.

There were few new Centres and so most put together well organised samples of work that made the job of moderation more straightforward. Thanks go to Centres for all the hard work that clearly goes into producing these samples.

Comments on the assessment of different skill areas

C1. Most Centres have read the feedback given over the years and now both set appropriate exercises which allow for a choice to be made by candidates and include a tick list to show how marks were awarded to candidates.

C2. Some Centres seem to concentrate on the making of visual observations and some Centres concentrate on measurements. The ideal is a mixture of the two so that candidates have an opportunity to demonstrate both sides of this skill. For new Centres it is worth stressing that full marks can only be obtained if candidates decide on the format of their observations/results for themselves.

C3. Some quite complex tasks were set to assess this skill. Tasks should not be trivial but this is not an A Level and making the task too demanding can perhaps restrict an otherwise excellent candidate. Again a balance of observational and empirical tasks should be included. Certainly there should be some opportunity for the drawing of graphs and their interpretation.

C4. Three points to stress here, as this is the skill that most frequently results in candidates marks being scaled down. It is the most difficult skill but candidates can score well if the task is well designed.

- There must be variables to control (the idea of a fair test must be involved). Therefore the comparison of at least two different sets of conditions must be involved. Planning how to make a salt will not do.
- It is permissible for candidates to plan an investigation which is similar to one they have already carried out. It does not have to be ‘original research’.
- The candidates must actually carry out the investigation. Only then can they gain the marks for evaluating procedures and suggesting improvements.

Conclusion

A final plea regarding mark schemes. They should relate to the criteria in the syllabus but also to the specific practical they refer to. This not only makes them more helpful to the Moderator but also makes them more useful to the Teacher/Assessor.

The most successful Centres tend to have a relatively small number of tried and tested exercises which they use every year (though there are notable exceptions). It is not generally a good idea to have a very large number of assessments, better to concentrate on getting the best out of candidates on a few good ones.

Paper 0620/05
Practical Test

General comments

The majority of candidates successfully attempted both questions within the time allocated. A minority of Centres did not include Supervisors' results with the scripts. It is important that Supervisors' results are included. These results are used as a comparison for certain parts of the questions to facilitate the marking.

Comments on specific questions

Question 1

Some strange filling in of the table – initial and final results sometimes the wrong way round. There were some rather odd titration results. In some cases answers in **(d)** and **(e)** made it clear that the first row of the table gave the actual volumes used. Candidates need to use tables with this (normal) layout for titration results.

(a) Mostly correct but some Centres seemed to have a lot of brown samples, although the Supervisor's sheet indicated differently.

(b) Colour changes sometimes the wrong way round – often by candidates with poor titration results; there may be a connection! 'Clear' was a common error in some Centres.

(c) Generally well answered. Neutralisation was the required answer.

(d) A good discriminating question. Poor answers lacked details and merely quoted volumes from the table. A significant number of candidates referred to reactivity of acids in **(ii)**. Many candidates confused the relative concentration of the two acids and others mentioned different concentrations. Specific reference to the acid **M** being twice as concentrated as acid **N** was required. A few candidates referred to **M** being dibasic and **N** being monobasic which received credit.

(e) The unit was often omitted and a significant number of vague answers were seen e.g. about 21.

(f) A good discriminating question. Some answers referred to the procedure instead of the apparatus. Answers referring to more accurate burettes and more accurate measuring cylinders were common. The use of a pipette instead of a burette was penalised.

(g) Despite having a solution which was clearly able to react with an acid and that, at the start, had contained undissolved solid, many candidates got this wrong.

Question 2

(a) A whole range of smells ranging from 'strong' to 'sweet' and even 'no smell' were evident.

(b) It would help if Centres followed the instructions rigorously – some had clearly used litmus. All could get a mark for the colour but getting a suitable pH was not easy! pH is a number!

(c) Some interesting test results were seen for hydrogen – 'it commonly relights a glowing spill and bleaches damp litmus'. It seemed as though some candidates decided what the gas was and then put down a test and result to match. Some odd observations in **(iii)**; some solutions gave white precipitates others became colourless! Most got some marks. In **(iv)** many candidates did not get the smell (but they noted the smell in **(v)**!) A mark for colourless/no change/oily was often given. In **(v)** many candidates seemed to find that the dichromate went green – not possible and probably a case of 'I know what this reagent does so I will write that down'.

(d) Generally well-answered.

(e) Many candidates gave iron (due to green colour). The oxidation state of copper was often correct.

(f) Lots of long answers, most candidates got the 'acid' mark but many failed to use the pH value they had found to describe the type of acid. A minority claimed it was an alkali – i.e. sodium hydroxide.

Paper 0620/06
Alternative to Practical

General comments

The majority of candidates attempted all of the questions within the allocated time. A wide range of marks were seen from different Centres and within Centres. The paper discriminated well particularly with **Questions 4** and **8**.

Comments on specific questions

Question 1

(a) Mostly correct, most common error was on the stand (labelled as 'holder' or sometimes 'tripod'). Spelling was sometimes a problem e.g. clump, climp etc.

(b) Usually correct.

Question 2

(a) Many candidates missed this out, overlooked by some candidates? Some labels were vague, just sticking a couple of words next to the diagram but not indicating what bits they were labelling.

(b) The common error was to just identify the products rather than give observations. Many seemed to think molten sodium would be made.

(c) Many gave a test for chloride ions rather than chlorine. Silver nitrate solution is *not* a test for chlorine.

Question 3

The table was commonly fully correct. Most common error was in reading the 'odd volumes' where halves appeared in some answers. A few seemed to read the scale backwards – so the first syringe contained 80 cm^3.

(a) The points were often well plotted. Graph lines have improved although many simply joined the dots together.

(b) Normal error was to either misread the x scale or in a few cases to read volume hydrogen from 33 cm^3 of acid.

(c) Mostly correct.

Question 4

This question was a good discriminator. Mostly correct, although a few struggled with the burettes "upside down" scale.

(a) The main error was 'exothermic'.

(b)(i) Despite the data they had put in the table, some got this wrong.

(ii) It was surprising how many candidates gave answers that contradicted the answer given in **(i)**! Some just repeated the volumes in the table without actually comparing them. The acid concentration was sometimes given the wrong way round. Most answers were not quantitative. Some focused on the calcium hydroxide as having changed concentration.

(c) Often correct, but some got the volume wrong yet gave a correct explanation for it. Some explanations left too much for the Examiner to do for themselves, such as the phrase (on it's own) 'by cross multiplying'.

(d) Many ignored the instruction about apparatus and tried repeating the experiment. A significant number of candidates gave vague answers e.g. use a pipette/more accurate measuring cylinder.

Question 5

(b) While most got the gas test result correct, a common error was to fail to state 'bubbles' in either gas test.

(c) Often correct, although answers such as 'not very strong' and 'not very weak' were seen – better if candidates answer the question directly.

(d) Well answered, no problems.

(e) A lot claimed the cation was iron (due to the green colouration). Of those who got copper, it was rare for the oxidation state to be included in the answer.

Question 6

(a) Some confused answers (such as 'one with lots of moles in'). Reference to water was required.

(b) A huge range of pH values were given, although most got an acceptable value.

(c) Most common error was to stick the paper in the drink. Some did chromatography of the two colourings (not the drink) and some thought the substances would move sideways more than upwards.

Question 7

(a) The line was very often not drawn with a ruler, either all points were joined or an attempt at a straight line was made, but without a ruler.

(b) Having drawn a line through all points, most candidates could work out that the one at pH5 was wrong. Some interesting phrasing for the explanation!

(c) Mainly correct.

Question 8

Most candidates scored at least a few marks on this question. A fairly common error was to collect the gas until the reaction stopped and then measure the volume – not a lot of good since the final volume will be the same if the volume of peroxide is constant. A few followed mass loss (a simple method that works), but some followed mass loss while collecting the gas in a syringe – not a very good idea since nothing is lost. A large number of candidates heated the peroxide. Methods that would not work were penalised.