CHEMISTRY

Paper 0620/01

Multiple Choice

General comments

Approximately 3 800 candidates sat the examination. They achieved a mean mark of 25.4 with a standard deviation of 6.7, giving a good spread of marks with a high reliability coefficient. The comments below tend to concentrate on features relevant to the lower-scoring candidates.

Comments on individual questions

Question 2 proved a little harder than anticipated, with 30% of the lower-scoring candidates choosing response A instead of the key C. While accurate, a burette does not deliver liquid quickly as required by the question.

Question 3 was found to be easy, with corresponding low discrimination across the ability range.

Question 7 was a little on the hard side. The lower-scoring candidates chose response B rather than the key C and this appears to suggest simple confusion between covalent and ionic bonding.

Question 11 was one of the hardest questions. The lower-scoring candidates seem to have been guessing with the key, B, being the least popular choice and response D the most popular choice amongst such candidates. In combustion, each hydrogen atom requires only a quarter of an oxygen molecule. In B, the 6 carbons require 6 molecules of oxygen: the 10 hydrogens require 10/4 molecules less the half molecule already present. Thus the answer is (6 + 10/4 – 1/2) = 8.

Question 18 was also difficult, with as many as 40% of the lower-scoring candidates choosing response A. Why is it so difficult to persuade such candidates that copper does not react with dilute acids?

Question 20 A third of the lower-scoring candidates chose response A, apparently not realising that copper(II) oxide is not volatile.

Question 23 was the hardest question in the paper despite being directly related to the syllabus. Response A was unduly popular across the ability range, showing that many candidates did not realise that the melting points of Group 1 metals decrease down the group.

Question 24 was also found to be hard, with a third of the candidates across the ability range choosing response A. This appears to be another idea that is difficult to 'get across' to candidates that aqueous halogen ions are not coloured.

Question 28 Over half of the lower-scoring candidates chose response D. This suggests confusion about the consequences of a metal being high in the reactivity series. Because such a metal is reactive, this means that its oxide is less readily reduced by carbon.

Question 29 was found to be harder than expected, with response D being quite popular across the ability range. Because they are mixtures containing metals, alloys conduct electricity.

Question 33 was another question that proved to be quite difficult. The 3 methods quoted in the question are used for rust prevention, but the issue is the practicability of these methods for a structure sufficiently large to need the use of girders.

Question 35 Response C was the most popular choice for the lower-scoring candidates. Presumably, they did not read the question with enough care, namely that calcium and magnesium ions do not have singly charged positive ions.

Question 38 It is somewhat surprising that over 50% of the lower-scoring candidates and some 20% of the higher-scoring candidates chose response A, implying that they think that ethanol polymerises!

Question 39 Amongst the lower-scoring candidates, the key (D) was almost the least popular choice. However, the question should have been answerable by straightforward recall of the relevant formulae.

Question 40 Over 40% of the lower-scoring candidates chose response B, the key being D. This may be another example of confusion about the nature of polymerisation (see **Question 38**).

CHEMISTRY

Paper 0620/02
Core Theory

General comments

Many candidates tackled the standard questions adequately and a few good answers were seen in many parts of the paper e.g. **Question 1** and **Question 3**. Many candidates found some of the questions which were set in unfamiliar contexts quite challenging, especially parts of **Questions 2** and **4**. Although the Periodic Table section in **Question 6** was also couched in unfamiliar terms, most candidates coped with this well. There were fewer very high marks than in previous sessions. This suggests that most of the candidates taking this Paper have been entered correctly for this tier. In general, the rubric was well interpreted and most candidates attempted all parts of each question. The standard of English was generally good. Although most candidates had a good knowledge of general chemistry, many were found, as in previous sessions, to have a poor knowledge of organic chemistry and tests for specific ions. For example, many did not know the bromine water test for unsaturated hydrocarbons or the test for the chloride ion. Fewer still could identify an alcohol functional group or write the correct formula for ethanoic acid. Many candidates had difficulty with **Question 1(g)** where they were required to complete the dot and cross structure for a water molecule and the role of moving ions in conduction in an aqueous solution of sodium chloride was poorly known. There were only a few instances where candidates disadvantaged themselves by giving multiple answers. Those cases which did occur were seen most often in **Question 1**. In **Question 1(f)**, however, many candidates disadvantaged themselves by writing down only one compound, despite the rubric clearly stating that two were required. It is encouraging to note that all but a handful of candidates confined themselves to a single answer in questions requiring a box to be ticked or a specific answer to be ringed. In more extended questions, candidates often disadvantaged themselves by sloppy and non-specific writing. Many candidates appeared not to be able to explain practical methods such as filtration and crystallisation adequately, although nearly all could identify pieces of laboratory apparatus. It was encouraging to note, that many candidates appreciated the correct method to do the calculation in **Question 2(c)(iii)**.

Comments on specific questions

Question 1

Most candidates obtained at least half the marks available for this question although few got full marks on **sections (a) to (f).** Completion of the dot and cross diagram for water was accomplished by only about a fifth of the candidates and few managed to give the simplest formula for phosphorus trioxide.

(a) Most candidates correctly identified sulphur dioxide as being responsible for acid rain. The commonest incorrect answer was carbon dioxide. Nitrogen dioxide was also seen even though it was not on the list.

(b) Calcium oxide was the commonest incorrect answer. The candidates who put this were presumably thinking of the decomposition of calcium carbonate rather than its reaction with acid. Phosphorus trioxide was also commonly seen but no logical reason for this incorrect answer can be given.

(c) The correct answer (carbon monoxide) was almost invariably seen.

(d) Although many candidates realised that water was a good solvent, a large minority chose one of the other oxides from the list such as sodium oxide or calcium oxide, thus reflecting a lack of knowledge of the states of these substances.

(e) Over half the candidates correctly chose calcium oxide as the answer. Sodium oxide was the commonest incorrect answer. Although this is an alkaline oxide, it is far too reactive and rare to be used for an industrial process.

(f) Most candidates realised that calcium oxide or sodium oxide form alkaline solutions. Many however gave either a single oxide answer or failed to gain the mark by writing phosphorus trioxide or sulphur dioxide as the second oxide.

(g) Although much leeway was given in marking the electronic structure of water, few candidates counted up the correct number of electrons. The commonest errors were (i) to put a pair of electrons in a non-bonding position (on the opposite side to where they should be), (ii) to draw another shell of electrons outside the electrons provided, (iii) to put an extra pair of electrons into the shell (making 10 in all), (iv) to put only a single electron as a bond and (v) to put a line as the bond rather than an electron pair

(h) This was unexpectedly poorly attempted compared with similar questions in previous sessions. Many candidates failed to count up the atoms properly and P_3O_6 and PO_3 were commonly seen as incorrect answers. The latter was often obtained through incorrect division e.g. the candidate showed this as '$P_4O_6 \rightarrow PO_3$'. A number of candidates wrote P_4O_6 rather than reducing the formula down further. Quite a few candidates thought they were 'balancing atoms' and gave the answer P_3O_2.

Question 2

This was the least well attempted question on the Paper, which is surprising since most parts involved fairly standard chemistry. The definitions of unsaturated and hydrocarbon were not well known, neither was the test for unsaturation. Although in general, candidates could identify the test for a nitrate, few could identify the test for a chloride. The context in part **(f)** proved challenging for many candidates and very few gained two marks here.

(a)(i) The incorrect answer 'polymers' was often ringed, presumably because candidates had not focused on the word 'propene' in the stem of the question.

(ii) The incorrect answers 'ethane' or 'ethene' were often seen. Many candidates seem to see the name of the homologous series and the name of the individual compounds in the series as not being linked or do not distinguish between these two.

(iii) Many candidates did not put their answers in the context of the stem of question and wrote about unsaturated solutions and solubility. Definitions of 'hydrocarbon' were often marred by the lack of the word 'only'. Almost all organic compounds, after all, contain carbon and hydrogen.

(iv) A significant minority of candidates failed to realise that unsaturated hydrocarbons contain double bonds and gave unrelated incorrect tests, the commonest being the litmus test or burning to see if a gas which popped was given off. Of those who gave the correct test, many appeared to think that saturated hydrocarbons contained double bonds and thus decolourized bromine water and vice versa.

(b) Although a considerable number of candidates failed to respond to this question, many gave a correct answer, only a few suggesting 'condensation'.

(c)(i) About half the candidates could correctly identify two negative ions, the most commonly selected being chloride and nitrate. Only a minority of candidates chose two metal ions.

(ii) Hydrogencarbonate was the commonest incorrect answer obtained through either not reading the question (which required selection of a metal ion) or not realizing that hydrogencarbonate contains two non metal atoms and so forms a negative ion.

(iii) This was well answered, 40 (mg) being almost invariably seen.

(iv) Many candidates did not know the test for chloride ions. The commonest incorrect answers were sodium and calcium.

(v) More candidates recognised the test for nitrate ions than for chloride ions, presumably because of its more distinctive nature. The commonest incorrect answers were sulphate and calcium.

(vi) It is encouraging to note that many candidates could balance the equation by addition of an electron (even though it was sometimes not given a charge – which was ignored at this level when marking). A significant minority of candidates put K^- on the right hand side of the equation rather than e^-.

(d) Nearly all candidates scored the mark for recognising a slightly alkaline solution. The most common error was to suggest that the solution was neutral.

(e)(i) Practically all candidates could name the condenser. A few thought that it was a burette or just named it 'tube for cooling', which would have been suitable if the question asked for a function rather than a naming exercise.

(ii) Nearly all candidates correctly identified the beaker as being the place where the water collects.

(iii) Most candidates gained the mark for recognising the difference in the boiling point.

(f) The unfamiliar context of this question about filtration proved to be challenging for many candidates. Many wrote about the water purification process that they had learnt about and talked about chlorination, killing bacteria etc, rather than accessing information from the diagram. About half the candidates obtained one mark, usually for recognising the process of filtration.

Question 3

This question was generally well done, many candidates obtaining at least two-thirds of the marks available.

(a) Most candidates scored all four marks here.

(b) Most candidates recognised that bubbles/ effervescence would be seen. Fewer got a second mark for recognition of the iron dissolving or a colour change of the solution. Some failed to get the 'bubbles' mark because they just stated that 'a gas is given off'. This is not an observation but the conclusion of what is seen happening. A small minority of candidates suggested, incorrectly, that a precipitate is formed. Many candidates mentioned fizzing. Candidates should be reminded that fizzing is a sound - the question asks candidates to describe what they would *see*.

(c)(i) Most candidates scored two of the three marks for this part, alloys often being incorrectly put in the second gap.

(ii) This was not as well answered as expected, many candidates merely giving the names of metal elements such as silver, copper or platinum.

(iii) Many candidates scored both marks, covering the iron with plastic, galvanising, electroplating and sacrificial protection being equally popular.

Question 4

Many candidates found parts **(a)** and **(b)** challenging and few obtained full marks for part **(d)**. Most candidates appeared to have little knowledge of functional groups and the structure of ethanoic acid.

(a) The majority of candidates wrote about change in pH rather than change in acidity. A common error was to suggest that the acidity went down then up again. Some candidates confused the issue by writing about neutralisation in this part of the question.

(b)(i) Most candidates gained a mark for this part, generally for suggesting that the acid came from the sweet or for applying the concept of neutralisation. Common errors were to suggest that the saliva came from the sweet or that the saliva was acidic.

(ii) More than half the candidates realised that a neutralisation reaction was involved, although some gave names of specific chemicals or an equation (acid + base → salt + water)

(c)(i) Few candidates could correctly identify the OH functional group. The commonest errors were (i) to ring the adjacent carbon, (ii) choose the COOH group or (iii) ring the whole HO-C-CO_2H section

(ii) Common errors here included naming the functional group as an alcohol or just as an 'acid'.

(iii) Few candidates could write the correct formula for ethanoic acid. The formula for ethanol was commonly seen. Many candidates were working towards the correct answer, however, by putting incorrect formulae such as CH_2COOH or CH_4COOH.

(d)(i) Only about a third of the candidates realised that the fizzing was related to a gas being given off. Many were content just to write that 'an acid is combining with a base', 'lemon juice is acid and calcium carbonate is alkaline' or 'there is a reaction'. Although the last has some merit, many reactions occur which do not involve fizzing.

(ii) Although most candidates had some idea of basic filtration apparatus, the drawings were often poor with, for example, a filter paper placed flat across the top of the funnel or no filter paper at all. A fairly common error was to suggest that the calcium citrate / solid was to be found in the beaker below the funnel rather than on the filter paper.

(iii) About a third of the candidates realised that the precipitate was washed to remove impurities or lemon juice. Common errors were to suggest that the precipitate was washed to either dissolve the citrate or to neutralise the acid.

(iv) Many candidates did not realise that steady evaporation of the solvent is necessary to form good crystals. Many suggested that the solution be heated until the solid was obtained. A significant minority thought that cooling the solution alone would produce crystals. A number of candidates merely stated 'by crystallisation' which just repeats what is stated in stage 5.

(v) Although many candidates realized that micro-organisms are involved in fermentation processes, a large number thought that a high temperature was essential.

Question 5

Most candidates achieved at least half marks on this question. **Part (a)(i)** was generally better answered than the other parts.

(a)(i) Most candidates gave a suitable definition of reduction. A number of candidates failed to gain the mark through sloppy thinking by writing statements such as 'removal of oxygen form an element' or giving conflicting statements such as 'removal of oxygen and loss of electrons'.

(ii) Although a considerable number of candidates realised that copper was formed in the reaction many thought that iron or copper compounds (especially the oxide) were formed. Some candidates did not consider what species were present in the tube and wrote down the first reddish-brown substance that came into their mind i.e. bromine.

(iii) Many candidates realised that an electrical circuit was required but explanations were often sketchy e.g. 'connect the solid to the electricity'. Many suggested electrolysis in the wrong context i.e. 'melt the copper and see if it is electrolysed', 'dissolve it in water and see if it lights a bulb in an electrolysis circuit'.

(b)(i) The commonest errors were to suggest that the hydrogen came from the air or from the copper oxide.

(ii) Most candidates gained at least one of the two marks available but many concentrated on the bulk properties of water (e.g. has a fixed volume and takes the shape of the container) rather than considering its particulate nature. Many candidates still seem to think that the particles in a liquid are far apart or further apart than in a solid and that there are significant gaps between the particles. This has been commented on in previous Principal Examiner Reports.

Question 6

This question was well answered by most candidates although few gained the mark for part **(e)(i)**. A recurring error was the suggestion that the Periodic Table was arranged according to the reactivity of the elements. This was often compounded by incorrect statements in part **(d)** such as 'the reactivity always increases down a Group'.

(a) Most candidates realised that the elements were arranged according to their proton number. A significant number of candidates thought that they were ordered by their reactivity.

(b) This was the best answered part of this question, most candidates gaining the mark. The few who gave incorrect answers either suggested that the proton numbers were the same or that they were both transition elements.

(c) Most candidates realised that Group 0 was missing. A significant number thought that there were no halogens or transition metals in Newlands' table.

(d) Most candidates obtained at least two of the three marks available and a wide range of answers were given credit. Common errors were to suggest that the modern Periodic Table is arranged according to either the reactivity down the Group or density.

(e)(i) Although most candidates realised that weak forces were involved, most failed to state where the weak forces were and many implied that there were weak forces between (all the) atoms.

(ii) Most candidates realised that the strong bonds between the carbon atoms were responsible for the hardness of diamond. Some candidates disadvantaged themselves by stating that there were strong bonds between the *molecules* or that there were 'strong and Van der Waals forces'.

Question 7

As in previous sessions, ideas about electrolysis are poorly understood at this level. The perennial problem of lack of student understanding of ionic conduction has been commented on in previous Principal Examiner Reports. However parts **(c)(i)** and **(iii)** invariably gained the candidates marks.

(a) Few students appeared to understand the meaning of volatility, although it does appear in ***section 3.2(b)*** of the syllabus. Copper was often put between methane and water.

(b) Most candidates realised that silver conducts electricity and that sodium chloride is soluble in water. The solubility of sulphur was less well known and most knew that copper sulphate solid conducts.

(c)(i) Most candidates were able to identify graphite or platinum as suitable electrodes. The commonest incorrect suggestions were iron and copper.

(ii) This part provided a narrow range of incorrect answers. The correct anode product was more often seen than the correct cathode product. Instead of chlorine, chloride, oxygen and sodium were common incorrect answers. In place of hydrogen, sodium or chlorine were common incorrect answers.

(iii) This was almost always correct.

(iv) As in previous years, candidates have difficulty identifying the correct particle responsible for electrolytic conduction. Many candidates thought that electrons were responsible for the conduction rather than ions. Those who mentioned ions often failed to write down the essential idea about their movement. A significant number of candidates suggested incorrectly that 'the aqueous solution has water in it and this conducts'. A few candidates failed to mention or imply that the ions in the solid cannot move. It is also not sufficient to say that 'there are no ions' because this implies that there are atoms or molecules rather than ions.

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Paper 0620/03

Extended Theory

General comments

Most of the candidates were able to complete the paper in the time available. A few left **7b(iii)** blank but this was probably due to an inability to complete the calculation rather than time constraints.

A major concern is that candidates did not erase incorrect answers thoroughly- the final answer and the erased version were often jumbled up and difficult to decipher. Candidates must cross out incorrect answers and re-do them or ensure that the errors are completely erased; there should not be any ambiguity about what constitutes the final response. A new practice has appeared which seems to be – write the answer in pencil then go over it in ink, this procedure virtually guarantees illegibility

Candidates still persist in writing symbols incorrectly – AL not Al, this is penalised. Candidates should not devise their own symbols for example Sa for surface area and Rf for rate of forward reaction. If the symbol used is not the conventional one, no credit can accrue from the comment.

Comments on specific questions

Question 1

Many scored 4 or 5 marks on this question. Some candidates were very confused especially the distinction between simple distillation and fractional distillation. A significant number were not aware that barium sulphate is insoluble and so that crystallisation is not an appropriate method of separating it from water. Another frequent error was to suggest that water could be obtained from aqueous copper(**II**) sulphate by filtration.

Question 2

(a)(i) Generally very well answered with many candidates being awarded full marks. A minority of the candidates followed the example and used F as the symbol for all the particles B, C, D and E. Several assumed that with a mass number of 40, particle C must be calcium. Other common errors were to write that particle B was $^{23}_{11}Na^{+}$ rather than $^{23}_{11}Na$, to give incorrect charges or not to give the charges on the ions.

(ii) Nearly always correct with most scoring both marks. Several candidates failed to score the second mark by saying 'B or sodium because the only difference is the number of neutrons' rather then specifying that isotopes have the same number of protons.

Question 3

(a) A proportion of the candidates think that a metal and non-metal combine to form a covalent compound. Most had the correct ratio of Mg:2Br and gained the formula mark. The charges on the ions were far more elusive e.g. two positive ions, a single positive charge on the metallic ion, the metallic ion with a negative charge and non-metallic ion positively charged or a totally covalent structure.

The following representation of the anion is unacceptable.

$[Br]^{2-}_{2}$

Despite the instruction in the question, many attempted to give the full electron distributions of both atoms, this practice simply serves to clutter the diagram and to increase the likelihood of mistakes.

The simplest formats for this type of formula are:

Mg^{2+} $2[Br]^{-}$ or Mg^{2+} $[Br^{-}]_2$

(b) (i) Good explanations of the term *lattice* were very rare. Most scripts stated that it was the structure of an atom or a compound. The idea of a regular pattern of particles (in a solid) was rarely encountered and very few attempted a meaningful diagram.

(ii) About 50% of the answers stated either that there is one Mg to two Br, that is just repeating the information in the question, or that bromine is diatomic. Those who came close often spoiled their answer by saying that Mg gave 2 electrons to two bromide ions. Acceptable explanations must include one of the following ideas:

Charges must balance;
using valencies;
Mg^{2+} and Br;
group II and group VII elements;
2e in outer level and 7e in outer level;
magnesium loses 2 electrons and brom<u>ine</u> gains 1 electron.

(iii) Many students had written OILRIG on their script but still could not decide whether a species was oxidised or reduced. Magnesium was incorrectly described as an oxidising agent but the other 3 points were then completed correctly. Candidates did not appreciate that magnesium was the <u>reducing agent</u> as it gave electrons to bromine which was <u>reduced</u> by accepting these electrons.

Question 4

(a)(i) The uses of sulphur dioxide were well known although some candidates incorrectly thought that it is used in beauty products, soaps, drugs, to make acid rain, to adjust the pH of soil and lakes and as a herbicide.

(ii) In general, descriptions of the Contact Process were poor. Sulphur dioxide is burnt in oxygen was a common error. It was suggested that the extra oxygen atom was derived from potassium dichromate(VI) or magnate(VII), carbon dioxide, vanadium oxide or zinc oxide. Most could recall that the catalyst is vanadium(V) oxide or platinum and that the operating temperature is 450°C.

(iii) "Fertilisers" which were wrongly thought to be made using sulphuric acid were urea, manure, sulphur trioxide, sulphur dioxide, sulphuric acid, ammonium nitrate, ammonia or sodium sulphate. The correct choices are ammonium sulphate or a super phosphate.

(b)(i) The changes in state were usually given as' liquid to gas' etc., rather than a process. The question required the names of two changes of state, which are processes, for example evaporation. Candidates who did give names of processes often included melting and sublimation which do not occur in distillation. Oxidation and reduction were surprisingly common suggestions.

(ii) This was very poorly answered. References to reducing carbon dioxide to carbon monoxide were more frequent than the correct response as were answers such as 'to remove oxygen from zinc (rather than zinc oxide). A popular misconception, presumably by analogy with the blast furnace, was that the excess carbon provided heat.

The equilibrium was not often mentioned in the answers. A model explanation is 'to obtain the maximum yield of zinc because an excess of carbon moves the equilibrium to the right.'

(c)(i) The majority of the candidates wrote the first equation correctly. Typical errors were incorrect number of electrons, electrons removed from Zn^{2+} or an extraneous “2” in the equation.

$Zn^{2+} + 2e = 2Zn$

(ii) The correct anode reaction can be written as:

$4OH^- - 4e = O_2 + 2H_2O$
or $4OH^- = O_2 + 2H_2O + 4e$
or $2H_2O = 4H^+ + O_2 + 4e$
Incorrect versions involved zinc and/or sulphate ions.

(iii) The electrolyte was thought to be sulphuric acid, copper sulphate, zinc sulphate or zinc hydroxide.

(d) Uses of zinc were well known but some unacceptable ones included supplements for healthy bodies, sun care products and extraction of other metals. Other answers were too vague to score e.g. ‘in the building industry’ or ‘covering metals’.

Question 5

(a)(i) Most answers involved rates of reaction rather than the favoured direction or the position of equilibrium. The equilibrium is displaced to the left, reverse reaction favoured, partial ionisation or many molecules and only a few ions are acceptable explanations.

At equilibrium, quite independent of the position of equilibrium, the rates are equal, therefore comments regarding rate of reaction have no validity in this question.

Statements such as “there is more of the back reaction” are meaningless.

(ii) The most common answer was relating to salt formation. Only a small percentage of responses referred to protons and those answering in terms of hydrogen often omitted the word ion. A notable number of answers had the acid and base the wrong way round.

(b) The predicted pH was usually correct but the most frequent reason given was ‘it is a weak base’, this simply repeats information given in the question. Rarely was partial ionisation/dissociation or the ability to accept protons/hydrogen ions or the concentration of hydroxide ions mentioned.

(c)(i) The equations given were frequently incorrect, many of these were variations of the equation given in the question. Some frequently encountered incorrect equations are given below.

$2CH_3NH_2 + 2HCl = (CH_3NH_2)_2Cl + H_2$
$CH_3NH_2 + HCl = CH_3NH_2Cl$
$CH_3NH_2 + HCl = (CH_3NH_3)_2SO_4$

The name of the salt formed was confused either with the example given or with ammonium salts.

(ii) Correct observations were common although occasionally the word “precipitate” was omitted or the colour was incorrect – yellow, green, red or blue were the popular choices. *Brown precipitate* was the correct response.

(iii) Very few candidates were awarded the mark. Often a reactive metal, typically sodium, potassium or magnesium, was suggested for this displacement reaction. The required response was a named stronger base – sodium or potassium hydroxide.

Question 6

(a)(i) The majority gave the correct answer heat (energy) although light and chemical energy were seen.

(ii) Most gave the correct answer - exothermic.

(iii) The equation was usually correct. Common mistakes were to offer an incorrectly balanced equation or to believe that the product was an organic acid.

(iv) The plotting of the points was generally accurate but often the line was not drawn or it was drawn faintly or partially (a section of line then a gap followed by another section of line etc.). The line should have been drawn clearly through data points and include the extrapolated section. 'Blocking' of the chart was common and, if correct, would be awarded the mark but a clear designation of the position of the points is preferable. The value for the heat of combustion was often given as a positive value, so no mark was awarded.

(v) Characteristics of a homologous series were confused and often included - same physical properties, same structural or same molecular formula instead of same general formula. Members differ by CH_2 or by 14amu were not accepted. The marking points were as follows:

Same general (molecular) formula;
same functional group;
consecutive members differ by CH_2;
similar chemical properties **or** react same way;
general methods of preparation;

(b) Candidates should be encouraged to draw clearer diagrams and not to repeat the isomer given in the question rotated through 90^o or 180^o. Many of the formulae contained four carbon atoms per molecule, trivalent or pentavalent carbon atoms or divalent hydrogen (-HO). The standard in this part of the question was poor. Equally the names of organic compounds would benefit from more attention by the candidates; methyl ethanol, propanol and prop-2-ol were given instead of propan-2-ol.

(c)(i) Answers often incorrectly referred to obtaining hydrogen from alcohols - probably as the theme of question was alcohols. Typical errors were to suggest either substitution using chlorine, which was thought to displace the hydrogen, or to burn the alkane then electrolyse the water formed. Many pleasing answers suggested using steam reforming or cracking. The first mark was awarded for the process and the second for a relevant comment for example:

cracking [1] heat or catalyst [1].

(ii) There are two methods of making carbon monoxide from methane; they are the incomplete combustion of the alkane or steam reforming. To burn methane in an insufficient supply of oxygen is acceptable but 'a limited supply' or 'a small amount of oxygen' are not. "Limited" does not mean an insufficient supply and "small amount" lacks precision, there could be an even smaller amount of methane.

(iii) Given the choice of two answers, the majority of students gave high pressure but few of them gave a correct reason.

Errors were:
To encourage the forward reaction;
to believe that the thermicity of the reaction was a valid reason;
to influence the rates;
equilibrium moved to reduce the pressure without explaining why.
The reason had to involve a discussion of the number moles of reactants/products or their volumes.

(d) Only about half the candidates were able to score in this question.

(i) Some named the ester as ethyl methanoate not methyl ethanoate.

(ii) The acid was often given in the form of its potassium salt or as imaginary chromium compounds of the acid.

(iii) Ethane was often given instead of ethene.

Question 7

(a) The theory of rates of reaction was well understood but many students did not gain the marks because they had not read the instructions and did not give their explanations in terms of collisions. The following gives some of the possible marking points. In each part, the award of the second mark is conditional upon the first one being gained.

(i)	Concentration of acid lower in experiment 2	[1]
	Less collisions or slower rate of collisions	[1]
(ii)	Larger surface area	[1]
	More collisions or faster rate of collisions	[1]
(iii)	Particles move faster, have more energy	[1]
	More collisions or faster rate of collisions	[1]

(b) (i) The graph was usually the correct shape scoring both marks.

(ii) Rarely were full marks given for the calculation. The correct calculation is given below.

Mass of one mole of $CaCO_3$ = 100
Number of moles of $CaCO_3$ = 0.3/100 = 0.003

Moles of HCl = 5/1000 x1 = 0.005

Reagent in excess is $CaCO_3$

Reason 0.003 moles of $CaCO_3$ would need 0.006 moles of HCl
or 0.005 moles of HCl only reacts with 0.0025 moles of $CaCO_3$

The award of this mark was conditional, it was necessary to show recognition of the 1:2 ratio. Many claimed that the acid was in excess – bigger number of moles they had incorrectly assumed a 1:1 ratio

The following was quite common:
Number of moles of $CaCO_3$ = 0.3/100 = 0.003
Moles of HCl = 5/1000 x1 = 0.006 (from 2 x 0.003)
Reagent in excess cannot answer
Reason cannot answer

(iii) While many correct answers were seen, some candidates gave their answer in grams of CO_2. The volume of gas had to be calculated from the limiting reagent. That is the one not stated to be in excess. On occasions the candidate stated that acid was in excess but then calculated the volume of gas from the moles of acid and similarly for $CaCO_3$.

Correct calculations:

$CaCO_3$ in excess	v = 0.005 x 0.5 x 24 = 0.06 dm^3
HCl in excess	v = 0.003 x 24 = 0.072 dm^3

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Paper 0620/04

Coursework

General comments

As has become normal in November, not many Centres entered course work. Those Centre which did enter submitted well organised samples which did both the schools and their candidates' credit.
It is pleasing to see schools teaching well and having candidates gaining well deserved, high marks in this part of IGCSE.

Just a few of brief reminders:

[1] For skill C1, it is useful if Centres send in a tick list showing how the mark scheme was applied, to give marks to each candidate.

[2] It can be a disadvantage if candidates are assessed for skill C3 in a task that they have planned themselves. These tasks do not always succeed and conclusions can be difficult.

[3] Tasks set for C4 should allow plenty of scope for the control of variables. This skill must be adequately demonstrated to receive high marks.

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Paper 0620/05

Practical Test

General comments

All candidates attempted both questions. There are still a minority of Centres, which failed to submit a copy of the Supervisor's results with the candidates' scripts. Supervisors' results are used by the Examiners when marking the scripts to check comparability. A few Centres encountered difficulty in obtaining one of the calcium compounds for **Question 1**. Suitable replacement compounds were suggested. No candidates were penalised as a result.

Comments on specific questions

Question 1

The table of results was generally fully completed. Marks were awarded for temperature changes similar to those reported by the Supervisor. Some Centres reported no visible temperature change for Experiment 1. Candidates noting a similar observation received the appropriate credit.

(a) Reference to bubbles/fizz/effervescence and the vigour of the reaction scored both marks. 'Gas given off' is not an observation and received no credit. References to temperature, already recorded in the table were ignored.

(b) Less able candidates failed to choose an appropriate scale for the y axis on the grid. Others plotted a straight-line graph instead of a bar chart. A significant number of candidates failed to read the label on the y axis and plotted the initial and final temperatures for the four experiments.

(c) (i) The smallest temperature change was sometimes given as in Experiment 2, as some candidates assumed a change of $0^{o}C$ was not a change at all. These candidates should realise that 0 is a smaller number than 2.

(ii) Well answered.

(d) The two reasons why the temperature changes in Experiments 1 and 4 were markedly different were due to the greater surface area of the powder used in Experiment 4 and the different calcium compounds used. Responses that explained these reasons correctly in candidates' own words scored credit. Many vague references to the different masses of compounds used and the varying concentration of the acid scored no credit.

(e) Only the more able candidates were able to explain that in their experiments the presence of solid at the end of the reaction showed that the calcium carbonate was in excess or vice verse. Vague answers such as 'you can see which reactant is in excess' and reference to moles of compounds used scored no credit.

(f) A good discriminating question which only the more able candidates managed to successfully attempt. Most answers suggested that the temperature changes would increase and erroneously discussed the increased rate of reaction. Few candidates realised that the temperature changes would decrease as a result of the energy released being dissipated through a larger volume of liquid.

Question 2

(a) The majority of candidates scored both marks for giving the correct colours and pH values.

(b) (i) Most candidates got the 'pop' result for the test on the gas. However, many failed to specify the use of the lighted splint and omitted the observation of bubbles/fizz etc.

(ii) Q did not react with magnesium but a number of candidates managed to record some kind of reaction. The observations for R and S were often vague- a large number of candidates noted a reaction without referring to an observation, while others noted the formation of different colours and precipitates.

(c) Most candidates used the correct test and noted the result. A minority tested for oxygen or chlorine and somehow managed to achieve a positive result. The observing of the effervescence was often missing.

(d) The majority of candidates correctly identified the formation of a white precipitate,

(e) Most candidates mentioned the green colour but a number omitted the formation of a precipitate.

(f) Hydrogen was usually correctly identified.

(g) Some answers mistakenly referred to gases other than carbon dioxide. Oxygen and chlorine were encountered.

(h) Some candidates failed to deduce the identity of liquid P as hydrochloric acid from the results to tests (a) and (d). Sulphuric acid, nitric acid and chloride were common answers.

(i) A good discriminating question. Many candidates concluded that the liquid Q contained iron(**II**) ions, failing to realise that in (e) Q had actually been added to iron(**II**) sulphate. Some candidates identified Q as ammonia despite the lack of smell and the strongly alkaline nature of the solution, which was in fact sodium hydroxide.

(j) Only the more able candidates used the pH of liquid R to infer the presence of a weak acid. 'Acid' or 'alkali/basic' were common answers.

CHEMISTRY

Paper 0620/06
Alternative to Practical

General comments

The majority of candidates successfully attempted all of the questions. Examiners thought that the paper was comparable in difficulty with previous years apart from **Questions 2** and **3**. These questions proved difficult to candidates from some Centres. Some Centres had not covered all sections of the syllabus. As in previous years most candidates had a good knowledge of basic practical techniques. Most candidates are able to complete tables of results from readings on diagrams and plot the points successfully on a grid.

Comments on specific questions

Question 1

(a) Most candidates scored two marks. However, some arrows were inserted with no labels and it was common to find arrows pointing at the ice or the collected water.

(b) Often the wrong substance was stated as being cooled e.g. the copper sulphate.

(c) A surprising number of candidates reversed blue and white. The colour change given was often incorrect. Colourless was often given instead of white and every conceivable colour was seen.

Question 2

(a) Most gained the mark for the colour.

(b) (i) Many candidates referred to the air or water being used up.

(ii) 20% and 83% were common incorrect response

(c) Most candidates got the idea of a slower reaction in **(i)** but much fewer gained a mark in **(ii)**. The main error was to say the reaction was slower, did not rust or water rises more. Credit was given for no change in the amount of rusting or the rusting occurred faster if the salt water had been used to adhere the iron filings to the test-tube.

Question 3

(a) About half of the candidates got the idea that all the acid needed to be used up.

(b) Most candidates scored credit though a few suggested distillation or just heating.

(c) Very poorly answered. Some confusion was evident with saturated hydrocarbons while others could not use the terms solute and solvent correctly. In **part (ii)** bromine was often used and few candidates could give a sensible suggestion.

(d) A good discriminating question. To stop the crystals melting, reacting and evaporating were common incorrect answers.

Question 4

The table of results was generally completed correctly.

(a) Many candidates were unable to give the observation of bubbles/fizzing etc. and referred to the temperature rise.

(b) Scale errors were common on the y-axis. Some candidates drew bars for the initial and final temperatures while a significant number drew a line graph instead of a bar chart.

(c) Generally well answered.

(d) A common error was to consider mass or the starting temperatures. Some candidates gave one reason for 1, and then the opposite argument of the same reason in 2. e.g. '1 the marble was chips 2 the calcium oxide was powder' scoring just the one mark

(e) A good discriminator. Some excellent answers were seen but vague references to 'you could see which reactant was in excess' or 'the acid is in excess because the temperature did not change much' were common.

(f) Most candidates thought that the temperature would be higher and some seemed to think that a larger volume of acid meant more concentrated or less concentrated. The more able candidates only suggested the idea of the temperature change decreasing because of the larger volume of acid involved.

Question 5

(a) Despite giving blue/purple few candidates gave a pH of 11-14 range. Acidic pH vales were common.

(b) Some candidates were unable to give no reaction for Q and just gave random changes and colour changes. White precipitates were also common.

(c) The mark given for bubbles/fizzing was often lost.

(e) Generally well answered though some precipitates were not of the correct colour.

(f) Generally well answered.

(g) A number of candidates identified oxygen instead of carbon dioxide.

(h) Nitric acid, sulphuric acid and hydrogen chloride were common incorrect answers.

(i) Most candidates identified the presence of acid. Instead of weak acid many referred to 'slightly' or 'mildly' or 'not strong'.

Question 6

The table of results was generally correctly completed.

(a) The points were normally plotted correctly, but despite being able to identify the inaccurate point in (b), they still drew a line through it. A significant number of candidates did not plot (0, 0).

(b) Most candidates identified the inaccurate point but some gave a range such as 4-8. In **(ii)** it was not uncommon to misread the scale and give 47 instead of 37.

Question 7

The standard of answers varied widely from excellent to very poor and was generally Centre dependent. This was a good discriminating question. Poor answers involved;

- mixing the fuel with the water and measuring the temperature rise
- heating the fuel directly and measuring the temperature rise
- failure to ensure a fair test
- reference to the diagram with no detailed method

Good answers involved heating the water with the diesel fuels and measuring initial and final temperatures of the water over a specified time interval, though preferably not two hours as given by some candidates!

Failure to show how a comparison of the results would indicate which fuel produces the most energy was common.