CO-ORDINATED SCIENCES

Paper 0973/11
Multiple Choice (Core)

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

General comments

Candidates performed very well on **Question 29** and **37**. **Question 22**, **25**, **30**, **31**, **35** and **40** proved the most difficult for candidates.

Comments on specific questions

Question 1

Some candidates were confused about respiration. Some thought that it was the release of energy for body activities and some thought it was breathing to supply oxygen to cells. Candidates should ensure they can distinguish between gas exchange and respiration.

Question 6

Many candidates understood that the question described assimilation. However, some confused it with absorption and ingestion.

Question 8

The range of answers for the percentage of oxygen in expired air suggested that candidates, while generally believing it was less than inspired air, were unsure of how much less. Many candidates believed there was no oxygen in expired air.

Question 10

The majority of candidates correctly selected the oviduct as the site of fertilisation. A few candidates selected the ovary or the uterus.

Question 15

Candidates are expected to know that impurities reduce the melting point of a substance and, by extension, understand that the greater the amount of impurities, the greater the reduction in melting point.

Question 20

Many candidates incorrectly chose option **C,** rather than the correct option, **B**. Candidates are required to know that ammonia is a base, and that bases react with acids.

Question 21

Many candidates incorrectly chose option **C,** rather than the correct option, **B**. Candidates should know that lithium, a Group I metal, has a low density and so it floats on water. Although candidates may have seen magnesium reacting with water, they should understand that it only appears to float because the bubbles of gas that form, cause it to rise to the surface of the water.

Question 22

Candidates chose the incorrect options **B** and **C** more often than the correct option, **D**. Candidates are expected to understand that because carbon is a non-metal, it forms acidic oxides, not basic oxides.

Question 24

Candidates chose the incorrect option **B** more often than the correct option, **D**. The three essential elements required for plant growth are nitrogen, potassium and phosphorus. Only option D contained just one of these elements.

Question 25

Candidates chose the incorrect options **A** and **D** more often than the correct option, **C**. Candidates are expected to know that lime, calcium oxide, is made by the thermal decomposition of limestone, calcium carbonate. They should also understand that when basic oxides dissolve in water they form alkaline hydroxides, such as calcium hydroxide. They are expected to know that calcium sulfate is the product of the neutralisation of sulfuric acid by calcium oxide.

Question 27

There was evidence that a large number of candidates were uncertain about this question. Many candidates chose the incorrect option **D** rather than the correct option, **C**. Candidates should be able to describe the formation of poly(ethene) from ethene monomer units.

Question 30

In this question, candidates needed to know the conditions for equilibrium. Many candidates selected option **A** (a resultant force and a resultant turning effect acting) rather than the correct option, **D** (no resultant force and no resultant turning effect).

Question 31

Many candidates incorrectly believed that there is an increase in chemical energy, rather than kinetic energy, as a man falls and accelerates through the air.

Question 35

Many candidates knew that distance should be divided by the speed, fewer remembered to subtract the direct distance (P to Q) from the indirect distance (P to R to Q) to find the difference in distance; as a result, they incorrectly selected option **B** rather than option **A**.

Question 37

Calculation of the combined resistance of two resistors in series caused few problems.

Question 38

A common mistake made by some candidates was to believe that a high current rating of the fuse could cause the fuse to blow.

Question 39

Most candidates recognised the shape of the magnetic field pattern around a straight wire, but fewer knew the correct direction of the field lines, leading them to option **D**.

Question 40

There appeared to be much uncertainty between options **A**, **B** and **C** in this question on nuclear change caused by β-decay. Candidates were quite unsure about the effect of this emission.

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

General comments

Candidates performed very well on **Question 5**, **12**, **13**, **14**, **16**, **28** and **34**. **Question 11** and **35** proved the most difficult for candidates.

Comments on specific questions

Question 8

The range of answers for the percentage of oxygen in expired air suggested that candidates, while generally believing it was less than in inspired air, were unsure of how much less. Many candidates believed there was no oxygen in expired air.

Question 11

Candidates were unclear about the concept of dominant and recessive alleles. Candidates should understand that a homozygous recessive individual can only pass on a recessive allele, and therefore all of its offspring must contain at least one recessive allele. Likewise, both parents must contain at least one recessive allele if they are to produce a homozygous recessive offspring.

Question 14

Candidates understood very well how to interpret diagrammatic representations of covalent molecules. They were able to use these diagrams to deduce the number of different elements in a compound, as well as the total number of atoms in the compound.

Question 15

Candidates are expected to know that impurities reduce the melting point of a substance and, by extension, understand that the greater the amount of impurities, the greater the reduction in melting point.

Question 16

Candidates understood very well that covalent compounds have lower melting points than ionic compounds because the attractive forces between molecules are weaker than the attraction between oppositely charged ions.

Question 23

There was evidence that candidates were unsure of the answer to this question. At the high temperatures produced by the combustion of fuel in a car engine, oxygen and nitrogen from the air combine to form oxides of nitrogen.

Question 25

Candidates chose the incorrect options **A** and **D** more often than the correct option, **C**. Candidates are expected to know that lime, calcium oxide, is made by the thermal decomposition of limestone, calcium carbonate. They should also understand that when basic oxides dissolve in water they form alkaline hydroxides, such as calcium hydroxide. They are expected to know that calcium sulfate is the product of the neutralisation of sulfuric acid by calcium oxide.

Question 29

Candidates needed to recall the equation $F = ma$. Many candidates incorrectly believed that the quantities required to calculate acceleration were mass and speed or resultant force and speed.

Question 30

In this question, candidates needed to know the conditions for equilibrium. Many candidates selected option **A** (a resultant force and a resultant turning effect acting) rather than the correct option, **D** (no resultant force and no resultant turning effect).

Question 31

Many candidates incorrectly believed that there is an increase in gravitational potential energy, rather than kinetic energy, as a man falls and accelerates through the air.

Question 32

Although a majority knew that nuclear energy powers the Sun, many believed that the process was fission rather than fusion. Some candidates thought geothermal energy to be the source.

Question 34

Almost all candidates were familiar with the effect of colour on absorption of radiation from the Sun and this question was particularly well answered.

Question 35

Candidates were required to identify that the right-hand diagram showed light on the verge of being totally internally reflected, and then to subtract 55° from 90° to determine the critical angle. Most chose the correct diagram, but a majority of these gave 55° as the answer.

Question 36

Many candidates knew that X becomes a N pole, but a number of these believed that it would remain so, despite the bar being soft iron and it being moved a large distance away from the magnet.

Question 37

The most common error was to confuse series and parallel combinations of resistors, and select option **D**, rather than the correct option, **A**.

Question 38

A common mistake made by some candidates was to believe that a high current rating of the fuse could cause the fuse to blow.

Question 39

Most candidates recognised the shape of the magnetic field pattern around a straight wire, but fewer knew the correct direction of the field lines, leading them to option **D**.

Question 40

The most common error was to confuse proton number with nucleon number; these candidates therefore selected option **A**. Also, a significant number of candidates confused β-decay with α-decay and chose option **C**.

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 messages

Candidates should be reminded to read the stimulus material and each question carefully. To be awarded full marks, candidates should ensure that they complete all the instructions contained within the question.

Candidates should try to match the answers they give with the number of marks available for each part of a question. A two-mark question will require two separate points to be made.

When asked for a comparison, candidates should use comparative phrases such as greater than or higher than rather than simply describing the information.

General comments

Calculations were frequently done well with all working shown.

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.

Comments on specific questions

Question 1

(a) (i) A common error was to suggest that part **A** was an intercostal muscle rather than the rib.

(ii) Many correct responses were given. The most popular responses were nose, trachea and bronchus. Alveoli, lungs and oesophagus were not accepted.

(iii) Many candidates correctly ticked the pulmonary artery. A common error was to select the vena cava.

(b) (i) Many candidates correctly suggested differences between the composition of expired and inspired air. Some candidates described the difference in carbon dioxide levels, but this was given in the question and could therefore not be credited. Some candidates suggested that expired air would be warmer. This is a correct statement but did not answer the question.

(ii) The test for carbon dioxide with limewater was well known.

(c) (i) Almost all candidates were able to use the graph to determine the breathing rate of the student while walking.

(ii) Most candidates gained one mark for describing the decrease in breathing rate. Very few candidates described a decrease in the depth of breathing. There was also some confusion between breathing rate and heart rate.

Question 2

(a) (i) Many candidates gained at least one mark. The formula for a bromine molecule (Br_2) was very well known.

(ii) Many candidates correctly described the Group VII elements as halogens.

(b) Most candidates were able to write the correct word equation for the reaction. The only common error was confusing bromine with bromide. Some candidates attempted a balanced symbol equation rather than a word equation. Such equations were accepted as long as they were correctly balanced.

(c) Some candidates knew the colour change from orange to colourless. Few candidates were able to explain that the colour change is caused by an unsaturated compound or by a carbon-carbon double bond.

(d) The test for bromide ions was not well known.

(e) Many candidates knew that lead and bromine were produced during the electrolysis of molten lead(II) bromide but some candidates were unable to place them at the correct electrodes.

Question 3

(a) (i) Most candidates were awarded at least one mark. There were some common errors:–

- the line not being at 5 m / s after 20 s
- the line not being at a constant speed for 90 s
- completing the journey after 120 s rather than 115 s.

(ii) Many candidates correctly determined the distance as 450 m. A few attempted to calculate the area under the graph.

(b) (i) Radiation was not well known as the method of energy transfer between the Sun and the Earth. Thermal energy was often suggested.

(ii) Infrared was not well known as the part of the electromagnetic spectrum that is responsible for heating the saddle. Gamma radiation and visible light were often suggested.

(iii) Some candidates gained full marks. A common misconception was to suggest that molecules expand.

(c) Many candidates were able to explain that spanner **B** was longer, but very few were able to explain that this meant there was a greater moment or turning force.

(d) Upright and same size were the two characteristics most commonly suggested. Some candidates correctly suggested laterally inverted. Some candidates who could not remember the term lateral inversion attempted to describe lateral inversion.

Question 4

(a) (i) Most candidates drew a correct food chain, but many drew the arrows the wrong way round. Arrows should be drawn to show the flow of energy through the food chain.

(ii) Grass as the producer and jackal as the secondary consumer were frequently given. Goats were sometimes suggested as the producer or the secondary consumer.

(b) Plants were often incorrectly suggested as the principal source of energy for all food chains. The Sun is the principal source of energy for all food chains.

(c) (i) Many correct differences were suggested, the most common being that humans have canine teeth and goats do not. A few candidates described similarities rather than differences. This highlights the importance of reading the question carefully.

(ii) Most candidates gained one mark. Usually this was for suggesting that goats only eat plants.

(iii) Dentine and enamel were well known as the top two layers in a human tooth.

Question 5

(a) (i) Copper and iron were often identified as the two metals that were transition elements. A common incorrect answer was lithium and sodium.

(ii) Hydrogen was not well known as the gas produced when an alkali metal reacts with water. Carbon dioxide was often suggested.

(iii) Some candidates worked out the order of reactivity correctly. A few named metals that were not mentioned in the question.

(b) (i) Most candidates balanced the equation successfully.

(ii) Copper oxide was not well known as the substance reduced. The idea that reduction means the loss of oxygen was better known.

(c) (i) Oxygen and nitrogen were well known as the two gases found in large quantities in clean air.

(ii) Carbon monoxide and hydrogen were often incorrectly suggested as greenhouse gases.

(iii) Candidates need to be careful to name the fossil fuels as accurately as possible. For example, crude oil or petroleum rather than oil. Many candidates incorrectly suggested gasoline or diesel.

Question 6

(a) (i) Few candidates knew the correct electrical symbol for a battery. A number of cells connected together was accepted.

(ii) Many candidates were able to complete the calculation correctly.

(iii) Many candidates gave vague answers such as ‘so they can be the same brightness’ or ‘so that they have the same voltage’. Candidates should be encouraged to give detailed explanations, so their ideas are fully expressed.

(b) (i)(ii) Many candidates were confused about conduction and convection.

(c) The role of friction was understood by some candidates. Few candidates were able to explain the transfer of electrons.

(d) Some candidates were able to explain that steel is magnetic and that plastic filler is not.

Question 7

(a) Red blood cells linked to oxygen transport and white blood cells linked to phagocytosis or antibody production were the most popular correct answers.

(b) Many candidates did not read the question carefully enough and attempted to join all the boxes together. The question only required one sentence to be completed.

(c) Many candidates were able to name two other characteristics of living organisms. A few attempted to use the characteristics given in the question.

Question 8

(a) Water, H_2O, was not well known as the substance that reacts with ethene to make ethanol.

(b) Many candidates had some understanding of the terms but missed marks by describing one atom rather than one type of atom for the description of an element and referring to compounds as mixtures rather than elements bonded together.

(c) This question proved demanding. Few candidates were able to suggest both carbon dioxide and water.

(d) The description of an exothermic reaction was well known.

(e) (i) Some candidates were able to state that there are six electrons in an atom of carbon and one electron in an atom of hydrogen. A common error was state that a carbon atom contains twelve electrons.

(ii) Few candidates stated that the atom of hydrogen contained no neutrons. One neutron was the commonest answer.

(f) Many candidates correctly showed at least one shared pair of electrons. Few candidates were able to show four shared pairs and no extra electrons.

Question 9

(a) (i) Few candidates were able to describe the frequency of a wave.

(ii) Many candidates correctly identified the piano as the instrument producing a sound with the lowest pitch. Guitar was often incorrectly suggested.

(iii) Many candidates correctly identified the piano as the instrument producing sounds with the widest range of frequencies. Flute was often incorrectly suggested.

(iv) Some candidates correctly stated the normal audible frequency range for a healthy human ear as 20 Hz to 20 000 Hz. Many other frequencies were suggested.

(b) (i) Many candidates correctly completed the calculation to determine the density of the alloy. Few candidates were able to state the correct units for density. Common incorrect suggestions were cm^3 or cm^3 / g.

(ii) Few calculations for the weight of the flute were correct. The calculation involved a unit conversion from grams to kilograms.

Question 10

(a) Phloem and xylem were well known as the parts of a plant that are adapted for transport. Capillaries and vena cava were the commonest incorrect responses.

(b) (i) Root hair cells were well known, although a number of candidates suggested plant cells.

(ii) Many candidates correctly identified part **X** as the cell wall, although a few thought it was the cell membrane. Almost all candidates correctly identified part **Y** as the nucleus.

(c) Experiment **C** was correctly identified by many candidates as the experiment where seeds would germinate.

(d) Some candidates correctly suggested that the seeds would not germinate. Fewer were able to explain why in terms of enzymes being denatured. Many candidates suggested that germination and growth would be improved due to the higher temperature.

Question 11

(a) (i) Oxygen and water were well known as the two substances present when iron rusts.

(ii) Many suitable methods to prevent the rusting of iron were suggested. Some candidates were also able to explain that the method suggested provided a barrier to the water and oxygen.

(b) Cutlery was frequently suggested as a use for stainless steel. Candidates should avoid vague suggestions such as for cars. Car bodies would have been a clearer response.

(c) This question was asking for a difference in the properties of a solid compared to a liquid. Many candidates described differences in particle separation and arrangement. Suitable answers described a solid as having a fixed shape or that a liquid takes up the shape of its container.

(d) Many candidates gained full marks and were confident about the changes of state**.**

Question 12

(a) This question proved demanding. Few candidates referred to the penetrative properties of alpha, beta and gamma radiations. Even fewer suggested that gamma penetrates lead but alpha and beta do not.

(b) (i) The idea of the nucleus splitting during nuclear fission was not well known.

(ii) The most popular and correct answer was 0.05 g.

(iii) The term isotope was not explained by most candidates. There was confusion between atoms and elements.

(c) Many candidates correctly identified at least one factor that can be changed to increase the turning effect in a d.c. motor.

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 should ensure that they use all the information provided in the question in their answers and data should be transcribed with care.

Candidates should ensure that units used in the question are included in their written answer and when converting them they should be compatible with the numerical answer.

Candidates should try to match the answers they give with the number of marks available for each part of a question. A two-mark question will require two separate points to be made.

General comments

In general, the use of scientific terminology was very good. Answers were often precise and constructed with thought.

Numerical calculations often arrived at the correct value and arithmetic operations were generally error free. Candidates should be aware that such questions are marked in stages and credit can be given for a correct operation leading to an incorrect answer if evidence for that process is clearly shown.

Comments on specific questions

Question 1

(a) Most candidates knew some of the features of each type of respiration, and there were many correctly completed tables.

(b) Bread making or alcohol production was usually given as a use of anaerobic respiration in yeast.

(c) Few candidates gave the release of less energy per glucose molecule as a disadvantage of anaerobic respiration. Some were given credit for discussing the efficiency of energy release, rather than simply stating that less energy is released.

Question 2

(a) (i) Most candidates knew that pencil is used on the chromatography paper due to it being insoluble.

(ii) Those who knew the formula for R_f usually calculated the correct value. Some subtracted the distances and a minority inverted the formula.

(b) (i) The mixture with the insoluble food colouring was usually correctly identified.

(ii) The mixture with the greatest number of soluble food colourings was usually correctly identified. Only the best answers explained why **X** had not been chosen or that **Z** had the greatest number of spots above the line.

(c) Successful responses explained that impurities cause a change in melting point or the melting to occur over a range of temperatures. Answers that simply restated the temperatures could not be awarded credit.

Question 3

(a) Some candidates correctly suggested that a fixed resistor would limit current through the wire. Others described the effect of a variable resistance instead.

(b) (i) The calculation of the resistance was almost always correct.

(ii) The formula for electrical energy was well known. Candidates were not as confident in choosing the appropriate unit.

(iii) The energy transfer was correctly stated by some, while others did not show knowledge of the forms of energy involved when a current flows through an ohmic conductor.

(c) Some candidates knew that resistance is indirectly proportional to cross-sectional area while many others doubled the value they obtained in **(b)(i)**.

(d) Those who knew that the student needs to measure the diameter of the wire to calculate cross-sectional area could often suggest an appropriate instrument. Others suggested that the length was required. Many showed they were unaware of the need for precision when measuring small distances by suggesting the use of a ruler.

(e) (i) Some candidates could apply a learned rule to indicate the correct direction of the force on the wire. Some curved arrows were drawn.

(ii) Increasing the current and the strength of the magnetic field were often correctly stated as ways to increase the force on the wire. Candidates often suggested two ways of increasing the strength of the magnetic field rather than describing two different ways. There was some confusion with electric motors with references to coils and a turning effect.

Question 4

(a) (i) The calculation of the mass of tofu needed was usually done well.

(ii) Most candidates were aware that plant-based products have less vitamin D than animal products. Fewer used the information to explain that vegans need to eat more to get their RDA or did not compare the vitamin D content per 100g.

(b) It was usually realised that pregnant women need to take in extra vitamin D for their developing baby. Fewer answers explained that vitamin D is needed for the growth of bones.

(c) Some candidates could name a disease caused by protein deficiency, other incorrect suggestions included anaemia, rickets and scurvy.

(d) There were some good descriptions of the chemical digestion of protein with many candidates being awarded full marks.

(e) Some candidates described chemical digestion as requiring the use of an enzyme. In questions of this type, candidates should be careful to describe the differences as required by the question.

Question 5

(a) (i) The numbers of particles in an atom of chlorine were often all correct.

(ii) Most candidates knew that atoms of Group VII elements have 7 electrons in their outer shell.

(iii) The meaning of the term isotopes was usually explained correctly. A few compared the numbers of protons and neutrons.

(b) Most candidates were challenged by the need to explain the normal states of chlorine and sodium chloride. The strongest responses made it clear that the forces between molecules of chlorine are weak, and the forces between oppositely charged sodium ions and chloride ions are strong. Marks could not be awarded for referring to the covalent bonds between atoms or molecules, or just

referring to the ionic bonds in sodium chloride. Few answers went on to compare the energy required to overcome the intermolecular and electrostatic forces.

(c) The equation for the reaction between chlorine and sodium bromide was sometimes correct, most errors occurring when formulae had been copied incorrectly from the question.

Question 6

(a) (i) The β-particle was sometimes identified as an electron. Many candidates were confused by the word nature, which is used in the syllabus, and described the properties of a β-particle. This would have been acceptable had they described the charge and mass of an electron.

(ii) The decay equation was usually completed correctly.

(b) Correct answers to the question based on a paper mill control system, described the decreasing count rate caused by fewer β-particles penetrating the thicker paper. Others stated that the count rate stopped and no particles penetrated. Many candidates did not answer the full question, just describing the feedback control system.

(c) (i) The half-life was usually determined correctly.

(ii) A number of candidates suggested correctly that the source is suitable for this use as the half-life is long enough to prevent the need for frequent replacement. Others were imprecise in their answers and simply stated that it takes a long time to decay.

Question 7

(a) (i) Many candidates knew the function of the optic nerve, but the functions of the other parts of the eye were not well known.

(ii) Using the appropriate words to describe the changes in the eye proved difficult for many candidates. Recommended terminology would be that the lens thickens, the suspensory ligaments slacken and the ciliary muscles contract.

(b) (i) Some candidates could name the retina as the receptor in the pupil reflex.

(ii) Few suggested that the circular and radial muscles are effectors, some just suggesting the iris. Generally, candidates seemed not to be aware that the effectors involved in a response are muscles or glands.

(c) The involuntary actions were identified by almost all candidates.

(d) The brain and spinal cord were usually named as the two parts of the central nervous system, whereas some incorrectly suggested the spine.

Question 8

(a) Many candidates could label the diagram of the electrolysis experiment.

(b) (i) Some knew that the electrolysis of copper(II) sulfate produces oxygen gas at the positive electrode. Other suggestions included hydrogen and various oxides of sulfur.

(ii) The ionic half-equation for the formation of copper was quite well known.

(c) (i) Those who stated that the discharge of bromide ions is oxidation usually explained that electrons are lost.

(ii) There were some good answers to the calculation of the volume of bromine gas, with candidates showing their working clearly. The most common error was to use 80 rather than 160 for the relative molecular mass.

Question 9

(a) Most candidates used the graph to deduce that the sprinter was stationary during the first 0.5 s, while others described the motion of the sprinter over the whole race.

(b) Many candidates realised that the value of the acceleration could be shown to be 2.0 m / s^2 by taking data from the graph and clearly showing the calculation.

(c) This calculation of the mass of the sprinter was generally done well.

(d) (i)(ii) When the correct forces diagram was selected, constant speed was usually identified. Complete answers went on to explain that the motion is caused by a resultant force of zero.

(e) (i) Many candidates described how sweat cools the skin by referring to the most energetic particles leaving the surface when water evaporates. Fewer completed their answer by explaining the temperature drop in terms of the fall in average energy of the remaining particles. Responses which involved a description of vasodilation and homeostasis did not answer the question.

(ii) The differences between evaporation and boiling were quite well known. The misconception that the term boiling means heating water to boiling point was apparent in some answers.

Question 10

(a) The eutrophication flow chart was often completed correctly. The most common error was the nature of the ions involved, with nitrogen ions suggested rather than nitrate ions.

(b) There were a few good suggestions for why deforestation causes eutrophication, these were based on the erosion of soil containing nitrate ions. Others suggested that the lack of absorption of water and mineral ions by trees leads to polluted run-off into water courses or that decayed matter and increased use of fertiliser is responsible. Some confused the terms eutrophication with extinction.

(c) This question on the effect of deforestation on animals was well answered.

(d) Organisms that make their own nutrients were usually described correctly as producers.

(e) Candidates often named at least two substances needed to make nutrients. Glucose and oxygen were incorrectly suggested by many. It was common for sunlight to be included in the list even though ‘substances’ was highlighted in the question.

Question 11

(a) Common features of members of a homologous series were often correctly identified. Being hydrocarbons and having similar properties were too vague to be awarded marks.

(b) (i) The conditions for cracking were well known. Just heat or pressure were insufficient.

(ii) Where the alkane was correctly named, the structural formula was usually drawn well. A common error was to include one or more double bonds.

(c) Many candidates worked out the formula of the product correctly. Often errors occurred in copying the formulae of reactants or in the balancing stage.

(d) The correct structure of poly(propene) was sometimes drawn. Other candidates included a double bond.

(e) The correct representation of the formula for the dicarboxylic acid used to make nylon was rarely seen.

Question 12

(a) There were some good answers to the calculation of the speed of sound, with candidates showing their working clearly. The most common error was in converting the units of time from ms to s.

Rather than dividing by 1000, some divided by 60 or did not notice that the data was not compatible with an answer quoted in m / s.

(b) The strongest explanations for the difference between the speeds of sound in wood and in air included the observation that particles in solid wood are close together. Some went on to describe the difference in the speed of transfer of vibrations, rather than sound waves.

(c) Successful candidates recalled a learned definition of a longitudinal wave.

(d) There were many good diagrams of the diffracted waves showing spreading round the aperture and curved wavefronts. Some wavefronts were incorrectly drawn with discontinuous lines.

CO-ORDINATED SCIENCES

Paper 0973/42
Theory (Extended)

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

CO-ORDINATED SCIENCES

Paper 0973/61
Alternative to Practical

Key messages

When drawing graphs, candidates should:

- label the axes with a quantity and a unit
- draw a line of best fit as a single, smooth line
- plot points to cover at least half of the grid.

Candidates should be consistent with regard to the use of significant figures.

General comments

Candidates demonstrated a good understanding of practical skills and techniques.

Candidates need to include enough detail in their experimental observations.

Candidates must read the questions carefully so that they answer exactly what is being asked in the question. The number of marks available is an indication of the number of points that have to be made if full credit is to be awarded.

Comments on specific questions

Question 1

(a) (i) The standard of drawing was generally high. A number of candidates drew outlines which were feathery, had gaps or had smooth edges rather than crinkly. Some drew the whole length of the celery stem or attempted three dimensional diagrams. Almost all diagrams were sufficiently large.

(ii) The majority of candidates identified one of the circles they had drawn. Common errors included placing a cross inside the drawing with no label line and the label line not reaching the circle.

(iii) The majority of candidates stated a correct conclusion. The most common incorrect responses identified liquids instead of water or discussed the transport of nutrients.

(b) (i) The standard of graph drawing was generally good. Some candidates reversed the axes and a significant number did not include units on the axes or did not label the axes at all. Whilst most scales were linear, some candidates had a different scale between 0 and 1 hour to that for the rest of the graph. Plotting of points was very good although some candidates used awkward scales and subsequently found the points difficult to plot. A small number used a scale where the points did not cover at least half of the grid.

(ii) Lines were generally well drawn but some were drawn feathery or point to point rather than best fit. Some candidates did not include 0,0 in their line.

(iii) The majority of candidates read the value from their graph correctly, those with more difficult scales often misread the value. A significant number did not show how they determined their answer on the graph. A vertical line at 1.5 hours and a horizontal line to the *y*-axis is the clearest way to show this.

(iv) The relationship was well described by most candidates. Some gave a snapshot of one point rather than a relationship.

Question 2

(a) (i) Many candidates gave three correct conclusions. Some candidates gave sugar instead of reducing sugar or gave positive and negative with no mention of the nutrient being tested. Reducing sugar and protein were sometimes reversed.

(ii) Many candidates knew which test requires heat. The most common incorrect response was biuret.

(iii) The appropriate apparatus was well known. Beaker and dropper were common incorrect responses.

(b) (i) The fat test was well known. Some candidates only named ethanol or gave ethanol and fat.

(ii) The result should be precise and be white emulsion. Some candidates described solutions or precipitates.

(iii) Many candidates appreciated that something must be flammable but far fewer identified the ethanol.

Question 3

(a) More able candidates interpreted the table, chose the correct reagent and described the observations for both compounds. For these candidates, the most common error was to only give the negative result. Many candidates either suggested a test not in the table or described the hydrogen carbonate releasing hydrogen and then describing the test for hydrogen.

(b) The limewater test was generally well known with good descriptions of bubbling the gas through the limewater. Incorrect responses included a white emulsion for the observation, the extinguishing of a lighted splint, the hydrogen test and the oxygen test.

(c) Candidates found this very difficult. Many described holding the solid, often a piece of metal, in tweezers or heating the substance in a beaker. Very few appreciated that the Bunsen burner flame needed to be blue or roaring. A significant number described a test using a lighted splint.

Question 4

(a) (i) Candidates found it very difficult to communicate their answers clearly. More able candidates circled the mistakes in the diagram and numbered them so that it was clear which explanation belonged to which mistake. Some referred to both tubes as test-tubes and so it was unclear which should have the stopper and some stoppered both tubes. Other incorrect responses included missing clamps, missing reagents, missing Bunsen burner and an inverted test-tube.

(ii) Most candidates recorded the values in the correct cells in the table, but fewer followed the example in the table and gave the values to one decimal place.

(b) (i) Many candidates correctly described the relationship between surface area and rate, although some discussed time instead of rate. A significant number reversed the relationship.

(ii) Candidates found this challenging. More able candidates described the use of a syringe but far fewer recognised the need to measure time. Some did not change the method but swapped the test-tube for a measuring cylinder. In chemistry experiments, counting bubbles is rarely appropriate as the reactions proceed too quickly for this to be possible and, in this instance, it also does not include collecting the gas.

Question 5

Candidates were generally quite well prepared for the style of answer required of a planning question. Stronger responses addressed the bullet points in the question, which are included as a guide to help candidates structure their plan. There were five points which needed to be included in the plan. Candidates needed to address at least one point from each aspect and then any two others in order to gain full credit.

Whilst a diagram and sample results table were not required, more able candidates included both to illustrate their answers, and these often included several of the points on the mark scheme.

Some candidates measured the time for the water to boil instead of the temperature of boiling. A significant number put their solutions into a heated water bath meaning that the temperature could not rise above 100°C. Few candidates included a balance to measure the mass of salt added and those who measured temperature often did not mention the use of a thermometer.

Most candidates added salt to water and boiled it, some heated to bubbling failing to appreciate that this does not necessarily indicate boiling and some just measured the temperature each time salt was added without boiling. Few boiled water on its own to determine the boiling temperature without the addition of salt. Some repeated each amount of salt added so that calculation of an average was possible. Few appreciated the need for five different masses of salt to be added in order to draw a graph of the results. Few candidates explained a safety precaution in the detail required such as gloves to protect the skin from the hot apparatus or boiling water.

Controlling the volume of water was well known, however, many candidates also incorrectly controlled the mass of salt added to the water.

Some candidates found it difficult to process the results and to draw a conclusion, many gave a conclusion from prior knowledge rather than explaining how the results can be used to find a pattern. Comparing results is not sufficient for a conclusion. If a graph is to be drawn, the quantities on each axis need to be given.

Question 6

(a) (i) Most candidates read the meters correctly. A small number of 0.22 A were seen.

(ii) Candidates found this difficult. Common incorrect responses included to prevent electrocution, to reset the meters, for accuracy and to stop the current flow.

(b) (i) Most candidates calculated the power correctly. A small number did not take the example from the table and give the value to two decimal places.

(ii) The unit of power was not well known. Common incorrect responses included P, J, N, Ω and V.

(iii) Most candidates discussed at least one of the variables decreasing in value. Some quoted data with no explanations linking the numbers.

(c) Candidates found this challenging. The most common incorrect response agreed with the statement explaining that as length increased the voltage decreased. Some quoted data with no explanations linking the numbers.

(d) Candidates found this very challenging. Many knew the symbol for a voltmeter but either connected it in series or drew a line though the meter. Few knew the symbol for a variable resistor, most drawing a thermistor.

Question 7

(a) (i) Almost all candidates measured the length correctly.

(ii) Almost all candidates calculated the extension correctly.

(b) (i) Almost all candidates calculated the extension correctly.

(ii) Almost all candidates calculated the mass of the stone correctly, a significant number gave the value to more than three significant figures.

(c) Almost all candidates calculated the extension correctly.

(d) Almost all candidates calculated the density of the stone correctly.

(e) (i) Many candidates appreciated that the scale should be read at eye level. Incorrect responses included laying the spring flat or only reading when the spring is not oscillating.

(ii) Some candidates appreciated that the experiment should be repeated and the results averaged. Responses that could not be credited described the use of the same spring, use of the same ruler, more accurate equipment or allowing more than one student to measure the length.

(f) Many candidates missed the fact that the question asked for a single piece of equipment and so the suggested piece of equipment must be calibrated. A measuring cylinder would be ideal.

CO-ORDINATED SCIENCES

Paper 0973/62
Alternative to Practical

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