CHEMISTRY

Paper 0620/12
Multiple Choice

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

Candidates performed very well on this paper. Questions **1**, **2**, **3**, **7**, **13**, **21**, **24**, **26**, **29**, **33**, **34**, **36** and **38** proved to be the most straightforward, with a high proportion of candidates selecting the correct response.

Questions **5**, **8**, **12**, **16**, **20**, **23**, **27**, **35** and **40** were the most difficult for candidates.

The following were common incorrect responses to the questions listed:

Question 5

Response **A**. Candidates recognised that ionic compounds are soluble in water and conduct electricity when molten, but did not correctly refer to “volatility”.

Question 8

Response **C**. Candidates opted for the first of the alternatives which assigned products to the correct electrodes, but did not take into account the fact that compound X was molten.

Question 12

Responses **A**, **C** and **D**. All responses had a significant number of candidates opting for them, indicating that the topic was not well understood by many.

Question 16

Response **B**. Most candidates realised that neutralisation was involved but many were confused by the term oxidation in response **B**.

Question 20

Response **A**. Candidates correctly identified an unreactive gas but did not realise the importance of the fact that it had to be denser than air.

Question 23

Response **C**. This response was nearly as popular as the correct answer. Many candidates were not familiar with the reactions of metals with steam.

Question 27

Responses **B** and **C**. Responses **B** and **C** were equally popular responses. Many candidates appeared not to have considered all of the information in the table carefully enough.

Question 35

Response **A**. Many candidates incorrectly assumed that the fractions in the table were in order of their boiling point ranges.

Question 40

Response **A**. Some candidates appeared not to be aware of the distinctive odour (“vinegar smell”) of ethanoic acid.

CHEMISTRY

Paper 0620/22

Core Theory

Key Messages

- It is important that candidates read questions carefully in order to understand what exactly is being asked.
- Many candidates need more practice in answering questions requiring free response, or about organic chemistry.
- Interpretation of data from tables was generally well done.

General Comments

Many candidates tackled this paper well, showing a good knowledge of core chemistry. Nearly all candidates were entered at the appropriate level and the standard of English was very good

Some candidates need more practice in reading and interpreting questions. The rubric was misinterpreted by a minority of candidates in a few questions.

In organic chemistry, few candidates could write the correct displayed formulae for ethanol, understand that alkanes are generally unreactive, or balance an equation for cracking.

Some candidates need more practice in answering extended questions. More practice is needed in selecting relevant information and organising ideas in a logical fashion. Others need practice in answering questions relating to practical procedures such as crystallisation.

Many candidates were able to extract information from tables and balance symbol equations. Others need more practice in writing both word and symbol equations. Many candidates were able to undertake simple calculations involving simple proportion as well as calculation of relative formula mass. Others need to revise these areas.

Questions involving general chemistry, including electrolysis and atomic structure, were well tackled by many candidates.

Comments on Specific Questions

Question 1

(a) In **(i)** many candidates suggested incorrectly that **E** is a saturated hydrocarbon, not considering that a hydrocarbon contains only hydrogen and carbon. Most candidates recognised the ionic structure in **(ii)**. Fewer recognised that carbon dioxide is a product of respiration in **(iii)**. The commonest error was to suggest structure **F**. Most candidates recognised that ethane is in the same homologous series as methane in **(iv)** and that structure **D** is used for cutting in **(v)**. The commonest errors were to suggest **E** in both **(iv)** and **(v)**.

(b) Some candidates gave a good definition of the term ‘element’. Others wrote statements which were too vague, e.g. ‘it contains only one carbon atom’, ‘it contains a certain number of carbon atoms’ or ‘it contains one type of substance’. A significant minority did not understand the question and wrote about the uses of diamond.

Question 2

(a) (i) Nearly all the candidates gave a suitable value for the boiling point of astatine. The commonest error was to suggest values lower than 184 °C.

(ii) Nearly all candidates gave the correct answer. Very few suggested that fluorine is a liquid or a solid.

(b) (i) Many candidates wrote a suitable word equation. A few did not obtain full credit because they wrote 'and' and 'gives' in place of the arrow and + sign. The commonest errors were to write 'iodide' instead of 'iodine' or omit the iodine. A few gave the products as 'brown solution'.

(ii) A majority of the candidates gave the correct answer by comparing the reactivity of iodine and chlorine. The commonest errors were to suggest that either iodine is less reactive than potassium chloride or it is low in the reactivity series, with no comparison with chlorine.

(c) (i) Nearly all candidates gave the correct answer, exothermic. A few suggested combustion or endothermic. The former is an example of a reaction which releases energy, not a general term.

(ii) Many candidates explained the electron transfer well. Others suggested that electrons were shared between sodium and iodine. A small number suggested that sodium gains electrons.

Question 3

(a) Some candidates gave well-written sequential answers giving all relevant details. Others wrote vague statements about the erosion of the column such as 'it breaks', 'it cracks', 'it decays' or 'it wrinkles'. Most candidates recognise sulfur dioxide. Fewer connected it explicitly to acid rain. Some gave vague statements about 'gases in the air' or 'carbon dioxide' being responsible for acid rain. Others concentrated on the iron pins rather than the limestone. The best answers also gave the products of the reaction between the acid and the limestone.

(b) Most candidates were able to select two methods for preventing rusting. Fewer gave a reason in terms of preventing air or water reaching the surface. Some candidates who selected galvanisation as a method did not gain credit for the explanation because they suggested that zinc rusts.

(c) Many candidates gave two suitable properties of transition elements. The commonest error was to suggest properties such as malleability or conductivity which are common to all metals. In some cases this may have been due to candidates not reading through the question to the end.

(d) This part was generally well done, most candidates giving the correct relative charges. The commonest error was to give an incorrect number of electrons, e.g. 52, or neutrons, e.g. 24, 58 or 82.

(e) Many candidates balanced the equation successfully. The commonest errors were to put 2H, H or O_2 as a product.

Question 4

(a) Some candidates identified both elements correctly. Others did not choose elements as requested in the question and gave compound ions, e.g. ammonium or phosphate. Other common errors included oxygen and potassium. The latter presumably arose from not reading the question carefully enough, which asks for the elements for plant growth in ammonium phosphate.

(b) (i) Nearly all candidates named the burette correctly. The commonest error was to suggest 'pipette'. A few candidates suggested 'measuring cylinder' or 'condenser'.

(ii) Nearly all candidates realised that acids have a pH value of less than pH 7. The commonest errors were to suggest pH 7 or pH values near to 8.

(iii) Some candidates realised that the pH decreases when the acid is added to the ammonia. Others did not gain the mark because they suggested that 'it goes to neutral' or 'it's neutralised'. This does not tell us the direction of change of the pH. A significant number suggested that 'the pH increases' or did not refer to pH at all, e.g. 'the colour changes'.

(iv) Most candidates identified neutralisation. The commonest error was to suggest 'combustion'.

(c) This was the least well answered part of this question. A variety of incorrect compounds were seen as products. These often contained sodium or phosphorus, e.g. NaO, NaOH, PO_3. Another common error was to suggest H_2 instead of H_2O. The balance on the left of the equation was often incorrect, 2 or 4 being common errors.

Question 5

(a) (i) This was almost invariably correct. The commonest error was to suggest iodide, which is not a positive ion.

(ii) Many candidates did not name the ion correctly, writing iodine instead of iodide.

(iii) Nearly all the candidates recognised that calcium and magnesium are in the same group. A few did not read the question carefully enough and suggested sodium and potassium.

(iv) Many candidates selected two suitable negative ions. A few suggested hydroxide ions but this could not be given credit because these ions were not in the table.

(b) (i) Nearly all the candidates gave a suitable reason why graphite is used for electrodes. A few suggested that they were reactive or less reactive.

(ii) This was the least well answered part of **Question 5**. Few candidates realised that hydrogen is formed at the cathode when an aqueous solution of sodium chloride is electrolysed. Most suggested sodium or sodium hydroxide. A significant minority did not realise that positive ions moved to the cathode and suggested chloride ions or chlorine.

(iii) Many candidates gained two marks for completing the electronic structure of the chlorine molecule. Common errors included two pairs of bonding electrons or incorrect number of outer shell electrons surrounding the right hand chlorine atom.

(c) This was generally well done. The commonest error was to put 'bromide' at the anode instead of 'bromine'. A significant number of candidates reversed the electrode products.

Question 6

(a) Some candidates focused on the impurities in the zinc oxide, suggesting that the impurities could be harmful to the skin. Others gave rather vague statements such as 'they could be dangerous' or 'they may react'. Many wrote about the zinc oxide rather than the impurities. Some wrote statements completely out of context such as 'the impurities react with gases in the atmosphere'.

(b) (i) Some candidates wrote good explanations of reduction involving loss of oxygen from zinc oxide. Others wrote vague statements such as 'it means reducing' or 'it is less'. Some wrote about carbon gaining oxygen without reference to the zinc oxide.

(ii) This was generally well answered. The commonest error was to suggest that carbon dioxide is formed. A few candidates wrote word equations without the arrow or plus signs.

(iii) Many candidates realised that carbon monoxide/a poisonous gas is produced in the reaction. A significant number of candidates suggested, incorrectly, that the fume cupboard was needed 'for the reaction to take place' or that 'it is used because of the high temperature needed'.

(c) Some candidates put the metals in order of their reactivity. Many reversed the order completely and gave the order with respect to the metal oxide rather than the metal. The more reactive the metal, the more difficult it will be to remove the oxygen from the oxide. So the oxides of the more reactive metals are less easily reduced.

(d) Many candidates suggested oxygen, hydrogen or carbon dioxide as the other product of this reaction rather than water.

(e) (i) Most candidates suggested 'filtration'. The commonest error was to suggest 'crystallisation'. A few candidates suggested 'distillation'.

(ii) This was the least well answered part of this question. Most candidates obtained credit for suggesting heating to the crystallisation point but few mentioned leaving until a significant number of crystals form, filtering off the crystals or drying between filter papers. The commonest errors were to suggest evaporating off all the water, filtering off at the wrong stage and heating in an oven.

(iii) Some candidates correctly selected either zinc carbonate or zinc hydroxide. Others chose salts such as zinc sulfate or zinc chloride or repeated the zinc oxide or zinc which were in the stem of the question.

(f) (i) Many candidates calculated the mass of zinc sulfate correctly. The commonest error was to suggest 10.4 g, which arises from dividing 6.5 by 16.1 rather than 16.5 by 6.5.

(ii) Some candidates calculated the relative formula mass correctly. Others did not take into account the four oxygen atoms in zinc sulfate and either added one atom of each element giving a value of 103 or multiplied the relative atomic mass of sulfur by 4, ignoring the oxygen, giving a value of 293.

Question 7

(a) (i) A significant number of candidates did not respond to this question. Many of those who did, placed the cross in an incorrect position. Common errors were to place the cross outside the column in the bitumen fraction, at the top of the column or near the middle of the column.

(ii) Most candidates correctly identified the naphtha fraction. The commonest errors were to suggest LPG, petrol or petroleum.

(iii) Many candidates gave a description of what lubricants do, e.g. 'making something smooth' or 'greasing', or trying to link the fraction to graphite. Others confused the lubricating fraction with the bitumen fraction and gave the answer 'making roads'. The best answers were from those candidates who chose waxes or polishes.

(b) Most candidates obtained partial credit by ticking the last box (methane is an alkane present in natural gas). Few gained full credit. The commonest error was to suggest that hydrogen is formed when alkanes burn.

(c) (i) Most candidates obtained full credit for a suitable description of cracking. Those who did not gain a mark generally muddled cracking with distillation.

(ii) Some candidates gave the correct formula for the alkene, C_3H_6. Common errors were $3CH_3$ and C_2H_6.

(d) (i) Many candidates obtained credit for the correct structure of ethane. Fewer obtained credit for the structure of ethanol. Common errors were to omit the oxygen atom, to draw the structure of methanol or to draw an impossible structure, e.g. hydrogen bonded to both a carbon atom and an oxygen atom. A few candidates attempted to draw a carboxylic acid group. A significant number of candidates did not respond to this question.

(ii) Nearly all the candidates recognised the sign for a reversible reaction. A few suggested 'equals'.

Question 8

(a) The best candidates gave careful answers which referred to diffusion, the random movement of particles and particles spreading out. Others either did not refer to particles at all or wrote about changes of state. Most candidates suggested the idea of particles spreading out. Fewer mentioned the word 'diffusion'. Only the best candidates gave answers which included the (bulk) movement of potassium(VII) manganate particles from higher to lower concentration. A significant number of candidates wrote, incorrectly, about all the particles gaining energy or melting.

(b) This was generally well answered with most candidates describing the particles as close together and only vibrating. The commonest error was to suggest that the motion was 'moving slowly' or

'spreading out'. Such answers may have arisen from candidates ignoring the word 'solid' in the stem of the question and referring back to **(a)**.

(c) Few candidates obtained full credit, mainly because they placed the level of the solvent above the level of the spot. Some did not notice the words 'beginning of the experiment' in the stem of the question and placed the solvent line at the top of the paper. Others placed the spot of dye half way up the paper.

CHEMISTRY

Paper 0620/32
Extended Theory

Key Messages

- Candidates need to know how to deduce formulae and how to write equations.
- Candidates need to know how to respond to questions which ask 'what would you see' or 'give observations when'.
- Working out should be clearly shown in all calculations.

General Comments

- Candidates need to differentiate between rate and equilibrium. The best advice is to think of the two as being totally unrelated.
- 'Equations' refers to balanced chemical equations as opposed to word equations which would be asked for specifically if required.

Comments on Specific Questions

Question 1

All parts to this question were answered very well by the majority of candidates. Full credit could often be given. Elements from the wrong period were occasionally given. In parts **(b)** and **(d)** there were no common errors.

(a) Sulfur and phosphorus were occasionally listed as gaseous.

(c) Sodium was occasionally seen.

(e) Silicon was occasionally seen.

(f) Magnesium was occasionally seen.

Question 2

(a) Full credit could not be given if atoms were not mentioned**.**

(b) This was well answered with many candidates obtaining full credit. Missing the charge on the sodium ion was a common slip, as was ignoring the charges shown in the question for C, and so the number of electrons was often stated as 8. In D some candidates worked out the number of protons by assuming they would be the same as the electrons – candidates should be aware that the number of protons determines which element it is.

Question 3

(a) Large numbers of candidates were aware that ammonia is used in the manufacture of fertilisers. The manufacture of nitric acid was another occasional correct answer. It is recommended that the *manufacture* of fertilisers or the *manufacture* of nitric acid is stated as the answer rather than merely fertilisers or nitric acid.

(b) The vast majority of candidates achieved the correct answer to this question.

(c) This question was answered well. Nitrogen was occasionally thought to be produced from 'the soil' or 'car exhausts' The production of hydrogen from 'the air' was only seen occasionally as was the 'electrolysis of brine'.

(d) Most answers were correct. Vanadium(V) oxide was seen very occasionally.

(e), (f) There was considerable confusion between rate and equilibrium**.** Answers to questions on rate should be based entirely on the collision theory, whereas equilibrium position (or yield) can shift depending on the thermicity of the reaction or the number of moles on either side of the equation as well as changing the concentrations of reactants or products.

(e) (i) Catalysts often confused with enzymes, i.e. suggestion that they are denatured at higher temperatures thus leading to slower reaction.

Many candidates thought that the rate decreased because the forward reaction was exothermic. This showed confusion between yield and rate. Those who realised that rate increased as temperature increased only rarely related this to an increase in the number of collisions leading to reaction in any given time.

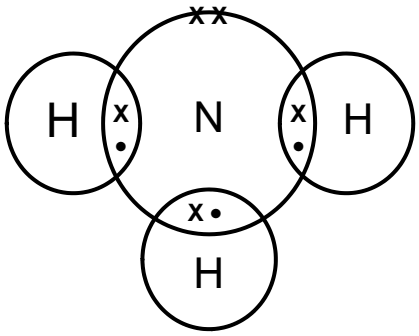
(ii) Many candidates thought that the yield increased, because yield always increased when temperature increased. This showed confusion between yield and rate. Reference to the forward reaction being exothermic was only seen occasionally.

(f) (i) This question was answered reasonably well.

(ii) This question was less well answered. 'Less space to move' was seen occasionally. The molecules being closer together was seen very infrequently..

(iii) This question was answered reasonably well. Financial issues were correctly referred to more often than safety issues.

(g) This question was answered well. Diagrams of the type shown below are preferred to some of the other varieties that were seen.



(h) (i) A minority of candidates knew the definition of a base as a proton acceptor. Many listed properties of bases and/or alkalis without giving the required answer.

(ii) Many who knew that ammonium sulfate was the product did not then give its formula. Others gave hydrogen and water amongst other incorrect products.

Question 4

(a) (i) Those who did not get the correct empirical formula could still be given partial credit if working was shown. Many rounded up the ratio of 1 : 2.5 to 1 : 3 or rounded down to 1 : 2 instead of multiplying both numbers by 2 and achieving 2 : 5.

(ii) Those who did not get the correct molecular formula could still be given partial credit if working was shown.

(b) (i) This question was answered very well. C_nH_{2n+2} was the most common incorrect answer.

(ii) This question was answered well, although answers other than empirical formulae, such as C_2H_4 were occasionally seen.

(c) This question was answered well, although the word *only* was sometimes absent from the meaning of hydrocarbon.

(d) This question was answered well. The most common error was not to include the initial colour of bromine on any of the three lines.

(e) (i) This question was answered well.

(ii) 1-ethyl ethene and styrene were seen amongst the incorrect names of the monomers. There were several correct names which often included but-1-ene.

(iii) Candidates seemed to find this question difficult. The most common error was to draw but-1-ene in a different way to the way it was drawn in **4(e)(ii)**, e.g. by bending the chain or drawing the double bond at the other end.

Question 5

(a) This question was answered very well.

(b) This question was answered very well. Platinum was seen very occasionally.

(c) Candidates answered this reasonably well. Melting point of aluminium and boiling point of aluminium oxide as well as cryolite behaving as a catalyst were amongst the incorrect answers.

(d) There were a wide variety of incorrect answers, which included a wide variety of incorrect formulae. Candidates need to learn how to write equations for electrode reactions as a priority.
$Al^{3+} + 3e^- \rightarrow$ **3**Al was seen occasionally for the cathode reaction.

(e) (i) This was usually answered correctly, although some thought that iron was more reactive than carbon. The reverse order was occasionally seen.

(ii) This could not be credited very often. Many candidates repeated the order of reactivity that they had given in **5(e)(i)** without explanation. 'Aluminium is not reduced by carbon' is a meaningless statement, as opposed to 'aluminium oxide is not reduced by carbon' which was seen infrequently.

Candidates should avoid using the word *it* as it is usually not clear what *it* is referring to, e.g. as in 'it is not reactive enough to reduce it'. Chemical substances should always be referred to in prose by name.

(f) This was usually answered correctly.

(g) Formulae and equations were shown to be a difficulty for candidates in all parts with the possible exception of **5(g)(i)**.

(i) This was usually answered correctly.

(ii) Those candidates who used correct formulae often omitted the 2 in front of CO. Thus the equation was unbalanced.

(iii) This proved the most difficult part of **5(g)**. Candidates who got the formulae correct had problems in balancing. This is an equation in which learning the balancing numbers is advised.

(iv) The formulae, particularly calcium silicate and occasionally silicon oxide were often incorrectly stated by candidates.

Question 6

(a) The requirement to 'describe two things that the student would observe' means that it is only necessary to describe what is seen rather than to name the substances concerned. Bubbling/fizzing/effervescence were often mentioned but the final colour of the solution, the dissolving/disappearance of some of the solid mixture and the fact that some solid would remain were hardly mentioned at all.

(b) The production of more copper by electrolysis or displacement by a more reactive metal was irrelevant to the requirements of the question. Candidates needed to say that the copper (which was already present) needed to be separated, washed and dried in order to make it *pure and dry*.

(c) (i) The colours of metal hydroxides are clearly stated on the syllabus but were unknown to the majority of candidates.

(ii) Writing ionic equations is a skill that needs to be given priority by candidates in future examinations.

(d) (i) The state symbol for copper hydroxide was often seen as (aq) or (l). State symbols were occasionally missing. Formulae were very often incorrect as were species chosen by candidates, despite the fact that the names were given in the question.

(ii) Carbon was often given as the correct answer, although metallic elements were occasionally stated.

Question 7

(a) Candidates should be aware that specific conditions are required in answer to a question of this nature. Room temperature/optimum temperatures are too vague to gain any credit. Some candidates quoted temperatures that were very high and would be more suited to the hydration of ethene rather than an enzyme catalysed reaction such as fermentation. Yeast and/or absence of oxygen were the points that most often gained credit.

(b) (i) Candidates answered this question well. The most common error was to incorrectly round the answer down to 0.16. Three significant figures are preferred.

(ii) This was carried out less well. The most common error amongst those who made a significant attempt at the calculation was either to miss out multiplication of the moles by two or sometimes to multiply by two twice. Some credit was available in both cases as long as clear working out was shown.

(iii) Candidates found this even more difficult. Again the mole ration of 2 : 1 was not always used correctly.

(c) (i) Candidates should be aware that raw materials are naturally occurring substances. Hydrocarbons or named alkanes (amongst many other incorrect substances) were often given as examples of raw materials.

(ii) Candidates answered this quite well, although formulae were not always correct.

CHEMISTRY

Paper 0620/52

Practical

Key Messages

When required to choose an appropriate scale for the *x* or *y*-axis of a graph at least half of the grid should be involved to plot the points. The axis does not have to start at 0. Points should be clearly plotted – minute dots are not suitable. Straight line graphs should be drawn with a ruler.

Candidates should make full use of the "**NOTES FOR USE IN QUALITATIVE ANALYSIS**" page of the examination paper. This gives the formulae of many ions and gases and will help to avoid confusion between, for example, ammonia and ammonium

General Comments

The majority of candidates successfully completed both questions and there was no evidence that candidates were short of time. The substitute salt used in **Question 1** caused no problems and few comments were submitted after carrying out the experiments. Supervisors' results were submitted with the candidates' scripts. The Examiners used Supervisors' results when marking the scripts to check comparability.

The results obtained by some Supervisors and candidates suggested that some centres did not use quantities specified in the Confidential Instructions.

Comments on Specific Questions

Question 1

(d) Almost all candidates completed the table of results. Good results were obtained by the majority of candidates, with larger volumes of water giving a lower temperature at which the crystals first appeared and the temperature values of candidates generally agreeing well with those obtained by the Supervisors. A minority of candidates incorrectly recorded the total volume of water in Experiment 4 as 16 cm^3.

(e) While most candidates plotted all points correctly, the scale on the vertical axis of the graph caused some problems. The most common error was to start the temperature axis at 0 °C meaning that the plotted points covered less than half of the *y*-axis. Most curves were good attempts and best fit straight lines drawn with a ruler scored credit.

(f) Many candidates did not clearly extrapolate their graph and show clearly where they had read their answer from the grid.

(g) Having done the experiment, the majority of candidates were able to state that a clear/colourless solution formed or that no solid or crystals were visible. Wrong answers referred to changes in temperature, crystals forming, excess crystals remaining or no more crystals dissolving.

(h) The more able candidates used the information provided to work out that not all of the salt would dissolve. Credit was awarded for realising that more water would be needed. Most responses referred to higher or lower temperatures being needed or to the rate of dissolving and could not be credited.

(i) A significant number of candidates obtained full credit. Those candidates obtaining partial credit joined their sketch graph to the original or labelled a completely wrong line correctly. A large number of sketch graphs were unlabelled.

(j) Often the suggested improvements were irrelevant to this experiment, such as using insulation, timing or starting at a common temperature or using more accurate apparatus. Using a pipette instead of a burette was a common suggestion. Vague answers discussed using a digital thermometer or not dipping the boiling tube in a beaker of water.

Those candidates who obtained credit repeated the experiments and found the average/mean of the readings. Others realised that taking the thermometer out of the boiling tube after each experiment may lead to a loss of solid. Responses discussing carrying out separate experiments to prevent possible loss of water by evaporation using the same boiling tube of the mixture were also credited.

Question 2

Solution **E** was aqueous diammonium iron(II) sulfate.
Solution **F** was ammonium trioxovanadate(V).

Tests on solution E

(a) Most candidates stated that the mixture was green or colourless. References to clear or transparent solutions were not credited.

(b) The majority of candidates reported the formation of a white precipitate.

(c) The formation of a green precipitate was often described as a green solution. Many correctly noted the colour change of the litmus paper or pH paper, but did not note the pungent smell of the gas. References to ammonia were ignored.

A number of candidates did not follow the instructions and note the appearance of the residue after five minutes. Credit was awarded for noting the colour changing to brown.

(d) Candidates need to record carefully during this qualitative analysis section. Many candidates did not note that the colour changed from pink/purple to colourless. The formation of a precipitate when aqueous sodium hydroxide was added was often omitted.

Tests on solution F

(e) (i) The appearance of the solution was well answered.

(ii) The pH of the solution was often not given. Vague references to the colour of litmus paper or to the solution being acidic scored no credit. The pH of the solution should have been that of a strong acid, i.e. 1–3. Some pH values recorded were higher than 7.

(f) Many candidates did not mention that effervescence occurred or that bubbles were formed. Others obtained credit for mentioning colour changes. Some only gave one colour change and had not followed the instruction to observe for five minutes. Good responses mentioned blue, green and purple colours.

(g) The full range of marks was seen. Many candidates correctly identified all four ions present in solution **E**, but there was some confusion between ammonia and ammonium. Other candidates confused the result of test **(d)** and concluded that iron(III) ions were present in the original solution **F** instead of iron(II) ions.

(h) Candidates who made correct observations in **(e)** and **(f)** often had difficulties in drawing a correct conclusion about solution **F**. The presence of an acid was more likely to be recognised than the presence of transition metal ions. Named transition metals, such as copper, were credited. Guesses such as iodine, zinc iodide, etc. were prevalent.

CHEMISTRY

Paper 0620/62

Alternative to Practical

Key Messages

Questions requiring candidates to plan an investigation should be answered with details of apparatus to be used, substances involved, and practical procedures clearly specified with some idea of a conclusion. Preliminary notes are advisable before writing the plan.

General Comments

The majority of candidates attempted all of the questions.

Candidates found **Question 4** to be the most demanding.

The majority of candidates were able to complete the tables of results from readings on diagrams and plot points successfully on a grid as in **Questions 2** and **4**.

Comments on Specific Questions

Question 1

(a) Most candidates obtained credit for identifying the thermometer and the condenser. There were references to cooling tubes and water jackets which were ignored.

(b) (i) Generally correct with ethanoic acid having a lower boiling point obtaining full credit. A minority of candidates stated that ethanoic acid had a low boiling point which obtained only partial credit.

(ii) Mostly correctly answered, but a number of candidates suggested that no more liquid came over, the flask was empty or the collecting vessel was full, and were not credited. Vague references to a change in temperature were common.

(c) Some candidates thought that large beads would not fit in the column or that it was to do with the spaces between the beads allowing gas to flow easily.

(d) Many correct answers based around named indicators obtained full credit. When using litmus paper, it was vital to mention that it should be blue litmus. Litmus turns red obtained only partial credit.

Question 2

(a) The volumes of gas were almost always correctly recorded from the gas syringe diagrams.

(b) The points were usually correctly plotted with the exception of the origin which was omitted by some. Some lines were not smooth lines and many included the anomalous point. A number of candidates used a ruler to draw a straight line graph.

(c) (i) The anomalous point was often correctly identified. The explanations were often vague and incorrect referring to errors in the experiment.

(ii) Despite having correctly identified the anomalous point some were unable to complete this question, instead giving a gas volume for some other point on the graph with 48 cm^3 being a common answer.

(d) Many candidates drew their curve to the left of the original graph, but only the better candidates levelled it off at the same level, with other candidates usually going higher.

Question 3

Electrolysis was correctly identified as the process by the majority of candidates.

(a) The reactivity of aluminium or the inert nature of platinum was often realised. Wrong answers discussed platinum being a better conductor of electricity than aluminium.

(b) Chlorine gas was correctly identified by the majority of candidates, with hydrogen the common incorrect response. A surprising number of candidates did not realise that chlorine would bleach the indicator and red, orange and yellow were common.

Question 4

(d) This table was completed by all candidates. The temperatures were mostly correct. There were some 2,2,4 and 12,14 and 16 incorrect volumes in the first column of the table.

(e) The most common error was starting the temperature axis at 0 °C meaning that the plotted points covered less than half of the *y*-axis. The points were generally plotted correctly and most curves were good attempts. Unfortunately, many candidates joined the points using straight lines.

(f) Extrapolations were generally good, although a few deflected sharply downwards. The omission of units was fairly common.

(g) The majority obtained credit for stating that a clear/colourless solution would form or that no solid/salt would be visible. Wrong answers referred to changes in temperature, crystals forming, excess crystals remaining or no more crystals dissolving.

(h) The more able candidates used the information provided to work out that not all of the salt would dissolve. Credit was awarded for realising that more water would be needed. Most responses referred to higher or lower temperatures being needed or to the rate of dissolving and could not be credited.

(i) A significant number of candidates obtained full credit. Those candidates scoring partial credit joined their sketch graph to the original or labelled a completely wrong line. A large number of sketch graphs were not labelled.

(j) Often the suggested improvements were irrelevant to this experiment, such as using insulation, timing or starting at a common temperature or using more accurate apparatus. Using a pipette instead of a burette was a common error. Those candidates who scored credit repeated the experiments and found the average/mean of the readings.

Question 5

Answers to this qualitative analysis question were centre dependent. It was evident that a minority of candidates had no knowledge of the tests required to complete the observations in the table for **(a)** to **(d)**.

(a) There were many correct answers specifying green to describe the appearance of the solution. A number of answers incorrectly included the terms solid or precipitate in their description.

(b) The appearance of a white precipitate was common. Credit could not be given for stating that the precipitate was soluble or that effervescence was seen.

(c) (i) There was a majority of correct answers citing the formation of a green precipitate.

(ii) Most candidates realised that the gas would turn red litmus blue but few mentioned the pungent smell of the gas. References to ammonia were ignored.

(d) Only the more able candidates deduced that a red-brown precipitate would form.

(g) Hydrogen was correctly identified by most candidates.

(h) Conclusions gaining full credit were rare. Credit was awarded for understanding that a transition metal salt or an acid was present. The mention of various named transition metals was given credit.

Question 6

The quality of answers to this question spanned the entire spectrum. This type of question needs the answer planned out first, which most candidates clearly did.

Some candidates did not mention rhubarb leaves and discussed starting with crystals of the acid.

The most common error was to extract and separate the acid from the leaves and then evaporate the solution obtained to dryness. The sand confused a number of candidates. A small number used the sand appropriately to assist in the extraction of the acid from the leaves. Others used it:

- to clean the leaves before crushing
- as a filter bed
- as a sand bath for heating
- to grow rhubarb
- to filter the extract.

Well planned answers from more able candidates gave essential experimental detail with a clear practical method.

Marks were awarded for:

- extracting the acid by crushing the leaves in a pestle and mortar with sand and water and a stated condition
- separating the extract by filtration
- obtaining crystals from the solution by heating to crystallising point and cooling

Very few candidates did not attempt this question.