**Location Entry Codes**



As part of CIE's continual commitment to maintaining best practice in assessment, CIE has begun to use different variants of some question papers for our most popular assessments with extremely large and widespread candidature, The question papers are closely related and the relationships between them have been thoroughly established using our assessment expertise. All versions of the paper give assessment of equal standard.

The content assessed by the examination papers and the type of questions are unchanged.

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| **Question Paper** | **Mark Scheme** | **Principal Examiner's Report** |
|---|---|---|
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# CHEMISTRY

**Paper 0620/11**

**Multiple choice**

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

Candidates performed well on this paper. There were 7427 candidates with a mean score of 30.5. The standard deviation was 7.0

**Questions 1**, **2**, **10**, **21**, **27**, **29**, **33** and **36** proved to be very straightforward with a large majority of candidates choosing the correct response.

There were no questions where less than half of the candidates chose the correct response but the following questions proved to be the most difficult.

**Questions 4**, **17**, **20** and **25**

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

**Question 4 Response A.** Candidates clearly did not realise that element T was argon and that a new shell would be started. Referring to the periodic table before answering would have aided candidates.

**Question 8 Response B.** Candidates mixed up which type of oxide is formed by which type of element.

**Question 14 Response A.** Candidates responded with an element that they knew was purified by electrolysis without considering the detail of the question.

**Question 17 Response C.** Candidates realised that one was right and one wrong but confused the two when applying it to this reaction.

**Question 24 Response A.** Candidates realised that they both had to change in the same way but chose the wrong alternative maybe through confusion with group I.

**Question 25 Response D.** Candidates simply did not know/appreciate that argon is relatively plentiful in air.

**Question 31 Response B.** Candidates did not read far enough. Had they read response C it is clearly a better answer even if they knew little about pipes in a chemical factory.

**Question 38 Response B.** Candidates just did not know which fraction is used by aircraft.

**Question 39 Response C.** Candidates did not know the definition of a homologous series and opted for the fact that all four are hydrocarbons.

**Question 40 Response A.** Candidates knew the =O bond and knew O-H but forgot that the O in –OH is joined to a C.

# CHEMISTRY

**Paper 0620/12**

**Multiple choice**

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

Candidates performed well on this paper. There were 9445 candidates with a mean score of 30.8. The standard deviation was 7.2

**Questions 1, 3, 10, 18, 22, 26, 31, 35** and **37** proved to be very straightforward with a large majority of candidates choosing the correct response.

There were no questions where less than half of the candidates chose the correct response but the following questions proved to be the most difficult.

**Questions 5, 27** and **30**.

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

**Question 5 Response A.** Candidates clearly did not realise that element T was argon and that a new shell would be started. Referring to the periodic table before answering would have aided candidates.

**Question 6 Response B.** Candidates mixed up which type of oxide is formed by which type of element.

**Question 8 Response C.** Candidates knew electrons were involved but had a mistaken idea of what happens.

**Question 12 Response A.** Candidates responded with an element that they knew was purified by electrolysis without considering the detail of the question.

**Question 17 Response C.** Candidates realised that one was right and one wrong but confused the two when applying it to this reaction.

**Question 19 Response A.** Candidates did not look at the molecule at the top of each column and considered the three reactions as all being oxidations.

**Question 24 Response A.** Candidates realised that they both had to change in the same way but chose the wrong alternative maybe through confusion with group I.

**Question 27 Response D.** Candidates simply did not know/appreciate that argon is relatively plentiful in air.

**Question 30 Response B.** Candidates did not read far enough. Had they read response C it is clearly a better answer even if they knew little about pipes in a chemical factory.

**Question 40 Response B.** Candidates just did not know which fraction is used by aircraft.

# CHEMISTRY

**Paper 0620/02**

**Core Theory**

## General comments

Many candidates tackled the standard questions reasonably and some good answers were seen in many parts of the paper e.g. **Question 1** and **Question 5**. Many candidates found some of the questions which were set in unfamiliar contexts quite challenging, especially parts of **Questions 2** and **6** (diffusion, structure of liquids and use of noble gases in providing an inert atmosphere). The rates of reaction question (**Question 6**) was not done as well as expected, many candidates having difficulties with the practical aspects as well as the theoretical aspects. Very few candidates scored very high marks. This suggests that most of the candidates taking this Paper have been entered correctly for this tier. In general, the rubric was well interpreted and most candidates attempted all parts of each question. However, in **Question 2(d)(ii)** a significant number of candidates did not read the instructions and chose substances not mentioned in the list provided. This question also showed that many candidates have a poor understanding of the specific environmental problems posed by the substances stated in ***section 11*** of the Syllabus. Although most candidates had a fairly good knowledge of general chemistry, many were found, as in previous sessions, to have a poor knowledge of tests for specific ions. For example, few obtained both marks for identifying the test reagent and the result for iron(III) ions. There appeared to be a slight improvement in the ability of candidates to answer questions on organic Chemistry compared with previous sessions but definitions still proved a stumbling block e.g. explaining the meaning of the words saturated and hydrocarbon. As expected from previous sessions, many candidates had difficulty in explaining that ions are responsible for conducting electricity in molten electrolytes. There were only a few instances where candidates disadvantaged themselves by giving conflicting answers. It is encouraging to note that all but a handful of candidates confined themselves to a single answer in questions requiring a specific answer to be ringed. In more extended questions, candidates often disadvantaged themselves by sloppy and non-specific writing. It was encouraging to note, that many candidates could obtain the correct answer for the formula mass calculation in **Question 4(d)(iii)**.

## Comments on specific questions

### Question 1

This was the best answered question on the Paper with many candidates scoring well over half marks. The major errors arose from a lack of knowledge of the concept of alkalinity and an insecure knowledge of iron extraction.

**(a) (i)** This was the best answered question in **part (a)**, with most candidates selecting iron(III) oxide. The commonest incorrect selection was lead(II) bromide.

**(ii)** This was generally well answered the commonest incorrect answer being iron(III) oxide.

**(iii)** Over two thirds of the candidates realised that calcium carbonate was used to manufacture lime. The commonest error was to suggest sodium hydroxide.

**(iv)** This was the least well answered of these first five questions. Many candidates did not seem to understand the term ‘alkali’. Hydrochloric acid was commonly seen as an incorrect answer but calcium carbonate and carbon dioxide were also commonly suggested as being alkaline.

**(v)** About half the candidates gained this mark with carbon dioxide being by far the commonest error.

**(b) (i)** This was the least well answered part of **Question 1**. Many candidates did not express themselves very well either, stating that carbon monoxide was being produced or iron was being made or just paraphrasing the equation. A minority of candidates failed to gain the mark because they did not refer to the equation and wrote about hydrogen being added.

**(ii)** Few candidates scored all four marks here. The commonest errors were to suggest that iron ore was bauxite and that lime rather than limestone was added to the blast furnace. Most candidates gained the third marking point (blast).

**Question 2**

This question was reasonably well answered but many candidates found **parts (c)** and **(d)** challenging. It was surprising how few candidates could name an inert gas in **part (c)(iv)** or name a hazard associated with the names of any two chemicals extracted from the list in **part (d)(ii)**. The rubric error sometimes seen in the latter question has already been mentioned in the General Comments.

**(a)** Most candidates scored the mark for identifying the order of reactivity, the commonest error being to suggest that magnesium is more reactive than calcium.

**(b)** Many candidates used the data in the table to give a correct intermediate condition of bubbles or speed of liberation of bubbles. Those who failed to gain the mark generally did so because they merely repeated the details of the observations with magnesium.

**(c) (i)** Most candidates realised that magnesium floated on top of the magnesium chloride. The commonest errors were (i) to refer to the hatching in the diagrams and (ii) to refer to the magnesium twice e.g. ‘the magnesium floats on the magnesium’. The latter could not be given benefit because many candidates also suggested that the magnesium was below the magnesium chloride despite the diagram.

**(ii)** A large minority of candidates had difficulty with this part. The commonest error was to state that ‘magnesium oxide does not react with carbon’ without any further explanation.

**(iii)** Few candidates gained the mark here. Candidates’ statements often did not go far enough to discuss the importance of the removal of the air. A common incorrect answer was ‘so that there was no reaction’ without stating which substances would be reacting. Air or oxygen was rarely mentioned. A large minority of the candidates thought that the inert gas actually either reacted with the magnesium or stopped the magnesium reacting with carbon (the latter being thought of perhaps as a continuation from **part (ii)**).

**(iv)** Many candidates could not name a gas that was inert. Incorrect answers ranged from metals to oxygen and hydrogen. Some candidates failed to read the question properly and wrote the names of compounds rather than elements e.g. carbon monoxide and carbon dioxide.

**(d) (i)** About half the candidates were able to draw the structure of ethene. Common errors included (i) a single rather than a double bond (ii) the incorrect number of hydrogen atoms and (iii) drawing the structure of ethane.

**(ii)** Rather than selecting two compounds from the list whose hazards were stated in the syllabus i.e. carbon monoxide and methane, many candidates opted for hydrogen sulfide, a compound which is not on the syllabus. This resulted in many candidates not gaining the marks. Candidates who wrote about carbon monoxide were most likely to gain a mark. Many candidates ignored the rubric and selected compounds other than from the list provided. These ranged from the understandable e.g. ethane (as a slip from methane) to the incomprehensible e.g. phosphorus. A not inconsiderable number of candidates wrote about sulfur dioxide, thus indicating that candidates tend to lump all ‘pollutant’ substances together.

**(e) (i)** Many candidates were able to construct the correct word equation from the symbol equation. The commonest errors were (i) to write carbon oxide instead of carbon monoxide (ii) to write the word ‘plus’ instead of + and (iii) to write water instead of hydrogen.

**(ii)** Most candidates were able to identify the sign for a reversible reaction.

**(iii)** As in previous years, many candidates had difficulty with understanding the correct test and result for the identification of specific metal cations. Various incorrect reagents were suggested, hydrochloric acid being one of the most common. Other common errors included (i) the use of a magnet to test for iron (ii) electrolysis and (iii) the use of barium chloride. Of those candidates who correctly suggested adding sodium hydroxide as the reagent, the second mark was often not gained because of the wrong colour precipitate – green or white being the commonest errors.

**Question 3**

This question was reasonably well answered and it was encouraging to note that many candidates scored at least 2 or 3 marks in **part (e)**. **Part (f)** was poorly done, candidates often having difficulty in giving accurate enough definitions merely because of the lack of one or two key words. This problem has been commented on in previous Examiner Reports.

**(a)** Over half the candidates scored the mark for identifying distillation. Common errors included cracking, filtration and heating.

**(b)** Many candidates had difficulty identifying fractions of petroleum distillation that were not in the stem of the question. Few candidates scored both marks here. The commonest correct answers were lubricating fraction and bitumen. Candidates often muddled up the names of the fractions with the names of particular hydrocarbons with the result that incorrect answers such as butane and propane were often seen. Natural gas was not an acceptable answer since this does not usually come from petroleum fractionation but is tapped off beforehand either from the oilfields or from a pre-fractionation process. Benzene or benzine were common incorrect answers, perhaps occurring because in many languages this word means petrol. This would have been incorrect in any case because gasoline was in the stem of the question.

**(c)** Under half the candidates could give a correct use for the paraffin fraction. Common incorrect answers included lubricant, road building, manufacture of chemicals and candles, waxes and medicines. The last was presumably written because the candidates were thinking of medicinal paraffin – an unfortunate throwback to the old name for alkanes – paraffins.

**(d)** Most candidates could recognise an alkane. The main errors were to write down only one alkane or to include B (ethene).

**(e)** Many candidates scored two or three marks for this question. The commonest errors were to suggest hydrogen instead of water or oxygen.

**(f) (i)** Few candidates gave a satisfactory definition of ‘unsaturated’. The best answers included statements such as ‘only contain single bonds’ or ‘don’t have double bonds’. Many answered the question as if it was referring to a saturated solution rather than a saturated compound.

**(ii)** Again, many candidates had difficulty in defining the meaning of hydrocarbon. The word ‘only’ was often omitted. This has been extensively commented on in previous Examiner Reports.

**Question 4**

Apart from **parts (b)** and **(e)** this question was not very well answered by the majority of candidates. The reasons for the use of fertilisers often missed the point that fertilisers / nitrogen is essential for plant growth. The fact that oxygen relights a glowing splint was not as well known as the Examiners expected but the calculation of the formula mass of ammonium nitrate was done better than expected compared with similar questions in previous sessions.

**(a)** Only just over a third of the candidates recognised ammonia as the gas which is given off when ammonium salts are heated with sodium hydroxide. Common errors included hydrogen, nitrogen, oxygen and ammonium hydroxide.

**(b)** Despite the fact that only a minority of candidates obtained the mark for **part (a)** most knew the correct colour change of litmus in the presence of ammonia. The most common error was to suggest that the litmus stayed red.

**(c)** Fewer than half the candidates obtained all three marks here but most scored at least one. Hydrogen was often seen instead of water and a variety of compounds were seen in place of ammonium chloride. It was encouraging to note that few candidates made the mistake of writing 'ammonia chloride'.

**(d) (i)** About one third of the candidates gave a sound reason for the use of fertilisers. A significant number of candidates thought that fertilisers were insecticides or destroyed bacteria.

**(ii)** Very few candidates realised referred back to the nitrogen in the formulae given. Common errors were (i) to suggest that nitrates were better than chlorides for the plant (ii) the suggestion that chlorides were poisonous and (iii) the suggestion that ammonium nitrate had more oxygen which was important for plants. Whilst the first two points have some merit they are not really close enough to the correct answer to gain credit.

**(iii)** Many candidates were able to calculate the formula mass of ammonium nitrate correctly (80). A considerable number of candidates counted the hydrogen atoms as if the formula was $NH_3NO_3$ thus arriving at the incorrect answer of 79. Another common error was to multiply some of the values e.g. N x 3 for the nitrate.

**(e)** A surprising number of candidates did not recognise the gas which relights a glowing splint. A range of incorrect gases was seen, the commonest being hydrogen.

**(f)** The candidates most likely to score the mark here referred to acid rain rather than the effects of acid rain. The main error was for candidates to refer to effects on the ozone layer. These general points seem to add credence to the idea that candidates as a whole tend to muddle up environmental effects. This has been commented upon in previous Examiner Reports.

**Question 5**

This question was fairly well answered. In **part (a)** only about a third of the candidates were able to explain in a convincing way why the flask and contents decreased in mass. The term catalyst was well recognised but graphical questions posed some problems for many candidates – few scoring all four marks for **part (b)**.

**(a)** Although many candidates realised that a gas was given off in the reaction, a large number failed to gain the mark because they 'muddied' their answer by writing extra material. For example answers such as 'carbon dioxide, which is a gas and water are given off' cannot gain credit because of the incorrect suggestion that the water disappears from the flask as well. Another example not infrequently seen was 'the carbon dioxide gets trapped in the cotton wool'. This could not be given credit because if the carbon dioxide gets trapped, it does not escape from the flask.

**(b) (i)** The majority of candidates gained the mark for identifying the time taken for the reaction to be complete (600 to 630 seconds allowed). Values of 700 or 770 were the commonest incorrect answers, the latter being obtained by referring to the end of the horizontal axis of the graph.

**(ii)** Most candidates identified the place where the reaction was fastest. Some, however, failed to gain the mark because they did not put the cross sufficiently near the beginning of the graph line. A not insignificant number of candidates placed the cross near the point where the line levelled off.

**(iii)** Many candidates had difficulty with this part. Many drew their line below the existing one for the higher concentration of acid. This may reflect a lack of practical knowledge and understanding of the loss of mass method for following rates of reaction. Even fewer candidates were able to assess where the final volume would be. Most joined their line to the existing one.

**(c) (i)** Most candidates gained the mark for increased rate with increasing temperature.

**(ii)** Markedly fewer candidates gained the mark for the effect of particle size on rate. This may merely reflect that the increased rate with decreased particle size is a more difficult concept to understand.

 

**(d)** Most candidates scored at least one mark here. The commonest errors were to suggest expansion instead of combustion and to get large and small the wrong way round. The latter point reinforces the comments about the difficulties candidates experience relating particle size and rate of reaction.

**(e)(i)** About half the candidates recognised the equation for respiration. The commonest errors were fermentation, combustion, digestion and photosynthesis. Oxidation was not accepted as a facile answer to this question since the question was intended to discriminate at a higher level than that response would have allowed.

**(ii)** The term catalyst was well known. Candidates who failed to get the mark often did so because they concentrated too much on properties of enzymes.

**Question 6**

This was the least well answered question on the Paper. This was not surprising, since previous Examiner Reports have commented on the fact that candidates experience difficulties with the concepts of the arrangement of particles in a liquid and diffusion. The quality of the explanations in **part (e)** was also poor.

**(a)** Fewer than half the candidates realised that bromine was diatomic. The commonest error was to write the formula for a bromine atom. A not inconsiderable number of candidates gave the bromine a negative charge.

**(b)** The arrangement of the molecules in a liquid was not well known. Most candidates seems to think that the particles are far apart rather than actually touching (or at least for drawing purposes, only a tiny distance apart). A large minority of candidates incorrectly drew the particles arranged regularly. Some candidates disadvantaged themselves by drawing the particles as tiny dots compared with the one shown. Sometimes these dots were put as 'satellites' around the central molecule drawn on the question paper.

**(c)** Few candidates could apply ideas about moving particles to the process of diffusion. The commonest points to score were for evaporation and the word diffusion. However, it is encouraging to note that more candidates, compared with previous years, wrote that diffusion is due to the random movement of molecules. Since diffusion is due to the random movement of molecules, answers referring to the movement of particles in a particular direction from high to low concentration cannot be accepted since this contradicts the idea of random movement. Ideas about the bulk flow being in the direction of high to low concentration are correct however.

**(d)** Few candidates scored both marks. The mark most commonly obtained was for the colour of the aqueous bromine. Many candidates wrote the correct colours but suggested that the products were green and the reactants brown.

**(e)** This question was poorly done. Many candidates expressed their ideas poorly. In this question where there are magnesium bromide, bromine and iodine potentially involved, candidates are advised to answer in terms of X is more reactive than Y rather than X is more reactive. Many candidates incorrectly compared the reactivity of iodine with the reactivity of magnesium or magnesium bromide. Another common error was to suggest that there was no reaction because bromine and iodine are in the same Group in the Periodic Table.

**(f)(i)** This was fairly well answered, common errors being to write multiples of ions or to write the formula with only one of the ions shown with a charge. A small number of candidates wrote the name rather than the formula.

**(ii)** About two thirds of the candidates could identify zinc bromide, although a few disadvantaged themselves by writing the formula. A significant minority of candidates wrote the incorrect answer 'zinc bromine'.

**(iii)** Many candidates realised that bromine trifluoride has a covalent structure. Apart from 'ionic' other incorrect answers included single bonded and molecular.

**(iv)** Most candidates correctly identified the ionic structures.

**(v)** Many candidates failed to recognise the movement of ions as being responsible for electrical conduction in molten electrolytes. Most candidates wrote about moving electrons or particles.

**Question 7**

Many candidates found **part (e)** of this question demanding. Previous Examiner Reports have also commented on the fact that many candidates have difficulty in explaining exactly how dry crystals are obtained from a solution. However, it is encouraging to note that a greater number of candidates than in previous Sessions are gaining a mark for the method of drying the crystals. Candidates generally performed well in **parts (c)** and **(d)**

**(a)** Just over half the candidates could balance the equation. The commonest error was to write chlorine as monatomic.

**(b)** Many candidates were successful in drawing the electronic structure of hydrogen chloride. Only a few drew an ionic structure. Common errors included giving hydrogen too many electrons and drawing too many chlorine atoms per hydrogen (despite the fact that the formula had been given in **part (a)**.

**(c)** Most candidates realised that acids have a pH below pH 7. The commonest error was to suggest pH 9.

**(d)** Most candidates realised that hydrogen is given off when a reactive metals reacts with hydrochloric acid. The only common error was to suggest water instead of hydrogen.

**(e)** Very few candidates scored both marks for this question. A typical incorrect answer involved heating the water and waiting for the crystals to appear with the implication that all the water is boiled off. Better answers suggested that the solution be heated until the crystallisation point and then left for the water to evaporate. It was encouraging to see (in comparison with previous sessions where a similar question has been asked) that a greater proportion of candidates suggested drying the crystals between sheets of filter paper.

**(f)(i)** Many candidates wrote chloride ions instead of chlorine and a considerable minority thought that zinc was formed at the anode.

**(ii)** Candidates were generally more successful at predicting the product at the cathode than at the anode.

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UNIVERSITY of CAMBRIDGE
International Examinations

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# CHEMISTRY

**Paper 0620/31**

**Extended Theory**

## General Comments

Examiners commented on the lack of initial thought and planning of many of the answers. Candidates gave the impression that they were aware of the salient facts and concepts but failed to be awarded marks because there was a lack of coherence, focus and structure in the response. There was often insufficient structure and relevant content. Comments of this type were made by a number of Examiners.

Candidates should be advised to read the question carefully, then think and finally write. This should ensure that they answer the question asked on the paper.

It is pleasing to report that answers to questions which have been deleted and rewritten elsewhere in the paper have almost invariably been clearly referenced. This is a great improvement on previous years.

The perennial comment about handwriting still needs to be repeated, if after every reasonable effort to decipher the comment, the examining team cannot ascertain the candidate's intentions then marks cannot be awarded. This idea needs to be extended to diagrams, it is essential that they are drawn carefully and all relevant detail is quite clear. In **Question 1(a)(i)**, it had to be obvious that the original spot is above the level of the solvent before the mark could be awarded.

## Individual Questions

### Question 1

**(a) (i)** Some very clear, accurate drawings of apparatus suitable for chromatography were seen, but there were a significant number of poor quality diagrams lacking in clarity and with inadequate labelling. Many candidates positioned the sample below the level of the solvent, others omitted a suitable container or did not show more than one spot on the chromatogram.

**(ii)** A high proportion of the candidates realised that it was necessary to run a chromatogram of pure chlorophyll and compare it with the chromatogram of the grass extract. A comparison based on colour did not suffice and the most common error was to not mention that the green pigment from grass would have the same Rf value or be the same height above the base line as pure chlorophyll.

**(b)** The role of chlorophyll was generally well known, many candidates were awarded full marks. Three of the following points were required:

- (chlorophyll is a) catalyst
- photosynthesis **or** chloroplasts
- photochemical reaction **or** needs light
- carbon dioxide + water form
- glucose **or** starch **or** oxygen **NOT** sugar.

Typical errors were:

- glucose decomposed to form carbon dioxide and water
- respiration was described not photosynthesis
- the omission of one of the two reactants.

**Question 2**

Some weak responses were seen, showing a poor understanding of electrolysis. Products at the anode and cathode were regularly confused. The state of the electrolyte was essential, molten was often omitted from potassium iodide and aqueous from potassium bromide. Although the question stated dilute aqueous sodium chloride, most answers were for the concentrated solution. Copper was the only product consistently identified although it was often incorrectly written as copper(II).

**Question 3**

**(a)** The majority of candidates scored marks on this question. **Parts (i)** and **(ii)** were usually correct and **part (v)** presented the most problems. The significance of the phrase "a diatomic gas" was not recognised and element F, which is iodine, was frequently suggested as the answer to **(v)**.

**(b) (i)** For the ionic compound containing elements C and F, its formula was usually correct as were the charges and electron configuration of the anion. The common errors were dots and crosses interchanged, charges omitted and in a few cases a covalent compound was drawn.

**(ii)** High melting and boiling points and electrical conductivity, either when molten or in aqueous solution, were the usual properties given. Other acceptable suggestions were:

- brittle
- hard
- soluble in water
- any correct chemical property of calcium iodide.

A fairly small proportion of candidates gave the fact that it would not conduct in the solid form, this was not an acceptable answer.

**Question 4**

This question was not well answered – many candidates appearing to choose a response randomly from the list given. They had difficulty applying their knowledge of reactivity of familiar metals to unfamiliar ones. Particular problems were:

**(i)** iron was a frequent, but wrong, response
**(ii)** candidates appeared to make random selections, e.g. La and Pd
**(iii)** BaO was suggested rather than +2
**(iv)** chromium was more popular than the correct choices La or Ba
**(v)** the term "transition" (elements) was often spelt incorrectly and a common error in this part was that the metals were isotopes or even isomers.

**Question 5**

**(a) (i)** The completion of this relatively simple ionic equation proved to be highly discriminating. Many candidates did not seem to appreciate the nature of an ionic equation and included molecular formulae

**(ii)** The explanation for the volume ratio had to include moles or charges on ions or number of ions. It was not sufficient to comment that there was "2" in the equation. Examples of acceptable responses would include:

one mole of $Ca^{2+}$ would react with two moles of $F^-$
one mole of $CaCl_2$ would react with two moles of NaF
to balance the charges $Ca^{2+}$ and 2 $F^-$

Many explanations erroneously included the concept of electron transfer and redox. The same ions are present in both the reactants and the products, they simply change partners.

**(iii)** Only a small proportion of the candidates were aware that washing with distilled water was to remove **soluble** impurities but others believed that it was to remove impurities (in general) or even dirt and dust. Some discussed the merits of distilled water over tap water rather than the reason for washing.

**(iv)** The correct reason why the solid was heated was to dry it. Many thought the reason was to melt the solid or to help dissolve the solid or to form crystals or to remove water of crystallisation or to dehydrate the solid. There were a very few correct answers.

**(b)** Most of the candidates were unable to answer this part and many tried to identify T so that they could write the correct formula. The crucial point of the calculation is to realise that 8 $cm^3$ of the phosphate solution reacted with 12 $cm^3$ of an aqueous solution of the nitrate of metal T. This can be deduced from the graph.

As both solutions have the same concentration, the mole ratio is the same as the volume ratio which is 12:8 or 3:2.
The formula is $T_3(PO_4)_2$
This is the simplest way of finding the formula but most of the successful attempts by candidates followed the route outlined below.
Moles of T ions = 0.012, moles of $PO_4^{3-}$ ions = 0.008
Then as above, the mole ratio was followed by the formula.

**Question 6**

**(a)** The first parts of this question were well answered showing a good knowledge of the Haber process. A minority incorrectly identified the catalyst as vanadium(V) oxide.

**(b) (i)** Explanations of the term "equilibrium" were poor - candidates stating it is when the forward reaction is the same or balanced with the back reaction, omitting the word 'rate'. Concentrations of reactants and products were rarely mentioned and, if they were, they were said to be equal rather than constant.

**(ii)** The required response was that the percentage of ammonia <u>decreases</u> as the temperature <u>increases</u> or vice versa. Both of the underlined words were required.

**(c) (i)** The graph had to show an increase, either a straight line or a curve was accepted.

**(ii)** The two marking points were:
increase pressure favours the side with lower volume or the smaller number of molecules or moles that is the right hand side **or** products side etc.

**Question 7**

**(a)** A pleasing proportion of the candidates were able to use the bond energies and show the reaction to be exothermic. The most frequent error was not realising that as there are two moles of hydrogen chloride, its bond energy should have been doubled. This omission meant that the energy used breaking bonds was 678 kJ and the energy released forming bonds was only 431 kJ, according to these figures the reaction is endothermic. However, many candidates convinced themselves to the contrary and wrote that it was exothermic.

The marks were only awarded if the data supplied in the question was used, a general discussion, even if correct, did not score the marks.

The calculation is given below:

total endothermic change = 436 + 242 = 678 kJ
or energy used breaking bonds
total exothermic change = 2 x 431 = 862 kJ
or energy released in bond formation
change for reaction = 184 kJ
this energy released not used , the reaction is exothermic.
It was not necessary to calculate 184, just show that exo change > than endo.
Many candidates used the sign convention correctly and were awarded full marks.

Candidates should be encouraged to be careful in their choice of words – energy is needed to break bonds but not to form them. Many mistakenly wrote the energy needed to form the H—F bonds was 1124 kJ.

**(b) (i)** Most of the candidates were aware that a base is a proton acceptor and were awarded both marks. For stating that a base accepts a hydrogen ion, only one mark was awarded. Correct answers were "spoilt" by the inclusion of comments such as water can accept a proton because it forms $OH^-$ or the process involves redox. Candidates should be advised to answer questions on this topic by giving a precise definition - *a base is a proton acceptor* and do not attempt to qualify or improve this response.

**(ii)** and **(iii)** The commendable standard attained in **part (i)** was maintained in these parts. It was generally realised that hydrogen chloride was the stronger acid due to the higher percentage of ions and that this solution would have a lower pH value.

There were some answers for which marks could not be awarded as they did not explicitly identify the acid – *the one acid is a strong acid and the other one is weak*. Probably this was intended to mean hydrogen chloride and then hydrogen fluoride, the order which the acids were given in the question but this is not certain.

**Question 8**

**(a)** Predictably most candidates gained the first mark for stating that PLA was biodegradable but the second mark proved far more challenging. Widespread misconceptions were that PLA is cheaper and that because it is biodegradable it is easily recycled but the most popular was that it does not produce toxic gases on combustion. The combustion of all carbon-containing compounds, which includes PLA, can produce carbon monoxide when burnt.

Any two of the following marking points were needed:

- biodegradable or breaks down naturally
- made from a renewable source **or** does not use up petroleum
- reduce visual pollution **or** reduces need for landfill sites **or** less danger to wildlife.

**(b) (i)** Acceptable responses were:
ester **or** polyester **or** fat **or** lipid **or** vegetable oil **or** carboxylic acid. Terylene was not accepted as the question requires a **type** of compound. Whereas the majority offered one of the above correct responses, a minority offered amide, alkane, alkene, carbon dioxide and protein which are all incorrect.

**(ii)** The main error was omitting acid from carboxylic acid.

**(iii)** It was generally recognised that the type of polymerisation is condensation because in addition to the formation of the polymer, water is also formed. Inevitably a minority were attracted to addition polymerisation because of the double bond in the polymer fragment or because there was only one monomer. A single monomer does not preclude a condensation reaction any more than two monomers preclude addition. The number of products is the crucial determinant.

**(c) (i)** The usual errors were hydrogen or carbon dioxide instead of water but the majority gave a correct equation.
lactic acid → acrylic acid + water
A correct symbol equation was awarded the mark.

**(ii)** The marks were awarded for the following points:

- bromine water or bromine in an organic solvent
- remains brown / orange / yellow
- goes colourless The colour of the reagent must be shown somewhere to score all three marks. This year candidates used the correct term "colourless" not "clear" and gave full observations - a commendable improvement on previous years.

**(iii)** Despite the clear instruction not to use an indicator, many candidates did so and consequently could not score any marks. It was necessary to specify an appropriate reagent and then describe an observation. A section of the marking scheme will illustrate a selection of acceptable responses.

suitable named metal, any metal above hydrogen up to magnesium (**NOT** sodium or any metal which reacts with cold water or lead)
**NB** observation mark cannot score for these metals
gas / hydrogen / bubbles / effervescence / fizzing
if un-named metal [0] observation can score [1]

insoluble metal oxide e.g. magnesium oxide
colour change or dissolves
**NOT** forms a salt and water – this is not an observation but a comment

any carbonate or bicarbonate
gas / carbon dioxide / bubbles / effervescence / fizzing

sodium hydroxide or alkali
temperature increase **or** accept indicator to show neutralisation, unspecified base scores [1] only

**Question 9**

**(a)** Many candidates gave the empirical formula from their knowledge of the elements rather than using the percentages in the question, but those using this information regularly established the correct ratio of 3:2 but then divided by 2 which gave 1.5:1. This was then rounded - sometimes to 1:1 and sometimes to 2:1, giving the formulae MgN and $Mg_2N$.
Moles of Mg 72/24 = 3 moles of N 28/14 = 2
$Mg_3N_2$

**(b)** Mostly correct with a few candidates using a higher stoichiometry than the simplest one. They multiplied the number of moles given in the question by 100 and arrived at this equation.

$3Al_4C_3 + 36H_2O \rightarrow 12Al(OH)_3 + 9CH_4$

Although this equation was awarded both marks, it should have been cancelled to give:

$Al_4C_3 + 12H_2O \rightarrow 4Al(OH)_3 + 3CH_4$

**(c) (i)** Many candidates stated that silicon was the limiting reagent, possibly since they thought that the low number of moles was the reagent with the least amount. The majority calculated the moles of $Br_2$ although 80 or 320 were used as the $M_r$ rather than 160. In many instances the correct reasoning comparing the moles was given but not always in a logical manner. Two of the methods used to solve this problem are given below.

**method 1**
moles of Si = 0.07 moles of $Br_2$ = 25/160 = 0.156
0.07 moles of Si would react with 0.14 moles of $Br_2$
But 0.156 > 0.14 therefore bromine is in excess
Silicon is the limiting reagent

Candidates might be advised that the phrase *moles of* must be followed by a symbol for atoms or a formula for molecules. This would have avoided the confusion with the mole ratio when moles of Br or $Br_2$ or $2Br_2$ were all calculated. The best practice in this type of calculation is to calculate moles of $Br_2$ and <u>then</u> use the ratio $1Si{:}2Br_2$.

**method 2**
0.07 moles of Si would react with 0.14 moles of $Br_2$
0.14 moles of $Br_2$ are 0.14 x 160 = 22.4 g
this less than the 25 g of bromine present
silicon is the limiting reagent

**(ii)** If a candidate showed some appreciation of the concept of a limiting reagent in **(i)**, then this part was usually correct – 0.07 moles of Si would form 0.07 moles of $SiBr_4$.

# CHEMISTRY

**Paper 0620/32**

**Extended Theory**

## General Comments

Examiners commented on the lack of initial thought and planning of many of the answers. Candidates gave the impression that they were aware of the salient facts and concepts but failed to be awarded marks because there was a lack of coherence, focus and structure in the response. There was often insufficient structure and relevant content. Comments of this type were made by a number of Examiners.

Candidates should be advised to read the question carefully, then think and finally write. This should ensure that they answer the question asked on the paper.

It is pleasing to report that answers to questions which have been deleted and rewritten elsewhere in the paper have almost invariably been clearly referenced. This is a great improvement on previous years.

The perennial comment about handwriting still needs to be repeated, if after every reasonable effort to decipher the comment, the examining team cannot ascertain the candidate's intentions then marks cannot be awarded. This idea needs to be extended to diagrams, it is essential that they are drawn carefully and all relevant detail is quite clear. In **Question 1(a)(i)**, it had to be obvious that the original spot is above the level of the solvent before the mark could be awarded.

## Individual Questions

### Question 1

**(a) (i)** Some very clear, accurate drawings of apparatus suitable for chromatography were seen, but there were a significant number of poor quality diagrams lacking in clarity and with inadequate labelling. Many candidates positioned the sample below the level of the solvent, others omitted a suitable container or did not show more than one spot on the chromatogram.

**(ii)** A high proportion of the candidates realised that it was necessary to run a chromatogram of pure chlorophyll and compare it with the chromatogram of the grass extract. A comparison based on colour did not suffice and the most common error was to not mention that the green pigment from grass would have the same Rf value or be the same height above the base line as pure chlorophyll.

**(b)** The role of chlorophyll was generally well known, many candidates were awarded full marks. Three of the following points were required:

- (chlorophyll is a) catalyst
- photosynthesis **or** chloroplasts
- photochemical reaction **or** needs light
- carbon dioxide + water form
- glucose **or** starch **or** oxygen **NOT** sugar.

Typical errors were:

- glucose decomposed to form carbon dioxide and water
- respiration was described not photosynthesis
- the omission of one of the two reactants.

**Question 2**

Some weak responses were seen, showing a poor understanding of electrolysis. Products at the anode and cathode were regularly confused. The state of the electrolyte was essential, molten was often omitted from lithium chloride and aqueous from potassium bromide. Although the question stated dilute aqueous sodium chloride, most answers were for the concentrated solution. Copper was the only product consistently identified although it was often incorrectly written as copper(II).

**Question 3**

**(a)** The majority of candidates scored marks on this question. **Parts (i)** and **(ii)** were usually correct and **part (v)** presented the most problems. The significance of the phrase "a diatomic gas" was not recognised and element F, which is iodine, was frequently suggested as the answer to **(v)**.

**(b) (i)** For the ionic compound containing elements C and A, its formula was usually correct as were the charges and electron configuration of the anion. The common errors were dots and crosses interchanged, charges omitted and in a few cases a covalent compound was drawn.

**(ii)** High melting and boiling points and electrical conductivity, either when molten or in aqueous solution, were the usual properties given. Other acceptable suggestions were:

- brittle
- hard
- soluble in water
- basic.

A fairly small proportion of candidates gave the fact that it would not conduct in the solid form, this was not an acceptable answer.

**Question 4**

This question was not well answered – many candidates appearing to choose a response randomly from the list given. They had difficulty applying their knowledge of reactivity of familiar metals to unfamiliar ones. Particular problems were:

**(i)** iron was a frequent, but wrong, response
**(ii)** candidates appeared to make random selections, e.g. La and Pd
**(iii)** BaO was suggested rather than +2
**(iv)** chromium was more popular than the correct choices La or Ba
**(v)** the term "transition" ( elements) was often spelt incorrectly and a common error in this part was that the metals were isotopes or even isomers.

**Question 5**

**(a) (i)** The completion of this relatively simple ionic equation proved to be highly discriminating. Many candidates did not seem to appreciate the nature of an ionic equation and included molecular formulae.

**(ii)** The explanation for the volume ratio had to include moles or charges on ions or number of ions. It was not sufficient to comment that there was "3" in the equation. Examples of acceptable responses would include:

one mole of $Fe^{3+}$ would react with three moles of $F^-$
one mole of $FeCl_3$ would react with three moles of NaF
to balance the charges $Fe^{3+}$ and $3F^-$

Many explanations erroneously included the concept of electron transfer and redox. The same ions are present in both the reactants and the products, they simply change partners.

**(iii)** Only a small proportion of the candidates were aware that washing with distilled water was to remove **soluble** impurities but others believed that it was to remove impurities (in general) or even dirt and dust. Some discussed the merits of distilled water over tap water rather than the reason for washing.

**(iv)** The correct reason why the solid was heated was to dry it. Many thought the reason was to melt the solid or to help dissolve the solid or to form crystals or to remove water of crystallisation or to dehydrate the solid. There were a very few correct answers.

**(b)** Most of the candidates were unable to answer this part and many tried to identify T so that they could write the correct formula. The crucial point of the calculation is to realise that 6 $cm^3$ of the phosphate solution reacted with 18 $cm^3$ of an aqueous solution of the nitrate of metal T. This can be deduced from the graph.

As both solutions have the same concentration, the mole ratio is the same as the volume ratio which is 18:6 or 3:1.
The formula is $T_3PO_4$
This is the simplest way of finding the formula but most of the successful attempts by candidates followed the route outlined below.
Moles of T ions = 0.018, moles of $PO_4^{3-}$ ions = 0.008
Then as above, the mole ratio was followed by the formula.

**Question 6**

**(a)** The first parts of this question were well answered showing a good knowledge of the Haber process. A minority incorrectly identified the catalyst as vanadium(V) oxide.

**(b) (i)** Explanations of the term “equilibrium” were poor - candidates stating it is when the forward reaction is the same or balanced with the back reaction, omitting the word ‘rate’. Concentrations of reactants and products were rarely mentioned and, if they were, they were said to be equal rather than constant.

**(ii)** The required response was that the percentage of ammonia <u>increases</u> as the pressure <u>increases</u> or the percentage of ammonia <u>decreases</u> as the pressure <u>decreases</u> . Both of the underlined words were required.

**(c) (i)** The graph had to show a decrease, either a straight line or a curve was accepted.

**(ii)** The two marking points were:

increased temperature favours the endothermic reaction
that is left hand side **or** reactants side **or** less ammonia at equilibrium
the corresponding exothermic argument was accepted.

**Question 7**

**(a)** A pleasing proportion of the candidates were able to use the bond energies and show the reaction to be exothermic. The most frequent error was not realising that as there are two moles of hydrogen fluoride, its bond energy should have been doubled. This omission meant that the energy used breaking bonds was 594 kJ and the energy released forming bonds was only 562 kJ, according to these figures the reaction is endothermic. However, many candidates convinced themselves to the contrary and wrote that it was exothermic.

The marks were only awarded if the data supplied in the question was used, a general discussion, even if correct, did not score the marks.

The calculation is given below:

total endothermic change = 436 + 158 = 594 kJ
or energy used breaking bonds
total exothermic change = 2 x 562 = 1124 kJ
or energy released in bond formation change for reaction = 530 kJ
this energy released is not used, the reaction is exothermic.

It was not necessary to calculate 530, just show that exo change > than endo.
Many candidates used the sign convention correctly and were awarded full marks.

Candidates should be encouraged to be careful in their choice of words – energy is needed to break bonds but not to form them. Many mistakenly wrote the energy needed to form the H—F bonds was 1124 kJ.

**(b) (i)** Most of the candidates were aware that a base is a proton acceptor and were awarded both marks. For stating that a base accepts a hydrogen ion, only one mark was awarded. Correct answers were "spoilt" by the inclusion of comments such as water can accept a proton because it forms $OH^-$ or the process involves redox. Candidates should be advised to answer questions on this topic by giving a precise definition - *a base is a proton acceptor* and do not attempt to qualify or improve this response.

**(ii)** and **(iii)** The commendable standard attained in **part (i)** was maintained in these parts. It was generally realised that hydrogen chloride was the stronger acid due to the higher percentage of ions and that this solution would have a lower pH value.

There were some answers for which marks could not be awarded as they did not explicitly identify the acid – *the one acid is a strong acid and the other one is weak*. Probably this was intended to mean hydrogen chloride and then hydrogen fluoride, the order which the acids were given in the question but this is not certain.

**Question 8**

**(a)** Predictably most candidates gained the first mark for stating that PLA was biodegradable but the second mark proved far more challenging. Widespread misconceptions were that PLA is cheaper and that because it is biodegradable it is easily recycled but the most popular was that it does not produce toxic gases on combustion. The combustion of all carbon-containing compounds, which includes PLA, can produce carbon monoxide when burnt.

Any two of the following marking points were needed:

- biodegradable or breaks down naturally
- made from a renewable source **or** does not use up petroleum
- reduce visual pollution **or** reduces need for landfill sites **or** less danger to wildlife.

**(b) (i)** Acceptable responses were:
ester **or** polyester **or** fat **or** lipid **or** vegetable oil **or** carboxylic acid.
Terylene was not accepted as the question requires a **type** of compound.
Whereas the majority offered one of the above correct responses, a minority offered amide, alkane, alkene, carbon dioxide and protein which are all incorrect.

**(ii)** The main error was omitting acid from carboxylic acid.

**(iii)** It was generally recognised that the type of polymerisation is condensation because in addition to the formation of the polymer, water is also formed. Inevitably a minority was attracted to addition polymerisation because of the double bond in the polymer fragment or because there was only one monomer. A single monomer does not preclude a condensation reaction any more than two monomers preclude addition. The number of products is the crucial determinant.

**(c) (i)** The usual errors were hydrogen or carbon dioxide instead of water but the majority gave a correct equation.
lactic acid → acrylic acid + water
A correct symbol equation was awarded the mark.

**(ii)** The marks were awarded for the following points:

- add bromine water or bromine in an organic solvent
- remains brown / orange / yellow
- goes colourless.

The colour of the reagent must be shown somewhere to score all three marks.

This year, candidates used the correct term “colourless” not “clear” and gave full observations - a commendable improvement on previous years.

**(iii)** Despite the clear instruction not to use an indicator, many candidates did so and consequently could not score any marks. It was necessary to specify an appropriate reagent and then describe an observation. A section of the marking scheme will illustrate a selection of acceptable responses.

suitable named metal, any metal above hydrogen up to magnesium
(**NOT** sodium or any metal which reacts with cold water or lead)
**NB** observationt mark cannot score for these metals
gas / hydrogen / bubbles / effervescence / fizzing
if un-named metal [0] observation can score [1]

insoluble metal oxide e.g. magnesium oxide
colour change or dissolves
**NOT** forms a salt and water – this is not an observation but a comment

any carbonate or bicarbonate
gas/carbon dioxide/bubbles/effervescence/fizzing

sodium hydroxide or alkali
temperature increase **or** accept indicator to show neutralisation unspecified base scores [1] only

**Question 9**

**(a)** Many candidates gave the empirical formula from their knowledge of the elements rather than using the percentages in the question, but those using this information regularly established the correct ratio of 3:2 but then divided by 2 which gave 1.5:1. This was then rounded - sometimes to 1:1 and sometimes to 2:1, giving the formulae MgN and $Mg_2N$.
Moles of Mg 72/24 = 3 moles of N 28/14 = 2
$Mg_3N_2$

**(b)** Mostly correct - with a few candidates using a higher stoichiometry than the simplest one. They multiplied the number of moles given in the question by 100 and arrived at this equation.

$3Al_4C_3 + 36H_2O \rightarrow 12Al(OH)_3 + 9CH_4$

Although this equation was awarded both marks, it should have been cancelled to give:

$Al_4C_3 + 12H_2O \rightarrow 4Al(OH)_3 + 3CH_4$

**(c) (i)** Many candidates stated that silicon was the limiting reagent - possibly because they thought that the reagent with the lower number of moles was the limiting one. The majority calculated the moles of $F_2$ although 19 or 76 were used as the $M_r$ rather than 38. In many instances the correct reasoning comparing the moles was given but not always in a logical manner. Two of the methods used to solve this problem are given below.

**method 1**
moles of Si = 0.08 moles of $Fr_2$ = 7.2/38 = 0.189
0.08 moles of Si would react with 0.16 moles of $F_2$
But 0.189 > 0.16 therefore fluorine is in excess
Silicon is the limiting reagent

Candidates might be advised that the phrase *moles of* must be followed by a symbol for atoms or a formula for molecules. This would have avoided the confusion with the mole ratio when moles of F or $F_2$ or $2F_2$ were all calculated. The best practice in this type of calculation is to calculate moles of $F_2$ and <u>then</u> use the ratio $1Si:2F_2$.

**method 2**
0.08 moles of Si would react with 0.16 moles of $F_2$
0.16 moles of $F_2$ are 0.16 x 38 = 6.08 g
this less than the 7.2 g of fluorine present silicon is the limiting reagent

**(ii)** If a candidate showed some appreciation of the concept of a limiting reagent in **(i)**, then this part was usually correct – 0.08 moles of Si would form 0.08 moles of $SiF_4$.

# CHEMISTRY

**Paper 0620/04**

**Coursework**

## General comments

Most of the Centres entering for this component had entered before and were experienced in correctly applying the criteria to candidates work. The few new Centres which entered produced some good work and it was only rarely that any adjustments were required to the marks of either group.

The tasks used by Centres to assess their candidates vary widely from the very simple and straightforward to very lengthy and complex tasks. Centres should be aware that very complex tasks are not necessary and can disadvantage weaker candidates. However, some Centres have candidates who cope well with such tasks and their candidates are to be commended. It is sometimes the case that Centres use tasks which are too straightforward and which do not give candidates the opportunity to demonstrate the skills necessary to gain higher marks. Further comments on this problem will be found under the sections on individual skills.

Some Centres use the minimum number of assessment tasks (4). This is fine, if time is limited but can disadvantage candidates as they only have one chance to gain the necessary levels. Other Centres use very many tasks and candidates must feel that they are being assessed all the time. The ideal is somewhere between the two extremes, giving the candidates a fair chance without overburdening them with assessment.

## Comments on the different skills.

### [C1]

This is assessed by the teacher as the candidates conduct their practical. No evidence is needed but Centres should submit mark schemes and a tick list showing how candidates achieved their marks.

To gain 6 marks the candidates need to 'modify or adjust' one step in the procedure. It is not intended that they need to change the whole method (this is part of skill C4) but only to make a decision as to which of two possible actions needs to be taken at some point in the procedure. This could be something as simple as deciding when the crystallisation point has been reached when preparing crystals of a salt.

### [C2]

It is intended that candidates should demonstrate their ability to make both quantitative and qualitative observations though not necessarily in the same exercise. If the task is too simple, such as heating a solid and observing a colour change, it is not going to be possible to give high marks. The same applies to the recording of a temperature or a mass if it is done in isolation.

This skill is concerned with making and recording observations. The drawing of graphs is part of skill C3.

### [C3]

The limiting factor here is Centres giving the candidate too much guidance as to what is required. For the higher marks it is not sufficient for them to simply answer a set of leading questions. It must be clear that they understand what they are doing. When graphs are drawn they should be of a suitable size (filling a minimum of half an A4 sheet), be accurately plotted and completed with a 'best fit' line or curve.

It is important that the controlled variable be on the 'x' axis and the dependant variable on the 'y' axis.

**[C4]**

It is important that the tasks set give the candidates the opportunity to demonstrate their understanding of the control of variables not being investigated. If the task is too simple and only two factors are involved, this is not possible.

It is also necessary for the candidates to actually carry out the planned investigation, otherwise, they cannot talk about the weaknesses of the method and possible improvements.

It can be a disadvantage if candidates are assessed in skills C2 and C3 on these exercises as a poor method can give poor results. They should ideally have other opportunities to demonstrate these skills.

Skill C1 cannot be assessed in a C4 task as it involves the following of instructions. There should be no instructions to follow in a C4 task other than those the candidate wrote themselves.

Centres are thanked for all the effort which goes into the preparation of samples sent for moderation. The Moderators appreciate these efforts which make their task more straightforward.

# CHEMISTRY

**Paper 0620/05**

**Practical**

## General comments

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

Centres reported few problems in obtaining the necessary chemicals and preparing materials for the examination.

**Question 1** showed the complete range of marks and was a good discriminating question.

**Question 2** was well answered by the majority of candidates.

## Comments on specific questions

### Question 1

The five experiments were carried out by the majority of candidates despite a small number of Supervisors reporting that they were pushed for time.

The table of results was generally completed fully and successfully. The most common error was to have the final temperature for an experiment higher than the initial temperature. Average temperatures were generally calculated correctly. A significant number of candidates did not record the times in seconds and were penalised.

**(a)** The points were usually correctly plotted. Some candidates were confused due to the different scale on each axis. Attempts at a smooth curve were variable. Some candidates joined up all of the points with a ruler while others were unable to draw a best-fit curve. Straight lines were not uncommon.

**(b)** Vague references to cloudy and milky scored no credit. Credit was given for a description including the colour white or cream or yellow. Green scored no credit.

**(c) (i)** Most candidates correctly answered this question. A few gave Experiment 1, which showed a lack of understanding. Some gave Experiment 6!

**(ii)** A good discriminating question which only the more able candidates managed to successfully attempt. Most explanations were based on 'it was hotter/at a higher temperature' rather than in terms of particles gaining energy and moving faster thus resulting in more collisions. The idea of heat as a catalyst was prevalent.

**(d)** The idea of a fair test or comparing the effect of the temperatures was realised by most candidates.

**(e) (i)** A good discriminating question. Good candidates successfully extrapolated their graph and read the temperature correctly. A lack of units or incorrect units was common. A common error was not to use the graph as requested. Some candidates assumed that 70 °C was the initial temperature and tried to work out a final temperature and then got the time for that temperature.

**(ii)** Only the more able candidates sketched a curve on the grid to the left of their experimental curve.

**(f)** Many candidates scored some credit with a correct idea of an improvement. Vague references to accuracy scored no credit i.e. 'repeat the experiments to obtain more accurate results' scored one mark while 'repeat and obtain average results' scored two marks. Some suggested keeping the temperature the same, which makes the investigation pointless.

**Question 2**

**(a) and (d)** The majority of candidates scored the mark for giving the correct colours. Some gave 'powder' and missed out the colour.

**(b)** Poorly answered. A small number of candidates recorded the formation of bubbles/fizzing/effervescence.

**(c)** Some candidates gave 'green' instead of blue. It was apparent that some candidates were not following the instruction 'leave to stand for 1 minute' as they recorded the colour as black.

In **(i)** the majority of candidates correctly identified the formation of a blue precipitate, but sometimes it was given as black. The colour after heating was often missed out.

In **(ii)** the two sections tended to merge but many correct answers were seen. Poor answers referred to soluble precipitates or insoluble solutions forming.

**(e)** Very few candidates commented on the fizzing or bubbles produced. Many candidates got the splint to relight but many commented on the splint popping and ignored the relighting. Vague answers included 'the splint put or went off'.

**(f) (i)** Vague answers did not compare the vigour of the two reactions.

**(ii)** Some answers mistakenly referred to hydrogen or carbon dioxide instead of oxygen.

**(g)** A good discriminating question with the quality of answer often being Centre dependent. The presence of copper was often recognised. A few candidates thought solid **S** contained iron or aluminium.

**(h)** A minority of candidates successfully identified the presence of manganese oxide or a transition metal or a catalyst. Many candidates thought that solid **V** was carbon or more concentrated copper oxide. Others quoted metal oxides because of the oxygen given off.

# CHEMISTRY

**Paper 0620/06**
**Alternative to Practical**

## General comments

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

Candidates found **Questions 4(c)**, **5(g)** and **6** to be the most demanding. Some Centres had not covered all sections of the syllabus. As in previous years most candidates had a good knowledge of basic practical techniques. The majority of candidates were able to complete a table of results from readings on diagrams and plot points successfully on a grid as in **Question 4**.

## Comments on specific questions

### Question 1

**(a)** The naming of the pieces of apparatus was generally well answered. Many candidates were unable to name the balance - many referred to weighing machines and scales. The stirrer was sometimes labelled as a thermometer or stick. Some candidates labelled the beaker as a flask.

**(b) (i)** The term excess was given by the more able candidates. Residue and precipitate were common incorrect answers

**(ii)** Generally well answered though some candidates used heating methods.

**(c)** Most candidates scored one mark for heating or evaporation of the solution. The idea of heating to crystallising point or until the solution was saturated was only realised by better candidates. A number of candidates just wrote ‘crystallisation’ or discussed the drying of the crystals and scored no credit.

### Question 2

**(a)** Most candidates realised that the solutions were left to stand to reach the same or room temperature. A minority were confused and discussed issues connected with the reaction going to completion or allowing impurities to settle.

**(b)** Most candidates gave the correct answer. A significant number mistakenly thought that the glass would react while others wrote about the glass shattering or breaking.

**(c)** Neutralisation scored no credit as this information was given in the stem of the question. A minority of candidates thought the reaction was endothermic.

**(d)** A good discriminating question. The inaccurate point was usually correctly identified. ‘The one at 30°C’ scored no credit, as there were two points at this temperature.
Some lines of best fit were seen and some candidates seemed unable to draw straight lines – freehand lines were common. In **part (iii)** many candidates were unable to read the volume from the intersection of the two straight lines and 10 or 25 were common answers. The unit was often correct.

 

**Question 3**

Some excellent answers were seen which often scored full credit. However, it also scored low marks for some candidates. Some candidates tried to give observations without any test reagent and were penalised.

**(a)** Generally well answered using a dilute acid. The use of limewater as a test reagent was seen. Some vague answers referred to the halide test but missed out the nitric acid. Chloride was often confused with chlorine.

**(b)** A number of candidates used an unnamed indicator. Most used litmus and scored full credit. A minority confused the colours for ammonia and some did not realise that chlorine bleached the indicator and just gave the change to red.

**(c)** The majority scored full credit. A few candidates added a dilute acid instead of sodium hydroxide or ammonia.

**Question 4**

**(a)** The table of results was usually completed correctly. The readings for experiments 3 and 4 were commonly incorrect. In some Centres the candidates were unable to calculate the average temperatures and worked out the differences instead.

**(b)** Most candidates plotted the points correctly but the different scales confused some. Smooth curves were not always drawn and joining points using a ruler were seen.

**(c) (i)** A few candidates gave experiment 1 but most were correct.

**(ii)** Centre dependent. The question discriminated well as better candidates answered in terms of particles. Weaker candidates gave vague answers involving reference to higher temperatures or heat.

**(d)** Most candidates understood the idea of a fair test or that the temperature was being investigated. Some poor attempts mentioned 'for accuracy'.

**(e) (i)** Candidates found this difficult. Only the more able candidates were capable of extrapolating the line correctly and others tried reading the value at 65°C. The unit given for the time was often missing or incorrect e.g. °C.

**(ii)** The line sketched often joined the existing line at the beginning or was often just left out.

**(f)** Use of a burette or repeat experiments were the common correct responses. The idea of repeating to obtain accurate values was a common error when the idea of averaging the results was required. A minority correctly described methods to reduce heat loss by insulation methods.

**Question 5**

**(c) (i)** Generally well answered. Insoluble in excess was a common incorrect response.

**(ii)** The responses were Centre dependent. Random guesses were frequent and confusion was common e.g. 'the blue precipitate dissolved to give a dark blue precipitate'. Some candidates missed both points with the excess ammonia and gave only dark blue or solution/soluble.

**(iii)** No reaction or change was a common error. A variety of coloured precipitates other than white were seen.

**(f)** Well answered by the majority of candidates. Carbon dioxide and hydrogen were sometimes seen instead of oxygen.

**(g)** Only the better candidates scored credit. Those that recognised a catalyst got confused and claimed magnesium oxide was present. Common incorrect answers included more concentrated copper(II) oxide, copper(III) oxide, Group 1 oxides and various carbonates. Few seemed to realise that the oxygen was formed from the hydrogen peroxide.

**Question 6**

**(a)** Most candidates used the berries. It was common to miss out the water and other solvents were used despite the question specifying an aqueous solution. Some candidates were totally confused and added acid to berries. Chromatography and descriptions of chromatography were another common incorrect answer.

**(b)** Base was often used instead of alkali. Some candidates used only an acid or an alkali. A correct description of a titration using an acid and alkali commonly scored marks. The most common missing factor was 'different colours in each' and many vaguely discussed colour changes. Some candidates seemed to think that they had to test the berry indicator to see if it was acidic and added Universal Indicator to it. Others used named indicators to test acids and alkalis and ignored the use of the berry indicator.