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CHEMISTRY

Paper 0620/12
Multiple Choice (Core)

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

General comments

Question 1 proved to be particularly straightforward for candidates.

Candidates found **Questions 5, 6**, **10**, **11**, **13**, **23**, **36**, **37** and **40** to be the most challenging.

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Comments on specific questions

Question 5 – Response A

Candidates chose the noble gas in the same period as aluminium, not realising that aluminium loses its outer shell to form Al^{3+}.

Question 6 – Response C

This response was far more popular than the correct response. Candidates realised that methane has four bonds, but this constitutes eight shared electrons.

Question 10 – Response B

Candidates were not sure of the difference between exothermic and endothermic. The two responses were chosen by roughly the same number of candidates.

Question 11

This question was poorly answered. All responses had more than 20% of candidates selecting them. This indicates that most candidates guessed.

Question 13 – Response A

Candidates clearly thought that increasing the volume of the sulfuric acid would increase the rate of reaction.

Question 23 – Response B

This was a popular incorrect response.

Question 36 – Response B

Candidates perhaps chose this response because it contained more gasoline than Arabian Heavy.

Question 37 – Response B

Candidates spotted alcohols and hydrocarbons but did not realise that both alkanes and alkenes were present.

Question 40 – Response A

This response was more popular than the correct one. Candidates were not familiar with the distinction between an alkane and an alkene.

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CHEMISTRY

Paper 0620/22
Multiple Choice (Extended)

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

General comments

Candidates performed well on this paper.

Questions 5, **18**, **32** and **37** proved to be particularly straightforward.

Candidates found **Question 8** to be the most challenging.

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Comments on specific questions

Question 1 – Response D

Candidates chose the gas that would move most quickly not realising that it would not change the colour of the Universal Indicator.

Question 7 – Response C

Candidates misread the alternatives. They recognised what they thought was the definition of a metallic bond and did not notice the words *negative ions*.

Question 8 – Response B

This response was chosen by more candidates than the correct one. Candidates were unsure of the meaning of the Avogadro constant.

Question 9 – Response C

This response was chosen by more candidates than the correct response. Since 31.0 g is a quarter of a mole of copper(II) carbonate, 20 g of CuO should be formed.

Question 14 – Response A

Candidates clearly thought that increasing the volume of the sulfuric acid would increase the rate of reaction.

Question 19 – Response D

This response was chosen by more candidates than the correct one. Candidates did not realise that using the same volume of a more concentrated acid would produce more hydrogen.

Question 21 – Response A

Candidates did not realise that barium sulfate is insoluble in water.

Question 24 – Response A

Candidates did not realise that helium has only two electrons in its outer shell.

Question 28 – Response A

Candidates chose the carbonate of the least reactive metal rather than of the most reactive metal.

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CHEMISTRY

Paper 0620/32
Theory (Core)

Key messages

It is important that candidates read questions carefully in order to understand what exactly is being asked.
Some candidates need more practice in revising definitions and in answering questions involving qualitative tests.
Interpretation of data from tables and graphs was generally well done.

General comments

Many candidates tackled this paper well, showing a good knowledge of chemistry. Most candidates answered every part of each question. The standard of English was generally good.

Some candidates need more practice in reading and interpreting questions. The rubric was misinterpreted or ignored by a minority of candidates in a few questions. For example, in **Question 2(e)(ii)**, some candidates wrote about the role of carbon monoxide in the extraction of iron rather than about the dangers associated with carbon monoxide. In **Question 5(e)**, some candidates did not refer to particles in their explanation. In **Question 7(a)**, many candidates did not refer to the bullet points in the stem of the question and did not write about chemical properties or give a word equation. In **Question 7(b)**, many candidates wrote down the names of the oxides instead of the metals. Some candidates attempted to write chemical (symbol) equations when word equations were requested. This often resulted in marks not being awarded because of errors in writing the correct formulae.

Many candidates need practice in answering questions relating to qualitative analysis and in giving precise definitions. For example, many candidates did not include the essential word *atoms* in their definition of the term *isotope*. Other candidates gave vague answers in an attempt to explain the term *thermal decomposition*, often omitting to mention the meaning of *decomposition*.

Many candidates were able to extract information from tables and graphs. Some candidates need more practice in balancing symbol equations. Many candidates were able to do simple calculations involving relative formula mass or calculations involving simple proportions.

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

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Comments on specific questions

Question 1

(a) (i) Most candidates identified oxygen. The commonest error was to suggest nitrogen. Magnesium and sulfur were other incorrect answers which were occasionally seen.

(ii) This was one of the least well done parts of **(a)**. Many candidates did not take note of the essential word *rapidly* in the question and gave the incorrect answer "magnesium". Other common incorrect answers were sulfur or nitrogen.

(iii) Nearly all candidates identified aluminium as a member of Group III of the Periodic Table. The commonest error was to suggest magnesium.

(iv) Many candidates identified argon as having a complete outer shell of electrons. The commonest errors were to suggest either magnesium or nickel.

(v) Most candidates identified nickel as a transition element. The commonest errors were to suggest either aluminium or lithium.

(vi) Few candidates correctly identified lithium. The commonest incorrect answers were to suggest nickel, aluminium or magnesium.

(b) The commonest error was to ignore the negative charge on the oxide ion and suggest that eight electrons were present rather than 10. A few candidates subtracted the electrons to give an answer of six. The number of electrons and neutrons in a nickel atom was sometimes reversed. The number of neutrons in the oxide ion was sometimes incorrectly given as 18. The commonest error for the number of protons in the oxide ion was either 6 or 18.

Question 2

(a) (i) Some candidates placed **A** correctly on the diagram; fewer candidates wrote **W** in a suitable place. A considerable number of candidates reversed the places with **A** placed at the top of the furnace and **W** at the bottom.

(ii) Most candidates realised that the slag was less dense because it floats above the iron. The commonest error was to refer to amount or thickness of the slag layer.

(b) (i) Many candidates gave a suitable explanation of the term *thermal* in terms of heat. A few candidates suggested that heat is given out in the reaction. Few candidates gave a suitable definition of the term *decomposition*, with many candidates just repeating the word in their answers rather than explaining it. Common errors were to give answers such as "acid impurities are removed" or "a new substance formed".

(ii) A majority of the candidates completed the equation correctly. The commonest errors were to attempt to complete the equation with O_2 or C.

(iii) Few candidates could describe the role of calcium oxide in the extraction of iron. The commonest correct answers referred to either the removal of impurities or the production of slag. Common errors included references to calcium oxide reacting with the iron or calcium oxide reacting with carbon monoxide to produce carbon dioxide. Other candidates simply referred to the equation in **(b)(ii)**.

(c) Many candidates drew suitable electrolysis apparatus. Common errors included not dipping the electrodes into the electrolyte; short circuits; missing one of the essential labels; or placing the electrode label on the wires in the external circuit.

(d) (i) Most candidates answered iron or a correct substance that could be used as a general electrode. The commonest incorrect answers involved either reactive metals such as sodium or magnesium, or liquids such as bromine.

(ii) Most candidates gave a correct property that an electrode should have. The commonest error was to suggest that "they should have charges".

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(e) (i) Many candidates gave a correct molecular formula for iron pentacarbonyl. The commonest errors were either due to miscounting, e.g.$FeCO_5$, FeC_4O_5, or thinking that the triple bond meant multiply by three, e.g. FeC_5O_{15}.

(ii) A considerable number of candidates gave vague answers, which referred to pollution, acid rain or the ozone layer. Answers referring to decreasing oxygen in the blood or reducing oxygen flow to cells were not sufficient. Those candidates who mentioned haemoglobin did not always make it clear enough that the carbon monoxide replaces the oxygen and so stops oxygen from being delivered to the red blood cells.

(f) (i) Nearly all the candidates realised that air / oxygen and water are needed for rusting. The commonest error was to state hydrogen and oxygen. A few candidates wrote combinations such as water and moisture, or air and oxygen. A few candidates suggested metals, e.g. steel and magnesium.

(ii) Some candidates related the increase in pH to a decrease in the rate of rusting. Other candidates wrote answers that were too simplistic, e.g. “it increases”. Candidates should be aware that the direction of both changes should be mentioned, e.g. an *increase* in temperature results in an *increased* rate of rusting. Many candidates tried to relate pH and temperature to rate of rusting at the same time and gave confused arguments.

Question 3

(a) Some candidates realised that nitrogen is relatively unreactive and forms 78% of the air and so it is the gas which is still present as a relatively high percentage. The commonest error was to suggest sulfur dioxide. A minority of candidates gave vague answers such as “polluted air”.

(b) (i) The term *hydrocarbon* was generally not explained very well. Many candidates realised that hydrocarbons contain carbon and hydrogen but few candidates wrote the essential word “only” or suggested that “no other element is present”. Other candidates incorrectly suggested that hydrocarbons are “elements containing hydrogen and carbon” or “mixtures of hydrogen and carbon”.

(ii) Some candidates gave the correct species (oxygen on the left and water on the right). In word equations, candidates should be encouraged to write the correct species as a word and not as a formula. The commonest errors were carbon monoxide or hydrogen on the right, and hydrocarbons of various types on the left or the right.

(iii) A minority of the candidates referred to global warming or the greenhouse effect. Other candidates gave vague answers relating to pollution or the ozone layer. Fewer candidates gave definite examples of the effects of global warming. The commonest correct answers referred to glaciers or polar ice caps melting. Many candidates just mentioned the “Earth warming” rather that the warming of the atmosphere.

(iv) Many candidates did not refer to combustion or burning. Common incorrect answers included “oxygen is reduced”, with no mention of combustion; “it reacts with carbon to form carbon dioxide”; and “carbon dioxide is oxidised to form carbon monoxide”.

(v) Many candidates calculated the relative molecular mass correctly. Most of those candidates who did not were able to show correct working. The commonest error was to omit the final addition of 96 to 18. Other common errors were to multiply or divide 96 by 18.

(c) (i) Most candidates gave good answers referring to the number of carbon atoms as well as the increase in boiling point. The commonest errors were to omit stating how the number of carbon atoms changed or to suggest that the boiling point decreases as the number of carbon atoms increases because of a misunderstanding of the negative sign.

(ii) Most candidates correctly identified pentane. Fewer candidates referred to 20 °C / room temperature in their explanation. A significant number of candidates gave the incorrect answer “butane because it’s at 0 °C”.

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(iii) Most candidates drew the structure of methane correctly. The commonest error was to draw ethane. Some candidates drew dot-and-cross diagrams, which were acceptable as long as they were correct.

Question 4

(a) Nearly all the candidates recognised the symbol for a reversible reaction. A few candidates incorrectly suggested that the symbol only referred to the backward reaction.

(b) Some candidates recognised that fertilisers are used to increase the growth of plants. Other candidates wrote vague statements about "plants having good growth". A significant number of candidates thought that fertilisers neutralised the soil or affected the soil pH in some way.

(c) Some candidates wrote the correct name (ammonium nitrate). The commonest errors were ammonia nitrate; ammonium oxide; ammonium nitrite; and ammonium nitride. A minority of candidates included water or did not include the word nitrate.

(d) (i) Many candidates realised that calcium oxide neutralises acidic soils. The main errors were to suggest that the soils were made more acidic or that the pH was lowered. A few candidates suggested that acidic soils have pH values above pH 7 and that the soils needed to be made even more alkaline.

(ii) This was generally well answered. Some candidates wrote statements that were too vague, e.g. "so that no bad crops are grown".

Question 5

(a) Many candidates circled the OH group. Some candidates included the adjacent CH_2 group. Other candidates either circled the whole of the right-hand side of the molecule or the $=CH_2$ group.

(b) Many candidates counted the number of carbon atoms correctly.

(c) (i) Most candidates realised that the double C=C bond was responsible for lavandulol being an unsaturated compound. A few candidates suggested that the OH group was responsible for unsaturation.

(ii) Some candidates recognised the aqueous bromine test for unsaturated compounds. Common errors were to suggest a flame test, litmus, water or burning. Other candidates gave the correct reagent but gave vague answers for the result such as "goes transparent" or suggested that the "bromine goes orange".

(d) The commonest error was to suggest the sequence **EDACB**.

(e) A minority of candidates gained full credit. Many candidates did not mention particles and wrote statements about bulk properties, e.g. "the solvent vapour moves from high to low concentration". The word *diffusion* was often omitted. Other candidates wrote about what happened on the chromatography paper and not what happened to the solvent vapour.

(f) (i) Many candidates correctly suggested that the dye should be placed on the baseline. The commonest incorrect answer was to suggest that the dye be placed below the baseline, in which case the dye might be in the solvent. A few candidates suggested that the dye be placed in the solvent.

(ii) Most candidates answered this correctly. The commonest error was to suggest dye **R**.

(iii) Most candidates answered this correctly. The commonest error was to suggest dye **R**.

Question 6

(a) The commonest error was to ignore the word *aqueous* in the stem of the question and therefore suggest sodium instead of hydrogen. Another common error was to suggest the anode product, chlorine.

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(b) Few candidates recognised that an electron is removed when a chloride ion is converted into a chlorine atom. The commonest error was to suggest hydrogen. Other common errors included oxygen or ion, which was sometimes written as "iron".

(c) Many candidates completed the electronic structure of chlorine successfully. The commonest errors were either to draw one or four bonding electrons or to draw two or four lone pairs of electrons on the right-hand chlorine atom.

(d) A minority of candidates described the test for chlorine. A common error was to give the silver nitrate test for chloride ions. Other errors included the use of ethanol or other substances such as iron. Those candidates who suggested litmus did not always state that it was bleached or went white. A considerable number of candidates suggested that red litmus turned blue.

(e) Many candidates did not use the information in the stem of the question and so did not realise that a chloride ion was formed and that the missing product would be sodium chloride. Common incorrect suggestions were O_2, NaO, Na, Cl and H_2. Those candidates who identified sodium chloride generally correctly balanced the equation.

(f) (i) Some candidates were able to do calculations involving simple proportions. Other candidates were not sure of the method. The commonest errors were to divide 1000 by 200 (giving an answer of 5 g) or to multiply 9 by 200 (giving an answer of 1800 g).

(ii) This was fairly well answered. A few candidates used the mass of water in their calculations rather that ignoring it.

Question 7

(a) Some candidates described at least three physical properties, which are common to nearly all metals. Other candidates wrote about specific properties of either sodium or transition elements. Many candidates did not take note of the bullet points referring to *chemical properties* and the inclusion of a *word equation*.

Some candidates confused chemical properties with physical properties. Answers such as "a chemical property of metals is that they have a low density" were not uncommon. Where word equations were given, they were often incorrect. The commonest correct word equations referred to the reaction of metals with either oxygen or acids.

Some candidates attempted to write symbol equations instead of word equations. This should be discouraged since there is a greater chance of error.

(b) Few candidates gained full credit. Many candidates wrote the names of the oxides instead of the metals. A common error was to suggest that magnesium is more reactive than calcium.

(c) (i) Many candidates knew that isotopes have different numbers of neutrons, but few candidates gave a precise definition of isotopes using the essential word *atoms*. Most candidates referred to elements, molecules or even compounds.

(ii) Few candidates recognised that the main use of the isotope ^{235}U is as a source of energy. The commonest incorrect answers related to "cancer treatment" or "testing for leaks in pipelines".

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CHEMISTRY

Paper 0620/42
Theory (Extended)

Key messages

Candidates must read questions carefully to ensure they address all that is asked.
The term *reduced* should not be used as if it were synonymous with *decreased*. It has a specific meaning in chemistry.
Working should be shown in calculations.

General comments

When a question asks for a specific number of answers, candidates should avoid giving more than the required number, as incorrect answers may contradicting correct answers given.

Candidates should only use technical terms, such as *filtrate* or *intermolecular*, if they know what they mean.

The terms *chemical equation* and *ionic equation* must be understood by candidates. Chemical equations must use chemical formulae and be balanced; a word equation is not accepted when a chemical equation is asked for. Ionic equations should not include spectator ions.

There was confusion between rate of reaction and equilibrium. These topics should be revised separately by candidates and they must read questions with care to see what is being asked.

Answers to calculations should be expressed as decimals and not fractions.

Comments on specific questions

Question 1

(a) (i) This was correctly answered by the vast majority of candidates. A small minority of candidates selected **B** or **C**, both of which also contained four carbon atoms.

(ii) This was correctly answered by the vast majority of candidates.

(iii) Although most candidates correctly identified compound **D**, a significant minority of candidates gave two answers; the correct answer, plus **E** as an incorrect answer.

(iv) This was correctly answered by the vast majority of candidates.

(v) This was correctly answered by the vast majority of candidates.

(vi) Candidates found this challenging. While the correct products were often seen, oxygen and hydrogen were often given as incorrect products, as were a large array of organic products such as butanol or methane. Despite the question asking for two products, some candidates gave only one while other candidates gave three.

(b) (i), (ii) and **(iii)**
While most candidates gave the correct answers, some candidates did not appreciate that there is a trend in the properties of the fractions of petroleum. These candidates incorrectly gave the names of a fraction from the middle of the sequence.

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(iv) The use of kerosene as jet fuel was well known.

(v) The need to heat the petroleum was well known, although some candidates incorrectly stated filtering or condensing.

Question 2

(a) This question required recall of a practical technique with which candidates should be familiar. However, while many candidates named filtration, they then proceeded to evaporate the filtrate to obtain crystals of what would have been ammonium nitrate, rather than obtain the required precipitate, which formed the residue.

(b) (i) Many correct answers were seen; one of the more common incorrect answers was +6, this being the oxidation state of the chromium, rather than the charge on the dichromate ion.

(ii) A minority of candidates performed well on this question. Many candidates did not know what an ionic equation was; those that did still often wrote an unbalanced equation with only one silver cation. It was common for candidates to use a dichromate ion with a different charge from the charge they gave in the preceding question part.

(c) This question required candidates to state and explain. A significant number stated only the colour change of the Universal Indicator paper and did not explain why it changed colour in this way. The release of a pungent gas is not sufficient to explain why the Universal Indicator became blue, nor is the fact that the solution was alkaline, since it was the gas produced that was being tested.

(d) (i) Most candidates correctly stated that the red solid was silver dichromate or that it was formed in the reaction between ammonium dichromate and silver nitrate. There were some good attempts at explaining why the red line was closer to the ammonium dichromate. Very few candidates appreciated that it was only the silver ions and the dichromate ions that needed to be considered, as these were the only ions reacting. There was confused thinking with some candidates stating that the solids turned to gases, while others thought that the solids diffused.

(ii) Most candidates correctly stated that the red solid would appear more quickly and the majority of these candidates were able to explain this in terms of particles having more energy or diffusing faster. Some candidates based their answers on the rate of the reaction; while reactions are faster at higher temperatures, the reaction between oppositely charged ions to form a precipitate is almost instantaneous and so any decrease in the time taken to react would have been insignificant compared to the time taken for the ions to diffuse and meet each other.

(e) (i) This question was very well answered by many candidates although some candidates just reused the terms *thermal* or *decompose* in their answers.

(ii) Candidates who could write the formula of chromium(III) oxide often performed well. However, some candidates thought the *(III)* in the name after chromium meant there were three chromium atoms in the formula. Other candidates did not read the stem of **(e)** and so tried to guess the products, rather than using the information they were given.

Question 3

(a) It was very common to see answers such as “the forward and backward reactions are equal”, which misses out the crucial idea of the *rates* being equal. It was not uncommon for candidates to suggest incorrectly that the concentrations of reactants and products were equal to each other, or to suggest that the reaction had stopped. These errors suggest that many candidates do not understand what is happening when a reversible reaction is at equilibrium.

(b) The explanation of why increasing the temperature increases the rate of reaction is clearly stated in *Section 7* of the syllabus. Candidates should be familiar with this explanation.

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(c) A significant number of candidates focused on the rate of the reaction, despite the question asking about the position of equilibrium. Some candidates gave contradictory answers, such as "the equilibrium moves left increasing the yield of products'"; such contradictions cannot be credited.

Some candidates answered in general terms, such as "the equilibrium will move in the endothermic direction" but did not say which way that was. It should be noted that there will be an endothermic direction and an exothermic direction; there is not an endothermic side or an exothermic side.

(d) Many candidates noticed that there were equal numbers of moles on each side of the equation and so the position of equilibrium would not change. As in **(c)**, some candidates answered in general terms and simply stated that the equilibrium would move to the side with more moles of gas but omitted to state which side that was.

(e) (i) This was generally well answered. The most common error was to omit the non-bonding electrons completely or include the incorrect number of non-bonding electrons. Some candidates miscounted the non-bonding electrons on chlorine and put five or seven; pairing electrons makes counting easier and may help avoid making this error.

(ii) This was very poorly answered. Some candidates confused cause and effect, stating that it is a gas and so it has a low boiling point. Of the candidates who went down the correct route of attractive forces between particles, a very common error was to claim that the covalent bonds were weak. Some candidates used the correct term *intermolecular* but clearly did not understand what it meant as they then contradicted themselves by writing about overcoming bonds between atoms.

Question 4

(a) (i) and **(ii)**
The majority of candidates indicated correctly the direction of flow of electrons and positive ions. However, the question was not always read carefully and so, despite being told that the electron flow was in the wire, some candidates attempted to show electron flow in the solution. Despite the instruction to label the arrows, many candidates drew unlabelled arrows.

(b) (i) The loss of electrons being oxidation was well known.

(ii) A common error was to write an unbalanced equation, the most common of which had one copper ion on the left but two atoms of copper on the right; presumably, candidates confused the magnitude of the charge with a stoichiometric coefficient.

(c) While most candidates could state and explain the mass change of the electrodes, some candidates were careless with terminology, stating that copper ions were added to the cathode (rather than copper atoms) or that the anode lost copper atoms (rather than copper ions). Some candidates incorrectly based the mass changes on the loss / gain of electrons from / to the electrodes. It was common for candidates to describe the formation of anode sludge as though they were using a pure copper cathode and an impure copper anode, despite there being no mention of this in the question.

Question 5

(a) The conversion of carbon dioxide to carbon monoxide was well known. Some candidates referred incorrectly to either carbon dioxide undergoing thermal decomposition or combustion.

(b) The involvement of an acid and a base in neutralisation was well known. Many fully correct chemical equations were seen, although some candidates gave word equations, despite being asked for a chemical equation.

(c) (i) Many candidates did not address this question. Some answers stated *how* rather than *why* and other candidates stated that either the carbon was needed to make the iron useful or to make the iron pure. Candidates who did address the question sometimes gave contradictory answers, the most common being that carbon made the iron brittle and soft.

(ii) Many candidates knew the use of oxygen to reduce the carbon content, but some candidates incorrectly stated that oxygen in the air was used, or that the iron reacts with oxygen rather than the carbon reacting with oxygen.

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(d) (i) Zinc blende was well known. Bauxite and galena were two of the more common wrong answers.

(ii) The two most common errors were for candidates to start with zinc sulfate, rather than zinc sulfide or to produce zinc, rather than zinc oxide in the reaction. As with other questions requiring equations, some candidates gave word equations rather than a chemical equation.

(iii) While most candidates knew sulfur dioxide's involvement in the formation of acid rain and an effect of acid rain, there were some vague answers, such as referring to "harming the environment" or "pollution".

(iv) The majority of candidates did not use the data provided, instead they simply repeated it or paraphrased it. The fact that zinc has a much lower boiling point than either of the impurities mentioned is not sufficient to explain why the zinc does not contain high levels of the impurities. Candidates were expected to state that zinc would be a gas as it has a boiling point below the temperature of the blast furnace but that the impurities would remain as solids.

Question 6

(a) (i) This was often well answered, with clear working shown. Some candidates gave either no working or very unclear working.

(ii) This question required candidates to multiply their previous answer by 24 dm^3. While many candidates correctly did this, some candidates entered into calculations which involved the use of the relative molecular mass of carbon dioxide.

(b) Few candidates correctly calculated the mass of barium hydroxide that could be made.

(c) (i) Many candidates got only part way through this calculation and gave the number of moles of barium hydroxide that were dissolved in 100 cm^3. They did not go on to work out the number of moles in 25 cm^3.

(ii) Candidates were expected to use the chemical equation. Many fully correct answers were seen with working clearly shown. A common error was not to take note of the stoichiometric ratio in the equation provided.

Question 7

(a) (i) A repeat unit was identified correctly by the majority of candidates.

(ii) The most common error was to redraw the repeat unit in brackets with continuation bonds, despite the question clearly asking for the structure of the monomer.

(iii) This was often well answered but it was not uncommon for candidates to have the observations the wrong way round. Candidates should state the starting colour as well as the final colour if they are describing a change that would be seen.

(b) (i) Many candidates find condensation polymers a difficult topic. Common incorrect answers were "amide" (rather than polyamide); "protein" or "polypeptide"; or "addition".

(ii) Candidates found this challenging. Candidates should be familiar with the block diagram format used for condensation polymers and should be able to recognise the portion of the structure that repeats. Many candidates circled the amide linkage rather than the repeat unit.

(iii) Many fully correct answers were seen; common errors included structures with hydrogen atoms forming two bonds or oxygen atoms with one bond only. Some structures showed little resemblance to the polymer drawn in the question.

(c) (i) Better performing candidates included clear working. The most common error was that once the ratio of 1 : 1.33 : 1.33 had been calculated this was then rounded to 1 : 1 : 1 or multiplied by 10 to give 10 : 13 : 13, rather than multiplied by three.

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(ii) Many correct answers were seen. Common errors included referring to needing to know the relative molecular mass of the polymer or needing to know relative atomic masses.

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CHEMISTRY

Paper 0620/52
Practical Test

Key messages

Before answering a question, candidates should read it carefully. Examples of guidance not being followed are **Question 1(i)** and **Question 3** where candidates did not use the information provided to answer the questions.
Candidates should be prepared to answer questions requiring the planning of an investigation. Candidates would benefit from attempting past examination papers with this style of question. These can be found on the 0620 *Specimen Assessment Materials* and on past Alternative to Practical Question Papers.

General comments

The majority of candidates successfully completed all questions.

Supervisors' results were submitted by all Centres with the candidates' scripts. The examiners used the Supervisors' results when marking the scripts to check comparability in **Question 1** and **Question 2**.

The results obtained by some Supervisors and candidates for **Question 1** suggested that some Centres did not use reagents that were close to the concentrations specified in the Confidential Instructions.

Comments on specific questions

Question 1

(b) Almost all candidates completed the table of results correctly. Common errors were:
not recording all readings to one decimal place
initial burette readings recorded incorrectly at values other than 0.0 cm^3
poor comparability with the Supervisor's results.

(c) Many candidates described the colour change correctly as blue to colourless. Some candidates incorrectly described the final colour as transparent or white.

(d) This was also well answered, with the majority of candidates correctly suggesting neutralisation or exothermic. There was a minority of candidates who stated that the type of reaction was endothermic, displacement or redox.

(e) (i) There was almost an equal split between candidates choosing solution **O** and solution **P** as the more concentrated solution. However, most of those who correctly chose solution **O** could explain why in terms of a greater volume of dilute hydrochloric acid being needed for neutralisation.

(ii) The expected answer was five times. The answer expected from the results in **(b)** received credit if calculated correctly. A number of confused answers were given which referred to volumes or differences in volumes.

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(f) The majority of candidates managed to halve their difference value from Experiment 1. A few candidates did not read the question correctly and answered "half" without doing a calculation. A significant number of candidates doubled the volume while other candidates failed to include the unit.

(g) Many candidates mistakenly thought that changing the temperature would change the volume of dilute hydrochloric acid used. Better performing candidates answered that there would be no effect on the volume as warming the solution of sodium hydroxide would only affect the rate of reaction and not change the volume or concentrations of the reactants.

(h) (i) This question was answered correctly by most candidates. The use of a pipette or burette was common though a minority of candidates stated "use a measuring cylinder".

(ii) The idea that the reliability of the results could be checked by repeating the experiments was well understood.

(i) The question asked for a different method, i.e. other than a titration, that could be used to compare the concentrations of the two solutions of sodium hydroxide, solution **O** and solution **P**. Information was provided to help candidates use a precipitation reaction method to answer the question. Many candidates ignored this information and used the same method with a different indicator. Some candidates mistakenly thought that just using an indicator would be a good method to compare the concentration of the two solutions of sodium hydroxide.

Better performing candidates gave details of a fair test; of measuring a dependent variable; and of how to use the results to draw a conclusion about the concentrations of the sodium hydroxide solutions.

Question 2

Solid **Q** was zinc bromide.
Solid **R** was sodium iodide.

(a) Most candidates correctly stated that the solid was white. References to yellow, cream or precipitate scored no credit.

(b) The majority of candidates reported the formation of a white precipitate, which dissolved in an excess of aqueous sodium hydroxide to form a colourless solution. References to "cloudy" or "solid formation" were ignored. Incorrect observations such as "fizzing" were not awarded credit.

(c) The majority of candidates reported the formation of a white precipitate, which dissolved in an excess of aqueous ammonia to form a colourless solution. A significant number of candidates did not get the precipitate to dissolve, probably because they did not add an excess of aqueous ammonia. References to "cloudy" or "solid formation" were ignored. Incorrect observations such as "fizzing" were not awarded credit.

(d) The formation of a cream precipitate was often described. Yellow and white were common answers. Some candidates gave two colours, e.g. creamy white, which was not awarded credit. This showed a lack of practical expertise and experience when carrying out the halide test.

(e) Some candidates identified the presence of zinc ions, although a number of candidates stated that calcium ions were present. Most candidates managed to identify the correct halide ion based on their observation in **(d)**.

(f) Many candidates carried out a flame test and recorded a yellow or orange colour, as expected. Some incorrect red, lilac and blue-green observations were recorded. A minority of candidates were unfamiliar with a flame test.

(g) Some candidates mentioned "no reaction", "no change" or "no precipitate". A significant number of candidates described the formation of a precipitate or a colour change and were not awarded credit.

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(h) Some candidates recorded the formation of a yellow precipitate. A significant number of candidates described the formation of a white or cream precipitate and were not awarded credit. This showed a lack of practical expertise and experience when carrying out the halide test.

(i) Many candidates correctly identified the sodium ion and the correct halide ion based on their observation in **(h)**. There was some confusion between iodine and iodide.

Question 3

(a) Some excellent answers were seen for this question. The question stated that the reaction was between solids, but most candidates dissolved the solids in water. Despite the fact that they were measuring a temperature change, a significant number of candidates heated the reactants with a Bunsen burner, which showed a lack of understanding.

There was a common misunderstanding of the definition of endothermic, which states that such reactions involve absorption of energy from the environment. There was also some confusion between equilibrium and rate of reaction. Statements such as “heating made the reaction faster, this means it was endothermic” were not awarded credit.

Better performing candidates gave answers which included experimental details such as:
- taking the initial temperature of (solid) ammonium chloride / barium hydroxide
- mixing / stirring the solids
- using a thermometer
- measuring the final temperature
- observing that the temperature decreases / test-tube feels cold.

(b) The majority of candidates gave a test for ammonium ions. Better performing candidates included adding aqueous sodium hydroxide to form ammonia gas, and then stated that the ammonia gas would turn red litmus blue. Common mistakes were using a dilute acid instead of aqueous sodium hydroxide, and adding aluminium foil.

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CHEMISTRY

Paper 0620/62
Alternative to Practical

Key messages

Before answering a question, candidates should read it carefully. An example of this guidance not being followed is **Question 2(h)** where candidates did not use the information provided to answer the question.
Candidates should be prepared to answer questions requiring the planning of an investigation. Candidates would benefit from attempting past examination papers with this style of question. These can be found on the 0620 *Specimen Assessment Materials* and on past Alternative to Practical Question Papers.

General comments

The vast majority of candidates successfully attempted all questions.

The majority of candidates were able to complete tables of results from readings on diagrams correctly, as in **Question 2**.

Comments on specific questions

Question 1

(a) Generally, candidates were able to identify the electrodes.

(b) Many candidates realised that an inverted test-tube or measuring cylinder could be used to collect a gas during electrolysis. Only a minority of candidates realised that the collecting apparatus should show a liquid level, otherwise air in the container would prevent collection. The use of a gas syringe was common; this is incorrect as it would not work.

(c) This was well answered, with candidates referring to a glowing splint relighting or bursting into flames. Some candidates incorrectly stated that a lighted splint relit.

(d) (i) Carbon dioxide was often correctly identified. Incorrect answers seen were hydrogen, oxygen and sulfur dioxide.

(ii) Many responses showed an understanding that the oxygen formed during the electrolysis reacted with the carbon electrodes. Some candidates mistakenly thought that the gas was formed by the sulfuric acid reacting with the carbon.

(e) A large number of confused responses were seen which referred to the pH decreasing as acidity decreased or hydrogen was lost. The majority of candidates understood that the solution became more acidic or contained more hydrogen ions. Many candidates did not realise that water was broken down.

Question 2

(a) This was often well answered. The most common error was to reverse the initial and final readings, while other candidates misread the burette diagrams.

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(b) This table of results was often completed correctly. A significant number of candidates did not realise that burettes are accurate to one decimal place and gave a reading of 24 cm^3 instead of 24.0 cm^3.

(c) This was also well answered, with the majority of candidates correctly suggesting neutralisation or exothermic. There was a minority of candidates who stated that the type of reaction was endothermic, displacement or redox.

(d) (i) There was almost an equal split between candidates choosing solution **O** and solution **P** as the more concentrated solution. However, most of those who correctly chose solution **O** could explain why in terms of a greater volume of dilute hydrochloric acid being needed for neutralisation.

(ii) The expected answer was five times. A number of confused answers were given which referred to volumes or differences in volumes.

(e) Over half of the candidates correctly gave 2.55 cm^3 as their answer. The most common error was mathematical, failing to halve 5.1. A few candidates did not read the question correctly and answered "half" without doing a calculation. A significant number of candidates doubled the volume while other candidates failed to include the unit.

(f) Many candidates mistakenly thought that changing the temperature would change the volume of dilute hydrochloric acid used. Better performing candidates answered that there would be no effect on the volume as warming the solution of sodium hydroxide would only affect the rate of reaction and not change the volume or concentrations of the reactants.

(g) (i) This question was answered correctly by most candidates. The use of a pipette or burette was common though a minority of candidates stated "use a measuring cylinder".

(ii) The idea that the reliability of the results could be checked by repeating the experiments was well understood.

(h) The question asked for a different method, i.e. other than a titration, that could be used to compare the concentrations of the two solutions of sodium hydroxide, solution **O** and solution **P**. Information was provided to help candidates use a precipitation reaction method to answer the question. Many candidates ignored this information and used the same method with a different indicator. Some candidates mistakenly thought that just using an indicator would be a good method to compare the concentration of the two solutions of sodium hydroxide.

Better performing candidates gave details of a fair test; of measuring a dependent variable; and of how to use the results to draw a conclusion about the concentrations of the sodium hydroxide solutions.

Question 3

(a) and **(b)**
These tests were well known, with white precipitate soluble in excess being the expected observations for both reactions. In **(a)(i)**, some answers were expressed poorly such as "soluble white precipitate".

(c) This was generally well answered with the recognition of the formation of a cream precipitate.

(d) This was well answered and many candidates identified sodium iodide.

Question 4

(a) Some excellent answers were seen for this question. The question stated that the reaction was between solids, but most candidates dissolved the solids in water. Despite the fact that they were measuring a temperature change, a significant number of candidates heated the reactants with a Bunsen burner, which showed a lack of understanding.

There was a common misunderstanding of the definition of endothermic, which states that such reactions involve absorption of energy from the environment. There was also some confusion

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between equilibrium and rate of reaction. Statements such as “heating made the reaction faster, this means it was endothermic” were not awarded credit.

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(b) The majority of candidates gave a test for ammonium ions. Better performing candidates included adding aqueous sodium hydroxide to form ammonia gas, and then stated that the ammonia gas would turn red litmus blue. Common mistakes were using a dilute acid instead of aqueous sodium hydroxide, and adding aluminium foil.

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