CO-ORDINATED SCIENCES

Paper 0654/12
Multiple Choice (Core)

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

General comments

Candidates performed very well on **Questions 1**, **2**, **14**, **18**, **29**, **34**, **35** and **37**. **Questions 6**, **10**, **11**, **20**, **24**, **28**, **32**, **36** and **40** proved the most difficult for candidates.

Comments on specific questions

Question 3

Most candidates selected the correct option. Options **B** and **C** were chosen by those who did not appreciate that palisade mesophyll cells produce the most glucose in a leaf cell.

Question 4

Option **D** was more popular than the correct answer, option **C**. Candidates should know the meaning of key syllabus terms such as osmosis and transpiration.

Question 7

Both options **A** and **C** were popular incorrect choices. Some candidates may have overlooked the ‘not’ aspect of this question on photosynthesis.

Question 10

This was found to be one of the most demanding questions on the paper. There was evidence that many candidates had guessed at the answer. Many candidates were not aware that the left ventricle of the human heart has the most muscular wall.

Question 11

There was evidence that many candidates had guessed at the answer. Candidates were not familiar with the idea that exercise increases the rate and depth of breathing.

Question 12

Options **B** and **C** were common incorrect choices. These candidates did not recognise that carbon dioxide and water are the products of aerobic respiration.

Question 15

Most candidates selected the correct answer. Some selected option **B** and mistook the atomic number as the number of neutrons.

Question 16

A few candidates selected option **D** which has the charges for the ions of sodium and chloride reversed.

Question 17

Both options **B** and **D** were common incorrect choices. These candidates did not appreciate that lithium bromide and potassium iodide are ionic compounds so will conduct electricity when molten.

Question 19

Option **C** was more popular than the correct answer, option **B**. Sodium is not formed at the anode as sodium ions are positive, Na^+, and would be attracted to the cathode. In this question, as the sodium chloride is aqueous, it is H^+ ions that are attracted to the cathode and hydrogen is produced. Chloride ions are negative, so the ions move to the anode and chlorine is produced.

Question 20

Option **B** was more popular than the correct answer, option **D**. These candidates selected the greatest temperature increase, which would represent an exothermic reaction rather than an endothermic one.

Question 22

Most candidates selected the correct answer, option **C**. Option **B** was a common incorrect choice and is the reverse of the key as the metal oxide of magnesium is basic and the non-metal oxide of sulfur is acidic.

Question 23

Most candidates selected the correct answer, option **D**. Option **C** was chosen by some candidates. The final step is not evaporating to dryness. Instead, crystals form when the solution is left to cool.

Question 24

Option **B** was more popular than the correct answer, option **D**. The melting point of sodium is lower than lithium as melting point decreases down Group I.

Question 28

Option **C** was more popular than the correct answer, option **B**. These candidates were not aware that the area under a speed-time graph is the distance.

Question 31

Most candidates selected the correct answer, option **A**. Some candidates selected option **B**. As silver is a metal, it is not a bad conductor.

Question 32

Option **C** was more popular than the correct answer, option **A**. Option **D** was also a common choice. Candidates should be able to apply their understanding of convection to an example where this thermal energy transfer occurs.

Question 36

Option **C** was more popular than the correct answer, option **D**. Steel is used to make a permanent magnet and not soft iron.

Question 40

This was found to be the most demanding question on the paper. Options **A** and **D** were more popular than the correct answer, option **C**. Candidates were not familiar with the final stage of the life cycle of a large mass star.

CO-ORDINATED SCIENCES

Paper 0654/22
Multiple Choice (Extended)

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

General comments

Candidates performed very well on **Questions 1**, **3**, **4**, **7**, **10**, **11**, **14**, **21**, **22**, **24**, **30**, **31**, **33**, **34**, **36**, **37**, **39** and **40**. **Questions 15** and **28** proved the most difficult for candidates.

Comments on specific questions

Question 6

Most candidates could identify the two arteries from the diagram. A few selected options **B** and **D**.

Question 8

The correct answer, option **B**, was usually selected by most candidates. Options **C** and **D** were chosen by candidates who thought the hormone that produces glucose is insulin.

Question 13

Some candidates thought that option **B**, an increase in carbon dioxide because of fewer tree leaves respiring, was a result of deforestation.

Question 15

Options **C** and **D** were common incorrect options. Candidates selecting these options were unfamiliar with interpretating the symbols of particles.

Question 20

The correct answer, option **B**, was usually correctly selected. Option **D** was a popular incorrect choice by candidates who thought the trend in melting point was increasing rather than decreasing from lithium to potassium.

Question 23

Most candidates selected the correct answer, option **B**. A few were confused about tin's position in the reactivity series and selected option **C**.

Question 25

Some candidates thought nitrogen was the main constituent of natural gas.

Question 28

Option **B** was more popular than the correct answer, option **D**. These candidates did not convert cm into m.

Question 35

Most candidates selected the correct answer, option **B**. Option **D** was a popular incorrect choice where candidates thought virtual images can be produced on a screen.

Question 38

Options **A** and **C** were common incorrect choices, showing confusion about why a step-up transformer is used.

CO-ORDINATED SCIENCES

Paper 0654/32
Theory (Core)

Key messages

Candidates should be reminded to read the stimulus material and each question carefully and complete all the instructions contained within the question. Some candidates did not answer the questions completely.

Any formula quoted should be in a standard form and use recognisable symbols.

General comments

In general, candidates had a good understanding of what the questions were asking. A good standard of scientific knowledge was displayed by many candidates.

Calculations were often done well with working shown.

Comments on specific questions

Question 1

(a) (i) Most candidates knew at least one of the parts. This was usually part **A**, as the part that supports the cell. Very few candidates were able to identify all the parts that are also found in animal cells. Some candidates wrote the names of the parts rather than the letters.

(ii) Many candidates gained two marks usually for knowing that bacterial cells have no nucleus and no chloroplasts.

(iii) Part **C** was correctly identified by many candidates as a chloroplast. Mitochondria was a common incorrect response.

(b) (i) Chlorophyll was well known as the green pigment.

(ii) Some candidates were able to write down the word equation for photosynthesis. Sunlight was often suggested as a reactant.

(iii) Light energy was correctly identified as the energy used in photosynthesis. Chemical energy and heat energy were common errors.

(c) Almost all candidates were able to identify two other characteristics of living things.

Question 2

(a) Egestion, ingestion and digestion were well known. Assimilation was not well known as the process involving the uptake and use of nutrients by cells.

(b) (i) Many candidates did not know that glycogen is made from smaller molecules called glucose.

(ii) Benedict's reagent was well known as the reagent used to test for reducing sugars.

Question 3

(a) (i) Most candidates gained at least one mark. All three words were quite well known.

(ii) Most candidates were able to gain at least one mark even if the genetic diagram was incorrect.

(b) Selective breeding by artificial selection was quite well known. Many candidates were able to describe selecting sheep with desirable traits and breeding the selected sheep together. Fewer candidates were able to describe selecting the offspring with desirable traits and repeating the process over many generations.

Question 4

(a) (i) A pathogen was well known as a disease-causing organism. Bacteria and viruses were not accepted as there are many bacteria and viruses that are harmless or even beneficial.

(ii) AIDS was the most popular and correct response.

(iii) Some candidates were able to describe two ways that HIV is transmitted.

(b) (i) Many candidates were able to identify **B** as the blood vessel that transports deoxygenated blood from the body to the heart. Fewer candidates were able to explain that **B** has a thin wall and large lumen.

(ii) Most candidates were able to calculate the magnification as 1250. Some candidates were not aware that magnification does not have units.

(c) Most candidates described the transport of mineral ions and water. A few confused the xylem with the phloem and described the transport of sucrose and amino acids.

Question 5

(a) (i) Calcium, magnesium and platinum were all incorrectly suggested as the metal that is extracted from bauxite.

(ii) Calcium, magnesium and platinum were all incorrectly suggested as an alkali metal.

(iii) Iron was well known as the main element in steel.

(iv) Platinum was not well known as the metal used as inert electrodes in electrolysis.

(b) (i) Most candidates named either magnesium chloride or hydrogen as one of the products in the reaction.

(ii) Most candidates used the data given in the question to explain that there was an increase in the rate of reaction because the hydrochloric acid was more concentrated.

(iii) Calcium, sodium and potassium were correctly suggested as metals in the reactivity series that are more reactive than magnesium.

Question 6

(a) (i) Few candidates were able to explain that ethene is a hydrocarbon because it contains carbon and hydrogen only. A number of candidates suggested that it is because ethene ends with ‘-ene’.

(ii) Few candidates drew a double bond between the two carbon atoms.

(b) (i) Few candidates were able to describe the colour change observed when ethene gas is reacted with aqueous bromine.

(ii) Some candidates knew that a polymer is a large molecule built up from many smaller ethene molecules called monomers. Few candidates knew that the polymer was poly(ethene) or that the reaction is an addition polymerisation.

Question 7

(a) (i) The meaning of oxidation was quite well known.

(ii) Most candidates knew at least one of the percentages.

(iii) Many candidates showed good data handling skills to determine the two products of the oxidation of gasoline/petrol.

(iv) Very few candidates were able to describe either of the two possible chemical tests for the presence of water.

(b) (i) Many candidates attempted to give explanations in terms of the inert nature of neon.

(ii) Some candidates were able to explain why neon is unreactive by describing the full outer shell of electrons.

(c) Evaporation and condensation were well known as the two changes of state described.

Question 8

(a) (i) Covalent bonding was quite well known as the type of bonding in a chlorine molecule. Ionic bonding was sometimes suggested.

(ii) Some candidates correctly determined the formula for a molecule of astatine as At_2.

(b) (i) Many candidates used the observations given in the question to show that the reaction is exothermic.

(ii) Many candidates correctly balanced the equation. Fewer were able to include the correct state symbols.

(c) Many candidates drew clear dot-and-cross diagrams to show the electronic configurations of a sodium ion and a chloride ion. Some candidates forgot to include the charges on the ions.

(d) (i) Many candidates knew the names of the electrodes.

(ii) Oxygen and sodium were often incorrectly suggested.

Question 9

(a) (i) Most candidates correctly identified a part of the graph where the student is walking at a constant speed.

(ii) Most candidates correctly identified a time when the student accelerates.

(iii) A few candidates suggested 0.3 m/s rather than 0.4 m/s for the maximum speed.

(b) Candidates showed a good understanding of the hazards of damaged insulation in a power cable.

(c) (i) The angle of incidence and the angle of reflection were often correctly labelled.

(ii) Most candidates knew that the angle of incidence equals the angle of reflection.

(d) (i) The charge on a β-particle was well known.

(ii) Many candidates suggested storing a small quantity of strontium-90 in a small box or container but failed to suggest that the container should be made from lead.

(e) Candidates found this question very demanding. Few candidates gave an explanation including centre of gravity and moments.

Question 10

(a) (i) Many candidates knew that the Sun consists mostly of hydrogen but few were able to suggest helium as the other element.

(ii) 100 000 light years was not well known as the approximate diameter of the Milky Way.

(iii) Few candidates were able to explain that stars cannot lose energy by conduction or convection because conduction and convection require a medium and space is a vacuum.

(iv) Refraction was quite well known as the effect that causes light waves to change direction.

(b) (i) Good mathematical skills were shown by some candidates in this calculation.

(ii) Many candidates were able to place infrared in the correct position.

(c) A few candidates did not know the seven colours of the visible spectrum. Many candidates placed the seven colours in the correct order. A few reversed the order.

(d) (i) Most candidates correctly calculated the resultant upward force.

(ii) Candidates needed to explain that acceleration is an increase in speed rather than a change in speed.

(iii) Many candidates missed marks because they suggested gravitational energy or potential energy rather than gravitational potential energy.

Question 11

(a) (i) Most candidates correctly determined the work done as 30 000 J.

(ii) Most candidates used the correct formula to determine the pressure but some forgot to multiply the area by four to account for the number of feet that the elephant had.

(b) (i) Very few candidates were unable to use the data in the question to determine that the elephant has the smallest audible frequency range.

(ii) Most candidates correctly stated that approximate range of frequencies audible to humans is from 20 Hz to 20 000 Hz.

Question 12

(a) Many candidates correctly drew an arrow going downwards.

(b) (i) The freezing point of water was quite well known. Popular incorrect answers were 100 °C and –100 °C.

(ii) Some candidates drew clear diagrams to show the arrangement of water molecules in liquid water and in solid ice.

(c) (i) Most candidates did not know the electrical symbol for an electric motor.

(ii) Most candidates calculated the combined resistance of the two lamps connected in series.

CO-ORDINATED SCIENCES

Paper 0654/42
Theory (Extended)

Key messages

Candidates should be encouraged to read questions carefully and complete the instructions provided. For example, **Question 3(b)(i)** asked for the function, but a number of candidates gave the name of the part instead. For **Questions 7(b)(i)** and **8(b)(ii)**, the question asked for the observations that would be seen but many described what was happening at a molecular level rather than what could be observed.

Candidates should be able to recognise the different responses required by different command words. *'Describe'* and *'Explain'* require different responses. For example, in **Question 1(b)(i)**, a description and an explanation were required but many candidates only gave a description of the results.

General comments

There was a high standard of scientific knowledge and understanding evident, with many candidates providing detailed and accurate responses. On occasions, some responses were lacking detail. Candidates can use the mark allocation of the question as a guide to how many specific points they need to make in their responses.

While many candidates had a broad knowledge of the syllabus, it was evident that some areas of the syllabus were better known than others. For general guidance, the syllabus can be used as a guide to what content needs to be covered and can provide an excellent revision tool for candidates.

Comments on specific questions

Question 1

(a) Some candidates misinterpreted the question and gave the name of the part labelled in Figure 1.1 rather than how the parts were adapted for photosynthesis. The best responses linked the parts with their role in photosynthesis.

(b) (i) This question asked candidates to describe and explain the results. Many candidates simply gave a description of the data and did not relate light intensity or energy from light to photosynthesis and the subsequent production of oxygen.

(ii) This question was well answered with many candidates identifying the increase in rate of reaction and linking this to increased energy of the particles and frequency of collisions.

(c) The meanings of the terms source and sink are clearly stated in the syllabus. Candidates should be encouraged to use scientific language that is given in the syllabus when answering questions.

(d) The majority of candidates could identify the pathway of water through a plant.

Question 2

(a) A common error was for candidates to describe the salt solution moving rather than the water moving across the partially permeable membrane. Candidates should be reminded to use the correct scientific terminology. The movement of water should be described as from a higher water potential to a lower water potential rather than in terms of water concentration.

(b) (i) The majority of candidates could describe active transport. Occasionally candidates contradicted themselves and described particles moving from a low to a high concentration down a concentration gradient.

(ii) Few candidates were able to link the presence of oxygen to aerobic respiration and the release of energy required for active transport. Many candidates simply repeated the information in the question.

(iii) The majority of candidates were able to state one function of nitrate ions in plants in relation to a biological compound such as amino acids.

(c) (i) Pulmonary vein was a common incorrect response.

(ii) Many candidates were able to provide two features of gas exchange surfaces.

Question 3

(a) (i) The advantages of asexual reproduction were generally well known. A common omission was to say that offspring would be genetically identical but not explain how this was a benefit.

(ii) Most candidates were able to describe fertilisation. A common error was to describe a seed being formed rather than a zygote.

(b) (i) Many candidates did not read the question carefully and gave the name of the part rather than the function. Occasionally candidates confused the function of the stigma with the anther.

(ii) A number of candidates described the petals in an insect-pollinated plant instead of the anther.

(c) (i) This question was well answered with many candidates identifying the correct number of chromosomes in a leaf cell and a cell in a gamete.

(ii) The correct answer of meiosis was commonly seen. Common incorrect answers included fertilisation and mitosis.

Question 4

(a) Most candidates could give at least one substance that is transported by the blood. A common error was to repeat that blood plasma contains blood cells.

(b) Some of the candidates misidentified the labelled blood cells as red blood cells and platelets. Occasionally candidates confused lymphocytes and phagocytes. The candidates that identified lymphocytes and phagocytes generally could describe the functions of these two blood cells.

(c) A number of candidates repeated the question and gave the explanation that infection was prevented from entering the blood. However, additional information was required, such as referring to pathogens and blood clotting.

Question 5

(a) Few candidates described the period number as relating to the number of shells. Most candidates incorrectly related the period number to the number of outer shell electrons.

(b) A small number of candidates described electrons as being shared rather than being lost. Most candidates that recognised electrons were lost also stated that three electrons were lost.

(c) (i) Some candidates did not know what to put for the first gap and this was often omitted. The attraction being between oppositely charged ions was more well known. Occasionally candidates incorrectly described the ions as either positive or negative or differently charged which was ignored.

(ii) The correct property of ionic compounds was generally identified.

(d) A common misconception was to describe an element being made of only one atom rather than one type of atom. Candidates described compounds more successfully, often referring to them being made of different elements. There was some confusion between mixtures and compounds.

(e) This question was very well answered with many candidates able to describe isotopes in terms of having the same proton number but a different number of neutrons.

Question 6

(a) Common misconceptions included that hydrogen was not a diatomic molecule and that magnesium chloride consisted of one atom of magnesium and one atoms of chlorine instead of two chlorine atoms. Occasionally some candidates tried to include water in their equation.

(b) (i) Almost all candidates identified student 3 as the correct answer.

(ii) A number of candidates confused the effect of surface area on the rate of reaction and gave student 3 instead of student 4.

(c) This question was generally well answered with candidates referring to kinetic energy and frequency and effectiveness of collisions. However, few candidates referred to fewer particles having the required activation energy.

(d) Activation energy and products were often labelled correctly. Occasionally the energy change was incorrectly labelled as heat loss.

Question 7

(a) Most candidates stated the correct term of homologous series.

(b) (i) Candidates should be reminded to read the question carefully. This question asked for observations. Many candidates described the reaction in terms of the breaking of the double bond and the name of the products instead of the observations that would be seen. Another common omission was for candidates to describe only the end result of decolourisation and not the initial colour that would be observed.

(ii) The majority of candidates identified addition as the type of reaction. Polymerisation was a common incorrect answer.

(c) Candidates generally completed this calculation correctly. Occasionally candidates calculated the molecular mass incorrectly or tried to complete the calculation with only the molecular mass of butane.

(d) Candidates generally were able to draw a formula with four carbon atoms but occasionally placed the double bond between the wrong carbon atoms. More frequently the incorrect number of bonds were given to each carbon, particularly the carbon atoms with double bonds. An easy way for candidates to check this is to count the number of bonds around each carbon atoms, which should be four.

Question 8

(a) Occasionally only one arrow was drawn. However, many candidates were able to draw the direction of movement of the ions to the correct electrodes.

(b) (i) Only the strongest candidates were able to identify the product formed at the anode. Responses included copper ions, sulfate ions, water and sulfuric acid.

(ii) Some candidates tried to describe this in terms of loss of electrons or oxidation. The question asked for the observations which should have referred to some form of bubbling or effervescence.

(c) Ionic half-equations were generally completed well. Occasionally the electrons were given an incorrect charge or placed on the wrong side of the equation.

(d) There were some very good responses to this question, particularly in terms of delocalised electrons enabling electrodes to conduct electricity. Occasionally electrodes were described as good conductors without candidates specifying what type of conduction they were referring to.

(e) The bonding in a molecule of carbon dioxide was generally completed accurately. Occasionally only single bonds between the carbon and the oxygen atoms were shown.

(f) Some misconceptions were evident amongst some candidates with a number referring to weak bonds between the atoms within molecules, rather than between the molecules.

Question 9

(a) Acceleration was commonly identified, the quantity weight was less frequently seen. Some candidates incorrectly identified time or speed.

(b) (i) Many correct responses were seen. The most common misconception was that the car was stationary between 250 s and 300 s rather than travelling at a constant speed.

(ii) This calculation was generally completed accurately. Occasionally candidates divided the time by the change in speed resulting in a value of 2. A small number of candidates displayed the incorrect units of m/s.

(c) (i) Many candidates recognised the increase in kinetic energy. Fewer recognised that the chemical energy store would decrease.

(ii) Candidates found this question demanding with few being able to identify the correct energy stores. Kinetic and potential energy stores were often identified.

Question 10

(a) (i) Candidates found this question demanding with many confusing the motor with a generator and trying to explain this in terms of the coil cutting the magnetic field lines.

(ii) A number of candidates could describe the forces on sides **AB** and **CD** as opposite. Only the strongest candidates were able to describe the forces as not being along the same line.

(iii) This question was more successfully answered with candidates often referring to a reversing of the current every half turn.

(b) (i) Most candidates were able to identify the soft-iron core.

(ii) Many correct calculations were seen.

(iii) This calculation proved difficult for some candidates, as they confused the formula and incorrectly arrived at a value of 10.

(iv) Few candidates were able to give the assumption that there was 100% efficiency.

Question 11

(a) (i) Candidates gave the incorrect nuclide notation for the beta particle. Some candidates reversed the values of 0 and –1, whilst some gave the nuclide notation for an alpha particle.

(ii) The correct answer of 0.4 was commonly seen. The incorrect value of 92.8 was commonly seen.

(iii) A large number of candidates gave variations on the same method of safety from the effects of radiation, namely, some sort of shielding. The best responses gave three different methods including references to keeping an increased distance or reducing the time spent exposed.

(b) Most candidates recognised the need to divide the distance by the time. The candidates made errors while calculating the distance and the time.

Question 12

(a) (i) Some candidates gave the reverse of the correct answer.

(ii) A variety of good responses were seen with many candidates able to describe the vibration of particles and the movement in terms of longitudinal waves.

(iii) Occasionally candidates only gave one frequency rather than identifying the range.

(b) (i) Several correct uses were seen. Sometime candidates were a bit vague in their responses and referred to cleaning of water or medical equipment rather than sterilisation.

(ii) Most candidates were able to give a danger of UV radiation.

(c) This calculation was generally completed well and most correctly expressed their answer in standard form.

CO-ORDINATED SCIENCES

Paper 0654/52
Practical Test

There were too few candidates for a meaningful report to be produced.

CO-ORDINATED SCIENCES

Paper 0654/62
Alternative to Practical

Key messages

It is advisable for candidates to read the questions carefully to ensure they have followed all the instructions. This ensures that numerical answers are given to an appropriate number of significant figures and that written responses give a full answer.

Where a value should be given to the nearest 0.5 then any values given should end with .5 or .0.

General comments

Candidates were generally well prepared for this examination and were familiar with several experimental techniques. Answers to the planning question were sometimes detailed and logical. Candidates found interpreting and evaluating experiments difficult.

The standard of graph drawing was quite good, although candidates need to remember that axes need to be labelled with quantity and unit, a line of best fit needs to be a single line and the scales should enable the plotted points to cover more than half of the grid.

Some candidates found rounding difficult and the term proportional was not well understood.

Comments on specific questions

Question 1

(a) The majority of candidates recorded 48.5 correctly, incorrect responses included 48, 49 and 50. However, the most common answer for 38.0 was 38, a small number gave 40.

(b) (i) The standard of graph drawing was quite good. Some candidates did not label the axes either with the quantity, or more often with the unit. A small number reversed the axes. A large number gave scales which were too small so that the plotted points did not cover at least half of the grid. The plotting of points was good. Where the scales were linear, but awkward, the points were often plotted incorrectly. The curves of best fit were generally good with the majority labelled. A significant number drew curves which were too far from the points or drew multiple lines.

(ii) Most candidates estimated the value from the graph correctly. A significant number of candidates did not show their working on the graph. It is expected that two lines should be drawn, one from 1.5 minutes to the curve and another from the intersection with the curve to the vertical axis. A single line or a mark on the curve are both insufficient.

(c) (i) Most candidates calculated the values correctly. Incorrect responses included: 80, 36 and 36.5 °C.

(ii) Candidates found this question demanding. The two most common incorrect responses described either the loss of thermal energy rather than the rate of loss of thermal energy or thought the rate of loss of thermal energy was larger from larger animals.

(d) (i) Identifying and excluding anomalies or reducing the effects of errors were not well known. Non-creditworthy responses included accuracy, calculating an average, reducing errors and checking results.

(ii) Candidates found this question demanding. Many described accuracy, reducing errors, recording the correct temperature or letting the thermometer reach room temperature.

(iii) Only the strongest candidates gained credit on this question. A common incorrect response was to ensure a complete reaction.

Question 2

(a) (i) The majority of candidates gave the correct colours. Common incorrect responses included blue or purple for **A** and blue or red for **B**.

(ii) Most candidates gave a correct conclusion. Incorrect responses included either iodine or chlorophyll being present or absent.

(iii) The vast majority of candidates gave a correct explanation of their conclusion. Some restated either the question stem or the conclusion.

(b) (i) Stronger candidates appreciated that the green colour would mask the colour produced by the test. Incorrect responses included chlorophyll is green and that it stops photosynthesis.

(ii) The experimental details were quite well known. Incorrect responses included: boil in water, scrape it off, use bleach, put in a dark room and remove magnesium.

Question 3

(a) (i) Almost all candidates identified the gas correctly. A very small number stated carbon dioxide.

(ii) Stronger candidates recognised the type of element. Common incorrect responses included non-metal or naming a metal, commonly zinc, copper or magnesium.

(b) (i) Candidates found this quite demanding as many did not appreciate that the test for carbon dioxide had been reversed with the answer being limewater or calcium hydroxide solution. Incorrect responses included sodium hydroxide, calcium carbonate, zinc sulfate, zinc hydroxide, sodium carbonate, magnesium carbonate, sulfate and chloride.

(ii) Whilst many candidates appreciated that the process was filtration, diagrams were often incomplete, incorrect or incorrectly labelled. Often there was no funnel drawn, a funnel with no filter paper, a hole in the filter paper, a filter paper laid across a beaker, precipitate or solution labelled in the boiling tube, or residue and filtrate labelled instead of precipitate and solution.

(c) Whilst some candidates correctly identified the cation, far fewer identified solid **J**. Incorrect responses for the cation included zinc, sulfate and chloride. Incorrect responses for solid **J** included Ca^{2+}, zinc, calcium carbonate, calcium sulfate, iron, sodium, copper and potassium.

(d) (i) The anion was identified correctly by stronger candidates. Common incorrect responses included nitrate, chloride, sulfate, sodium, calcium and hydroxide.

(ii) Candidates found this diagram very demanding. The most successful connected the two tubes with a delivery tube. Very few drew an airtight apparatus with the delivery tube under the level of the solution and included heating.

(e) Stronger candidates knew one reason for a blue flame but very few gave two correct reasons. Incorrect responses included consistent flame, complete combustion, no soot, accurate, to identify metal ions, more reactive and less reactive.

(f) Very few candidates gave a correct explanation. The improvement was much better known. Incorrect responses included adding more hydrochloric acid, using concentrated hydrochloric acid and using barium nitrate.

Question 4

Many candidates addressed the bullet points and gave a logical description of the investigation.

A list of apparatus is unable to gain credit unless the apparatus needed for the investigation is used in the method. Many measured the amount of ammonium sulfate instead of the mass or amount of ammonia instead of volume and many did not specify the apparatus they would use to measure them. Scale or scales is insufficient for balance.

A small number of candidates drew a correct labelled diagram of their assembled apparatus.

A significant number of candidates gave a specific time for the reaction rather than allowing the reaction to finish.

Many repeated their experiment although some did not explain why it should be repeated.

Control variables were generally well known. Some discussed variables without either describing them as control variables or stating that the variable was the same each time. A significant number thought the mass of ammonium sulfate should be controlled or thought that the control meant specifying how it was changed e.g. 1 g, 2 g, 3 g etc.

Candidates find processing results and reaching conclusions very demanding. Stating a conclusion from previous knowledge or simply looking for a pattern in the results is not creditworthy. Many suggested drawing a graph without specifying the quantities on each axis. Few candidates explained how the shape of the best-fit line would lead to a conclusion. If a graph is not drawn, a statement should be made about what happens when the mass of ammonium sulfate is increased. For instance, does the volume of gas increase, hence a positive relationship, or decrease, hence a negative relationship, or stay the same.

Question 5

(a) (i) The majority of candidates measured the height correctly and many calculated the actual height correctly. A small number multiplied by 6 or repeated the value for *h*.

(ii) The majority of candidates measure the angle correctly. Incorrect responses included 48, 49, 53 and 54°.

(b) Candidates found this very demanding and this highlighted a misunderstanding of the term proportional. For two variables to be proportional their ratio throughout the table of results needs to be constant. These variables were not proportional, but many candidates thought they were. The question was worth two marks and so the answer had two distinct aspects. As *H* increased, *θ* increased and as *H* increased so the increase in *θ* became smaller so the variables are not proportional.

(c) Some candidates found this demanding although a significant proportion correctly described filming the experiment. Incorrect responses included repeating and having another person to help.

(d) Many candidates appreciated that 64 was greater than half the distance between 61 and 66 so the value of *H* must be just greater than half the difference between 10 and 15. Common incorrect responses included 12.5 and 12 cm.

Question 6

(a) (i) The majority of candidates recorded the dimensions correctly. Incorrect responses included recording the dimensions in the incorrect order, 4.3 instead of 3.3, 3.6 instead of 2.6 cm and values greater than the tolerance.

(ii) Whilst the majority of candidates calculated the value correctly, many did not give the value to three significant figures.

(iii) The majority of candidates gave the correct value. Incorrect responses included 63.4 and 63.46 g.

(iv) Whilst the majority of candidates calculated the correct value, some did not round their value correctly.

(b) Candidates often gave generic responses such as the cuboid is irregular, rather than specifying how the cuboid was not regular

(c) (i) Almost all candidates recorded the correct volumes. Incorrect responses included 40, 42, 86 and 90 cm^3.

(ii) Almost all candidates calculated the volume correctly.

(iii) Almost all candidates calculated the density correctly.

(d) (i) Candidates found this extremely demanding. Incorrect responses included reshaping the clay, spilling water, parallax, more errors in method 2, more accurate and that the scale is exact.

(ii) Stronger candidates calculated and used 10%. Incorrect responses included a statement with no calculation, only a 10% calculation or used the values of volume rather than density.

(iii) Candidates found this demanding with only the strongest gaining credit. Many thought the value for density would be lower. Other incorrect responses included inaccurate, larger because the volume is larger and stays the same because it is the same clay.