

CHEMISTRY

Paper 5070/01
Multiple Choice

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

General Comments

A large number of questions were high scoring, amongst these were **Questions 5, 9, 14, 21, 23, 27, 30, 31** and **37**. However, only one question on the paper failed to satisfactorily discriminate between the candidates.

Comments on Individual Questions

Question 7

The answers to this question were split between the alternatives A and B. In deciding between alternatives A and B the candidates had to realise the full implication of the word element in the stem of the question. The word element immediately removed any alternative containing the word sand from the possible answers and thus alternative B could be eliminated.

Question 20

As in question seven, careful reading of the question was imperative in order to arrive at the correct answer. During the titration described in the question, the pH of the solution would increase to 7 as indicated in alternative C, and mistakenly shown as the answer by almost fifty percent of candidates. However, the last eight words of the second sentence in the stem meant that the pH would eventually reach a value of 12.

Question 28

All sodium salts are soluble and therefore sodium carbonate and sodium nitrate could not have been solid Y, although sodium carbonate was a very popular answer.

Question 33

Petrol is a mixture of hydrocarbons and on combustion will release carbon dioxide and steam. If methane had been present in petrol it would have produced carbon dioxide and steam on combustion and thus alternative A was incorrect.

Question 36

The fact that ethene decolourised aqueous bromine was known by most of the candidates and consequently the choice of answer was in the most part between alternatives A and C. The solubility of ethene could then be deduced by its method of collection, which was shown on the diagram.

Question 38

Isomer B was chosen incorrectly by over forty percent of candidates, although counting the number of carbon and hydrogen atoms in the isomer B would have shown that its molecular formula was the same as that of pentane shown in the stem of the question.

CHEMISTRY

Paper 5070/02

Theory

General comments

Many candidates tackled the paper well and good answers were seen in many parts of the paper especially in **Questions A1, A3, A4** and **A7**. In general, the rubric was well interpreted and most candidates attempted all parts of each question. It was encouraging to note that many candidates had a good grasp of the tests for iron(II) ions and nitrate ions (**Question A6 parts (d) and (e)**). Many candidates had difficulty explaining structures especially related to properties e.g. **Question A2** although the same candidates were capable of drawing good 'dot-and-cross' diagrams (**Question A5**). A considerable number of candidates had difficulty in writing ionic equations although most candidates made a good attempt at writing full symbol equations and drawing the structure of specific organic compounds. There were only a few instances where candidates disadvantaged themselves by giving multiple answers. It was encouraging to note that most candidates gained at least half the marks available for the calculation questions although **B8(b)(ii)** and **B10(a)** proved difficult for a minority. Candidates should be advised not to round up in the middle of their calculations, only at the end – this resulted in some incorrect answers but fewer than in previous sessions. Although some candidates who scored well on **section A** failed to maintain this standard in **section B** many performed equally well in both parts of the Paper and a significant number performed better in **section B**. Most candidates wrote to the point and it is encouraging to note that many concentrated on the main requirements of the question and did not put in too much extraneous material. The standard of English was generally good and there were few instances of mis-used words although in **Question B10** the word marine was sometimes used in relation to water in streams and lakes. In **section B** there did not appear to be any one question which was unpopular. The new format of **section B**, however, did have the effect of leading more candidates than usual to answer all four questions rather than the three required.

Comments on specific questions

Section A

Question A1

This question was almost invariably well answered with most candidates gaining at least four of the five marks available. **Parts (d) and (e)** were generally least well answered.

- (a) This was generally correctly answered, although some incorrectly suggested sulfuric acid, presumably through misreading the question by just focusing on the words 'Contact process'.
- (b) Nearly all candidates correctly chose copper(II) chloride as a compound which gave a blue precipitate with sodium hydroxide.
- (c) Most candidates realised that ethanoic acid is a weak acid. The commonest incorrect answer was hydrochloric acid. Few put sulfuric acid.
- (d) This was the least well done part of **Question A1**. A significant proportion of the candidates gave the incorrect answers chlorine, manganese(IV) oxide or sulfuric acid.
- (e) Although a wide range of possible oxidising agents were chosen by the candidates as a whole, the most popular correct answer was potassium dichromate. Sodium chloride was a not infrequently seen incorrect answer.

Question A2

Many candidates found this question challenging. It is clear that many do not analyse the diagrams of the structures and mistake atoms for ions. Candidates should realise that the Examiners will generally show ionic structures with + and – charges and intermolecular forces by dashes or dots. Many candidates wrote about atoms and bonds in general rather than focusing on the structures (layers in **part (a)** or the giant structure in **part (c)**). As in previous sessions, many candidates had difficulties with the concept of (lack of) moving electrons in **part (b)** and just wrote about moving molecules or ions.

- (a) Although many candidates gained a mark for mentioning the layers sliding over each other, few scored the mark for stating that the forces between the layers are weak. Common errors included (i) writing about the atoms moving over each other, (ii) the idea that the forces between the layers are covalent bonds – including statements such as weak covalent bonds, (iii) writing about ions moving over each other, (iv) writing about weak forces but not stating where they were.
- (b) Many candidates knew that non-conduction was due to something not moving but it was all too often the incorrect particle e.g. atoms or ions.
- (c) Few candidates scored both marks here. Although many mentioned strong covalent bonds few indicated that there were many bonds (macromolecule / giant structure / covalent lattice / lots of bonds). A considerable number of candidates gained a mark from realising that the structure was hard. Many muddled hard with strength or gave rather vague answers. Far fewer candidates gained the mark for high melting point.

Question A3

This question was generally well answered. Although most candidates could identify the electrode product in the table, fewer could explain why chlorine was liberated at the anode in **part (a)(iii)**. In **part (b)(i)** many candidates failed to realise that the question referred to the electrolysis using two copper electrodes rather than different electrodes. Some candidates had great difficulty interpreting the results in the table because they failed to select the relevant data to compare i.e. searching for data pairs where two of the variables were the same. This resulted in an unexpectedly large number of candidates failing to gain a mark for the lack of effect of temperature in **part (b)(ii)**.

- (a) (i) Although this part was generally answered well, some candidates reversed copper and oxygen when considering the products of electrolysis of aqueous copper(II) sulfate. In addition, it was not uncommon for candidates to suggest hydrogen was formed at the cathode. Most candidates were able to write the ions present in dilute sulfuric acid. The commonest errors were to suggest oxide ions instead of hydroxide ions and for incorrectly copying the formula for the sulfate ion.
 - (ii) This part was well answered although some candidates lost marks by a failure to compare the elements in the reactivity series, merely stating that sodium has a high reactivity.
 - (iii) The quality of the answers here was very centre-specific. Most candidates failed to gain a mark because they wrote about chlorine ions rather than chloride ions or merely rephrased their answer to **part (ii)** stating that chlorine was more reactive. Other common errors included (i) sodium chloride is more concentrated, (ii) the ion with the highest concentration is discharged – without being specific.
- (b) (i) A considerable number of candidates ignored the fact that both electrodes were copper and so wrote 'electroplating' and often including electroplating of other metals e.g. silver/ iron. Many gave answers relating to the extraction of metals, a not inconsiderable number even referring to the extraction of aluminium.
 - (ii) Many candidates struggled to extract the relevant data from the table and did not understand how to select the relevant data to compare i.e. the effect of current on the mass of copper deposited. The effect of temperature was particularly badly done, with only about half the candidates getting the correct answer, perhaps because they were expecting a definite relationship where there was not one. There were many confused answers. A common error was to suggest that, for example, the mass deposited increased up to a certain point then stayed level as the current increased. Many candidates wrote vague statements such as 'the mass goes up and down with the current' or the 'current increases the amount copper deposited' (no indication of whether the current is increasing or decreasing).

Question A4

Most candidates scored four or five marks for this question. The part least well done was **(b)** but there were also some characteristic errors in filling in the table in **part (a)** e.g. inverting the relative masses of the electron and neutron.

- (a) The table was generally filled in with the correct charges and masses. Common errors were (i) failure to put a plus charge for the proton, (ii) to give the electron a mass of 1 unit, (iii) to suggest that the relative mass of a neutron was 0. There were only a few instances of totally incorrect numbers being put down and these often related to the diagram in the stem of the question e.g. 6 (mistaking number of neutrons for the charge on the neutrons)
- (b) Nearly all candidates correctly identified the correct nucleon and proton number but few wrote the correct formula for boron.
- (c) Most candidates drew good diagrams of a suitable isotope of X. Common errors were (i) incorrect numbers / arrangements of the electrons (ii) drawing 6 neutrons.

Question A5

Although many candidates scored fairly well on this question, fewer scored full marks in **part (b)** sometimes due to failure to represent all the electrons in the ions. If only the outer shell electrons are required, the Examiners will usually draw the candidates' attention to this, as in **part (a)**. If there is no statement to this effect, candidates should assume that all electrons have to be drawn.

- (a) Most candidates drew good 'dot-and-cross' diagrams. Only a handful drew ionic structures. The commonest errors were to omit some of the electrons in the chlorine atoms or to add extra electrons around the carbon. Some candidates drew the bonding pairs of electrons in a 'sausage' connecting the chlorine and carbon atoms. While this was not penalised on this occasion, it should be discouraged as being not standard practice.
- (b) The structure of the calcium ion and the chloride ion was not always well known. Common errors included (i) giving calcium a charge of +1, (ii) bracketing the two chlorine atoms and giving an overall charge – often of -1, (iii) drawing the diagram with arrows showing the origin of the electron and its destination but showing the electron in both atoms, therefore implying that the chloride ion has nine electrons in its outer shell, (iv) leaving two outer electrons on the outer shell of the calcium.

Question A6

Many candidates gained over half marks for this question. It was encouraging to note that the test for nitrate ions was well known. However, the context of the tests for iron(II) and calcium ions made **part (d)** considerably more difficult. Most candidates gained at least one mark for the calculation in **part (c)** but only a minority were able to interpret the data in the table to successfully answer **part (b)**.

- (a) This was generally well answered. The commonest reasons for not gaining a mark were either writing the name rather than the formula or writing the incorrect formula for calcium nitrate. A not inconsiderable number of candidates wrote formulae for compounds that could not have been derived from the table e.g. CaCl_2 .
- (b) Only a minority of candidates gave convincing answers here. Many were thinking of acids in general and gave the answer 'acidic because nitric acid is formed'. Although many identified the hydrogen ion, they failed to get the mark because they went on to imply that nitrate ion was also acidic.
- (c) The commonest error in the calculation was a misreading of the stem of the question. Many candidates read 25 dm^3 as 25 cm^3 and consequently divided by 1000. However most gained one mark for multiplying their answer by 56 in order to obtain the mass. [correct answer = 630 g]

- (d) Only a minority of candidates scored two marks or more here. Many wrote the correct colour of the precipitates but failed to mention the word precipitate. Very few mentioned the names of the precipitates – the ‘explain’ part of the question. Quite a few candidates thought incorrectly that the precipitates redissolved. A large number of candidates wrote about pH changes, gases given off and action of litmus.
- (e) Many candidates scored all four marks for the correct answer to the nitrate test. Those scoring three marks generally omitted ‘warm’. A common error was to suggest that nitric acid should be added first, which would negate the whole test. Most candidates realised that aluminium is one of the required reagents but a few just suggested sodium hydroxide and the formation of a white precipitate. Incorrect reagents were occasionally seen, silver nitrate and barium chloride being the commonest of these. Only a few candidates chose the brown ring test.

Question A7

This question was generally well done, many candidates scoring 4 or 5 marks.

- (a) Most candidates could draw the structure of chloroethene. The commonest errors were (i) lack of double bond, (ii) lack of chlorine atom, (iii) linking several chloroethene molecules.
- (b)(i) This was generally well done. The commonest error was to put the incorrect number of oxygen molecules.
- (ii) Practically all candidates recognised calcium chloride as the product. A few put calcium oxide.
- (c) Most candidates scored both marks. A minority of candidates chose incorrectly an addition polymer. The mark for a suitable use was generally obtained. The commonest error was to suggest the rather vague ‘used in fibres’.

Section B

Question B8

Many candidates scored well on this question, most marks often coming from the calculations. **Part (a)** was least well done, few candidates scoring more than a single mark.

- (a) Most candidates obtained a mark for ‘fractional distillation’ but fewer gained a second mark. Those who mentioned boiling points rarely focused on the fact that the fractionation works because of the differences in the boiling points. Many candidates failed to gain the ‘boiling point’ mark because they implied the petrol being boiled off first then the other fractions one by one i.e. simple distillation rather than fractional distillation. Only a few gained a mark for mentioning cracking in a correct context. Incorrect contexts included (i) cracking petroleum / crude oil, (ii) cracking an incorrect fraction or compound e.g. gasoline or propane.
- (b)(i) Most candidates obtained the correct answer [10 800 g].
- (ii) It was encouraging to note how many candidates could do this calculation. A variety of methods were given credit. Even if candidates did not obtain full marks, they often gained the marks for identifying the correct mole ratio and for the use of moles elsewhere in the calculation. [correct answer = 3498 g / 3500 g]
- (c) Most candidates realised that the catalytic converter changed carbon monoxide to carbon dioxide but fewer gained the mark for nitrogen forming from nitrogen oxides. The commonest error was to suggest that nitrogen dioxide is formed.
- (d) Most candidates wrote about acid rain or an effect of acid rain. A few wrote about global warming (which was accepted since nitrogen oxides are potent greenhouse gases). A small number of candidates failed to gain the mark because they suggested effects on the ozone layer.

Question B9

Most candidates who attempted this question acquitted themselves well. Although few candidates scored all three marks in **part (a)** many gained full marks for **parts (b)** and **(c)**. The calculation proved difficult for many candidates. Those who could see how to do this using moles or ratios gained full marks but many simply used the figures 18, 0.92 and 100 to get the incorrect answer.

- (a) Most candidates understood the term homologous series but few seemed to realise that three separate points were required. Most candidates wrote about a general formula although some failed to get this mark because they wrote about the same 'molecular formula'. Some mentioned the general formula and then expanded on this unnecessarily. Few mentioned the same functional group. Many candidates failed to obtain the mark for 'trend in physical properties' because they wrote vague statements such as 'they show an increase in physical properties' or 'they have different physical properties'. The mark for 'similar chemical properties' was quite frequently obtained.
- (b)(i) The boiling point of butanol suggested by the candidates was generally in the correct range (105-130°C). A large minority of candidates made the error of thinking that butanol was the member of the alkane homologous series above pentanol and consequently gave the incorrect value of, for example, 170°C.
- (ii) The formula for hexanol was almost invariably correct.
- (c)(i) Most candidates obtained a mark for the correct equation for the addition of steam to ethene. A few disadvantaged themselves by writing a word equation. Candidates should realise that the word equation in this examination has always referred to a symbol equation. The only general error was to write hydrogen or oxygen as an additional product.
- (ii) The majority of candidates correctly identified the addition reaction. Fewer put hydration. A not uncommon error was to suggest that the reaction was hydrolysis.
- (d) About half the candidates carried out the calculation perfectly. A variety of methods was seen. The commonest error was to simply use the figures given in the stem of the question and divide 0.92 by 18 and then get a percentage. Several candidates [correct answer = 10%]

Question B10

Few candidates gained full marks for this question although most were able to score over half marks. Both the calculation - **part (a)** and the eutrophication question - **part (b)** were challenging for many.

- (a) A significant number of candidates attempted to work through this question logically even if they did not get full marks. A variety of methods were used but candidates who were most successful either worked out the individual percentages of nitrogen in each fertiliser first or worked out the mass of nitrogen in 500 g of fertiliser. A common error to add the mass of total nitrogen and dividing by the total formula masses added together i.e. $3 \times 14 / 233$. For this particular calculation this gave a figure very close to the correct answer but this was fortuitous. The method is mathematically incorrect and so was not given credit. Many candidates lost a mark because they worked out the individual percentages in each fertiliser but added these together rather than averaging them. [correct answer 17.6%]
- (b) Many candidates wasted a lot of space describing how fertilisers were washed into the river. Many discussed algae without mentioning increased growth. It is not enough just to write that algae grow. Many do not appear to understand eutrophication fully and wrote that the algae use up the oxygen in the water. A significant number of candidates wrote about the sunlight being blocked without any further qualification. A number of candidates mentioned oxygen depletion but failed to capitalise on this by not mentioning the death of organisms in rivers and lakes. As in previous years a significant number of candidates wrote about marine organisms dying through eutrophication. This misunderstanding of the term marine has been commented on in previous Examiner Reports as well as above.

- (c) The quality of answers to this question was very variable, few candidates gaining all three marks. Many candidates chose incorrect reagents to add to the sulfuric acid. Of these, potassium was the most popular. This was not allowed as it would be far too dangerous. The method of titration was often described but few mentioned repeating the titration without an indicator. Many candidates gave unnecessary details about the titration. It should be stressed that in this type of question it is not necessary to give a full account of the procedure. The mark for drying was only obtained by about half the candidates. Common errors were (i) to add silica gel to the solid (rather than drying over silica gel), (ii) to add sulfuric acid as a drying agent. Most of the candidates who gained the mark opted for crystallising and drying between sheets of filter paper. This was allowed because slow cooling of a hot solution of lead iodide does produce crystalline material.

Question B11

This question was usually well answered although **part (a)(ii)** proved difficult for many candidates. In general, many candidates showed a good understanding of the processes used to protect iron from rusting. Candidates usually lost marks through writing vague or confused statements or not completing their ideas.

- (a) (i) Most candidates gained the mark for loss of electrons or increase in oxidation number. Common errors included (i) writing about the conversion of iron(II) to iron(III) or vice versa (ii) using a context of oxidation that was not relevant to the reaction e.g. writing about gaining oxygen or losing hydrogen.
- (ii) Many candidates struggled to write the correct equation. The usual errors were to forget to balance the 2OH^- on the left or to write the formula of the product as FeOH or FeOH_2 . The mark for the state symbols was not often obtained. Common errors included making the product an aqueous solution and omitting the state symbol altogether for the hydroxide ion.
- (b) (i) Although many candidates gave a satisfactory answer to this question, many others did not go far enough in their answers and failed to point out that oxygen and/ or water could not get to the surface of the iron. A common error was to suggest that the tin gave sacrificial protection to the iron.
- (ii) Many candidates scored two of the three marks available. The mark for the zinc acting as a protective barrier to oxygen and water was not always obtained because candidates tended to focus on the sacrificial protection method. Many candidates confused the issue by statements comparing tin, iron and zinc reactivity so it was not certain which pair was being compared. Candidates who obtained at least marks generally mentioned that zinc was more reactive than iron together with some relevant statement relating to sacrificial protection.
- (c) Although this was generally well answered, many candidates failed to gain the mark through lack of sufficient explanation. It was not enough to write that 'there is a layer of aluminium oxide on the surface'. Some qualification about this layer was required to obtain the mark.
- (d) Many candidates gained both marks for this question although a significant number gave rather weak reasons for the use they had selected.

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Paper 5070/03

Practical Test

General comments

The overall standard was variable. Although many candidates demonstrated capable practical skills in both the quantitative and qualitative questions, some appeared to have little experience of these types of exercise. Supervisors are thanked for providing the required experimental data to enable assessment of their candidates' work.

Comments on specific questions

Question 1

- (a) In many Centres the acid/base titration was well done and candidates achieved full or nearly full marks for this part of the exercise.

Full marks were awarded for two results within 0.2 cm^3 of the Supervisor's value, and then for averaging two or more results that did not differ by more than 0.2 cm^3 .

Teachers should continue to emphasise that, in all titration exercises, candidates should repeat the titration as many times as necessary, until they have obtained **consistent** results. These titres i.e. best titration results should be ticked and then averaged. While many candidates do follow this procedure, a significant number tick only one result (or none at all) and then often average all their results regardless of how consistent they are.

There were few candidates who scored full marks in the calculations that followed. Those who carefully read the information provided and showed the essential steps in calculations were generally the most successful. The calculations were marked consequentially throughout, even when this led to improbable answers.

- (b) This proved more difficult than expected. There were a variety of errors made - some candidates did not use the volumes of **P** and **Q** in the calculation, a few inverted the volumes and some lost a mark by over-approximating. Answers should be given to 3 significant figures throughout.
- (c) Few candidates appreciated that the answer in (c) was the same as that in (b) and mistakenly determined the number of moles of hydrogen ions in 150 cm^3 of P.
- (d),(e) Despite the problems with (b) and (c), many correctly multiplied the answer from (c) by 60 to obtain the mass of ethanoic acid in 150 cm^3 of the vinegar and then calculated the percentage by mass.

Question 2

While the total score for this question was generally higher than for **Question 1**, marks were frequently lost for incomplete rather than incorrect answers. It is important that candidates follow the instructions provided e.g. test **and** name any gas evolved and make full use of the qualitative analysis notes provided in the paper. Candidates should use the terminology and method of expression found in the qualitative analysis notes as a model for writing observations. It was not necessary to make all the observations to obtain full marks for this question.

R was magnesium sulfate, and **S** was sodium hydrogencarbonate.

Tests 1 and 2

In both tests **R** produces a white precipitate which is insoluble in excess. Although many candidates used the correct term, 'precipitate' or an acceptable equivalent i.e. solid, suspension or powder, some still recorded that 'the mixture turned milky' or 'a white solution was formed'.

Tests 3 and 4

Most candidates correctly recorded that there is no reaction of **R** with either nitric acid or silver nitrate. While most noted a white precipitate with barium nitrate, some referred to white, milky or cloudy solution.

Test 5

When the acid is added to **S**, effervescence occurs. Many candidates recorded this bubbling, some used the gas to turn limewater milky and a smaller number then named the gas as carbon dioxide. Any gas produced in a reaction must be identified by a test that must be given along with the result of the test. No credit can be obtained for naming a gas if it has not been identified by the correct chemical test.

Test 6

Some candidates identified the carbon dioxide produced by heating **S** but very few noted the condensation. When acid is added to the residue, bubbling takes place as a result of carbon dioxide being produced.

Test 7

The addition of **S** to the copper(II) sulphate solution produces a blue solid and bubbling. While candidates usually made one or both of these observations, few identified the gas.

Test 8

Most of the candidates turned damp red litmus paper blue with the gas produced but not all of these named the gas as ammonia.

Test 9

In **(a)** the solid dissolves to form a colourless solution which on warming in **(b)** bubbles producing carbon dioxide and a white precipitate is formed. Very few candidates scored all 4 marks. As previously, bubbles were sometimes noted but the gas was not identified and the solution became white or cloudy.

Conclusions

The white precipitate formed when **R** reacted with barium nitrate confirmed that the anion in **R** is a sulfate. Most candidates who reported this precipitate in **Test 4 (b)** provided this conclusion.

Two other elements present in the sodium salt **S** were carbon and oxygen. Candidates were awarded this mark providing they had correctly identified carbon dioxide gas in any of the tests.

CHEMISTRY

Paper 5070/04

Alternative to Practical

General Comments

The Alternative to Practical Chemistry paper is designed to test the candidates' knowledge and experience of practical chemistry.

Skills include recognition and calibration of chemical apparatus and their uses, recall of experimental procedures, handling and interpretation of data, drawing of graphs, analysis of unknown salts, and calculations.

The standard continues to be maintained and the majority of candidates show evidence of possessing many of the aforementioned skills.

Most candidates show competency of plotting points accurately on graphs and joining the points as instructed.

Calculations are generally completed accurately using the appropriate significant figures.

Report on Individual Questions

Question 1

Candidates were asked questions on an experiment to find the formula of magnesium oxide. 0.36 g of magnesium was placed in a crucible, the lid was placed on the crucible to prevent the powdered magnesium oxide, once formed, from leaving the crucible and the lid was frequently lifted to allow more oxygen /air to enter the crucible to react with the magnesium. Most candidates answered **(b)(i)** correctly, the reason for the lid being placed on the crucible, but few correct answers to **(b)(ii)**, the reason for the lifting of the lid, were seen. Incorrect answers included 'allowing heat to escape' or 'to reduce the pressure inside the crucible'.

(c)(i) Magnesium is a grey, silver or shiny metal. Answers such as white/silver were not allowed.

(ii) Magnesium oxide is a white or yellow powder or solid.

(d) The crucible was reheated to ensure that all the magnesium had reacted or to achieve a constant mass.

The results of the experiment are used to calculate the formula of magnesium oxide.

(e)(i) 0.6 g of magnesium oxide was formed giving in **(ii)** a mass of 0.24 g of oxygen.

(f) Using these results the formula is MgO. Correct working must be shown to score 2 marks.

Question 2

This was a generally well answered question with many candidates scoring full marks. The products at the electrodes were **A** bromine, **B** lead, **C** oxygen and **D** hydrogen. Most candidates scored well on this section. Correct symbols were allowed instead of names e.g. Br₂ etc., but ions e.g. Pb²⁺ were not.

- (b)(i) The lamp would become less bright or dims when water was added to the dilute sulfuric acid.
- (ii) The lamp would become less bright and eventually goes out. To obtain the second mark candidates were required to state that the ions were no longer mobile or solid lead bromide does not conduct a current. Explanations based on electron movement were not acceptable.

Correct answers to **Questions 3 to 7** were (c), (b), (b), (a) and (c) respectively.

Question 8

The majority of candidates scored well on this question.

1.44 g of iron was used in the experiment which on adding to dilute sulfuric acid, produced hydrogen. This can be confirmed by the gas 'popping' in a flame. It is of concern that many candidates continue to test hydrogen with a glowing splint. In (b) (iii) many correct equations were seen although common errors included the use of Fe^{2+} in an otherwise molecular equation and one or more incorrect formulae.

- (c) This proved to be a very difficult question. Candidates were expected to use the information in the stem of **part (c)** to answer the question. The end-point of any titration is noted when one extra drop of the titrating agent produces a colour change. In this case the extra drop of potassium manganate(VII) gives a pink colour. Close variations on pink were allowed.
- (d) The three titres were 25.1, 24.4, and 24.6 cm^3 giving a mean value of the second and third titres of 24.5 cm^3 . In cases of incorrect titres candidates must take the mean of the nearest two titres to score the mark.

Answers to calculations were:

(e) 0.00049; (f) 0.00245; (g) 0.0245 moles; (h) 1.37 g; (i) 95.3%.

Arithmetic approximations/errors are penalised a maximum of twice and any error may be used consequentially in subsequent parts of the calculation and score marks.

Question 9

A high scoring question, with many candidates scoring full marks.

- (a) Three marks were awarded for effervescence/fizzing, gas turned lime water milky/white confirming the gas to be carbon dioxide.
- (b) A blue coloured solution, not compound, was produced.
- (c) A blue precipitate which was insoluble in excess aqueous sodium hydroxide.
- (d) A blue precipitate which dissolved in excess aqueous ammonia to produce a deep blue solution. Candidates must state that the colour of the solution was darker or deeper than the colour of the precipitate.

Question 10

- (a) The correct thermometer readings were 21, 35, 43, and 48. Two marks were awarded for all correct readings.
- (b) Candidates were asked to plot the points on the grid. Marks were awarded as follows: all points plotted correctly (1), points connected by two smooth curves (1) passing through zero (1). Most candidates scored at least two of these marks, the majority scoring all three.

- (c) Experiment 2 reached completion first. Candidates were asked to explain their conclusion based on the observation that the last two volumes of oxygen, in experiment 2 were the same.

Candidates were asked to read their graphs to answer **parts (d) and (e)**.

To gain the marks candidates must read their own graph to an accuracy of the nearest half small square. Many candidates read to an accuracy of +/- half a small square which is not accurate enough to gain the mark(s).

It should be stated that most candidates do read to the required accuracy.

- (d) Candidates were asked to estimate the time taken in experiment 1 to double the volume of oxygen from 15 to 30 cm³. On reading the two correct points, an answer in the region of 2.5 minutes was obtained.

- (e) Using the rate of reaction equation, candidates were required to read the volume, on each graph, corresponding to 2.5 minutes. Dividing each volume by 2.5 gave the rate of each reaction after 2.5 minutes. Answers in the region of 8.5 and 16 cm³/minute, for experiments 1 and 2 were obtained.

A common error was to divide by 3.5 rather than 2.5. This error was obtained by subtracting 2.5 from 6, the maximum time of the reaction, rather than using 2.5.

- (f) Using the answers from (e) the faster rate was obtained using copper as the catalyst. This suggests that copper is the better catalyst. An explanation such as the initial statement was required to gain the mark.

- (g) The mass of copper would be unchanged at the end of the reaction as the mass of a catalyst is unchanged during a reaction.

- (h) The rate could be further increased by heating, increasing the concentration of hydrogen peroxide or powdering the catalyst.