CO-ORDINATED SCIENCES

Paper 0973/11
Multiple Choice (Core)

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

General comments

Candidates performed very well on **Questions 1**, **4**, **23**, **28** and **30**. **Questions 3**, **6**, **8**, **10**, **15**, **17**, **19**, **33**, **35** and **36** proved the most difficult for candidates.

Comments on specific questions

Question 5

This question investigates the necessity of light and carbon dioxide for photosynthesis. All options were frequently selected suggesting that candidates were unsure of the correct answer. This could either be due to a lack of knowledge of photosynthesis, or unfamiliarity with the iodine test.

Question 6

There were a significant number of incorrect answers on this question about the functions of different parts of the digestive system. Most successfully identified the gall bladder's function of bile storage, but many thought that the pancreas absorbs water.

Question 7

Candidates were divided on whether evaporation during transpiration occurs from the surface of the mesophyll cells or from the air spaces through the stomata.

Question 11

Candidates realised that using a homozygous dominant parent to produce homozygous recessive offspring would not work but were uncertain as to whether one parent could be heterozygous.

Question 13

A significant proportion of candidates labelled the line for photosynthesis as respiration. Taken with **Question 5** this suggests a lack of understanding of photosynthesis and the relationship between photosynthesis and respiration.

Question 15

Candidates chose the incorrect option **B** more often than the correct option **C**. They are expected to be able to identify physical and chemical changes and understand the differences between them.

Question 16

There was evidence that many candidates had guessed at the answer. Candidates are expected to be able to interpret and balance symbol equations.

Question 17

There was evidence that many candidates had guessed at the answer. During the electrolysis of the ionic compound, dilute sulfuric acid, oxygen is formed at the anode and hydrogen is formed at the cathode.

Question 19

Strong candidates deduced that an increased particle size of the solid decreases the rate of a reaction but does not change the amount of product formed.

Question 20

There was evidence that many candidates were unfamiliar with flame tests. Candidates should be able to describe and use flame tests to identify lithium, sodium, potassium and copper(II) cations.

Question 23

Candidates understood how to deduce the order of reactivity for metals from a set of experimental results and correctly selected option **B**.

Question 24

Candidates chose the incorrect option **C** more often than the correct option **D**. Candidates are expected to describe the use of carbon in the extraction of some metals from their ores and know that this process is reduction.

Question 26

Candidates chose the incorrect option **A** more often than the correct option **D**. Limestone, calcium carbonate, is used to treat acidic soils.

Question 27

Many candidates chose the incorrect option, **B**. Ethanol may be formed by fermentation of sugar and by reaction between ethene and steam**.**

Question 29

Many candidates could not identify option **D** as the correct answer, this being the only one with no resultant force acting.

Question 33

This question on melting and boiling was poorly understood. The majority of candidates believed that melting involves an increase in temperature and boiling a decrease, leading them to select the incorrect option **C**. Many thought the opposite. Very few knew that there is no temperature change involved in either process.

Question 34

It was widely known that an inverted image is produced, but a significant number believed the image to be enlarged.

Question 35

The first three options were all popular choices suggesting that candidates were unfamiliar with sound. **C** was the correct option.

Question 36

The topic here was electrostatic charging. Although most candidates were aware that electron transfer is involved, a large proportion thought that electrons moved from the cloth to the rod rather than the other way round. A significant number of candidates believed that protons move onto the rod.

Question 37

The most common mistake was to think that lamps in a lighting circuit are connected in series.

Question 38

This question on fuses involved using Ohm's law and was found demanding by most candidates. Many calculated the current by dividing the resistance by the voltage, leading them to choose the incorrect option **C**.

Question 40

Many candidates selected the incorrect option, **B**. This was due to candidates choosing half of the time range shown on the graph (i.e., half of 40 s) rather than the time for the activity to decrease by half.

CO-ORDINATED SCIENCES

Paper 0973/12
Multiple Choice (Core)

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

CO-ORDINATED SCIENCES

Paper 0973/21
Multiple Choice (Extended)

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

General comments

Candidates performed very well on **Questions 1**, **2**, **4**, **5**, **8**, **21**, **28** and **30**. **Questions 7**, **14**, **27**, **32** and **36** proved the most difficult for candidates.

Comments on specific questions

Question 7

Candidates were divided on whether evaporation during transpiration occurs from the surface of the mesophyll cells or from the air spaces through the stomata.

Question 14

There was evidence that some candidates confused this question with the separation of a dissolved solid from a solution. Others appear not to have realised that evaporation alone, whilst it separates a liquid from a solution, does not result in obtaining the pure liquid.

Question 26

The majority of candidates selected the correct option **A**. Candidates should be able to describe the properties of molecules within a fraction obtained from petroleum, and consequently deduce that alkanes containing more carbon atoms in their chain are less volatile and so evaporate more slowly at the same temperature.

Question 27

Although the correct answer, option **D**, was chosen most often, there is evidence to suggest that some of the more able candidates chose the incorrect option **A**. They are expected to be able to deduce the structure of the polymer product from a given alkene and *vice versa*.

Question 29

This question was generally well answered, but a small proportion of candidates calculated acceleration by dividing mass by resultant force, arriving at the incorrect option **B**.

Question 30

The most common error here was to overlook the fact that kinetic energy depends on the square of the speed, therefore incorrectly arriving at option **C**.

Question 32

This question on melting and boiling was poorly understood. The majority of candidates believed that melting involves an increase in temperature and boiling a decrease, leading them to select the incorrect option **C**. Many thought the opposite. Very few knew that there is no temperature change involved in either process.

Question 36

The topic here was factors affecting the resistance of a wire. Option **B** was a more popular choice than the correct option **D**. Candidates making this mistake probably believed that halving the cross-sectional area would have the opposite effect to increasing the length, giving an overall effect of doubling the original resistance.

Question 38

In this question on the use of transformers in electricity distribution a significant proportion of candidates thought that both the current and the efficiency increase, not appreciating that increasing the voltage involves a corresponding decrease in current for a fixed quantity of power.

CO-ORDINATED SCIENCES

Paper 0973/22
Multiple Choice (Extended)

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

CO-ORDINATED SCIENCES

Paper 0973/31
Theory (Core)

Key message

Some candidates missed available marks due to their responses not answering the question completely. In these cases, candidates should be reminded to read the stimulus material and each question carefully and complete all the instructions contained within the question.

Any formula quoted should be in a standard form and use recognisable symbols. Formulae consisting of units should be avoided. Similarly, formulae consisting of a mixture of words, symbols and units should also be avoided.

General comments

A good standard of scientific knowledge was displayed by many candidates. Some candidates should be congratulated for their clear and accurate responses. Calculations were often done well with working shown.

Comments on specific questions

Question 1

(a) Almost every candidate gained full marks on this question.

(b) (i) Many candidates correctly labelled a ventricle. Almost every other part of the heart was selected by other candidates.

(ii) Many candidates correctly suggested that the function of part **Y** (valve) is to ensure a one-way flow of blood.

(iii) The septum was not well known. The aorta or vena cava were popular incorrect answers.

(iv) Muscle was well known as the type of tissue that the heart wall is made from.

(v) Pumping blood was well known as the function of the heart.

(c) Pulmonary artery or pulmonary vein were sometimes identified as one of the main blood vessels to or from the lungs. Renal artery or renal vein were rarely identified for the kidney. Many candidates just stated an unqualified artery or vein.

Question 2

(a) Coal was often correctly suggested as a fossil fuel. Natural gas was less frequently suggested. An unqualified gas was not accepted. Some candidates suggested oil or crude oil but petroleum had already been mentioned in the question.

(b) All three answers were well known although few candidates gained full marks. Bitumen, instead of naphtha, was a common error for the third gap.

(c) (i) Most candidates correctly stated that there are two elements in one molecule of octane. Twenty-six was sometimes suggested.

(ii) Most candidates correctly stated that there are 26 atoms in one molecule of octane. Eight and eighteen were sometimes suggested

(iii) Exothermic was correctly suggested by many candidates, with endothermic also being popular.

(iv) The limewater test for carbon dioxide was well known. A few candidates described the test for hydrogen gas.

Question 3

(a) (i) Some candidates knew that line **XY** is the normal. A common incorrect answer was line of reflection.

(ii) Many different angles were suggested as the angle of incidence. Some candidates labelled the incident ray.

(iii) 40° was correctly stated by many candidates. Popular incorrect answers included 50°, 80° and 140°.

(b) (i) More candidates incorrectly divided resistance by current than correctly multiplied resistance by current.

(ii) The correct answer of 4 Ω was far less popular than 8 Ω or 16 Ω. Very few candidates were able to explain their answer.

(iii) The lamp and switch were usually correctly identified. Battery was often suggested for the cell and an unqualified resistor for the variable resistor.

(c) Most candidates used an incorrect formula and divided the force by the distance. Some candidates omitted to convert the distance from centimetres to metres.

Question 4

(a) (i) Heterozygous for the description of the genotype and **rr** for the genotype were often correctly suggested.

(ii) This question was well answered.

(iii) A ratio of 3:1 was correctly suggested by many candidates.

(b) Ovule and pollen were popular and correct answers.

(c) Egg or ovum were often suggested. Ovary was sometimes suggested incorrectly.

(d) This question was not well answered. Some candidates were able to correctly deduce that a chromosome was being defined in the first row. Very few candidates knew the definition of a gene. A few candidates knew that an allele was a version of a gene.

Question 5

(a) Most candidates were able to state at least one physical property of metals.

(b) (i) 950 kg was frequently given as the mass of the aluminium in the alloy.

(ii) Some correct properties of aluminium alloys were correctly stated.

(c) (i) Bauxite was not well known as the ore of aluminium. Iron or iron ore were often incorrectly suggested.

(ii) Few candidates were able to define electrolysis.

(iii) Iron and copper were popular correct answers to this question.

(d) (i) Many candidates confused conserved with preserved and omitted to mention anything about aluminium ore being a finite resource.

(ii) Recycling was rarely mentioned.

Question 6

(a) (i) Infrared was often misplaced one place to the left or right.

(ii) X-rays and γ-radiation were frequently linked correctly to diagnosing broken bones and treating cancer respectively.

(b) (i) The correct order was α then β then γ. The reverse order was popular, but most other combinations were also suggested.

(ii) Mutation and cancer were both commonly suggested correct answers.

(c) (i) Many candidates found the definition of an isotope difficult.

(ii) Few candidates were able to complete this half-life calculation. Sixteen days was two half-lives and so the initial mass of iodine-131 was 0.2 g. Many candidates suggested 0.1 g.

(d) Some candidates were able to state the average range of audible frequencies but few were able to correctly compare this range with the range of the hospital patient.

(e) Few candidates knew that the form of energy stored in petroleum was chemical potential energy. Kinetic energy was a common correct answer for the second space.

Question 7

(a) This question was well answered. Some drew four lines and could not be awarded full marks.

(b) Some candidates completed the left-hand side of the equation correctly and some completed the right-hand side of the equation correctly. Fewer completed the whole equation correctly.

(c) Cell membrane and cytoplasm were the most popular correct responses. However, many candidates only identified one of these and so scored no marks.

(d) Zygote was quite well known. Fetus was a common incorrect response.

(e) Nucleus was well known.

Question 8

(a) (i) Most candidates correctly identified chlorine as the gas.

(ii) Many candidates correctly identified carbon monoxide. Some suggested methane.

(iii) Some candidates correctly identified nitrogen. Many others suggested oxygen.

(iv) Methane was well known as a greenhouse gas.

(v) Helium was well known as a noble gas. Nitrogen was sometimes incorrectly suggested.

(b) (i) Many candidates identified the gas collected as carbon dioxide. Hydrogen was a common incorrect suggestion.

(ii) Some candidates answered in terms of acidity rather than pH change. Few candidates explained that carbon dioxide is acidic or that it is a non-metal oxide.

(iii) Most candidates were able to state at least one way of increasing the rate of the reaction. A common error was to suggest an unqualified ‘temperature’ rather than increase the temperature (of the acid).

Question 9

(a) (i) Few were able to explain that forces **K** and **M** needed to be equal and opposite because there would be no resultant force and consequently the surfboard would move at constant speed.

(ii) Gravitational (force) or weight were often correctly suggested.

(iii) The two quantities needed to calculate the work done by the wind were not well known. The weight of the wind surfer was often suggested.

(b) (i) Many candidates doubled the amplitude when labelling the wave.

(ii) Some candidates were able to give a general definition of frequency but few were able to explain the significance of the 0.1 Hz. A suitable explanation would be that one wave passes a fixed point every ten seconds

(c) (i) The idea that the remaining water molecules would be less energetic was well known.

(ii) The idea that the temperature of the sea water would decrease was well known.

(d) Many candidates correctly calculated the density of sea water as 1024 kg / m^3. Some candidates were confused by the volume of the sea water being quoted as 5.0 m^3. They then used 125 (i.e. 5 × 5 × 5) as the volume.

Question 10

(a) (i) Almost all candidates correctly determined the total decrease in mass as 57 g.

(ii) The decrease in mass will be less than in the first investigation was the correct prediction identified by many candidates. All the other predictions were suggested by a few candidates.

(b) Evaporation was well known as the process by which water is lost from the surfaces of the mesophyll cells during transpiration. Respiration and osmosis were suggested by a few candidates.

(c) Stomata was the correct response. Xylem and leaf were common incorrect responses.

(d) Many candidates gained one mark but few gained more than one mark. A correct reference to xylem was the most popular marking point. There were very few references to root cortex cells.

(e) (i) Few candidates gave a suitable response. The popular response was growth.

(ii) Light and carbon dioxide were frequently given as requirements of photosynthesis.

Question 11

(a) (i) Most candidates did not know what electronic structure meant. Popular incorrect answers were 19, 39 and one outer shell electron.

(ii) There were many answers referring to one outer shell electron. But few candidates linked the number of outer shell electrons with group number.

(iii) The correct numbers were 19 electrons and 20 neutrons. These were the most common numbers suggested, although few candidates gained both marks.

(iv) Very few candidates gained both marks.

(b) Few candidates gained both marks. A common error was to state that a compound contains two or more elements but to omit chemically combined from the definition. Another common error was to refer to a compound as a mixture of elements.

(c) This was well answered by many candidates.

Question 12

(a) Many candidates were able to suggest that the area of the normal wheels was less, but few candidates stated that the pressure would therefore be greater.

(b) Most candidates identified diagram **Z** as the gas but fewer suggested that the diagram showed the molecules separated from each other.

(c) (i) Kinetic energy was usually identified as the form of energy gained as the tractor accelerates.

(ii) Gravitational potential energy was usually identified as the form of energy gained as the tractor moves up the hill.

(d) Most candidates correctly determined the constant speed as 0.5 m / s.

CO-ORDINATED SCIENCES

Paper 0973/32
Theory (Core)

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

CO-ORDINATED SCIENCES

Paper 0973/41
Theory (Extended)

Key messages

Candidates are reminded to check whether questions relating to graphs are asking for a description, an explanation, or both, of the data. This was particularly important in **Questions 9(b)** and **10(c)(ii)**.

An important skill that candidates should practise is the conversion of units and rearrangement of formulae. When completing calculations, candidates should remember to state the formula used, show the working, express the value to an appropriate number of significant figures and include units.

It is particularly important for candidates to read questions carefully and use their knowledge to give a response to the context of the question. Some candidates gave scientifically accurate answers but they did not answer the question asked.

General comments

In general, candidates showed a good level of understanding of the syllabus content and were able to apply their knowledge to unfamiliar contexts. Most candidates were able to articulate their ideas well and give clear and concise responses. Candidates who were awarded high marks could explain the meaning of scientific terms using the wording in the syllabus.

Some areas of the syllabus were better known than others. Candidates should be reminded to revise all the material detailed in the syllabus. A useful tool is to use the syllabus as a revision guide and go through the syllabus ensuring that each learning objective has been covered.

Comments on specific questions

Question 1

(a) (i) Almost all candidates were able to correctly identify the sperm cell, however, fewer knew the name of the root hair cell. Common incorrect responses included animal cell and either root cell or hair cell.

(ii) Only some candidates correctly identified cell **A** as a ciliated cell, and a relatively small proportion were able to explain the adaptations in terms of moving cilia. Many candidates incorrectly identified the cilia as villi and gave a response in terms of improved absorption.

(iii) Many candidates were able to state a large surface area as an adaptation of a red blood cell. The term biconcave was not always seen, however, credit was still given where surface area was discussed. Other adaptations, such as no nucleus or the presence of haemoglobin, were also credited.

(b) The main components of blood were well known with a range of correct responses seen. A small number of candidates included red blood cells in their response.

(c) (i) This question asked candidates to explain the structure of artery walls. While most candidates could identify that this was because of the high blood pressure in arteries, few included details of the thick walls preventing bursting.

(ii) Most candidates were able to explain why veins have valves.

(iii) The majority of candidates were able to give either improved, easier or faster diffusion as a correct response. Some candidates correctly answered in terms of a shorter diffusion length, while responses in terms of gas exchange were less common.

Question 2

(a) The correct response of alkenes was commonly seen.

(b) While many candidates knew that the process by which ethene is made is called cracking, many incorrectly stated fractional distillation.

(c) (i) Candidates were required to include details of both the long chain shape of a polymer molecule and its nature in terms of either monomers or small molecules. Many candidates correctly referenced long chain molecules in their response, however, credit was not given for a statement relating to a long chain hydrocarbon.

(ii) Almost all candidates correctly drew the structures of chloroethene and poly(tetrafluoroethene).

(d) A relatively large number of candidates stated the correct formula for hydrogen. Some candidates included a full symbol equation in their response, for which full credit was given.

(e) Not all candidates could correctly describe what is meant by a saturated hydrocarbon. Many incorrect responses mentioned the water content of the molecule, showing little understanding of technical terminology.

(f) While some candidates could correctly draw this structure, many did not realise that the compound formed by the reaction would not contain a double bond.

Question 3

(a) (i) The majority of candidates were able to correctly calculate weight.

(ii) Most candidates could correctly apply the formula for work done to this context. A number of candidates did not recognise that the unit for work done is the Joule, with incorrect units including Newtons and Newtons per metre.

(b) (i) The vast majority of candidates could calculate the potential difference across the motor. Candidates are reminded that they must include full details of their workings for ‘show that’ questions.

(ii) Most candidates could correctly apply the formula to calculate resistance. Some candidates failed to recognise that they needed to use the potential difference across the motor, rather than the e.m.f. of the circuit.

Question 4

(a) (i) Almost all candidates used the key correctly to give an answer of 4.

(ii) While the majority of candidates gained marking points 1 and 4, many candidates did not realise that genotypes need to have both alleles included. Responses of t and T were commonly seen in the second and third sentences.

(iii) Some candidates correctly stated the probability as being 0%, however, many incorrect responses identified the probability as 100%.

(b) The majority of candidates were able to identify that mitosis produces nuclei with paired chromosomes, while fewer also indicated that the cells produced have diploid nuclei and that mitosis occurs after exact duplication of chromosomes. A small number of candidates selected the statements which related to meiosis.

(c) Some candidates were able to state that a human diploid cell contains 46 chromosomes, with commonly seen incorrect responses including 23 and 48.

(d) Most candidates were unable to state that a change in a gene or chromosome is a mutation, no other response was credited.

Question 5

(a) (i) This question required candidates to describe the numerical change in the pH value of an acid as alkali is added. Many candidates failed to gain a mark by describing that the acid was neutralised or became less acidic, rather than giving a quantitative description of the pH increasing.

(ii) Most candidates correctly stated the type of substance being produced as a salt. A small number tried to answer this question with the name of a specific compound.

(iii) Candidates were challenged by the question, with a very small number being able to correctly determine the formula of the salt produced and balance the equation. Many candidates did not appreciate that the sulfate ion will remain intact after the reaction, with compounds such as potassium sulfide and potassium oxide being included as products.

(iv) Not all candidates were able to state the formula of the ion present in acids, with incorrect responses often stating the formula of small molecules rather than an ion.

(b) Most candidates were able to correctly calculate the relative formula mass of ammonium sulfate.

(c) (i) This question required candidates to state the sources of hydrogen and give two conditions required for the Haber process. Most candidates were able to state all three conditions required, however, far fewer included accurate descriptions of the sources of the gases, with common incorrect responses stating that both gases are obtained from air.

(ii) Not all candidates were able to correctly complete this calculation. Where the correct answer was calculated, candidate's work was well structured and clear. Common mistakes included calculating the number of moles present in 51 kg of ammonium nitrate. A significant proportion of candidates did not know how to attempt this type of calculation.

Question 6

(a) (i) Most candidates were able to state that the source of energy for the tides is the Moon, with some candidates including additional information relating to the gravitational attraction of the Moon.

(ii) Many candidates failed to state the formula for kinetic energy. Amongst those candidates who could recall the formula for kinetic energy, some incorrectly rearranged the formula to determine the speed of the water flow.

(b) (i) A significant number of candidates failed to attempt this question. Of those that did attempt it, most correctly identified that the magnetic fields go from north to south.

(ii) This question required candidates to identify the slip rings and describe their use in a simple a.c. generator. Most candidates confused Fig. 6.2 with a motor and incorrectly stated that the labelled part was the split ring commutator and then described the production of an alternating current.

(iii) Most candidates recognised that the output from an a.c. generator will be sinusoidal in nature, however, some graphs were drawn very inaccurately showing a varying time period or amplitude. A small number of candidates sketched a graph with an increasing then constant output voltage.

(c) This question required candidates to recall the speed of light, and then use this value to calculate the frequency of the wave. While many candidates correctly stated the speed of light, many used the speed of water calculated in **6(a)(ii)**. These candidates were awarded error carried forward marks for this question. The formula for wave speed was generally well known and candidates were able to rearrange it to determine the frequency.

Question 7

(a) Stigma was commonly seen as a correct response to this question. However, a significant number of candidates were unable to identify this part of a flower. An incorrect response of anther was commonly seen.

(b) Most candidates correctly described the features of the pollen and flowers from an insect-pollinated flower, with common responses including spiky and sticky pollen alongside colourful petals. A minority of candidates answered in terms of the features of wind-pollinated flowers, which was not always made explicitly clear in the response.

(c) Most candidates could state the ovule or ovary as the location for fertilisation.

(d) A significant number of candidates were able to describe how asexual reproduction leads to a lack of genetic variation in a species, with some only giving vague responses relating to offspring being similar to their parents. A smaller number of candidates then went on to include details of either a difficulty in adapting to environment change or to the ease of disease spread.

(e) Many incorrect responses, including light, nutrients and unqualified descriptions of temperature were seen. Germination requires oxygen, water and a suitable temperature.

Question 8

(a) Most candidates were able to state the proton number for argon, and many could also give the electronic structure for magnesium.

(b) (i) The vast majority of candidates knew that isotopes have varying numbers of neutrons, while some answered in terms of nucleons, fewer included detail on the identical numbers of protons.

(ii) Some candidates related the chemical properties to the number of electrons in the outer shell of chlorine, however, many incorrectly linked the number of protons to the chemical properties, or gave vague, unqualified answers in terms of the number of electrons.

(c) Most candidates were able to explain that argon's low reactivity is caused by the full outer shell of electrons.

(d) Only the most able candidates were able to give a satisfactory description of metallic bonding. While some candidates mentioned a sea of electrons in their response, very few also included detail of the lattice of positive ions. The option to include a diagram to help with the description was not well utilised, with few candidates labelling what they did draw. A significant number of candidates answered in terms of ionic bonds forming between a metal and a non-metal.

(e) Some candidates gave the correct formula for magnesium chloride.

(f) Candidates found this equation less challenging than **5(a)(iii)**, however, there were still a significant number of candidates who could not determine the formula of the salt being formed. Incorrect responses included fluorine and chlorine bonding together and incorrect ratios used in sodium fluoride. Candidates who correctly determined the formula of the product often then went on to correctly balance the equation.

Question 9

(a) Candidates were able to describe the motion of the smoke particles as being caused by collisions with other particles, however, many failed to include that these particles are light, fast moving air particles. Some candidates simply gave a description of the random movement of particles in a gas rather than describing Brownian motion.

(b) This question proved challenging for candidates. There was a requirement for candidates to use the shape of the graph to describe and explain how the resistance of the filament lamp changes as potential difference increases. Very few recognised that the resistance is equal to the reciprocal of the gradient. Many candidates simply described the relationship between current and potential difference without any mention of resistance, while others were able to state that the resistance increases, but without any explanation of why this happens. Only a small number of candidates related the change in resistance to the increasing temperature of the filament.

(c) (i) Many candidates were able to correctly draw two accurate rays on the diagram. Fewer drew the inverted image required to gain full marks. Some candidates incorrectly drew an undeviating ray through the principal focus closest to the object while there was a significant proportion of candidates who appeared not to know how to draw any meaningful rays.

(ii) The refractive index was calculated correctly by many candidates. Incorrect responses of 22 and 1.79 were commonly seen where the formula was not known.

Question 10

(a) Most candidates were able to identify the two involuntary actions.

(b) Most candidates stated the ability to respond to a stimulus as being sensitivity.

(c) (i) Most candidates could correctly use Fig. 10.1 to calculate the time taken for the blood glucose concentration to return to normal.

(ii) This question required candidates to explain the shape of the graph shown in Fig. 10.1. A significant proportion of candidates gave descriptions of the shape of the graph, often quoting specific data, but without any sort of explanation which did not earn any credit. Of the candidates that explained the graph, most included the release of insulin as part of their answer. Very few included anything about the pancreas detecting the increase in blood glucose concentration.

(iii) Only a small proportion of candidates could identify this type of response as negative feedback.

(d) The correct answers of adrenaline and glucagon were commonly seen, however, most candidates only included one of these answers. Commonly seen incorrect responses included insulin and glycogen as well as testosterone. At times, ambiguous spelling of glucagon made it difficult to distinguish from glycogen.

Question 11

(a) Almost all candidates were able to state that experiments 2 and 3 show that volume of acid does not affect the rate of reaction.

(b) This question required candidates to state how increasing temperature and concentration affect the rate of a reaction, and then give an explanation for each factor. The majority of candidates gained marks for stating that in both cases, the rate of reaction increases. Some candidates explained that increasing temperature increases the (kinetic) energy of the particles, while others simply stated that the particles move faster, both of these responses were credited. Very few candidates could give an explanation of why increasing concentration increases the rate of reaction, with many responses relating entirely to the rate of collisions rather than using ideas about particles as given in the stem of the question. Where candidates knew that a higher concentration of acid contains more particles, many failed to gain a mark, as they did not qualify their response with the idea of per unit volume.

(c) While some candidates were able to convert the concentration of hydrochloric acid from mol / dm^3 to g / dm^3, many failed to correctly calculate the relative formula mass, using only chlorine.

(d) This question proved challenging for candidates. Many incorrect responses stating that breaking bonds releases energy were seen. Some candidates were awarded two marks for explaining that bond making is exothermic while bond breaking is endothermic. Very few could then compare the energy taken in by the reaction to the energy given out to give a full explanation as to why the reaction is exothermic overall. Responses involving a comparison of the number of bonds broken and made were common.

Question 12

(a) (i) Most candidates correctly calculated the resultant force, however, a small number gave a final answer of 7.9 which was not given any credit.

(ii) Most candidates were able to describe how the rocket would move upwards, but few linked the upwards resultant force to an upwards acceleration.

(iii) Many candidates knew that the gravitational field strength decreases as the rocket moves away from Earth. Some responses simply stated that gravity decreases in space, which in this case was given credit. Very few candidates answered this question in terms of the decreasing mass of the rocket.

(b) A large proportion of candidates gained full marks for this challenging calculation. Most candidates were able to apply the formula for speed to calculate the total distance travelled, credit for this was given even where the unit conversion for time was missing or incorrect. Some candidates incorrectly used the formula for the area rather than the circumference of a circle to determine the radius of the orbit, and this was commonly followed by a subtraction of 2 000 km to obtain the final answer.

(c) (i) Some candidates correctly identified the ionising radiation types as alpha and beta but very few could explain that this was caused by the charge of the particles. Most incorrect responses tried to use the penetrating ability of the ionising radiations to explain their deflection.

(ii) Some candidates were able to use correct nuclide notion to determine the proton and mass numbers for the decay of iodine-131. A significant number of candidates were unable to state the notation for a beta particle, leading to incorrect responses.

CO-ORDINATED SCIENCES

Paper 0973/42
Theory (Extended)

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

CO-ORDINATED SCIENCES

Paper 0973/51
Practical Test

Key messages

It is advisable for candidates to read the questions carefully to ensure they have answered all aspects of the question, 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.

General comments

Candidates generally demonstrated good understanding of basic practical knowledge and techniques. The reading of the instruments was generally good. The standard of graph drawing was generally high although candidates need to remember that axes need to be labelled with quantity and unit and a line of best fit needs to be a single line.

Candidates found interpreting and evaluating experiments and recording precise observations very challenging.

Comments on specific questions

Question 1

(a) The majority of candidates drew a large clear detailed diagram of the leaf. Some outlines were sketchy with multiple feathery lines and gaps, very few were too small and almost all showed the required detail.

(b) (i) Most candidates gave an appropriate length to the nearest mm. A small number gave their value in cm or measured the width of the leaf.

(ii) Most candidates drew a line and measured it correctly. The most common error was not to draw the line and so the measurement could not gain credit. A small number measured the width.

(iii) Most candidates calculated their value correctly. A small number inverted the division. Rounding was a problem for a significant number of candidates.

(c) (i) Many candidates knew the testing reagents. Many gave sugar rather than reducing sugar or reversed the other two reagents.

(ii) Many candidates did this practical carefully and recorded their results accurately. Some contaminated the samples and had mixed results.

(iii) Most candidates interpreted their results correctly to name the nutrients present in leaf **B**.

Question 2

Candidates were generally quite well prepared for this style of question and many addressed the bullet points and gave a logical description of the investigation. Control variables were well known.

A diagram and a results table were not required, stronger candidates included both to illustrate their answer, and these often contained several of the marking points.

A significant number did not name the apparatus they were using, scale is insufficient for balance.

Many candidates thought the water would drip off the leaves into a container. Some put the plants into plastic bags to collect the condensation without appreciating that the wind on the outside of the bag was not the same as the wind on the leaves. Many used fans with different settings without using a plant with no wind, the task needed a comparison between wind and no wind.

Measuring the amount of something is too vague, the quantity being measured needs to be specified, in this experiment it was mass and/or volume.

Candidates 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. If a graph is to be drawn then the quantities on each axis need to be specified.

Question 3

(a) (i) Many candidates heated carefully and recorded all three masses to the same number of decimal places.

(ii) The best diagrams were large, drawn with a ruler and pencil and the apparatus labelled. Some omitted the gauze, the Bunsen burner or the crystals being heated.

(b) (i) Almost all candidates subtracted the values correctly. Some used the mass of the empty basin instead of the basin and powder after heating.

(ii) Almost all candidates divided the values correctly.

(iii) Almost all candidates subtracted the values correctly. Some candidates used the mass of the basin and hydrated crystals rather than the dry powder.

(iv) Most candidates divided the values correctly.

(v) Most candidates divided their values correctly. Many quoted their answer to several significant figures rather than just one which would denote the whole number of water molecules in the formula.

(c) Most candidates correctly described the addition of water. Crystallisation was also seen.

(d) Many candidates suggested repeating the values but few either averaged these repeats or used them to identify and exclude any anomalies. Using values to more significant figures or decimal places was a common incorrect response.

(e) Candidates found this challenging. Misreading the balance, rounding values and less water in the copper sulfate were all common responses.

Question 4

(a) Most candidates recorded the results to tests 1, 2 and 3 correctly. Test 4 often had a white precipitate and the test 5 flame colour was often red or lilac.

(b) Stronger candidates interpreted their results correctly and gave two appropriate ions. Some only gave the cation and chlorine was quite common.

Question 5

(a) (i) Many candidates recorded an appropriate measurement. Common incorrect responses included a value in mm or a value to the nearest cm.

(ii) Candidates found the diagram quite challenging. Many had the beaker sitting on top of the blocks rather than between them.

(iii) Most candidates recorded a suitable height for the beaker.

(b) Most candidates calculated the volume correctly from their values and many had measured carefully and so had a value within the expected range. It was common for the value to be too large.

(c) Almost all candidates recorded a volume and many had poured the water carefully so had a volume within the range expected. It was common for the value to be too large.

(d) Almost all candidates subtracted the values correctly. A small number reversed the numbers.

(e) (i) Stronger candidates appreciated the irregular nature of the beaker, usually the pouring spout, or discussed the blocks not being parallel. Misreading the measuring cylinder was a common response.

(ii) Many candidates appreciated that some of the water spilled or remained in the beaker. Not accurate and parallax were very common responses.

Question 6

(a) Most candidates recorded a value for current.

(b) Most candidates recorded all values for current and many gave values which were less than 1.00 A and increased down the table. Many either quoted the values to only one decimal place or gave some to one and some to two decimal places.

(c) Almost all candidates calculated the resistances correctly. A small number inverted the division.

(d) (i) The standard of graph drawing was generally good. Some candidates reversed the axes and a significant proportion omitted the labels and/or the units on the axes. Whilst many scales were linear some were awkward which often led to the incorrect plotting of points. A small number used a scale where the points did not cover at least half of the grid.

(ii) Many candidates drew a smooth curve close to all of the points. Some drew dot-to-dot lines, used a ruler between points, drew multiple lines or drew a straight line between the first and last points.

(e) Many candidates appreciated the increase in resistance, fewer described the non-linear nature of the curve. Proportional should be reserved for straight lines which pass through the origin.

CO-ORDINATED SCIENCES

Paper 0973/61
Alternative to Practical

Key messages

It is advisable for candidates to read the questions carefully to ensure they have answered all aspects of the question, 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.

General comments

Candidates generally demonstrated good understanding of basic practical knowledge and techniques. The standard of graph drawing was generally high although candidates need to remember that axes need to be labelled with quantity and unit and a line of best fit needs to be a single line.

Comments on specific questions

Question 1

(a) The majority of candidates drew a large clear detailed diagram of the leaf. Some outlines were sketchy with multiple feathery lines and gaps, very few were too small and almost all showed the required detail.

(b) (i) Most candidates measured the length correctly, the most common error was to give the value in cm rather than mm. A small number measured the width. 450, 45 and 40.5 were all common responses.

(ii) Most candidates drew a line and measured it correctly. The most common error was not to draw the line and so the measurement could not gain credit. A small number measured the width.

(iii) Most candidates calculated their value correctly. A small number inverted the division. Rounding was a problem for a significant number of candidates.

(c) (i) Most candidates knew the testing reagents. A small number reversed the answers, gave reducing sugar or amino acids for protein or carbohydrate for starch.

(ii) Colours of the testing reagents were well known. Yellow, orange, purple and colourless were common responses for biuret; brown, blue, green, white and yellow were common for iodine.

(iii) Candidates found this challenging. Stronger candidates appreciated that the green colour masks the colour of the test. Affecting the results was a common response that was too vague to gain credit. A significant number thought the leaf would carry on photosynthesising if the colour was not removed.

(iv) Candidates found the detail needed challenging. Many simply repeated the question stem or stated that no flames should be used without an explanation.

(v) The observation was quite well known. White was insufficient and a significant number gave precipitate or solution rather than emulsion. The best answer for this question is white emulsion, cloudy and milky are insufficient.

Question 2

Candidates were generally quite well prepared for this style of question and many addressed the bullet points and gave a logical description of the investigation. Control variables were well known.

A diagram and a results table were not required, stronger candidates included both to illustrate their answer, and these often contained several of the marking points.

A significant number did not name the apparatus they were using, scale is insufficient for balance.

Many candidates thought the water would drip off the leaves into a container. Some put the plants into plastic bags to collect the condensation without appreciating that the wind on the outside of the bag was not the same as the wind on the leaves. Many used fans with different settings without using a plant with no wind, the task needed a comparison between wind and no wind.

Measuring the amount of something is too vague, the quantity being measured needs to be specified, in this experiment it was mass and/or volume.

Candidates 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. If a graph is to be drawn, then the quantities on each axis need to be specified.

Question 3

(a) (i) Candidates found the diagram challenging. The best diagrams were large, drawn with a ruler and pencil and the apparatus labelled. The gauze was often missing or placed under the Bunsen burner. A beaker was often drawn instead of a basin. Some drew the Bunsen burner with an upwards arrow and labelled it, this is sufficient.

(ii) The majority of candidates interpreted the information in the question to elicit the colour seen. Stops bubbling, no water seen and powder formed were common non-creditworthy responses.

(b) Almost all candidates quoted the values to two decimal places. A small number truncated the values rather than rounding or used the three decimal place values from the readings.

(c) (i) Almost all candidates subtracted the values correctly.

(ii) Almost all candidates divided the values correctly. The most common error was 0.1 which has insufficient significant figures.

(iii) Almost all candidates subtracted the values correctly. Some candidates used the mass of the basin and hydrated crystals rather than the dry powder.

(iv) Most candidates divided the values correctly, many quote the value as 0.2 which has insufficient significant figures.

(v) Most candidates divided their values correctly, many quoted their answer to several significant figures rather than just one which would denote the whole number of water molecules in the formula.

(d) Many candidates suggested repeating the values but few either averaged these repeats or used them to identify and exclude any anomalies. Using values to more significant figures or decimal places was a common error.

(e) Candidates found this very challenging. Misreading the apparatus, rounding values, more copper sulfate used, less water in the copper sulfate and the copper sulfate expands and increases in mass were all common responses.

(f) Adding water was well known. Freezing and crystallisation were common incorrect responses.

Question 4

(a) Candidates needed to use the evidence in the table to elicit the test in each case which would allow one of the three unknowns to be identified by giving a different result to the test compared to the other two. Many candidates gained full credit. Some answers cited the reagents without giving the results for the test which allowed the identification. A significant number used tests which were not in the table and so not creditworthy, including bromine, litmus and universal indicator.

(b) Many candidates described the correct test. Omitting precipitate in the observation was very common.

Question 5

(a) Many candidates measured and recorded the diameter correctly.

(b) (i) Candidates found this challenging. The most common response was to make it accurate which is a repeat of the question stem. Stopping the beaker moving was also common.

(ii) Candidates found this quite challenging and many drew the arrow inside the beaker.

(c) Most candidates measured the height correctly. Some gave 72 or 7.0 cm.

(d) Most candidates calculated the volume correctly. Many candidates showed their working which allowed partial credit to be gained from an incorrect answer.

(e) The majority of candidates read the measuring cylinder correctly. Common incorrect responses included 116, 114.5, and 110.5 cm^3.

(f) Most candidates calculated the volume correctly.

(g) (i) Candidates found this challenging. Rounding, inaccurate measuring, parallax, thickness of the glass and moving water were common incorrect responses.

(ii) Stronger candidates gained credit. Parallax, inaccurate measuring cylinder and glass thickness were common incorrect responses.

Question 6

(a) Most candidates recorded the correct ammeter reading. A small number gave 0.12 A.

(b) Most candidates calculated the resistance correctly. The data in the table is to one decimal place and so the answer to the calculation needs to be given to one decimal place, 2.72 was a common incorrect response.

(c) (i) The standard of graph drawing was generally good. Some candidates reversed the axes and a significant proportion omitted the labels and/or the units on the axes. Whilst many scales were linear some were awkward which often led to the incorrect plotting of points. A small number used a scale where the points did not cover at least half of the grid.

(ii) Many candidates drew a smooth curve close to all of the points. Some drew dot-to-dot lines, used a ruler between points or drew multiple lines.

(iii) Many candidates read the value from the graph correctly. Stronger candidates calculated I from their value from the graph.

(d) Many candidates appreciated the increase in resistance, fewer described the non-linear nature of the curve. Proportional should be reserved for straight lines which pass through the origin.

(e) Many candidates recognised the component as a resistor with the more successful recognising it as a variable resistor. Fuse and thermistor were common incorrect responses.

CO-ORDINATED SCIENCES

Paper 0973/62
Alternative to Practical

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