CHEMISTRY

Paper 0620/01
Multiple Choice

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

General comments

The statistics for this paper were very satisfactory: a mean of 27.4, a standard deviation of 6.6. These data show that the marks of the 3492 candidates were well spread. With few exceptions, the individual questions also proved to be satisfactory examination elements.

Comments on individual questions

Question 1 It is policy that the first question should be relatively easy in order that the candidates should not be 'put off'. However, this question was so easy that it did not effectively discriminate across the ability range.

Question 7 proved to be very slightly difficult but had excellent discrimination. The most popular incorrect choice was response B but such elements are metals and form ionic oxides. Amongst the lower-scoring candidates, response C was also quite popular. However, sulphur dioxide as an acidic, covalent and polluting oxide is in the syllabus.

Question 13 was found to be quite easy and did not discriminate very well.

Question 18 proved to be decidedly hard, surprisingly so, but with good discrimination. However, response B was popular right across the ability range, although it is alkali, not acid, that releases ammonia from its salts.

Question 19 was also found to be hard, with relatively low discrimination. It is disappointing that response A attracted so many candidates across the ability range. Aqueous barium ions are used to test for aqueous sulphate ions, giving a white precipitate of barium sulphate: hence key B.

Question 26 proved to be harder than expected, especially as this was, in essence, a 'recall' question based directly on the syllabus. The issues involved are resistance to chemical attack and cost.

Question 27 The lower-scoring candidates preferred response A to the key (B). Such candidates evidently did not appreciate that magnesium is sufficiently high in the reactivity series for its oxide to resist reduction by carbon.

Question 31 was unsatisfactory in that response D proved to be too attractive. This may be a matter of wording. Car fuels do contain sulphur as an impurity so that sulphur dioxide is formed as a direct result of combustion of the ***fuel***. This is not the case for nitrogen: hence, key B, not D.

Question 33 Amongst the lower-scoring candidates, response C was more popular than the key (A). This is evidence that such candidates do not realise that acetylene is a hydrocarbon (although the ending 'ene' should have provided a hint).

Question 34 The lower-scoring candidates showed a lack of knowledge of terminology in that response D was more popular than response C which, in turn, was more popular than the key (B).

CHEMISTRY

Paper 0620/02

Paper 2 (Core)

General comments

Some of the candidates tackled the paper well and good answers were seen in some parts of the paper e.g. **Questions 1** and **2** but many candidates exhibited a less than thorough grasp of the subject matter. Some quite straightforward questions e.g. the recognition of an alkane and the products of combustion of organic compounds, proved difficult for candidates. In general, the rubric was well interpreted and most candidates attempted all parts of each question. The exceptions to this were in **Question 2(c)**, where many candidates did not respond to the test for copper ions and 3(e)(iii), where many candidates left a blank space instead of drawing a diagram of chromatography apparatus. It is interesting to note that these are both practical procedures. In general, questions relating to practical aspects of Chemistry are not tackled well by candidates taking this Paper. This is reinforced by the poor responses elicited to **Question 7(c)**, which also relates to a practical procedure. The standard of English was generally good. Although most candidates had a good knowledge of atomic structure, many were found to have a poor knowledge of general organic and inorganic reactions. The concept of functional groups and homologous series seemed to be not well known. Many candidates had difficulty in remembering specific uses for particular compounds, the boxes in **Question 4(b)** often being left blank. There were few 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. However in **Questions1(b)(iv)** and **3(e)(vi)** some candidates ticked only one box when two responses were required – a case of not reading the rubric correctly. A considerable number of candidates appeared to have difficulty in explaining electrolytic processes (**Question 6**). This follows the general pattern from this paper in previous years. It was encouraging to note that the majority of the candidates showed a good ability at balancing equations when the formulae were given.

Comments on specific questions

Question 1

This question was well answered by most candidates with many scoring nearly full marks. The equation was usually balanced and good observations were made for the reaction of sodium with water. The main problems arose from rather vague definitions of isotopes and a poor understanding of the major use of uranium-235.

(a) Most candidates realised that lithium was the least reactive of the alkali metals, correctly identifying C as the answer. The most common error was to choose A. B was rarely chosen.

(b) (i) The equation was almost always correctly balanced. A few candidates put 1 molecule of water rather than 2, presumably ignoring the H in sodium hydroxide.

(ii) Most candidates scored 2 marks for correct observations. A minority of candidates, however, still insist on putting answers such as 'hydrogen is given off' or 'turns indicator solution blue'. Candidates should realise that observations means, what you see, hear or smell. 'Hydrogen' given off or 'gas given off' are not observations – the former also requires a further test, which is not asked for. Candidates should be encouraged not to assume more than there is in the question – the question does not say anything about indicator solution being added or a lighted splint being applied.

(iii) Nearly all candidates gave the correct colour change for litmus but the reasons were not always correct. Many candidates assumed, incorrectly, that ammonia was given off. These candidates were clearly thinking of the test for ammonia without thinking that ammonia contains nitrogen and that there is no nitrogen involved in the reaction of sodium with water. It was disappointing to note that a considerable number of candidates, after having given the correct colour change, suggested that the solution was acidic. Some candidates failed to gain the second mark because they suggested that sodium itself was alkaline, probably by referencing the term 'alkali metal' rather than realising that the alkali is formed when the sodium reacts.

(iv) About half the candidates gained both marks for this part. The first box was often ticked. Many candidates did not seem to think this false statement through even though they gave a correct answer to **Question 5(a)** which tested the same idea.

(c) About two thirds of the candidates thought that rubidium was less reactive than sodium, despite giving a correct answer to part **(a)**. This may indicate that candidates are familiar enough with the reactions of lithium, sodium and potassium, but their knowledge of the more general pattern down the Group is poor.

(d) (i) There were many vague answers defining isotopes. Many candidates failed to gain the mark because they mentioned molecules or elements alone rather than mentioning that it is the atoms in these that contain a different number of neutrons. A considerable number of candidates thought, incorrectly, that the number of electrons or protons was different or that the relative atomic mass was different.

(ii) Most candidates identified the correct number of protons in a sodium atom. A few candidates wrote 12 rather than 11, presumably confusing them with neutrons, perhaps from not reading the question properly.

(iii) Most candidates identified potassium as having 19 electrons, but a large minority suggested 39, confusing this with the mass number.

(iv) Many candidates gave vague answers about the main use of uranium. The answer 'fuel' on its own was not sufficient to gain the mark because this merely overlaps with conventional fuels. Many put 'for bombs'. This was not accepted, because it is hardly the main use – the atomic bomb only having been used twice. Similarly, answers such as 'fission' and 'in reactors' are too vague to give credit.

Question 2

This question was well answered by most candidates apart from part **(c)**, Many candidates scored at least two thirds of the marks available. The electronic structure of methane was well known but knowledge about the nomenclature of ethane was variable.

(a) The correct answer, carbon dioxide was almost always seen. A few candidates failed to balance the equation by putting carbon alone or carbon monoxide.

(b) (i) Most candidates scored all three marks for this part, the commonest errors being to put oxidation for the first part and exothermic for the last. A not insignificant number of candidates suggested that copper was a halogen.

(ii) About half the candidates realised that carbon was oxidised to carbon dioxide. Most of the others suggested that it was the copper that was oxidised, despite the fact that oxygen is being removed from the copper.

(iii) The test for carbon dioxide was less well known than expected for such a standard test. Many candidates suggested using litmus paper. Others failed to gain the marks by not suggesting any reagent or suggesting that 'water' turns milky.

(c) Only about 20% of the candidates realised that sodium hydroxide is used to test for copper(II) ions. Many suggested using electrolysis or had no idea, leaving the question blank. Of those that correctly suggested using sodium hydroxide, many failed to capitalise on their marks by not stating that a precipitate was formed. Many thought that the colour of the precipitate was brown, presumably still thinking of copper metal rather than copper ions.

(d) (i) Most candidates were able to draw the electronic structure of carbon. Common errors were to put 6 electrons in the outer shell or to put an odd number of electrons (usually 3) in the outer shell (presumably through carelessness in counting).

(ii) An encouragingly large number of candidates realised that carbon is in Period 2 of the Periodic Table, relatively few 'Period 4's' were seen.

(e) (i) About half the candidates realised that the relevant homologous series was the alkane homologous series. Common errors included the more generalised 'hydrocarbon' or 'alkenes'.

(ii) Most candidates realised that the structure represented ethane, even if they failed to identify the correct homologous series. Common errors included 'methane', butane' or the not uncommonly seen 'carbon hydroxide'! Ethanol was also sometimes seen as an incorrect answer. Taken together, an analysis of part **(e)** and **Question 6(e)(i)** suggests that many candidates do not appreciate the idea of functional groups and homologous series.

Question 3

This question was poorly answered, many candidates only obtaining a third of the marks available. This reinforces the contention that many candidates have difficulties in the areas of practical procedures and organic chemistry.

(a) Few candidates managed to identify the –O-H group as the functional group in alcohols. Many circled the adjacent CH_2 group as well. This has been commented upon in previous Principal Examiner Reports. Many candidates also circled the C = C double bonds or groups of 3 carbon atoms where the chain branches.

(b) Although many candidates identified the double bond as being present in the carbon, about half of these insisted that this meant that the compound was saturated and consequently lost the mark. Some candidates were content to write just 'unsaturated' without giving any explanation.

(c) Few candidates realised that the combustion of a compound containing carbon and hydrogen produces carbon dioxide and water as the products. Carbon dioxide was the combustion product most often seen. Carbon monoxide was often put down despite the fact that the question states that excess oxygen is present. Hydrogen was commonly seen in place of water and combinations of alkanes and alcohol were also suggested.

(d) (i) Only about half the candidates correctly identified the condenser. Incorrect answers included gas syringes, delivery tubes, distillation flasks etc. Candidates should be advised to learn the names of pieces of apparatus from diagrams or from books.

(ii) Many candidates realised that the boiling point of water is 100^oC but there were many answers which were wildly different from this e.g. 35°C. Some candidates failed to gain the mark through not including the Celsius unit.

(iii) This part was almost universally correct.

(e) (i) Few candidates placed the cross on the origin line. The most common error was to place it below the line. Many placed the cross on one of the spots, indicating that they had no real knowledge of the process of chromatography. The cross must be placed below the separated pigments. Several candidates placed the cross on the origin line but to one side and thus failed to gain the mark.

(ii) Most candidates correctly identified that there were four different pigments on the chromatogram. The commonest incorrect answer was 2.

(iii) This part was poorly done, few candidates being able to draw the sheet of paper dipping into a container. A considerable number of candidates obviously had no knowledge of chromatography and left this question blank. The commonest error was to put the origin line below the level of the solvent. Other common errors were (i) to not show the solvent (ii) to show chromatography on a filter paper circle without a wick and (iii) lack of indication that the filter paper should dip into the solvent.

(iv) Diffusion was poorly explained by the majority of candidates. It should be realised that the essential point about diffusion is that the movement of the molecules is totally random. The idea that substances move from a more concentrated area to a less concentrated area is only what is seen as the result of diffusion. Furthermore, it is not a 'one-way traffic' only and molecules do not 'know' which way to go. Diffusion is based entirely on probability, molecules moving in random directions.

(v) Less than a third of the candidates were able to draw the correct displayed formula for ethanol. Common errors were (i) to draw ethane (ii) to draw propanol (iii) to connect the hydrogen of the OH group to a carbon atom (iv) to show the bond between the carbon and oxygen as a double bond.

(vi) The commonest incorrect answer was a combination of boxes 2 and 3, many candidates thinking that ethanol was an unsaturated compound. This tallies with the fact that so many double bonds were drawn in the purported structure of ethanol in part **(v)**.

Question 4

As in previous examinations, both definitions (of a compound) and uses of specific chemicals were not well known. However, most candidates achieved about half marks. Full marks were very rare.

(a) Although many candidates realised that a compound consists of several different types of atoms, few gained the mark through not accessing the idea that the atoms are bonded (joined, etc.) together. A large number of candidates threw away the mark by stating that 'there was a mixture of elements'. Mention of a mixture justifiably negates any positive aspects of what has been written. Many candidates wrote vague statements relating to atoms joining without mentioning that the atoms have to be different types.

(b) The boxes for the uses of calcium oxide and calcium carbonate were often empty. When a use was suggested, it was often vague or incorrect. Many candidates seemed to think that calcium oxide was used as a food or drink – muddling up with 'lime' the fruit or 'milk of lime'. The latter was often seen as just 'milk'. Similarly, many candidates suggested that calcium carbonate be used as a food. 'Toothpaste' (an acceptable answer) was commonly seen as a use for calcium carbonate but just the answer for neutralisation was unacceptable unless this was qualified. Most candidates wrote the correct formulae, the most common errors being to write $NaCl_2$ for sodium chloride and CaCO or $CaCO_2$ for calcium carbonate. The relative number of atoms present in ammonium nitrate was generally calculated correctly but a wide variety of responses were seen in naming this compound. The most common errors were (i) ammonia nitrate (ii) ammonia on its own (iii) nitrogen oxide.

(c) About two thirds of the candidates were able to calculate the formula mass of ammonium nitrate correctly (= 80). The commonest error was 92, obtained by multiplying the 4 hydrogens by 4, rather than by 1.

Question 5

The first parts of this question were generally well attempted but only a few candidates gained all the marks in part **(d)**. It was encouraging to note that many candidates could use the information from the table to predict the reaction of strontium with water but this was balanced by a poor understanding of acid-alkali reactions.

(a) About two thirds of the candidates realised that calcium was a very reactive metal and so could not be extracted using carbon. A few candidates failed to gain this mark because they merely said that it was more reactive than copper. This is not the same as implying that it is very reactive or above carbon in the reactivity series. Other errors were to imply that the method was cheaper or that it was a good conductor of electricity.

(b) Most candidates obtained at least one of the two marks available here. Some, however, were content to just repeat the statements for calcium or just mention that bubbles were given off without any further clarification.

(c) Few candidates knew a correct use for acetylene. Many thought that it was used for cleaning.

(d) (i) At least two thirds of the candidates completed the equation successfully. The main error was to leave it unbalanced. However, a few candidates insisted on putting a 2 in front of the $CaCl_2$ which lost them the mark. Candidates should be advised that spaces with dotted lines are usually left for balancing the equations/writing the species in this particular paper. Some candidates balanced the equation with water incorrectly appearing as H_4O_2.

(ii) A minority of candidates realised that this was a neutralisation reaction. Redox, oxidation or exothermic was a common response. Candidates should be advised that the answer 'exothermic' will not be credited in these situations because they are not expected to know whether particular reactions are exothermic or endothermic, (although admittedly neutralisation reactions are exothermic).

(e) (i) Few candidates could identify a burette. Pipette, measuring cylinder or separating funnel were common incorrect responses.

(ii) Many candidates gained one of the two marks here, usually for realising that the pH fell on adding the acid to the alkali. Few, however, suggested figures for the pH before and after adding acid or realised that the pH of the calcium hydroxide was in alkaline region. Many lost marks through writing vague statement such as 'the pH goes to neutral' (from which direction?) or 'the pH changes'. 'Going to a more acid pH' was not accepted as an answer because this is too similar to the stem of the question. A worryingly high number of candidates suggested that the pH went up when the acid was added to the alkali, suggesting that they either did not appreciate the pH scale or exhibited muddled thinking as to which solution was added to which.

Question 6

This question was poorly done, the majority of the candidates obtaining no more than one third of the marks available. Electrolysis is an area which core candidates find particularly difficult especially in terms of movement of ions and determination of electrode products. Far too many candidates still think that the charge in the electrolyte is carried by electrons.

(a) Many candidates were able to write the simplest formula of lead bromide as $PbBr_2$ but a considerable number put PbBr or Pb_2Br, presumably through not realising that the ions in the diagram need first to be counted. It was encouraging to note that most candidates tried to write down an empirical formula rather than just putting down the number of ions shown in the diagram.

(b) Many candidates appeared not to understand the difference between structure and bonding as evidence by answers such as ionic + molecular or ionic + covalent. The commonest mark obtained was for 'ionic'. The fact that the structure is a giant structure was seldom realised.

(c) (i) Most candidates correctly identified the cathode as 'B'. The commonest error was to muddle the cathode with the anode.

(ii) Many candidates either failed to read the 'metal' in the stem of the question or failed to realise that the electrode needed to be unreactive. Consequently, only a few candidates gained this mark. The commonest incorrect answer was 'graphite', with 'iron' and 'copper' also frequently seen.

(iii) As previously noted, this sort of question is often poorly answered. Far too many candidates still think that the charge in the electrolyte is carried by electrons.

(iv) Many candidates realised that bromine and lead were the products of the electrolysis. A significant minority, however, thought that the bromine was released at the cathode. Many put the ions rather than the elements formed and some, thinking that the reaction was being carried out in solution thought that hydrogen or oxygen, or both were released at the electrodes.

(d) (i) This was poorly answered, many candidates balancing the equation with Br or 2Br, not realising that bromine is diatomic.

(ii) Only just over half the candidates knew the colour of bromine but a significant minority gave the incorrect answer 'blue', perhaps thinking of the (wrong) colour of chlorine. Many also responded incorrectly with 'colourless', perhaps thinking of the sodium bromide/sodium chloride.

(iii) This was poorly answered. Many candidates made no comparison between the reactivities of bromine and iodine. It was not enough just to say that 'bromine was more reactive', because many candidates gave the wrong comparison e.g. 'bromine is more reactive than sodium/than sodium iodide'. Many candidates gave answers suggesting that both were unreactive or vague responses about bromine and iodine being 'in the same group so they don't react'.

(e) (i) The diagrams of ethene were rarely correct. Common errors included giving the structure of ethane or a double bond with an ethane structure.

(ii) A common error here was to select the bromo-compound with the double bond. Many candidates failed to realise that one of the bonds in the ethene breaks and bromine adds across.

Question 7

The rate aspects of this question were usually fairly well done, although few candidates gained three marks for the practical procedure involved in measuring the rate of reaction.

(a) A majority of the candidates selected A and D as being transition metals but a significant number failed to read the rubric and only selected one of the two. The reason for selection was rarely incorrect although some candidates gave properties of transition elements that were not stated in the table. In this question, the answer is clearly meant to be extracted from the information in the table. Some candidates gave unacceptably vague answers such as ' because of their boiling points'.

(b) The correct answer 'iron sulphate' was often seen. The most common error was 'iron sulphur oxide', which shows a lack of appreciation of the sulphate group.

(c) Only a few candidates could provide a convincing explanation of how to measure the rate of reaction using the apparatus given. The most common mark obtained was for the appreciation that the gas was collected in the measuring cylinder. Even here, the measuring cylinder was variously called a test tube, flask or various other things. It was rare for candidates to specify that that the volume of gas was to be measured. Many put vague statements such as 'the gas goes into the tube and the liquid level goes down' without any suggestion of taking a reading. Candidates rarely mentioned the time aspect and those that did, sometimes did not gain the mark because it was not clear what the time referred to or the time did not refer to the volume of gas being measured or even the number of bubbles of gas being counted. For example, statements such as 'the time was taken when all the iron was used up' or 'time the reaction to see when it finishes' are far too vague to warrant credit.

(d) (i) About two thirds of the candidates gained at least one mark for relating increase in rate to increase in concentration. Only a few realised that doubling the concentration, doubled the rate. Candidates should also realise that there must be a definite comparison here to gain the first mark. Writing 'concentration increases the rate' has no meaning unless we are told whether we are increasing or decreasing the concentration.

(ii) Most candidates realised that the speed of the reaction was slower when lumps of iron were used. However, many candidates penalised themselves by writing that 'it takes longer for the reaction to finish'. This was not given credit, since it does not access the concept of rate.

(iii) Nearly all candidates obtained the mark for this part. Most of those candidates who referred to length of time rather than rate in part **(ii)** managed to refer to rate in part **(iii)**.

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Paper 0620/03
Paper 3 (Extended)

General comments

There were very few candidates that scored less than 10 marks on this paper; nor were there many candidates that scored more than 70 marks. In particular the latter was somewhat unusual compared with previous years. Candidates definitely found the paper more difficult than in previous years; this was possibly due to the fact that there were fewer questions based on recall than in previous years. In several places on the paper, candidates did not seem to read the questions carefully enough and gave correct statements that were, unfortunately, not answers to the question.

It would seem necessary to point out that if a question asks for an equation, this invariably means that a balanced chemical (i.e. symbol) equation is required and not a word equation. A small but significant number of candidates did not seem to be aware of this.

As in previous years, Organic Chemistry, namely with regard to **Question 8**, seems to be a problem area for large numbers of candidates. There were many who failed to score almost any marks on **Question 8**, as if they had totally ignored this area of the syllabus (which comprises all of ***Section 14***). There were, however a small number of candidates who scored very highly on this question, showing that it was not a difficult question, if prepared for with adequate revision.

Individual Questions

Question 1 and **Question 2** were by far the best answered questions on the paper. Only the very weakest candidates failed to score highly on these questions.

Question 1

(ii) Unfortunately, many more candidates thought that carbon monoxide (which is neutral) rather than carbon dioxide (which is acidic) was the correct answer. In part (**iv**) nitrogen was a common incorrect answer. The word 'active' was obviously misunderstood as meaning most abundant. The other four parts to the question were usually well answered.

Question 2

(ii) This was the part of the question that was most likely to be wrong. Many candidates thought that E was the correct answer, presumably because it conducted electricity at room temperature (which ionic compounds do not). The low melting point should have been another clue that this could not have been an ionic compound. Similarly it was not uncommon to see E given as the answer to part (**v**) presumably because metals conduct electricity at room temperature. However metals do not dissolve in water, nor do they have such low melting points. Answers to the remaining parts were usually very good and there were no common incorrect answers to these parts.

Question 3

(a) This scored very highly.

(b)(i) This usually scored very highly, although there were those who used atomic numbers instead of relative atomic masses. A mixture of both was (surprisingly) also seen. Part (**ii**) also scored quite highly, although some changed units from kilograms to grams, for some reason, and made errors in doing so. Many thought that there were 100 grams in a kilogram.

(c)(i) This usually scored well.

(ii) Candidates usually found this question to be quite difficult. It was nice to see that there were a few candidates who realised that the pH of the soil could not become alkaline if calcium carbonate was used, but far too many thought that calcium carbonate would produce carbon dioxide, either by thermal decomposition or by reaction with acid in the soil, and that the carbon dioxide could then be used in photosynthesis. This was despite the information in part (**b**) which states that calcium carbonate needs to be heated strongly to make it decompose. However several candidates did realise that there would not a problem with leaching if calcium carbonate was used, nor could the calcium carbonate be taken up by the plant if it was not in solution.

(ii) This was often answered successfully, the main use referring to the iron and steel industry.

Question 4

(a)(i) Quite often this scored full marks, but there were those who did not know the formula of methane, and gave hydrogen as a product instead of water. Word equations were also occasionally seen here (see General Comments)

(ii) This part question gave rise to probably the worst misconception amongst candidates on the whole paper, presumably a result of not understanding the meaning of 'poorly ventilated' and, in particular, missing the importance of the fact that air or oxygen could not enter the room. Therefore, answers focused on the results of gases not being able to escape, namely that there would be a build up of carbon dioxide leading to suffocation, or that there would be a build up of methane leading to explosion. All that was required was a realisation that toxic carbon monoxide would form (as a result of incomplete combustion due to inadequate oxygen supply).

(b) Most candidates were aware that there would be a reduced acid rain problem. Not all knew, or at least failed to state, that this would be caused by reduced sulphur dioxide emission.

(c)(i) This scored very highly.

(ii) Although carbon dioxide was frequently and correctly referred to, there was not much mention of water being produced from hydrocarbons. Some thought that hydrocarbons would be broken down into carbon (ignoring that this would form a solid deposit). There was also a lot of reference to processes such as cracking, which produced a variety of organic chemicals, but which does not occur in catalytic converters. It was not obvious to all candidates that the question required the *names* of the less harmful products, i.e. carbon dioxide and water.

Question 5

In general this question was answered poorly, the main problem seeming to be a misunderstanding of what the questions were referring to, as mentioned in the General Comments.

(a)(i) Many scored the mark here, even in some cases including 'finely divided' as reference to the iron catalyst. However vanadium (V) oxide was seen frequently, as were other catalysts from both industrial and laboratory reactions. Candidates should realise that catalysts are usually specific to particular reactions or types of reaction.

(ii) The majority said that lower temperatures were cheaper, or required less energy, but in too many cases there was little realisation that more ammonia would be produced at lower temperatures, and that this was related to the fact that the forward reaction was exothermic.

(b)(i) This merely required that the unreacted gases were passed over the catalyst again or that they were converted into ammonia. Instead, there were descriptions that focused on processes such as fractional distillation which were completely off the mark.

(ii) Here, the fact that ammonia has a *higher* boiling point was usually missed by all but the very best candidates. Melting point has no relevance to liquefaction.

(c)(i) Most of the equations missed out water on the right hand side, and therefore did not score any marks out of the two marks available.

(ii) There were many vague statements about lack of nutrients in urea but not many referred to the correct answer which had to mention the lack of phosphorus or potassium or both.

(d) There were many excellent answers, achieving full marks, However, candidates should be aware that they have to use all of the electrons available from the outer shells of all the atoms and that all atoms have to achieve a full outer shell. Bonds must also only contain even numbers of electrons. When drawing the diagram, some candidates restricted themselves to using only a small space, even though the whole page was available for the diagram. This often meant the examiners found the electrons difficult to see.

Question 6

(a) This question was done well by large numbers of candidates. Mistakes included inappropriate rounding up. In carrying out empirical formula calculations, candidates should be aware that empirical formulae are small, whole number ratios. It is rare that numbers greater than three are seen in empirical formulae. If numbers are too large or not whole numbers candidates should realise that they must have made a mistake and should, therefore, check their calculations.

(b)(i) Carbon/Graphite electrodes were often seen as both positive and negative electrodes. Pure and impure copper were often the wrong way round for the positive and negative electrodes. Copper sulphate was often correctly identified as the electrolyte, although sulphuric acid was a common incorrect answer.

(ii) It was not uncommon to see 2 Cu on the right hand side of otherwise correct half equations. Other errors included the usual problem of putting the electrons on the wrong side.

(iii) Zinc was well known, although iron and tin were often seen amongst other incorrect metals.

(c) Some candidates confused metallic bonding with ionic bonding in copper compounds and therefore confused the movement of electrons with that of ions. For the malleability part, there were a small number of excellent answers but very few knew that the key point in the answer was reference to particles in copper being arranged in layers which could slide over each other. Some are still of the opinion that it is the electrons that slide. It was surprising to see a small but significant number of candidates who confused the brittleness of sulphur with that of ionic compounds, i.e. a description of positive and negative 'sulphide ions' are displaced so that they would repel each other, in much the same way as sodium chloride.

Question 7

(a)(i) Many realised that the gradient would be steeper at the start, but did not realise that the volume of hydrogen would be doubled.

(ii) The fact that the gradient would be less steep scored quite often, but very few made any comment concerning the volume of hydrogen, let alone state that the volume would be the same. Many think that a slower reaction means that less hydrogen is produced, not that the same amount of hydrogen is produced more slowly. The question specifically requires a description of how the graph would change and not how the rate of reaction changes. This was by no means obvious to all. Furthermore, it is not good enough to make vague and ambiguous statements such as 'the graph is lower', when it is necessary to specify whether the gradient is steeper or less steep (not the same thing)

(b) It was pleasing to see that candidates realised, almost universally, that this question was on rate, not on equilibrium. Explanations, particularly concerning concentration, were not very successful. Increasing concentration means that there are more particles per unit volume or that particles are closer together, not merely that there are more particles, as was commonly stated. Similarly, at higher temperatures particles move faster and therefore collide more often is all that was required for both marks.

(c)(i) Glucose and oxygen were often correctly identified, but sugar is not specific enough as an alternative to glucose.

(ii) The correct answer, chlorophyll, was given in most cases.

Question 8

(a)(i) This scored highly, but there were some candidates who described a catalyst without saying that an enzyme was a biological catalyst. Saying that an enzyme was 'a catalyst that was a protein' was acceptable, but 'organic catalyst' was not.

(ii) Candidates should be advised that any drawing of a polymer should have continuation bonds at both ends, otherwise it is not a polymer. Many answers did not show such bonds.

(iii) A variety of answers were seen. The only correct answer, chromatography, was rarely included. Benedict's reagent was often mentioned, but this is not a technique, even if it could distinguish between the products.

(b)(i) Candidates usually showed only one monomer, even though it stated in the question that proteins are made from more than one monomer. The macromolecules were usually made from diamines and dicarboxylic acids, and were therefore polyamides rather than proteins. However, there were some excellent answers showing mastery of difficult concepts at this level.

(ii) Amino acids usually scored highly.

(c)(i) Some good answers missed out water on the right hand side, thereby only scoring one mark out of two.

(ii) There were also some excellent answers here, amid the majority who did not seem to be at all familiar with organic chemistry. Some very good candidates drew ethyl propanoate rather than propyl ethanoate, and thus scored one mark for drawing the correct ester linkage.

(iii) Those that described the bromine water test often omitted to give the original bromine colour and thus could only score two out of three. Many gave tests for fats which would have worked for both saturated and unsaturated fats.

(iv) This proved to be beyond all but the best candidates, even though knowledge of the production of soap by hydrolysis of fats is clearly stated on the syllabus. Many substances, both organic and inorganic were listed here, and there were some who could not resist listing both soap and water.

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Paper 0620/04

Coursework

General comments

As usual only a few Centres submitted coursework for moderation in November. There were few problems and those tended to be concerned with more able candidates.

There were a few who quite justifiably scored the highest mark but others who were given high marks which were not merited on the strength of the evidence submitted.

Where moderation changes were necessary it was usually due to the nature of the exercises set rather than the ability of the candidates.

Most of the difficulties arose with skill C4 which is the most difficult to score highly in.

C4 planning tasks should be set which involve a task which is not too simple. There should be a number of variables which could affect outcome and those not being investigated should be explicitly controlled. It is usually easier to award high marks if the investigation has quantitative aspect. Trivial investigations rarely give access to the full range of marks.

Other points to bear in mind are:

- making sure that C1 tasks allow candidates the opportunity to make a choice. The outcome of this choice should be part of the mark scheme.
- ensuring that candidates have opportunities to experience both quantitative and observational exercises for skill C2.
- Making sure that work sheets do not give too much guidance in skills C2 and C3.

Comments on specific questions

Not Applicable

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Paper 0620/05

Practical Test

General comments

The vast majority of candidates successfully attempted both questions. A few centres encountered problems obtaining magnesium powder. Some centres reported problems with larger than expected temperature changes resulting in problems with plotting the points in 1(b). These problems were taken into account by the examiners and as a result no candidate was penalised. A minority of centres failed to submit Supervisors' results despite this point being made in previous reports. Supervisors' results are used in comparison with candidates' results when marking the scripts. Some centres returned unreasonable comments e.g. 'the size of the test tubes was not specified'. The syllabus does contain details of apparatus for teachers requiring such guidance.

Comments on specific questions

Question 1

The vast majority of candidates successfully completed Experiments 1, 2 and 3 and recorded the temperatures in the table. The observations recorded varied widely from detailed and comprehensive, to very few. A significant number of candidates failed to test the gas in Experiment 3 as requested. Other candidates tested the gas but failed to record the observation and just noted that hydrogen was present. More able candidates recognised the colour changes in the solutions and to the solid. Many candidates failed to note the bubbles/fizz/effervescence produced and just stated 'gas formed'.

(a) All parts were generally well answered using their results and observations in the table. In part **(ii)** some answers referred to the positive test for hydrogen, which was irrelevant here. A minority of candidates mistakenly identified the gas as oxygen in (iii).

The majority of candidates successfully carried out Experiments 4 and 5. A minority of centres had candidates with temperatures in excess of 90°C for Experiment 4. These candidates were not unfairly penalised in **(b).**

(b) The majority of candidates successfully plotted the results for Experiments 4 and 5 on the grid. However a large number of candidates failed to draw smooth line graphs, either as curves or straight lines as appropriate. Uneven lines and 'medical charts' were prevalent. Other candidates failed to label the graphs as requested.

(c) The majority of candidates were able to estimate the temperature as needed. Some candidates were unable to indicate clearly how they obtained their answer while others used the graph for Experiment 5 instead of Experiment 4.

Question 2

Candidates found this qualitative analysis question easier than in previous years. Several candidates scored high marks on this question.

(a) The mark allocation of 3 indicated that three observations were required. Some candidates failed to give three observations. A number of candidates did not mention the colour changes involving the pH paper while others used litmus paper. Recognition of a sublimate or description thereof was rare.

(c) Any pH less than 7 scored credit and colours were compared with the Supervisor's results. In part **(ii)** few candidates noted the smell of the gas and others recorded bleaching of the litmus paper.

In **(iii)** and **(iv)** some candidates still use terms such as 'milky' and 'cloudy' instead of white precipitate.

(d) The correct description of the yellow precipitates formed was common. A minority of candidates noted white or green precipitates.

(e) A few candidates noted the gas formed as ammonium instead of ammonia, while others incorrectly identified chlorine.

(f) Solid **F** was ammonium chloride and many candidates recognised this. A few incorrectly identified the solid as a sulphate.

(g) A minority of candidates were unable to deduce the identity of the anion using the notes provided despite obtaining correct observations in (d). The use of the word iodine instead of iodide was penalised.

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Paper 0620/06
Alternative to Practical

General comments

The majority of candidates attempted all of the questions within the time allocated. The paper showed good discrimination between candidates of different ability. Candidates found **Question 4** easy to answer and were able to interpret the information given. **Question 6** proved difficult for many candidates who were unable to apply their knowledge and understanding to an unfamiliar situation. Some responses showed that candidates were unable to follow instructions as directed and lost straightforward marks.

Comments on specific questions

Section A

Question 1

(a) In **(a)** the beaker box was often correctly labelled. However, tongs were frequently identified as scissors, forceps, holders, grabbers etc. Watch glass or evaporating dish was given credit for the second box. Many answers referred to bowls, petri dishes and crucibles.

(b) Endothermic was a common incorrect answer.

(c) Generally well answered. A minority of candidates mentioned basic or alkaline with no pH number.

Question 2

Part **(a)** was generally well answered, though some responses referred to black or red.

(b) A good discriminating question. Only the better candidates described the role of oxygen. A large number referred to air or water being the cause.

(c) A common incorrect answer was 83.3% or 21%.

(d) A good discriminating question. Incorrect responses referred to no rust, slower rusting and an increased percentage.

Question 3

The table was usually correctly completed. In **(a)**, the points were often plotted correctly. However a smooth S curve was often not drawn.

(b) A significant number of endothermic answers were seen.

(c) A good discriminating question. Only the more able candidates were able to describe the reaction being slow to start with, then speeding up and latterly slowing down. Many incorrect answers gave the rate as increasing and the reaction as finished. The data showed that the reaction had in fact not finished.

In **(ii)**, 'all the calcium was used up' was a common answer and some vague references to temperature and pressure was evident.

Question 4

This question was well answered by the vast majority of candidates. A few mentioned the pop test in **(b)(ii)** and there were also some references to the reactivity series - candidates were instructed to use the table of information to answer the questions. Weaker candidates were unable to identify hydrogen in **(b)(iii)** and oxygen, sulphur dioxide and carbon dioxide were given.

The table of results was often correctly completed, as was the plotting of the points in **(d)**. Smooth line graphs were often missing on the graph and a straight line was required for experiment 2. In **(e)** the estimated temperature was sometimes given for experiment 3 instead of 2.

Part **(f)** was a good discriminator. The sketches were expected to start between 20 and 30°C, be below experiment 2 for **(f)(i)** and anywhere below experiment 3 for **(f)(ii).**

In part **(g)** incorrect answers referred to the glass breaking or smashing and some to the effect of light. Meaningful improvements were rare in part **(h)**. Correct answers described methods of insulating the container or using a burette or pipette instead of a measuring cylinder.

Question 5

In **(a)(ii)** some candidates reversed the colour change, i.e. from blue to red. Many candidates did not mention the initial colour of the litmus paper turning blue and others referred to bleaching.

In **(c)** only the better candidates mentioned the weak nature of the acid and many vague answers referred to 'slightly acidic'. In **(e)** and **(f)** the cations were sometimes not mentioned and therefore one mark was deducted. Iodine and bromide were incorrect answers given in **(f).**

Question 6

This question was a good discriminator. A minority of candidates attempted distillation or chromatography in **(a).**

In part **(b)**, common errors involved using water as the solvent or dipping the paper into the solution. Some good descriptions of chromatography were given and the idea of applying a spot of the paint on the paper was allowed.

In **(c)(i)**, the paint needed to be applied to a surface. In addition, an indication of checking whether the paint was dry or not was often missing. Incorrect answers to **(c)(ii)** included use of a catalyst/drying agent/concentrated sulphuric acid/dehydrating agent.