CONTENTS

FOREWORD

This booklet contains reports written by Examiners on the work of candidates in certain papers. **Its contents are primarily for the information of the subject teachers concerned**.

CHEMISTRY

GCE Ordinary Level

Paper 5070/01
Multiple Choice

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

General comments

All the questions had good discrimination factors with all the alternatives in each question being popular with a moderate proportion of the entry.

Comments on specific questions

Question 6

The number of protons equals the number of electrons in an atom, thus neither alternatives **A** or **B** were correct. Negative ions have more electrons than protons thus option **C** was the answer.

Question 9

Metals and graphite conduct electricity due to the movement of electrons. Ionic compounds, such as potassium bromide, conduct electricity due to the movement of oppositely charged ions in solution or when the compound is molten.

Option **A** was more popular than the correct option **D**, with many candidates believing incorrectly that potassium bromide conducted electricity due to the movement of electrons.

Question 15

Lithium chloride is the chloride of a Group 1 element, as is sodium chloride, and behaves the s[...] sodium chloride when its aqueous solution is electrolysed. Therefore hydrogen gas is formed at the cath[...]

Question 20

A catalyst lowers the activation energy for a reaction, by altering the route of the reaction, but does not alter the energy change of the reaction, making **C** the correct answer.

Question 25

The majority of the candidates gave option **B** as their answer, despite the fact that the quantity of sodium hydroxide added to the acid was only half the quantity needed for neutralisation. The answer to the question came from the generalisation:

acid + base → salt + water

Question 33

It is aluminium that has a protective coating of its oxide and not magnesium. To answer the question correctly, candidates had to realise that magnesium is above iron in the reactivity series.

Question 40

This question caused great confusion although it was based on the statement in the syllabus: 'the manufacture of margarine by the addition of hydrogen to unsaturated vegetable oils to form a solid product'.

Paper 5070/02

Theory

General comments

The performance of candidates was variable. Some very strong performances were seen, but unfortunately a large number of candidates were not well prepared for the examination in terms of their subject knowledge or skills at answering examination questions. Some questions proved particularly challenging, particularly those involving evaluative skills and demanding application of knowledge to unfamiliar contexts. These issues have led to fewer high scores being seen, with a broader spread of marks across the mark range. Most candidates used their time very well in the examination, but a worrying number left part or full questions unanswered, sometimes failing to attempt three ***Section B*** questions.

Questions that demanded that candidates assimilate and apply information given in an initial question stem caused difficulties to some candidates. For example, in **Question A1** candidates did not relate the table to the map, so losing marks in part **(a)**. In ***Section B***, **Question B9** demanded the application of syllabus knowledge to a novel context. This proved very difficult for most candidates. In several questions, many candidates made errors in their answers because they had not followed the question instructions carefully, for example omitting a discussion of structure in **Question A2 (e)**, omitting an explanation of graph shape in **Question B7 (a)**.

When asked to suggest how a reaction could be carried out, many candidates choose reagents that would lead to unsafe, often explosive reactions. Such answers are not given credit. It is assumed that if a candidate is asked to suggest a practical procedure, then their suggested method needs to be able to be carried out safely using normal equipment in a school laboratory. For example, in **Question A3 (b)(iii)**, many candidates chose to react hydrochloric acid with Group 1 metals. Such answers did not score. Similar issues occurred in **Question A6**.

Calculations were generally very well done, but candidates need to take care to round their answers correctly (see a full discussion under **Question B8**). Answers to two or more significant figures are accepted as fully correct, provided that any rounding is correctly carried out. Answers should preferably be given to two or three significant figures.

Areas of the syllabus that are well understood include water purification methods, structural fo cell voltage related to metal reactivity, some calculations, electroplating and gas tests.

Areas of the syllabus that were less well understood included giant and simple structures, testing fo strength, drawing curves for standard rate graphs, the explanation of fractional distillation and electrode equations.

<u>Comments on specific questions</u>

Question A1

This question demanded that the candidates apply their understanding of water chemistry to some data about water quality in a river.

(a) The commonest error here was that some candidates did not relate the samples **A** to **E** with the map, and so included a discussion of water temperature at **B** and **C** in their description of temperature changes between the source and the sea.

(b) Most candidates knew that fertilisers cause a reduction in oxygen content, but were less secure in their understanding of how this happens. Many thought that the increased numbers of algae or ‘plants’ use up oxygen, rather than that the oxygen fall is caused by its use by decomposing bacteria.

(c) This part of the question was very well answered.

Question A2

Parts **(a)** to **(d)** were well answered by most candidates.

(b) Bromine was often given as the substance that was a liquid over the largest temperature range, rather than lithium. This may have been because candidates are familiar with bromine existing as a liquid.

(c) Many candidates listed all the substances, elements and compounds that contained non-metallic elements. The question demanded an identification of elements only, suggesting that some candidates are not clear in their understanding of the distinction between elements and compounds.

(e) This part of the question was not well answered. The question asked candidates to ‘use ideas about structure’ (i.e. simple molecular as compared to giant covalent). Many candidates did not make references to the structures in their answer. Others gave additional explanations that revealed confusion about the mechanism of melting in methane, for example by discussing the need to *break bonds.* Some thought that silicon dioxide was held together by intermolecular forces rather than covalent bonds.

(f) Surprisingly few candidates gave the syllabus method of ‘electrolysis of molten’ salt here. Many gave a displacement method. Such answers were given partial credit if the metal chosen could be used safely. Answers using Group 1 metals as displacement metals, for example, were not given credit. A surprisingly common error was to attempt a halogen displacement, for example using chlorine. Such a method would produce bromine rather than lead.

Question A3

(a) Most candidates knew that sulphuric acid is the catalyst for esterification. ‘Concentrated’ was not insisted upon, but ‘dilute’ was rejected. The commonest reason for not scoring both marks in **(a)(i)** was by giving unrealistic temperatures. The ‘text book’ condition is ‘warm with concentrated sulphuric acid’. Many gave temperatures of hundreds or even thousands of degrees Celsius. Most knew the structure of the acid. Common errors were:

- drawing propanoic rather than ethanoic acid (such answers were allowed ‘error carried forward’ into the equation in **(iii)**)
- errors in drawing the carboxylic acid group e.g. omitting the double bond to the oxygen or attaching the OH group via the hydrogen.

(b)(i) This was intended to be a simple question to give a test for acid strength. '*Use Unive[...] which goes red in hydrochloric acid and yellow/orange in ethanoic*' would score [...]. However, many candidates tried to suggest complicated rate experiments using metals ra[...] a simple test. If such descriptions were safe, achievable and workable, a single mar[...] awarded. Unsafe suggestions, such as use of highly reactive metals, were rejected. Wr[...] outcomes such as 'more hydrogen evolved by hydrochloric acid' were also rejected.

(ii) This was well answered, with most candidates correctly choosing a suitable metal or carbonate. Answers using unsuitable reagents, e.g. copper or potassium, did not score. Candidates were much better than in previous years at giving a true observation, for example 'bubbles are seen'. As usual, inferences such as 'hydrogen is given off' did not score.

Question A4

(a) The mechanism of the action of carbon monoxide in the body was well understood. Vague answers such as 'toxic', 'leads to suffocation' were not credited.

(b) Most candidates gave the correct oxidation numbers, although weaker candidates often failed to score. A relatively common error was to represent the oxidation numbers as ionic charges i.e. Pd^{2+} and C^{4+}. Such answers were not awarded a mark. In **(iii)**, candidates needed to discuss both oxidation *and* reduction to explain the concept of redox. Answers dealing with only one of these were not credited.

(c) Most gave the manufacture of iron in the blast furnace as their answer here, but a surprisingly common error was to think that carbon monoxide is used to produce sulphuric acid.

Question A5

The ionic equation posed no difficulty for many candidates. Almost all knew the direction of electron flow in the circuit, and could use the meter readings to generate a reactivity order. All suggested either magnesium or aluminium as metal **M**, leading to very high marks in this question.

Question A6

This question was a high scoring question. The mark scheme allowed a correct separation method, even if the reagent suggested by the candidate was not workable. Such independent marking increased the scores of many candidates. The reagents were marked correct if they would lead to a safe, workable method. Thus, adding lithium or lithium oxide to dilute hydrochloric acid was not considered acceptable. Heating to dryness was allowed in **(i)** for lithium chloride (although crystallisation by heating to saturation and cooling the hot solution is a much better answer) but was not allowed as a method of producing hydrated copper(II) sulphate crystals in **(iii)**. Many candidates confused the terms filtrate and residue, and discussed *filtering off* excess copper carbonate and evaporating the *residue.* The calculation was well attempted, but caused unexpected difficulties for candidates. Common errors included:

- wrongly calculating the molecular mass of ammonium sulphate (such an error was allowed an 'error carried forward' if the rest of the method was correct)
- failing to divide by 2 for the two moles of ammonia represented in the equation
- dividing by 2 twice by using the mass of ammonia as 34 g and then dividing by 2 for the number of moles again
- carrying out the calculation 'upside down' by multiplying by 2.

Answer: **(b)** 198 g.

Section B

Question B7

(a) This question was essentially a 'rates of reactions' question asked in the context of the decomposition of carbonates, rather than the more familiar dilute acid reactions. The different context confused some weaker candidates who drew graphs showing a fall in volume of gas, confusing the experiment with the more familiar loss of mass graphs for the reaction between carbonates and dilute acid. Most candidates, however, realised that the reaction would produce a standard rate curve. A common error was to draw the initial rate as constant, with a sloping *straight line* from the origin which did not curve until the reaction was almost finished, rather than showing *a curve* from the origin to the end of the reaction. Some candidates missed out the explanation of the graph shape, losing a mark.

(b) The calculation in this part of the question was very well done. Too many candidates, however, did not answer the question, but calculated the *mass* of carbon dioxide rather than the *volume* that the question demanded.

(c)(i) Most knew that zinc carbonate decomposes faster, but the reasons were less well explained. A simple statement relating relative thermal stability of the carbonates was all that was required to score, but several common misconceptions occurred, for example:

- that *zinc* is less stable than *magnesium* (with no mention of 'carbonates')
- rate is *slower* because zinc is less reactive than magnesium
- that the rate of reaction depends on the *strength of the ionic bond* between the metal ion and the carbonate. This answer suggests that candidates think the entire carbonate ion is lost during the decomposition
- vague discussions about 'stronger and weaker bonds' did not score.

(ii) This was a very good discriminator. Weaker candidates often thought that the volume of carbon dioxide would not change if the same mass of carbonate was used. Many discussed the volume being 'different' because the number of moles would be 'different'. Such an answer scored a single mark. For two marks, most able candidates linked the idea of *fewer moles of* reactant with *a lower volume* of gas produced.

Answer: **(b)** 3 dm^3.

Question B8

(a) This part was well answered, although weaker candidates often gave the three answers upside down.

(b) This demanded an explanation of fractional distillation, and proved very difficult for all candidates. Three mark answers were very rare. The main misconception is that the process works by selective *evaporation* rather than selective *condensation*, implying confusion between the laboratory and industrial processes. For example, a fully correct answer would read:

'*The crude oil is heated and* <u>*evaporates*</u> **[mark 1]**. *The column is cooler at the top than at the bottom. As the vapours rise up the column they cool. Each fraction* <u>*condenses at a different temperature*</u> **[mark 2]**. *The fractions with the* <u>*lowest boiling point condense and are removed at the top, those with the highest condense at the bottom*</u> **[mark 3]**.'

The commonest wrong answer centred on the idea that the fractions separate by evaporating one at a time, for example:

'*The crude oil contains fractions with different boiling points* **[correct, but no marks]**. *When the crude oil is heated, the fraction with the lowest boiling point* evaporates *first and leaves at the top of the column. The fractions boil off in order until the one with the highest boiling point evaporates last and leaves at the bottom.*'

This answer scores two marks; one for recognising that the crude oil evaporates, and the second for recognising that fractions with lower boiling points emerge at the top, and those with higher emerge at the bottom. However, the idea of selective evaporation is incorrect for the industrial process. Candidates are confusing this with the laboratory experiment, where only one outlet of the column exists.

(c)(i) The calculation was well done, although some candidates lost marks by rounding wrongly. Answers should preferably be given to two or three significant figures, but answ than three significant figures are not usually penalised. However, if candidates rou answers, this must be done correctly or the mark will not be scored. So, for example:

The percentage of carbon in hexadecane is shown on a calculator as 84.9557%. Best answers are *85%* or *85.0%*. Other acceptable answers are; *84.96%, 84.956% or 84.9557%*. If candidates *round up wrongly* they will not score e.g. *84.9%* is wrong.

(ii) This equation was difficult to balance, and so discriminated well between candidates.

(iii) Many candidates wrongly thought that it was the number of moles of carbon dioxide produced in the equation that caused the flame to be smoky, rather than identifying ideas about incomplete combustion due to the high amount of carbon in hexadecane or high volume of oxygen needed for complete combustion to occur.

(d) This part of the question proved surprisingly difficult. Many candidates could not think of two non-oil based car fuels. The syllabus fuels are hydrogen and ethanol, but others, such as palm oil, were accepted. Many gave solar, which is not strictly a fuel so did not score. Other, surprisingly common, wrong answers included biogas, petrol and water.

Question B9

This was the least popular of the optional questions. The question was an unfamiliar context for the candidates and they were expected to apply their knowledge of syllabus chemistry to a new situation.

(a)(b) These were relatively straightforward. Many candidates gave much more detail than was necessary in part **(a)**, where a simple identification that exothermic processes give out energy was all that was required. In **(b)** most gave Fe_2O_3 as the formula of iron oxide, scoring one mark, although weaker candidates gave a range of formulae including Fe_3O_2 and FeO. Some candidates did not manage to balance the rest of the equation.

(c) This required evaluative skills. The description of the temperature change was not as highly scoring as expected. Many candidates did not relate the gradient to the rate of temperature increase. Vague answers such as 'temperature increases' did not score. The simplest statement to score two marks was: 'temperature increases slowly at first then faster'. Surprisingly few candidates scored this mark. The explanation of the temperature change proved very difficult for all but the best candidates. Very few realised that the solid steel acts as a coolant, using energy as it melts. This explanation tested candidates' abilities to think in a new context and many did not score. In giving an advantage of recycling steel, many candidates gave answers that were too vague for credit, for example 'less pollution', 'less waste' or 'saves resources'. Better answers were more specific, for example discussing landfill area, saving *finite* metal resources or *finite* energy sources.

(d) The diagrams here were not well attempted. Diagrams of alloys are not part of the syllabus – candidates were expected to use their knowledge of metallic structure to reason out the difference between high and low carbon steel structures. Common problems were:

- candidates left their diagrams unlabelled, so that it was difficult to tell which atoms were intended to be carbon and which iron
- candidates thought that in 'high carbon steel' the carbon atoms vastly outnumber the iron atoms
- some diagrams were very poorly drawn, with such large spaces between the atoms that the state could have been gaseous.

Very few candidates related malleability, softness or weakness of low carbon steel to the ability of the layers to slip.

Question B10

This question was the most popular of the optional questions.

(a) The diagram in this part was well done. Some candidates did not know the polarity of the battery and hence labelled the anode and cathode the wrong way round, but this mistake was not penalised in this instance. More serious errors were choosing the wrong silver salt e.g. silver sulphate or chloride, both of which are too insoluble to be suitable for electrolysis, or choosing an electrolyte that did not include silver ions. Some candidates did not have the nickel object fully immersed in the electrolyte. Again, this was not penalised in this instance, but for electroplating to be successful, the cathode object should be fully immersed.

(b) The ionic equations were less well answered. Common errors included:

- representing the silver ion as Ag^{2+}
- giving the equation for oxygen formation from hydroxide ions at the anode
- omitting state symbols
- representing the correct equations at the wrong electrodes.

(c) This was well answered, but too many candidates gave the names of *salts* **A** and **B** as sulphuric and hydrochloric acid. The gas tests are well known by all abilities of candidates. It is unfortunate that minor errors often cost marks e.g. testing for oxygen with *a lighted* splint, testing for hydrogen with a *glowing* splint or stating that chlorine turns red litmus *blue* then bleaches it.

Paper 5070/03

Paper 3 – Practical Test

<u>General comments</u>

The overall standard was satisfactory and many candidates were able to demonstrate good practical skills. Unfortunately, a minority seemed to have little relevant practical experience and therefore found both exercises taxing.

<u>Comments on specific questions</u>

Question 1

(a) The titration was usually well done, Iodine/thiosulphate titrations are relatively complex and it was pleasing to see a significant number of candidates scoring full or nearly full marks. Full marks were awarded for recording two results within 0.2 cm^3 of the Supervisor's value and then for averaging two or more results which did not differ by more than 0.2 cm^3.

Teachers are asked to continue to emphasise that in any titration exercise, candidates should repeat the titration as many times as necessary, until they have obtained consistent results, and then to average these *consistent* results, having first 'ticked' them to indicate that these are their most accurate values. Although many candidates do carry out this procedure carefully, a disappointing number still tick only one result. Similarly a number of candidates average all their results, irrespective of how consistent they are. Deciding whether to disregard some results is an important skill, and teachers are asked to reinforce this message.

It was clear that some candidates altered their results whilst attempting the calculations so that their results would then produce a 'correct' final answer. This almost always led to candidates losing marks. It is always advisable to record results as soon as possible and to have confidence in their accuracy.

(b) Most candidates were able to calculate the correct concentration of the solution **P** w[illegible] $M\text{IO}_3$. Only a few inverted the volume ratio or mole ratio although more candidates [illegible] used mole ratios other than the correct 6:1. The answer was required to three significan[illegible] and few candidates over approximated.

(c) This part of the question asked candidates to use their answer to part **(b)** to calculate the relative molecular mass of $M\text{IO}_3$ by dividing 3.30 (the mass of $M\text{IO}_3$ dissolved in 1.0 dm^3 of water) by their answer to **(b)**. The majority were able to do this successfully, the calculations were marked consequentially throughout, so a candidate making a mistake in one part could go on and score full marks elsewhere.

(d) Candidates were then required to use their answer to **(c)** to obtain a value for the relative atomic mass of *M* and to use this to identify the metal. Although most candidates completed the first part successfully by subtracting 175 (127 for I + 48 for O_3) from the relative molecular mass, far fewer could suggest a sensible identification of *M*. The equations given in the paper make it clear that *M* must be a Group I metal and many candidates simply gave the nearest element to their value of the atomic mass without thinking about whether this was a sensible choice. A significant number of candidates confused relative atomic mass with proton (atomic) number, so that an answer for the atomic mass of approximately 20, meant that the metal was identified as potassium rather than sodium. As referred to earlier, a number of candidates obtained an atomic mass close to 23, decided that the metal must be sodium and then worked backwards to get the 'correct' titration value. This is poor science as well as poor examination technique and candidates need to appreciate that results are often subject to experimental error.

Question 2

This was a relatively straightforward exercise and many candidates scored high marks. Where marks were lost it was usually for incomplete rather than incorrect observations. Most candidates used the correct terminology to describe colour changes and the formation of precipitates, but a significant number still confuse 'precipitates' with 'solutions'. The use of incorrect terms leads to uncertainties and makes it difficult for Examiners to award marks.

Test 1

Aqueous sodium hydroxide was added to solutions of three metal salts. **R** (nickel sulphate), **S** (copper(II) sulphate) and **T** (cobalt nitrate). With **R** a green ppt is formed, with **T** and **S** the precipitate is blue. None of the precipitates dissolve in excess. With **T** the precipitate slowly changes colour to an indeterminate pink/grey colour when shaken. Shades of colour were acceptable, but generally mixtures of colours were not. With all three metal ions the addition of hydrogen peroxide causes effervescence and oxygen is produced. Candidates are expected to report the observation, effervescence, and then give the test and name the gas. With oxygen the test is that the gas relights a glowing splint. There was some confusion over hydrogen that 'pops' with a lighted splint and oxygen which sometimes relights a glowing splint with a 'pop'. Oxygen could be identified with *any* of the metal ions, but the effervescence was required with *each* metal. With copper the hydrogen peroxide turns the precipitate black and with cobalt the precipitate turns brown. It is the solid which changes colour not the solution.

Test 2

With aqueous ammonia, **R** forms a faint blue or green precipitate which dissolves in excess to give a blue solution. Many candidates added the ammonia too quickly and so missed the first mark but they could score the second mark for the final colour of the solution. With copper, the initial blue precipitate is easier to see, and this also dissolves in excess to produce an appreciably darker blue solution. Again candidates who missed the initial precipitate could still score the second mark, provided the final blue solution was darker than the original copper(II) sulphate. With cobalt the precipitate is blue or green, and it does not dissolve in excess.

Test 3

When aqueous barium nitrate is added to **R** and the mixture allowed to stand, the precipitate can be seen to be white. The addition of acid does not cause the precipitate to dissolve. Those candidates who thought the precipitate was green did not score the observation mark but could go on to score the conclusion mark, provided there was no precipitate with silver nitrate.

Test 4

There is no reaction when aqueous silver nitrate is added to **R**, nor is there a reaction when nitr... added. Minor colour changes, caused by dilution, were ignored

Conclusion

The formation of a precipitate, of any colour, with barium nitrate which does not dissolve in acid and the lack of reaction with silver nitrate confirms the anion as a sulphate and most candidates scored this mark.

Paper 5070/04

Alternative to Practical

General comments

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

Skills including recognition and calibration of chemical apparatus and their uses, recall of experimental procedures, handling and interpretation of data, drawing and interpretation of graphs, analysis of unknown salts, volumetric analysis and associated 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 the quality of drawing appropriate curves through the points continues to improve. Candidates should be instructed to read graphs, wherever possible, to the nearest half a small square. Wherever appropriate, curves should be drawn to include the zero.

Comments on specific questions

Question 1

The volume of liquid in the measuring cylinder was 24 cm^3.

Question 2

(a) The alcohol produced from the fermentation of sugar is ethanol having the formula C_2H_5OH.

(b) The process requires the presence of yeast.

The student was asked how it was known when all the alcohol had been distilled. The statement 'when the temperature went up', was often seen but insufficient to gain the mark. The answer required the observation relating to the thermometer particularly the reading increasing beyond the boiling point of ethanol.

(d) The colour change of potassium dichromate(VI) was orange to green, the product of the reaction being ethanoic acid.

(e) The reaction of ethanoic acid with the remaining ethanol, gives the ester, ethyl ethanoate, of formula $CH_3COOC_2H_5$ not $C_4H_8O_2$ as the latter formula does not distinguish it from other isomeric esters.

Question 3

This question was designed to test the candidate's knowledge of Chromatography. The topic had n tested to this extent for some time. It was evident that most candidates were aware of the concept but had not experienced the practical aspects particularly the drawing of the solvent level line and subsequent measurements needed to calculate the R_f value.

(b) The line should be drawn with a ruler below, and parallel with the start line. Various lines were seen including vertical lines

(c) There were few good answers to the question as to why a pencil was used rather than a pen. It was necessary to state that ink consists of, or is a mixture of a number of dyes, components or substances, which may be separated during the chromatography. Answers such as the ink would spread or dissolve in the solvent were insufficient to gain any marks.

(d) **X** contains the substances S and U and **Y** contains R, S and T.

(e) The points were accurately drawn on the examination paper at 4.0 and 5.5 cm and no other measurement was acceptable. The R_f value was 0.73. Many candidates subtracted one value from the other. Answers left as a fraction were not acceptable.

Questions 4 – 7

The correct answers to the multiple-choice questions were, (a), (b), (a), and (c) respectively.

Question 8

(a) The correct mass of marble was 1.55 g.

(b) The reason for loosening the stopper was to prevent pressure build-up in the flask as a result of the production of carbon dioxide. Any answer that referred to the production of carbon dioxide was acceptable.

(c) It was encouraging to see that the large majority of candidates were able to give the correct colour change for methyl orange and the correct way round.

(d) Most candidates read the burette readings correctly and deduced the correct mean titre. In cases where candidates read the burettes incorrectly a mark was given for the mean value so long as it was appropriate to their titres.

The correct answers to the calculations using the mean value of 23.6 cm^3 were:

(e) 0.00236; **(f)** 0.00236; **(g)** 0.0236; **(h)** 0.05; **(i)** 0.0264; **(j)** 0.0132; **(k)(i)** 100 g, **(ii)** 1.32 g, **(iii)** 85.2.

Throughout, candidates are expected to maintain the accuracy of their calculations. Rounding up or down results in the loss of marks. Any incorrect calculation may be used subsequently and marks are awarded provided that these subsequent calculations are correct.

Question 9

This is a standard analysis calculation. The correct answers are:

(1) A colourless solution is produced. Reference to solids or compounds lost this mark.

(2) A white precipitate, soluble in excess.

(3) A white precipitate, insoluble in excess.

(4) The expected test for the nitrate ion is the addition of Aluminium powder followed by aqueous sodium hydroxide. The mixture should be heated. This results in the formation of ammonia, which should be confirmed by a correct test such as litmus turning blue. Most candidates gave the correct chemicals but omitted to heat the mixture.

The correct formula for aluminium nitrate is $Al(NO_3)_3$.

Question 10

This question involved the drawing of a graph and joining the two sets of points with two smooth curv accuracy of plotting points continues to improve as does the drawing of curves. Candidates who joine points with a set of straight lines lost the mark. A further mark was lost if the curves were not contin through the zero.

Any candidate who incorrectly read one or more of the syringes was expected to plot these incorrect volumes and subsequent marks could be obtained.

(a) Hydrogen is the gas evolved.

(b) The correct volumes are 18, 40, 54, and 60 cm^3.

(d)(i)(ii) Marks were awarded on the candidate's reading of their own graphs to the nearest half small square accuracy.

(e)(i) Magnesium should be powdered to increase the rate of the reaction.

(ii) The final question required the candidate to realise that, although the rate can be increased by increasing the concentration of the acid, the volume used must be reduced by an amount which maintains the same number of moles. Very few correct answers were seen, many candidates suggesting that both the volume and concentration should be increased.

Answers which suggested that the concentration should be increased and the volume decreased were awarded one mark out of the possible two.

Combinations, such as 25 cm^3 of 0.200 mol/dm^3, were required to obtain both the marks.

Answers emphasising the need to maintain the same number of moles of acid were also rewarded.