CHEMISTRY

Paper 5070/01
Multiple Choice

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

General Comments

Only two questions were high scoring and only one question failed to discriminate satisfactorily between the candidates.

Comments on Individual Questions

Question 3

Aqueous sodium hydroxide reacts with both nitric and hydrochloric acid in each case forming a colourless solution of a salt. The criterion for a distinguishing test is that it gives two totally different observable results. Thus the use of sodium hydroxide was not, in the question asked, a suitable reagent to be used in distinguishing between the two acids.

Question 5

The alternative D was simple recall of the definition of a covalent bond with the word pair replaced by the word two. In describing covalent bond formation the number of electrons involved in the bond formation is extremely important.

Question 6

The dotted lines on the diagram of graphite were meant to represent the forces of attraction between the layers of carbon atoms making the popular answer D incorrect.

Question 8

Mercury is the only metal which is a liquid at room temperature. Therefore like all metals it conducts electricity due to the movement of electrons and was not the answer to this question.

Question 19

Alternative C was more popular than the correct answer B. Magnesium oxide does react with dilute sulphuric acid and forms magnesium sulphate solution but no gas. Hence C was incorrect.

Question 35

The names of the first four alcohols in the homologous series of alcohols are:- methanol, ethanol, propanol and butanol. All the names of the alcohols end in –ol and thus cholesterol, ending in -ol, would most likely be an alcohol.

CHEMISTRY

Paper 5070/02
Theory

General comments

This Paper contained several questions with unfamiliar context which some candidates found challenging. There seemed to be a greater polarisation of candidate achievement than in previous sessions. Although many candidates tackled this paper well and coped with the information handling and problem solving aspects involved, a great number failed to get to the heart of many of the questions. Good answers were seen in **Questions A3, A4** and **A5** parts **a** to **c**. Many candidates had difficulty with **Questions A6, B9** parts **d** and **e** and **B10** part **e**. Few candidates, however, scored full marks on the other questions, generally losing marks on those parts which required a degree of explanation and continuous prose. The rubric was generally well interpreted. Many of the candidates attempted all parts of each question and most attempted three questions in part **B**. Many of the candidates who scored well on ***section A*** continued to maintain this standard in ***section B***.

In **section A** the tests for iron(II) ions were fairly well known but the test for sulfur dioxide and unsaturation were often poorly remembered. Although most candidates' could define the term *isotope*, and had a reasonably good knowledge of knowledge of chemical properties, electrolysis and the conduction of electricity by mobile ions was poorly explained. Explanations of evaporation and diffusion were also poorly understood. In ***section B*** many candidates tended to give rather unnecessarily lengthy answers to questions involving free response e.g. **Question B7(a)**, **B8(e)**, **B10(b)** and **(c)**. In extended questions, many candidates disadvantaged themselves by writing vague statements or by not interpreting the question rigorously enough. For example, in **Question A6(c)** many candidates failed to interpret the graph in terms of accurate dating or explained the trends by referring to generalities which were outside the scope of the question. In ***section B*** the least popular question was B8 although many candidates who did attempt this question gained a reasonable number of marks. Conversely, **Question B9** was the most popular but elicited fewer marks than expected since parts **(d)** and **(e)** were rarely obtained. A considerable number of candidates had difficulty in writing symbol equations and many had difficulty in balancing the electrons in the copper refining in **Question B7**. There were only a few instances where candidates disadvantaged themselves by giving contradictory answers. It is encouraging to note that many candidates performed reasonably well on the calculations and many quite poor candidates acquitted themselves well by calculating the empirical formula in **Question A3(d)** and the concentration of fumaric acid in **Question B8(b)** correctly.

Comments on specific questions

Section A

Question A1

Most candidates scored at least half marks for part **(a)** but the definition of a compound was often poorly written. An explanation of electrical conduction in an ionic solution was poorly known. This has been commented on in previous Examiner Reports.

(a) (i) Most candidates gained this mark. The commonest error was to suggest ethanoic acid.

(ii) This was, in general well answered, copper(II) chloride being the commonest error.

(iii) Although about 50% of the candidates realised that ammonium sulfate is used as a fertiliser, calcium oxide or sodium iodide were common incorrect suggestions.

(iv) Most candidates realised that nitrogen dioxide could be formed from lightning activity. The commonest error was to suggest another acidic gas, sulfur dioxide.

(v) Many candidates correctly suggested that calcium oxide reduces soil activity. The commonest error was to suggest ammonium sulfate.

(vi) This was the most poorly answered question for part **(a)**. Few candidates realised that calcium hydroxide is alkaline even though many realised that it reduced soil activity as an answer to part **(a)(v)**. A variety of incorrect answers were seen. Ethanoic acid was the commonest incorrect answer but sodium iodide was a not uncommon incorrect answer.

(b) Although many candidates realised that a compound contained two elements many failed to gain this mark because they either contradicted themselves by including the word mixture in the answer or suggested that two atoms (rather than two different atoms) were combined. A significant number of candidates failed to mention that the atoms or elements were bonded or joined

(c) Few candidates gained the mark here because they suggested that the moving electrons are responsible for the conduction in aqueous solution rather than ions. Some did not even get this far and just suggested molecules or particles moving. Some candidates only answered one part of the question and referred to either the solid alone or the solution alone.

Question A2

Although many candidates gained half the six marks available, few gained more than 4. All parts of the question apart from part **(b)** seemed to be equally challenging.

(a) Many candidates wrote the correct formulae for the reactants and products but few were able to balance the equation. A not uncommon error in the formula for ethanol was to write C_2H_6OH.

(b) Most candidates realised that the reaction was fermentation. Common errors were to suggest respiration, exothermic or decomposition.

(c) Most candidates appreciated that the speed at 20°C increases at 60°C. The commonest errors were to fail to mention the decrease at the higher temperature, to suggest that the speed decreases from 20°C and to suggest that speed increases all the way up to 60°C (and beyond). Some candidates stated that the enzymes were denatured. This could not be given credit since it did not say anything about the rate of reaction.

(d) This was generally not very well done. Most graphs did not finish at the final volumes and a considerable number of candidates opted for a lower initial rate of reaction.

Question A3

This question was well answered by many candidates, the most challenging section being part **(c)**. It was encouraging to note that even candidates who did not do well overall, were able to obtain at least two of the three marks available for the empirical formula calculation.

(a) Many candidates were able to state the percentages of oxygen and nitrogen in clean air. The commonest errors were to suggest swap the figures for nitrogen and oxygen, to give the percentage of nitrogen as 70% and to make the total percentage of nitrogen plus oxygen in the air 100%. This was not given credit because the syllabus states that 1% of the air is other gases. This was also stressed in the stem of the question.

(b) (i) Most candidates could define the term *isotope*. Common errors were (i) to suggest that the number of neutrons and protons were different (ii) to suggest that the atomic number (or atomic mass number) was different.

(ii) Even when candidates could not define an isotope correctly, many were able to calculate the number of neutrons in an atom of argon-40. Only a few candidates muddled the number of electrons with the number of protons.

(c) (i) About half the candidates were able to balance the equation. The two main errors were (i) to fail to balance the equation (ii) to write the formula for sodium chloride as $NaCl_2$.

(ii) The use of argon to provide an inert atmosphere for the reaction to take place (so that the correct products are formed) or to prevent the sodium reacting with the air was not well known. Many candidates were content just to suggest that the argon is unreactive without reference to the reaction mixture. The commonest error was to suggest that argon acts as a catalyst.

(d) Most candidates gained two of three marks for the empirical formula. Although only a few candidates inverted the molar masses and the given masses in the calculation and tired to calculate percentages first, the majority were able to set about the calculation in an orderly manner. A surprising number of candidates failed to gain the third mark for the correct formula because they (i) altered the correct ratio they had calculated (ii) wrote X for xenon or FI for fluorine. [Correct answer $XeOF_4$.

Question A4

This question was probably the best answered in the Paper. Many of the more able candidates gained full marks. Parts **(a)**, **(b)** and **(d)(ii)**, however, proved to be good discriminators.

(a) This was reasonably well answered but many candidates just suggested that the reaction was reversible or that the methylamine ion was formed. Some candidates who gave hydroxide as an answer were rather non-specific, often omitting the word ion. A common error was to suggest that the reaction was similar to that of ammonia without any further qualification.

(b) This proved to be a good discriminator. Although many candidates realised that a precipitate would be formed, suggested a red-brown precipitate. Some did not mention a precipitate at all.

(c) The calculation was generally well done, the commonest errors being to suggest 4.8 cm^3 instead of dm^3. Incorrect molar masses were occasionally used. [Correct answer 4.8 dm^3]

(d) (i) Most candidates could define the term *catalyst*.

(ii) This part caused candidates most problems in this question. Few realised what to do and many took the path of trying to perform a percentage purity calculation, multiplying figures by 100. Of those who did use the correct molar masses of methanol and methylamine, few knew how to proceed further. A few wrote the incorrect units for the answer. [correct answer 232.5 kg].

Question A5

Only part **(c)** was reasonably well-answered. The test for sulfur dioxide was not well known and the question about diffusion, although an improvement on similar questions in previous sessions, still proved difficult for many.

(a) Although a minority of candidates wrote a word equation rather than a symbol equation, many identified the correct products. The main errors were (i) not balancing the equation (ii) writing the halogens , one or both, as single atoms (iii) writing the incorrect formula for potassium bromide or chloride – usually as KCl_2 or KBr_2.

(b) The test for sulfur dioxide was not well known. Common errors were to suggest (i) litmus paper (ii) bleaching of indicator paper (iii) litmus plus potassium dichromate (iv) adding sodium hydroxide. candidates who wrote the correct reagent tended to get the correct colour change.

(c) This was the best answered part of this question, the density of bromine generally providing a mark. Many candidates had difficulty interpreting the negative numbers for the boiling points and incorrect answers such as – 45^{o}C were frequently seen. A considerable number of candidates left one or other of the spaces blank.

(d) As in previous sessions this type of question was poorly done. Few candidates wrote about how particles changed in their energy or movement from the liquid to the vapour phase. Most, however, gained a mark for mentioning diffusion. The explanations for diffusion were on the whole poor, although there did seem to be a slight improvement over previous sessions' answers. Too few candidates mentioned particles, often being content to write vague statements about bulk properties e.g. 'the bromine moves around the room' or 'the bromine moves from where it is more concentrated to where it is less concentrated'.

Question A6

Most candidates found this question difficult and many had problems interpreting the graph and even reading the dates from the graph correctly. Part **(c)(ii)**, an admittedly difficult question, proved particularly challenging. A peculiar aspect of this question was that the difficult parts **(c)(i)** and **(ii)** were often best attempted by candidates who did not gain particularly high marks in the Paper overall. Perhaps they concentrated on the data itself rather than trying to analyse the question in terms of preconceived or learnt ideas.

(a) The effect of the ozone layer on absorbing ultraviolet radiation was well known. However, many candidates lost the first mark through vaguely writing about the rays of the Sun or light. More candidates gained the second mark. Of the correct answers suggested, causing skin cancer was the most generally seen. Some candidates failed to gain the second mark because they did not specify the type of cancer or just wrote it 'harms the skin'.

(b) Few candidates were able to write a balanced equation for the conversion of ozone to oxygen, despite the fact that they were given the formulae of both molecules. The commonest error was to forget to balance the equation. Many candidates also clouded the issue by writing CFC's into the equation and showing these breaking down into chlorine. These type of equations will not be asked for in the examination – if required they will be given in the question.

(c) (i) Many candidates failed to read the graph properly and stated that CFC production increased until 1990 instead of 1988. Some credit was given, however, if this mistake was repeated by suggesting that the CFC production then decreased from 1990 (rather than from 1988). Many candidates failed to gain the mark because they suggested that the CFC production was decreasing from 1980 to 2006 without any reference to the increase.

(ii) Many candidates failed to score the marks for this part of the question because they did not refer to the graph. Many just wrote about the effect of CFCs on the ozone layer and on the ozone concentration at the poles without reference to dates. Many just wrote vague or incorrect statements such as 'the ozone level has been decreasing because of the CFCs' or 'the ozone at the South Pole has decreased so there will be less flooding'. A number of candidates also wrote about melting ice through muddling ozone destruction with global warming. Although CFCs are also greenhouse gases, the context of the question does not allow this interpretation.

Section B

Question B7

Of the **Section B** questions this proved to be fairly popular but it rarely provided candidates with more than six out of the ten marks available. Although many candidates scored well in part **(a)** Part **(b)(ii)** was rarely answered correctly and many lost marks on the relatively easy questions involving recall in part **(c)**.

(a) Candidates who drew a diagram to explain the purification of copper, tended to score more marks than those who did not. Even if the question does not state that a diagram should be drawn, a good labelled diagram will always gain the marks in place of a written description. Written descriptions tended to be vague and rambling, with the equations inserted at almost any point. Very few candidates mentioned that a power supply is required for the electrolysis.

(b) (i) Although many candidates had obviously learnt this equation by heart, some failed to add the electrons or put the electrons on the wrong side of the equation. Other common errors were to put oxygen on the left hand side of the equation and hydroxide and water on the right or to fail to balance the equation, especially on the right hand side.

(ii) This was very poorly done. Few candidates related the fading of the colour to the fact that copper(**II**) ions were not being replaced.

(c) (i) Although this was generally well answered by many candidates a considerable minority failed to get the marks because they gave the names of the processes e.g. Haber process, rather than the name of the industrial product made. This was a clear case of not reading the question properly.

(ii) This was, in general, poorly answered, many candidates writing 'catalyst' as an answer despite the fact that the stem of the question states 'other than catalysts'. Few candidates seemed to know the properties of transition elements. The commonest correct answer was 'high melting point'. Common incorrect answers included (i) stating that the transition element itself was coloured (ii) writing about chemical properties in a rather vague fashion i.e. 'transition elements are less reactive than Group I elements' (iii) stating general properties of metals e.g. electrical conduction.

Question B8

Of the **Section B** questions, this proved to be the least popular, perhaps because they were put off by the unfamiliar formula at the head of the question. However many candidates who chose this question gained marks not only in part **(a)** but also in parts **(c)** to **(e)**. The calculation was fairly well attempted and even weaker candidates gained some marks here because they had been well-drilled in this type of question.

(a) Although many candidates apparently knew the test for an unsaturated compound, fewer than expected gained both marks for this. The commonest errors were to reverse the colour change or failed to mention the colour of aqueous bromine. Few gained the mark for writing the equation. Those who did gave a simplified structural formula or just put R for the COOH groups. Very few rewrote the formula in full and just breaking one of the C-C bonds and adding bromine across. Many just wrote the formula and added bromine to the end of the carboxylic acid group.

(b) There were many correct answers to the calculation with clear working. The main error was a failure to spot that 1 mole of fumaric acid reacts with 2 moles of sodium hydroxide. [The correct answer was 0.03 mol dm^{-3}]

(c) (i) Although many candidates answered this correctly, many others gave the name of a polymer such as Terylene or polythene.

(ii) Most candidates gave a correct use for nylon, fishing lines or nets being the most popular answer.

(d) Many candidates wrote vague answers referring to land, water or air pollution, rather than giving specific examples. 'Landfills' seemed to be a popular incorrect answer. This does not give the Examiner any indication of the problems involved. Many failed to gain a mark by just rewording the 'non-biodegradable' in the stem of the question e.g. 'the plastics don't decompose'.

Question B9

Of the **Section B** questions, this proved to be the most popular but many candidates failed to gain more than one or two marks from parts **(c)** to **(e)**. Part **(a)** was answered well by some Centres but not by others. Only a handful of candidates knew anything about flue gas desulfurisation. Most gained their marks for this part by referring to acid rain.

(a) Many candidates failed to gain more than one mark because they merely stated that photosynthesis involves the taking up of carbon dioxide and the release of oxygen. This was not awarded a mark because half this information could be extracted from the diagram. Candidates are expected to know the overall word equation for photosynthesis. Most candidates gained a mark by mentioning either chlorophyll or sunlight.

(b) It was pleasing to note that many candidates drew good dot and cross diagrams for carbon dioxide. Common errors included only putting one lone pair of electrons on each carbon atom and failure to recognise that there were two double bonds. Only a minority of candidates drew carbon dioxide with one oxygen atom or drew an ionic structure.

(c) (i) It was pleasing to note that a considerable number of candidates were able to balance this difficult equation. Candidates who doubled up the number of atoms were more successful in getting the mark than those who did not. $12(O_2)$ was a common error resulting from this.

(ii) Relatively few candidates gained this mark, mainly because they did not specify carbon dioxide as the gas responsible for increased global warming. Some failed to gain the mark because they suggested sulfur dioxide was responsible.

(d) (i) Few candidates could explain the effect of removing carbon dioxide on this equilibrium. Most were content to make statements about the effect on the algae or other microscopic organisms in the oceans, rather than to regard this purely in terms of the equilibrium.

(ii) Many candidates gained the mark here, usually for a Group I carbonate or ammonium carbonate. The commonest error was to suggest calcium carbonate.

(d) Very few candidates seemed to know anything about flue gas desulfurisation. Most thought that it involved adding calcium carbonate to either the coal or to lakes. There was much confusion between this and neutralising acid rain. Only a handful of candidates mentioned calcium sulfite or calcium sulfate. Nearly all candidates gained their marks through suggesting an effect of acid rain. Few candidates, however, linked sulfur dioxide to acid rain or to an effect of acid rain.

Question B10

This question gave good differentiation between candidates especially in parts **(b)**, **(c)** and **(d)**. Most candidates, however, did not seem to know the essential conditions for converting iron into steel. Although many candidates balanced at least one of the equations in part **(d)** correctly, few balanced both equations.

(a) Nearly all the candidates named haematite as an ore of iron.

(b) Those candidates who knew the reactions well and quoted equations gained full marks. The main errors tended to arise from candidates thinking that calcium carbonate reacts directly with sand. Surprisingly few candidates mentioned the formation of slag / calcium silicate.

(c) This proved a good discriminator. Candidates who wrote their answers as one sentence omitting the mention of the reactants and products often gained all three marks. Those who started writing about the carbon dioxide and coke, often ended up by writing far too much and giving confusing statements. Common errors were to suggest that energy is taken in on bond forming, to write conflicting statements about energy used in bond breaking and bond forming together with the words exothermic and endothermic correctly applied and to forget about the balance between the exothermic and endothermic reactions.

(d) Many candidates managed to balance one of the equations but few balanced both. Common errors were to balance with 2 moles of C or CO or not balance the iron atoms correctly.

(e) Very few candidates realised that oxygen is blown into the molten iron to make steel. Most wrote answers as if they were considering the blast furnace rather than the (basic) oxygen converter. The commonest errors were to suggest the addition of more carbon or the addition of other metals.

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Paper 5070/03
Practical Test

General comments

The overall standard of this paper was very good, with many candidates obtaining high marks in both questions. Most of the candidates were well prepared for the practical test and demonstrated good practical skills in completing the quantitative and qualitative tasks. Supervisors are thanked for providing the required experimental data to enable assessment of their candidates' work.

Comments on specific questions

Question 1

(a) Many candidates carried out both tests successfully recording a white precipitate that disappeared in acid in **Test 1** and remained in **Test 2**. However, despite obtaining the correct observations, there was some variation in the conclusion drawn about the impurity present and SO_4^{2-} was frequently suggested despite the negative sulphate ion result in **Test 1**. NaC*l* or Cl^- was accepted as the answer but not sodium chloride or chloride as the question specified the formula of the impurity must be given.

(b) The majority of candidates scored full or nearly full marks with the acid/carbonate titration demonstrating proficiency in both technique and the recording and processing of data.

Full marks were awarded for obtaining 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 most candidates did follow this procedure, there were a few who either failed to tick any results or having correctly ticked the best results, averaged all their titres regardless of how consistent they were.

There were relatively few candidates who scored full marks in the calculations that followed. The calculations were marked consequentially throughout even when this led to improbable answers.

(c) While there were a number of candidates who were able to calculate the correct concentration of sodium carbonate in **P**, there were some who inverted the volume ratio or used a 1:1 mole ratio. Answers were required to three significant figures and there were only a few examples of candidates over approximating.

(d) Even if they failed to score in **(c)** most candidates scored this mark, many by carrying their error forward. Nevertheless there were some candidates who calculated the mass of sodium carbonate in 25 cm^3 rather than in 1 dm^3.

(e) Many were uncertain what to do in the final calculation. Consequently, while some did not make any attempt, there were others who calculated the percentage by mass of impurity or faced by a mass in **(d)** greater than 6.00 g, chose to invert the masses rather than obtain an answer which was in excess of 100%.

Question 2

This was a relatively straightforward exercise but it nevertheless proved a good discriminator between candidates. There were a few candidates who failed to follow the instructions carefully enough and others who lost marks for incomplete rather than incorrect answers. Teachers should continue to encourage candidates to make full use of the qualitative analysis notes supplied on the last page of the exam paper. The terminology and method of reporting provided are a model for the successful recording of observations. It was not necessary to make all the observations to obtain full marks for this question.

R was zinc sulfate **S** was iron(II) sulfate **T** was lead(II) nitrate

Solution **R**

Test 1 While almost all candidates noted the white precipitate formed on adding aqueous ammonia, not all succeeded in getting it to dissolve in excess reagent.

Test 2 As in **Test 1**, most candidates obtained a white precipitate in **(a)** but many more were able to get the solid to dissolve in excess reagent in **(b)**. In **(c)** no reaction occurs when aqueous hydrogen peroxide is added to the mixture from **(b)**. Nevertheless, there were candidates who reported effervescence, formation of precipitates or colour changes.

Test 3 Most candidates realised that there was no reaction on adding either the acid or aqueous potassium manganate(VII).

Solution **S**

Test 1 When aqueous ammonia is added to solution **S**, a green precipitate is formed which is insoluble in excess reagent. Almost all candidates obtained both marks here but there were a few who recorded the colour as blue or believed the solid dissolved in excess.

Test 2 As in **Test 1**, most candidates obtained a green precipitate which was insoluble in excess. In addition the majority noted that the precipitate turned red-brown when aqueous hydrogen peroxide was added. While brown was acceptable as a description of the colour, red alone or orange was not. Relatively few candidates scored all the marks allotted for the gas evolved. A significant number did not report any effervescence and some who did failed to identify the gas.

Test 3 Most candidates realised that they were looking to observe whether or not the aqueous potassium managanate(VII) decolourised and so scored the mark. Recording that the potassium manganate(VII) dissolves in a liquid however is not equivalent to the loss of its colour.

Solution **T**

Test 1 Almost all candidates noted the white precipitate which was insoluble in excess aqueous ammonia.

Test 2 As in **Test 1**, most candidates obtained a white precipitate and generally recorded that it dissolved in excess aqueous sodium hydroxide. On addition of hydrogen peroxide a dark brown solid is produced and this accompanied by effervescence as oxygen is evolved. The majority of candidates reported the precipitate but a few noted its colour as red-brown. A significantly higher proportion of candidates observed the effervescence than with Solution **S** and successfully tested for and identified oxygen.

Test 3 Encouragingly many candidates noted the white precipitate formed with dilute sulphuric acid and the purple colour of the mixture after addition of aqueous potassium manganate(VII).

Conclusions

The majority correctly used their evidence from **Tests 1** and **2** to draw appropriate conclusions – Zn^{2+} for **R** and Fe^{2+} for **S**. In the case of **R** the precipitate was required to have dissolved in both tests before the mark was awarded, and since the question specified the formula of each cation should be given, no credit was given for the name or symbol.

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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 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.

Comments on specific questions

Question 1

(a) This question shows the apparatus used to make ammonia. The tube containing calcium oxide is included in the apparatus to dry the ammonia. Alternative answers include dehydration or absorption of water.

(b) Ammonia is collected in apparatus Y as it is less dense than air and soluble in water.

(c) (i) Phosphorous is the other essential element found in ammonium phosphate, although many candidates suggested that phosphate is the element.

(ii) The presence of the ammonium ion in ammonium phosphate is confirmed by heating it with aqueous sodium hydroxide producing ammonia which turns litmus paper blue. Answers must state that it is the gas that is tested with litmus, not the solution. Several candidates confused the test with that of the nitrate ion.

(iii) The mass of nitrogen contained in 1 kg of ammonium phosphate is 281.9 g.

Question 2

(a) The mass of zinc nitrate used in the experiment is 1.89 g.

(b) Zinc oxide is a white or yellow solid. Alternatives to solid include powder and ash. Both colour and solid are required to gain the mark.

(c) The reaction takes place in a fume cupboard to prevent the toxic gas, nitrogen dioxide, from coming into contact with the candidates.

(d) The number of moles in 1.89 g of zinc nitrate is 0.01.

(e) Using the equation for the heating of zinc nitrate, 0.01 moles of zinc nitrate produce 480 cm^3 of nitrogen dioxide and 120 cm^3 of oxygen. A common error is to give the volumes in dm^3 rather than cm^3 as required by the question. In this case only 1 mark is lost.

(f) Nitric acid is used to react with zinc oxide to make zinc nitrate.

Questions 3 to 7

Correct answers to the multiple choice questions are (d), (c), (d), (c), (b)

Question 8

(a) 1.70 g of the carbonate is weighed out.

(b) Carbon dioxide is evolved which on passing into limewater turns it milky.

(c) The colour change of methyl orange is orange to yellow although other changes of dark to light involving the colours pink, red, orange and yellow are acceptable.

(d)-(l) The three titres are 25.9, 25.3 and 25.5 cm^3 respectively giving a mean value of 25.4 cm^3. As per usual, when errors occur in reading the burette diagrams or subtracting the volumes, the mean must be taken from the closest two titres. Answers to the calculation are (e) 0.00254, (f) 0.00254, (g) 0.0254, (h) 0.05, (i) 0.0246, (j) 0.0123 moles. The answer to (j) may then be used together with the answer to (a) to give the relative formula mass of M_2CO_3 as 138 and the relative atomic mass of M as 39. In (l) the information suggests that M is a mono-positive ion, being in the same group, group 1, as sodium. Having a relative atomic mass of 39 suggests that M is potassium. Errors may be carried forward throughout this question and, if used correctly, further marks may be gained. This also applies to the final part of the question where alternative group 1 elements may be correctly concluded for different values of atomic mass.

Question 9

This question involves the analysis of iron(III) nitrate.

(a) A coloured solution indicates that a transition metal ion is present in the compound C. Candidates who state that C is a transition metal lose the mark.

(b) and (c) In both tests the precipitate is insoluble in excess indicating the presence of Fe^{3+} ions.

(d) Nitrate ions are confirmed by adding aqueous sodium hydroxide and aluminium powder and, on warming, ammonia is evolved which turns litmus paper blue.

Candidates in general scored highly on this question.

Question 10

(a) Candidates are asked to complete the table. 0.25 g of propanol is burnt. The initial and final temperatures are 26.3° and 35.2° giving a temperature rise of 8.9°.

(b) Using the results in the formula, the heat produced when one mole of propanol is burnt is -1780 kJ/mole. The mark is lost when the negative sign is omitted.

(c) Exothermic reactions have a negative enthalpy change.

(d) Candidates, in general, were unable to suggest more than one reason for the difference between the theoretical and practical values. Acceptable answers include heat loss / no insulation / incomplete combustion or evaporation of the alcohol.

(e) The results are plotted on the graph. Candidates are given credit for plotting the points accurately and joining the points with a smooth curve.

(f) The candidate's graph is read to assess the accuracy of the answer which is 0.58+/- 0.01 g. Most candidates scored well on this question. The plotting and joining the points with a smooth curve was in general of a high standard.