CO-ORDINATED SCIENCES

Paper 0973/11
Paper 1 Multiple Choice (Core)

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

CO-ORDINATED SCIENCES

Paper 0973/21
Paper 2 Multiple Choice (Extended)

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

General comments

This paper was fairly well answered, but there was widespread evidence of guessing in some of the questions.

Question 13 was very straightforward for candidates.

Candidates found **Question 15**, **20** and **31** to be particularly difficult**. Questions 12**, **25**, **28**, **34**, **37**, **38** were also difficult for candidates.

Comments on specific questions

Question 2

In this question a significant number of candidates confused the terms flaccid and plasmolysis.

Question 4

This question involved interpreting a graph and choosing correct statements about it. There was evidence of guessing, possibly suggesting that many candidates did not read both parts of each statement, since they should have realised that if an enzyme denatures it will not act faster.

Question 6

Some candidates may have guessed at which secretions of the pancreas are enzymes. Reiterating the nomenclature of enzymes to ensure that candidates are aware that almost all enzyme names end in 'ase' would have solved this.

Question 8

Many candidates believed that photosynthesis involves only two molecules of carbon dioxide and water for every six of oxygen. Using the blank space on the multiple choice exam paper for rough working is acceptable and could help some candidates.

Question 12

There was widespread guessing at the answer to this question about energy passed down to the next trophic level. All of the processes stated either use energy, or are a direct loss of energy (excretion), therefore the answer must be **A**.

Question 13

This question on deforestation was very well answered.

Question 14

Some of the more able candidates chose the incorrect **A** rather than the correct answer, **C**. They should be able to describe and explain separation of a coloured mixture by chromatography.

Question 15

Candidates chose the incorrect **B** and **C** more often than the correct answer, **D**. They are expected to recognise the symbols of the elements, and to know that nitrogen gas is a diatomic element.

Question 17

Candidates chose the incorrect **B** more often than the correct answer, **A**. They should be able to calculate stoichiometric reacting masses and volumes of gases, using relative formula mass, the mole and the molar gas volume, 24 dm^3.

Question 18

Candidates chose the incorrect **A** more often than the correct answer, **D**. They are required to identify endothermic and exothermic reactions, and understand that in exothermic reactions the reacting chemicals lose energy as thermal energy.

Question 20

Candidates chose the incorrect **B** and **C** more often than the correct answer, **A**. They should be able to identify oxidising agents as substances that cause the loss of electrons, oxidation, of another substance. They should also be able to identify reducing agents as substances that cause the gain of electrons, reduction.

Question 24

Lower performing candidates chose the incorrect **C** rather than the correct answer, **B**. Candidates are expected to describe the reaction of a more reactive metal with the aqueous ions of a less reactive metal.

Question 25

Candidates chose the incorrect **C** and **D** more often than the correct answer, **A**. They are required to know how a car exhaust system uses a hot catalyst to remove carbon monoxide and nitrogen monoxide.

Question 28

This question on speed–time graphs was not well answered, with slightly more than half the candidates opting for the incorrect **D**. These candidates simply multiplied the final speed by the total time.

Question 29

Most candidates could calculate the resultant force on the rocket, but a common error after this was to multiply the resultant force by the mass instead of dividing, leading to a choice of option **B**.

Question 31

This question on energy was particularly badly answered, with all three incorrect options being more popular than the correct **D**. Particularly common choices were **C** (found by multiplying the output energy by the efficiency instead of dividing) and **B** (found by failing to multiply by the gravitational field strength in the calculation for gravitational potential energy).

Question 32

Many less able candidates seemed unfamiliar with the term thermocouple and often opted for **A** (expansion) or **B** (pressure).

Question 34

A majority of candidates could not recall the direction of refraction of light entering a glass block.

Question 37

Slightly fewer than one in three candidates could recognise the current–voltage characteristics of an ohmic resistor and a filament lamp.

Question 38

Many candidates could not answer this question on resistance and current in a parallel circuit correctly. Most were unaware that the combined resistance would be less than $3.0\,\Omega$, leading to them choosing either **C** or **D**. However of these, most did know that the greater current would be in ammeter Q.

CO-ORDINATED SCIENCES

Paper 0973/31
Paper 3 Theory (Core)

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

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Paper 0973/41
Paper 4 Extended Theory

Key messages

Candidates should read the stimulus material carefully and follow the guidance given. Questions with command words that require candidates, for example, to use information in a diagram, state, explain, describe, use the correct notation, show, identify, calculate, suggest, list and use ideas all require different types of responses. Marks were often missed because the candidate has not answered all aspects of the question using the required terminology. This was evident in **Question 1(a)(iii)** where many candidates did not use the letter 'a' for recessive alleles and the letter 'A' for dominant alleles, in **Question 2(c)(iii)** where the equation given was not balanced and in **Question 8(d)** where general differences between diamond and graphite were listed rather than why graphite is used as an electrical conductor but diamond is not.

Candidates should try to match their answers with the number of marks available for that part of the question. A question worth 3 marks will require 3 separate marking points. For example, **Question 6(c)** where the candidate was required to suggest how the positive charge is produced on the bee as it flies through the air. For this question candidates need to mention electrons, the direction in which electrons move and the cause of the movement of these electrons for the 3 marks. Candidates should attempt all questions even if they only know one part of the answer, for example, **Question 4(b)** which required three ways aerobic respiration is different from anaerobic respiration in humans. Some candidates did not attempt this question rather than try to think of at least one difference.

When completing calculations candidates need to state the expressions or formulae required before attempting the calculation, to show all their working, to express their answer to an appropriate number of significant figures and to include the unit as required. Candidates also need to read the question carefully to ensure all the values given are in the appropriate units, for example, in **Question 4(a)(ii)** the unit of 2 hours needed to be converted to 120 minutes and in **Question 6(a)(ii)** where the unit of 0.20 g needed to be converted to 0.00020 kg.

Candidates should use correct scientific terminology and scientific language when describing phenomenon and have a good understanding of the definitions and specific scientific terms used in the syllabus. This was particular important in **Question 1(a)(ii)** where homozygous recessive was required to describe 'aa', in **Question 1(b)(i)** where goblet cells were required as the answer, in **Question 2(a)** where a full description of a hydrocarbon was needed, in **Question 5(b)** where definitions of an acid and base were required in terms of being a proton donor and proton acceptor respectively, in **Question 6(d)** where candidates needed to know about Brownian motion as evidence for the molecular model of matter and in **Question 9(d)** where a description of thermal energy transfer was required in terms of molecular vibrations and transfer of electrons.

General comments

A high standard of vocabulary, legibility and scientific knowledge were displayed by the majority of candidates. The use of scientific knowledge and scientific terminology was generally good with just a few candidates giving vague responses which prevented them from accessing all the available marks for a question. Candidates appeared to have sufficient time to complete the question paper.

Most candidates completed the required calculations throughout the question paper and these calculations were attempted in a logical manner with clear steps including the use of expressions, formulae and units when required. Some candidates had difficulty rearranging equations and balancing chemical equations.

Comments on specific questions

Question 1

(a) (i) Most candidates gained the first mark for identifying the number of people with the genotype aa. The number of people with the sex chromosomes XY was more challenging, with many candidates giving the answer 1, 3 or 5.

(ii) The majority of candidates only wrote homozygous or only wrote recessive but homozygous recessive is required to fully answer this question.

(iii) Candidates who followed the instructions and used 'a' for recessive alleles and 'A' for dominant alleles usually gave the correct parent gametes, offspring genotypes and the percentage likelihood of the child having cystic fibrosis. A few candidates gave the parent P gametes and the parent Q gametes as AA rather than Aa but were still awarded marks as an error carried forward. Other candidates gave aA and aA as the parent P gametes and the parent Q gametes and were unable to complete the genetic diagram. Many candidates did not follow the instructions and used letters P and Q or X and Y to represent the parent gametes.

(b) (i) Some candidates gave goblet cells as the answer. Many other candidates gave answers such as ciliated cells, cilia, blood cells and villi.

(ii) Many candidates linked the idea that the thick and sticky mucus produced by the cells lining the airways to the idea that this mucus traps bacteria. Fewer candidates then explained that the cilia were unable to remove the mucus containing the trapped bacteria.

(c) The majority of candidates gave smoking as a major cause of lung cancer.

Question 2

(a) Many candidates were able to describe a hydrocarbon as containing hydrogen and carbon. However, a significant number of candidates did not state that a hydrocarbon only contains the elements hydrogen and carbon. Marks were not awarded when a hydrocarbon was described as an element, a mixture or an atom.

(b) (i) Many candidates identified the type of bond in an alkane as being a single bond.

(ii) Many candidates identified C_3H_8 as the molecule that is a saturated hydrocarbon.

(c) (i) The other type of hydrocarbon was usually identified as an alkene. Common incorrect answers included named hydrocarbons such as methane, ethane and propane.

(ii) Candidates found this question challenging with many vague answers such as heat, hot, temperature and pressure. Some candidates also confused a catalyst with a catalytic converter. The best answers about the conditions needed for cracking were a high temperature or a stated high temperature and the need for a catalyst or the need for a high pressure.

(iii) Many candidates did not balance the equation for the cracking of $C_{24}H_{50}$ correctly. These candidates tried to add a hydrocarbon such as C_2H_4 in the space before the C_6H_{12} rather than the number 2.

(d) The majority of candidates linked sulfur dioxide to acid rain but usually linked carbon monoxide to global warming rather than poisoning of living organisms.

Question 3

(a) Candidates found this question about the advantage of generating electricity from nuclear fission challenging. Many candidates gave vague answers such as nuclear fission being renewable, sustainable, environmentally friendly, cheap or not harmful.

(b) (i) Many candidates gained one mark for giving the correct nuclide notation for beta but often gave the answer for the atomic number of lanthanum as 55 rather than 57. A significant number of candidates did not attempt this question.

(ii) The majority of candidates attempted to calculate the time taken for the mass of barium-141 to decrease by 10 g. These candidates showed clear steps in their calculations, but some gave their final answer as the mass left rather than the time taken. A few candidates tried unsuccessfully to calculate the time taken by using proportion rather than halving the mass four times from 160 g to 10 g.

(c) (i) Many candidates gave the correct expression, pressure = force / surface area, but failed to rearrange this equation and substitute the given values of pressure and surface area to show that the force is 2.2×10^6 N.

(ii) Many candidates gained one mark for giving the equation for calculating the moment of the force but fewer were able to rearrange the equation to give the distance *d*.

(iii) Candidates found this question about explaining why the velocity of blade A changes challenging. These candidates gave incomplete answers such as velocity is a vector, velocity can change, speed changes and blade A is spinning rather than realising that the velocity changes because the direction of blade A is changing.

Question 4

(a) (i) The majority of candidates identified sugar C as the sugar with the largest volume of gas produced.

(ii) Most candidates were able to calculate the rate of respiration for sugar A in cm^3 / min. Some candidates did not convert the value from the table of volume of gas produced in 2 hours into volume of gas produced in 120 minutes.

(iii) The majority of candidates gave carbon dioxide as the name of the gas produced during anaerobic respiration in yeast. Incorrect answers included oxygen and ethanol.

(iv) The majority of candidates gave bread making or fermentation as their answer to the practical use for the anaerobic respiration of yeast.

(b) Most candidates realised that one difference between aerobic respiration and anaerobic respiration is that only aerobic respiration requires oxygen. Some candidates wrote about aerobic respiration releasing more energy or not having lactic acid as one of the products. Other differences were not as well known. A few candidates thought that anaerobic respiration in humans has ethanol as one of the products or that aerobic respiration is faster.

(c) This question about the characteristics of living organisms was very well answered.

Question 5

(a) The majority of candidates identified pH 1 as the pH value of a strong acid.

(b) Candidates that gained marks for this question usually identified that dilute hydrochloric acid is a donor and aqueous sodium hydroxide is an acceptor but were unable to identify that they were a proton donor and a proton acceptor respectively.

(c) (i) The majority of candidates were able to write a symbol equation using the information given in the question, but a few found it more challenging to balance the symbol equation. A few candidates missed the arrow between the reactants and products.

(ii) The test for carbon dioxide using lime water and giving a positive result of a white precipitate was well known by candidates.

(d) Candidates found this question about calculating the number of moles of sulfuric acid and the number of moles of copper oxide to determine the limiting reactant in the reaction challenging. Many candidates only calculated the relative formula mass of sulphuric acid and copper oxide and then compared these answers giving copper oxide being the limiting reactant as it had a smaller value. Other candidates only calculated the number of moles of sulfuric acid and the number of moles of copper oxide and then just gave the numerical value of 0.02 or the difference between 0.025 and 0.02 on the answer line.

Question 6

(a) (i) Many candidates stated the expression speed = distance / time and then rearranged this expression to correctly calculate the maximum distance a bee can travel in 60 seconds. A few candidates did not rearrange the expression correctly and attempted to calculate the distance by dividing the speed by the time.

(ii) Many candidates stated the expression kinetic energy = $\frac{1}{2} \times \text{mass} \times \text{velocity}^2$ to calculate the kinetic energy of the bee. The mass of the bee was given as 0.20 g in the question and many candidates did not convert this mass into 0.00020 kg before substituting the numerical values into the expression.

(b) The majority of candidates gained a mark for stating that a difference between visible light and ultraviolet light was the wavelength or the frequency. A few candidates incorrectly gave the wavelength of visible light as being less than the wavelength of ultraviolet light. The similarity between visible light and ultraviolet light was more challenging. A few candidates gave the answer that they are both transverse waves or both travel at the same speed, but many candidates thought that both visible light and ultraviolet light are visible to humans.

(c) This question about how the bee becomes positively charged as it travels through the air was challenging to many candidates. Incorrect ideas included the bee collecting positively charged pollen which makes it positively charged, the bee leaving the negative charge on the flower, the bee having more energy and so more charge, positive electrons moving onto the bee from the flower and protons moving from the air to the bee. Candidates that mentioned electrons moving from the bee to the air also usually mentioned that this was due to friction between the bee and the air as the bee was moving through the air.

(d) Many candidates did not attempt this question. Some candidates did not describe how Brownian motion provides evidence for the kinetic molecular model of matter but just described what happens to pollen when suspended in water. Many answers given by candidates were just simple descriptions about pollen moving on the surface of water. Other candidates confused Brownian motion with diffusion or wrote about the increase in the movement and kinetic energy of particles when temperature increases or an increase in the frequency of successful collisions between particles.

Question 7

(a) The majority of candidates identified the optimum temperature as 25 °C, amylase particles gain kinetic energy and at temperatures above 75 °C all the amylase has become denatured. Fewer candidates identified the substrate as starch, the product as simpler sugars and the active site having changed in shape.

(b) The majority of candidates gave the answer of the pancreas for one part of the alimentary canal that secretes amylase. Another part of the alimentary canal that secretes amylase was not well known with vague answers such as the mouth, the stomach and oesophagus seen.

(c) (i) Most candidates identified carbon, hydrogen and oxygen as the chemical elements present in all proteins but often missed out nitrogen. Amino acid was a common incorrect response.

(ii) Candidates usually gave the name of the test as Biuret but there were a few candidates who gave the answer burette or Benedict's test.

Question 8

(a) Most candidates gave the answer D and often put a ring around the boiling point being –183 °C, showing that they had understood that oxygen is a gas at room temperature.

(b) (i) Many candidates gave clear ordered steps in the calculation of the volume occupied by 224 g of oxygen gas. Some candidates gave the relative molecular mass, M_r, for oxygen as O = 16 rather than O_2 = 32 in the calculation and then calculating the moles of O_2 as 14 rather than 7. The final answer of 336 gaining these candidates just 2 marks rather than 3 marks.

(ii) The majority of candidates described the property of iron when chromium is added as not rusting or being more resistant to rusting. A few candidates incorrectly described various changes in melting points and boiling points because of the change in bonding between the iron and chromium.

(c) Most candidates gained one mark for drawing one dot and one cross in one of the overlapping circles between the H and the N. The completion of the whole diagram was more challenging with many candidates adding extra dots and crosses or forgetting to complete the electronic structure with eight electrons in total.

(d) This question required candidates to explain why graphite is used as an electrical conductor, but diamond is not. Many candidates only described general differences between the structure of graphite and diamond such as graphite is soft, metallic and can be used as a lubricant, and diamond as hard, transparent and used to make tools and jewellery rather than answer the questions about graphite being used as an electrical conductor. Most candidates gained just one mark for stating that graphite has electrons that can move and diamond does not have electrons that can move.

Question 9

(a) (i) Candidates found this question about explaining why the peak at X was different to the peak at Y very challenging. Few candidates explained that as the magnet is falling it is increasing in speed and that the peaks were caused by the South pole and then the North pole of the magnet passing through the coil of wire.

(ii) Most candidates sketched the data to show that both peaks would be smaller but very few candidates realised that the shape of the graph would be the same and that the line would cross the *x*-axis at the same point.

(b) Candidates usually ticked that potential difference is equal to work done per unit charge and relates to the energy transferred by a circuit component. Fewer candidates ticked that electromotive force is equal to work done per unit charge and relates to the energy supplied by the source.

(c) The majority of candidates gained one mark for understanding that the forces between atoms are strong, that this allows the atoms to vibrate but keeps the atoms in a fixed position. Fewer candidates appreciated that in solids the arrangement of atom is regular or ordered or in a lattice. Many candidates gave answers such as the arrangement being small, arranged or random.

(d) Many candidates gave answers that included atoms vibrating and that these vibrations are passed onto the next atom. Fewer candidates gave answers that included the transfer of free electrons.

Question 10

(a) (i) In this question candidates were expected to compare photograph A taken in 1985 with photograph B taken in 2000 to conclude that there was a decrease in areas of forest in photograph B. Then candidates needed to explain why this decrease affected the concentration of carbon dioxide in the atmosphere. Most candidates gained one mark for stating that there would be an increase in the carbon dioxide in the atmosphere. However, only a few candidates linked this increase in carbon dioxide to a reduction in photosynthesis.

(ii) The majority of candidates were able to give several effects of a decrease in the areas of forest on animal species in the area. These usually included migration, the habitat being destroyed and lack of suitable food sources.

(b) Many candidates did not give a complete definition of an ecosystem as a unit containing all of the organisms and their environment interacting together in a given area. These candidates did not include the idea of the environment or of the organisms interacting together.

(c) Many candidates stated that the Sun is the principal source of energy in the ecosystem, but some candidates only mentioned that light is involved. Other candidates thought that the principal source of energy are the green plants or producers.

(d) The majority of candidates were able to state one advantage of asexual reproduction and this was usually that asexual reproduction is faster than sexual reproduction or that asexual reproduction is still possible if the plant is isolated. Fewer candidates were able to give a second advantage of asexual reproduction. The idea that favourable traits are kept was not well understood.

Question 11

(a) (i) Most candidates gave the answer of bromine, but a significant number of candidates gave the answers of bromide, oxygen or lead.

(ii) Many candidates gave answers in terms of electron transfer rather than the idea that ions are able to move.

(b) Many candidates did not attempt to construct the ionic half-equation for the formation of copper. Candidates that attempted to construct the ionic half-equation usually did not give the correct notation for the two electrons as $2e^-$ or tried to include $CuSO_4$ or C in their answer.

(c) (i) Many candidates did not suggest the change in mass of the cathode after the electrolysis. Those candidates that did suggest a value usually gave the answers of 0.0 or –0.62.

(ii) Candidates found this question about explaining why the anode loses mass very challenging. Many candidates wrote about the anode oxidising, copper reacting with sulfate and the anode losing oxygen. Few candidates understood that copper atoms become copper ions and that these copper ions move into solution.

Question 12

(a) The majority of candidates gave the relationship of $n = \sin i / \sin r$ but many candidates then did not use this relationship correctly to calculate the refractive index of the glass block. These candidates just divided 53 by 31 to give the answer of 1.71°.

(b) (i) Many candidates gave the answer as 4.8 and did not include the 10^{-7} from the label on the graph as part of their answer.

(ii) The majority of candidates were able to describe how Fig. 12.2 shows that red light travels through glass faster than violet light.

(c) The majority of candidates first calculated the volume of the glass block using the measurements given in Fig. 12.3 and then used this volume together with the density of glass to calculate the mass.

CO-ORDINATED SCIENCES

Paper 0973/61
Alternative to Practical

Key messages

Candidates were generally well prepared for this examination and were familiar with several experimental techniques.

Interpreting and evaluating experiments proved challenging.

It is advisable for candidates to read the questions carefully to ensure they have answered all of what is being asked, this will help ensure that numerical answers are given to an appropriate number of significant figures and that written responses cover all aspects of the question, this was particularly evident in the planning question.

General comments

Candidates generally demonstrated good understanding of basic practical knowledge and techniques. The standard of graph drawing was quite good although candidates need to remember that axes need to be labelled with quantity and unit and to read instructions carefully before drawing lines of best fit.

Undertaking practical work helps the candidates to interpret and evaluate experimental methods and results and also to describe methods such as those required by the planning question.

Explaining an answer requires more detail than stating an answer.

Candidates had sufficient time to complete the paper.

Comments on specific questions

Question 1

Testing nutrient content of milk and rice.

(a) (i) Most candidates drew a table with columns and rows clearly indicating food and testing reagent. Some did not include the testing reagents. A small number omitted the question.

(ii) Final positive colours were quite well known, starting colours were much less well known. Many candidates put positive and negative or tick and cross into the table rather than the colours observed or put colours without relating them to the testing reagents. A significant number omitted the question.

(iii) Nutrients were well known. Incorrect responses included carbohydrate and sugar for iodine solution and fat for biuret solution.

(b) (i) Candidates found this challenging. Whilst many appreciated it released the starch from the cells they did not discuss the starch going into the water so that it could be tested. Many thought it was to clean, soften or cook the rice.

(ii) Candidates found this very difficult and most repeated the stem of the question. Most able candidates appreciated that there is only one colour possible with iodine for a positive test. A significant number omitted the question.

(iii) Candidates found this very difficult with few discussing the colour of the milk masking the colour of the test. Incorrect responses included: they are not miscible, this is a not a fat test, ethanol does not work, milk does not contain fat and fat does not dissolve. A significant number omitted the question.

Question 2

Biological drawing.

(a) The majority of candidates drew a large, detailed diagram of the Euglena. Some drew outlines which were sketchy with multiple feathery lines and gaps, a small number were too small or did not include any internal detail.

(b) (i) Many candidates measured the length correctly, the most common error was to give the value in cm rather than mm. Other common responses included 600, 0.6 and 0.06.

(ii) Those that drew the line usually measured it correctly but many either did not draw a line and so the measurement could not gain credit or drew the line outside the euglena but a different length to that of the cell.

(iii) Many candidates calculated their value correctly. A small number inverted the division. Many did not give their answer to two significant figures and rounding was an issue for a significant number of candidates.

(c) Most candidates gained some credit with many identifying two differences and one similarity. Non-creditworthy responses included cell wall, vacuole, one has a nucleus and the other does not, one has one flagellum and the other has two, thick and thin walls, one has chloroplasts, one has no internal structures for the differences. For the similarity many repeated the stem of the question i.e. they are both one cell.

Question 3

Neutralisation.

(a) (i) The majority of candidates read the thermometers correctly. The most common error was recording the temperature at 4 minutes as 29 thus not following the pattern in the table where all temperatures were given to one decimal place. Other incorrect responses included 33, 30.5, 35.5 for 33.5 and 29.5 for 29.0.

(ii) Many candidates named a suitable piece of volumetric equipment. Incorrect responses included syringe, beaker and conical flask. Where a pipette is chosen candidates need to be more precise and name a graduated or volumetric pipette.

(b) (i) Candidates who followed the instructions were able to construct the axes and plot the points correctly. Some reversed the axes and a significant number omitted the label and/or the unit on the axes, many giving C°. Many started the temperature axis from 0 °C and so their points did not cover at least half of the grid. Some candidates did not use a linear scale. Plotting of the points was generally good except where scales were awkward and required the use of a calculator.

(ii) More able candidates followed the instructions and drew the two lines and extrapolated them to 2.0 minutes. Many candidates drew one line often as a curve. A significant number omitted the question.

(iii) Those candidates who drew the two lines correctly usually read the values from the graph correctly. For those that did not draw the lines many used the values from the table. A significant number omitted the question.

(iv) The majority of candidates subtracted the two values correctly. A significant number omitted the question.

(c) The majority of candidates calculate the value of Q correctly. A significant number omitted the question.

(d) Candidates found this very difficult. Changing the beaker to metal or glass or reducing the temperature were common incorrect responses. A significant number omitted the question.

(e) Whilst many candidates appreciated that the temperature would decrease few quoted room temperature or explained why the temperature decreased. Many thought the temperature would decrease to 0 °C. A significant number omitted the question.

Question 4

Formation of silver chloride.

(a) (i) Many candidates measured the height correctly. 1.3 and 15 were common incorrect responses. A small number omitted the question.

(ii) Many candidates described the relationship correctly. The most common error was not to use the variables in the question. A significant number omitted the question.

(iii) Candidates found this very difficult. Fair test and accuracy of results were the most common non-creditworthy responses. A significant number omitted the question.

(b) Candidates found this drawing very difficult. Frequently the filter funnel was either missing or had no stem, the filter paper had a hole at the base or was laid flat over a beaker and there were no labels. A large number omitted the question.

(c) Candidates found this very difficult with few correct answers seen. The information needed was in the question stem at the top of page 10. White. cloudy and colourless were popular responses with few mentioning silver.

Question 5

Resistance.

(a) The majority of candidates knew the symbol for a voltmeter although a number drew a line through it. Many connected the meter in series rather than in parallel. A significant number omitted the question.

(b) The majority of candidates read the voltage correctly, 2.6 and 2.9 were common incorrect responses. Reading the ammeter proved to be much more difficult, 0.31, 0.3, 0.25, and 0.16 were common incorrect responses.

(c) (i) Whilst many calculated the value of resistance correctly, far fewer recorded the answer to 2 significant figures to match the other values in the table.

(ii) The unit of resistance was well known. Popular answers included N and J. A significant number omitted the question.

(d) Candidates found this very challenging. Common incorrect responses included to stop the current, to not be electrocuted and to reset the meters.

(e) (i) Candidates found this difficult. Many thought the other lamp would shine brighter, V and I would increase, the energy would increase or the power would increase. A small number omitted the question.

(ii) Candidates found this very difficult with few correct answers seen and many omitting the question. Opening or closing the switch were common responses. Few tested each lamp individually.

(f) Candidates found this difficult. Circuit 3 was common with the reason being parallel circuit, circuit 1 was quite common with the reason being it has less power.

(g) Candidates found this extremely difficult with few correct answers seen and many omitting the question. It was expected that there would be 2 calculations, the first either multiplying the

resistance of circuit 2 by 2 or halving the resistance of circuit 1. The second being a 10 per cent calculation of one of these values and a comparison to see if they were within 10 per cent or the ratio of these values and a comparison. Most did not do any calculations but simply stated that the values either were or were not within 10 per cent which was not creditworthy.

(h) The arrangement of the lamps in series and in parallel was well done by the majority of candidates. A few did not use three lamps or drew lines through the lamp symbol. A significant number omitted the question.

Question 6

Planning question.

Candidates found this planning question very difficult. Many did not read the question carefully and so described an experiment that did not enable the aim of the experiment to be investigated. Many described a Hooke's Law experiment measuring extension and some described a pendulum experiment. Consequently, a significant number did not give an answer which was creditworthy in any aspect or omitted the question.

The whole range of marks was seen, few candidates however gave detailed answers gaining full or almost full credit.

A significant number did not name the apparatus they were using, measuring length with no ruler or measuring diameter with no vernier or micrometer. Few repeated with samples of the same wire or then repeated for wires of different materials.

Safety measures were not well known.

Some candidates drew a results table, few contained units.

Control variables were not well known, many used different lengths of different wires.

Candidates continue to find processing results and drawing conclusions challenging. Where repeats have been undertaken, averaging is insufficient – the reason for averaging needs to be explained.

Citing a conclusion from previous knowledge or simply looking for a pattern in the results is insufficient. The use of the results to formulate a conclusion for the details of their investigation is required. For example, look to see when the material of the wire is changed does the mass required to break the wire increase, decrease or stay the same which means there is no relationship. A graph for this experiment was most likely a bar chart or a histogram.