CO-ORDINATED SCIENCES

Paper 0654/01
Multiple Choice

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

General comments on whole paper

The mean of this paper was 63%, which is not up to the standard of recent examinations.

Comments on specific questions

Questions 1 to 14

Question 3

Though candidates are required to know that synovial fluid reduces friction between bones, it would appear that few of them were familiar with a diagram showing exactly where that fluid is situated, and well over a half opted for the position occupied by the articular cartilage. With less than a quarter selecting the correct answer, the question proved unacceptably difficult. The redeeming feature was that the quarter in question were generally the more able candidates.

Question 8

In contrast to **Question 3**, this question was found very easy, with 98% obtaining the correct answer. It is clear that it is thoroughly well-understood that milk provides a supply of calcium.

Question 13

Unfortunately, a few of the otherwise better candidates were a little hazy over the 'role of decomposers in food chains' (syllabus), since they struggled to link decomposition with the release of inorganic ions. It was a little surprising that almost a fifth of candidates believed that oxygen is released by this process.

Questions 15 to 27

Question 15 discriminated very well, partly because, apart from response **A**, the lower-scoring candidates appear to have guessed between the other three responses. Although the 'mole concept' is no longer on the syllabus for this paper, the question tells candidates that two coins contain the same number of atoms of two different elements. The atoms of different elements differ in mass and in the number of electrons they contain so arriving at the key, **D**, ought not to have been so tricky - over 80% of the higher-scoring candidates did answer correctly.

Question 19 proved to be easy across the ability range and thus did not discriminate well.

Question 25 proved to be hard although it is, in essence, a variant of the more traditional two-condition rusting reaction.

It is a real-life observation that the colours of dyed fabrics tend to fade over time and, in particular, curtains at sunny windows are more at risk and may well be protectively lined. The fastness of dyes is referred to in the "Suggested approaches" in C12 of the syllabus. Given that oxygen is reactive, it is a reasonable suggestion that the cause of fading may be a photo-activated oxidation

Response C was overly popular across the ability range indicating that the particular set of responses was less effective than anticipated.

Experiment 1 imitates the real-life situation and so is useful as part of the test of the suggestion. The fact that Experiment 2 was ticked in all four responses tells candidates that they do not need to think about controlling the 'light' variable.

This leaves consideration of what else there is in air that is contributing to the fading of the dye. Nitrogen and oxygen are, of course, the two main constituents of air and it is useful to test both separately - the suggestion might be wrong!

Question 27 The lower-scoring candidates seem to have guessed although this was thought to be a straightforward question of recall.

Questions 28 to 40

Items which candidates in general found relatively easy (over 70% facility) were **Questions 28**, **30**, **32**, **33**, **34** and **38**. Items which had a low facility (i.e. a low proportion of candidates answering correctly) were **Questions 33**, **35**, and **37**. The following comments about individual items might prove to be instructive.

Question 30 was only answered correctly by 64% of the candidates; some 28% answered **D**, the solid with the biggest volume. A similar proportion answered **Question 31** correctly, with 27% thinking that hot air can go downwards by convection.

Light items often cause candidates difficulty, and **Question 33** was no exception. Only just over one-third of the candidates could identify the angle of incidence in the diagram. Nearly half the candidates failed to think and chose the angle labelled 30°.

In **Question 35**, 78% realised that one of the longest wires would have the greatest resistance, but only just over half of these knew it would be the thinner of them.

Candidates found **Question 37** hard. Very few went for **A**, but support for the other options was evenly spread, suggesting that guessing was a popular way of tackling this question.

Question 39 was well answered. The vast majority knew that the particles emitted in a thermionic diode are electrons; it was a pity that some of these did not also know where the emission occurred.

Candidates did not find **Question 40** particularly easy. 45% answered correctly. The most popular incorrect answer was 1.92 g, which is obtained by multiplying the mass given by 4.

CO-ORDINATED SCIENCES

Paper 0654/02

Core Theory

General comments

Most candidates were able to attempt most questions. There was a good range of marks and differentiation on all questions. The candidates scored fairly well on all questions. Very few gained no marks on any question and very few gained full marks on any question. Although it appeared that candidates often knew the answer to the question, their answers were very vague. Language difficulties played some part here, although the general level of English was good. Performance depended not only on scientific knowledge but on the ability to understand the question and how many marks were available.

It is becoming apparent that when a numerical answer is required, weaker candidates will merely take any numbers that are given in the question and either multiply them or divide them. Quite often they make up a formula / equation to confirm this. Another problem with calculations is that candidates will often draw a triangle with three letters in it and expect that this will be accepted as a formula/equation. Any formula quoted should be in the standard form and use recognisable symbols. Formulae consisting of units should be avoided.

There was no evidence of candidates running short of time to complete the examination.

Comments on specific questions

Question 1

This question was fairly well answered..

(a) Most candidates gained some marks but few gained full marks. Many candidates ticked more than one box in each column and therefore lost marks.

(b) (i) The process of evaporation was not well understood. Whilst many candidates appreciated that it was the particles with more energy that would evaporate, many wrongly suggested that it was the particles which were vibrating more. Few candidates appreciated that evaporation is a process occurring at the surface of the water.

(ii) The better candidates were able to quote the correct formula and carry out the calculation. The commonest error was to state that density equalled mass times volume.

Question 2

This question was answered reasonably well, with most candidates able to gain three or four marks.

(a) (i) Many candidates correctly positioned the alveolus in the lung..

(b) (i) Surprisingly few candidates were able to correctly explain the meaning of the term tissue. Few candidates described it as a collection of cells.

(ii) Very few candidates were able to identify the correct position of the tissue.

(c) (i) The arrows drawn by many candidates here did not show the path clearly enough. Some arrows had arrow heads at both ends.

(ii) Diffusion was the commonest answer but respiration was a common wrong answer.

(iii) Many candidates correctly described the structure, but few were able to explain how it helped gaseous exchange occur efficiently.

Question 3

All parts were accessible to many candidates, with some candidates gaining good marks.

(a) All three parts were well answered.

(b) (i) and (ii) These parts were well answered.

(iii) Many candidates got either the left hand side or the right hand side correct but few managed both. Common errors were to include heat or limewater somewhere.

(c) The differences between the alkali metals and the transition metals was quite well known. Some candidates lost marks because they failed to state clearly enough which of the two types of metal they were describing.

Question 4

There was a wide spread of marks on this question.

(a) (i) Many candidates merely explained that the forces were equal rather than equal and opposite.

(ii) Whilst there were many correct answers, many candidates omitted the formula.

(iii) There were very few correct answers here. Many candidates tried to use the number 30 in their calculation, presumably because 30 seconds was mentioned in the question.

(b) This was usually answered incorrectly. Most candidates worked out how long the brakes were applied for rather than how long before the brakes were applied.

(c) (i) Many candidates appeared confused as to the nature of the passage of sound through air. The idea that sound is a vibration was not usually given nor that the sound wave required particles or molecules to travel through.

(ii) The link between amplitude and loudness of sounds waves was not well known.

(d) (i) This was again poorly answered. A number gave an answer which would have been correct for part **(ii)**.

(ii) Few candidates knew that the answer was either frequency or wavelength.

Question 5

This question was surprisingly poorly answered.

(a) (i) and (ii) Whilst most candidates gained one of the two marks here, few gained both.

(b) Most candidates managed this part by mentioning lubrication or reducing friction. A number of candidates suggested that it removed friction.

(c) Many candidates suggested that bone was hard or cartilage was soft. But only the better candidates were able to relate this to their function.

Question 6

Some parts of this question were very poorly answered. Few candidates had any idea about part **(b)**.

(a) (i) Many candidates correctly answered 24 for this, but there were many different wrong answers.

(ii) Few candidates gained even one mark here. The idea that a polymer was many monomers linked together was not well known, nor was the fact that a polymer was a long chain.

(b) (i) A reasonable number of candidates appreciated that a carbohydrate could not contain elements such as sulphur or nitrogen, but many candidates did not appreciate why a carbohydrate is called a carbohydrate (i.e. a compound containing only carbon, hydrogen and oxygen and the hydrogen and oxygen are in the ratio of two to one).

(ii) The responses to this by the majority of students were disappointing. The different context in which the question was asked confused most candidates. The commonest answers suggested that as sulphur was so reactive it was dangerous to have near petroleum because there would be an explosion.

(c) (i) Most candidates realised that an analgesic relieved pain, although many suggested that it only removed a particular pain.

(ii) Many candidates gave vague answers which although on the right lines were not clear enough to be deemed correct. A simple mention of harmful was not accepted.

Question 7

There was a wide range of marks on this question.

(a) (i) Rather than the correct answer oxygen, many candidates gave one of the products of combustion as their answer.

(ii) Most candidates correctly identified global warming or the greenhouse effect as the correct answer, although there were still far too many descriptions of destroying the ozone layer.

(b) (i) and (ii) These were well answered.

(c) The phrasing of this question about efficiency seemed to confuse most candidates. Many suggested that 40% of the gas was wasted

(d) (i) Few candidates were able to recall the use of a transformer. Many candidates suggested voltmeter.

(ii) Surprisingly few gained the mark here. Perhaps the fact that they were not thinking about transformers confused them.

(e) (i) Many candidates gained the mark here, but many also referred to a mixture of elements.

(ii) Lots of differences were suggested but only about half were suitable.

Question 8

(a) (i) The nucleus was well known.

(ii) Only the better candidates suggested DNA here.

(b) (i) There were many vague answers here referring to changes in the organisms.

(ii) The graph was usually correctly interpreted.

(iii) There were few correct answers. Most answers were left as a percentage of 3%.

(iv) Few candidates mentioned ionisation or ionising radiation.

(c) (i) There was little evidence that many of the candidates knew what to do here.

(ii) Whilst few candidates gained a mark for the correct answer of seven, a number of candidates gained an error carried forward mark from part **(i)** for correctly realising that the answer had to be twice the value of part **(i)** minus one.

Question 9

There were some good answers to this question.

(a) Most candidates managed to correctly identify at least one method.

(b) (i) Magnesium or calcium were correctly identified by many candidates**.** However, there were many irons and salts.

(ii) There were few answers suggesting that the water flowed over different rocks. Many answers were very vague talking about different environments.

(iii) This part was well answered with most candidates gaining at least one mark.

(iv) This part was also well answered.

(c) (i) Most answers here were far too vague to receive any credit.

(ii) Again, few candidates were able to offer clear enough descriptions of the solubilities of these two salts to gain either mark. The most able candidates were able to access this question and gain both marks. There did seem to be a lack of awareness that if two marks were signified for this part question, there would be two marking points.

Question 10

(a) (i) Electron was well known.

(ii) Coulomb was less well known.

(b) (i) and (ii) Most candidates seemed to be guessing here in part **(i)**. This was emphasised in part **(ii)** where there was little attempt to relate the answer to the amount of current flowing through the resistor.

(c) (i) Most candidates correctly wrote down the formula.

(ii) Few candidates worked out the correct answer to be 12V.

(iii) Very few candidates realised that the answer had to be the same as part **(ii)**.

Question 11

(a) The idea of a food chain seemed well understood. Most candidates correctly identified the caterpillar as the primary consumer.

(b) Many candidates managed to state an adaptation but less were able to explain the purpose of this adaptation. Again the indication of two marks should have alerted the candidates to this fact.

(c) (i) This was well known.

(ii) The only common wrong answer here was chloroplasts.

(d) There were five marking points here but few candidates gained more than two marks. Many gained only one. The best known aspects were the role of xylem, osmosis in the roots and transpiration.

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Paper 0654/03
Extended Theory

General comments

There were some excellent responses to this Paper, with many candidates showing thorough knowledge and understanding of the material in the syllabus, and able to use their knowledge in new situations. However, a very large number of candidates struggled throughout, finding themselves faced with questions that were well beyond their knowledge of the specification.

Comments on specific questions

Question 1

This question tested material from the Supplement of the syllabus, and it was clear that many candidates were unfamiliar with it.

(a) (i) Very few candidates appeared to use the diagrams in giving their answers to this question. Many of them wrote an answer and crossed it out two or three times before deciding on the answer they wanted to give.

(ii) The concepts tested here are not easy, and it was clear that even when candidates had learned this material they did not really understand it. Descriptions often suggested that the lungs inflated which caused the movements of the rib cage or the diaphragm.

(b) Many candidates knew that goblet cells secrete mucus which traps bacteria, and that cilia sweep the mucus upwards. However, there was also considerable confusion, and many candidates wrote about white blood cells.

(c) (i) There were some good answers here, but many were not sufficiently specific, for example just saying that the goblet cells and cilia were killed.

(ii) Some candidates appreciated that alveolar walls might break down, or that the surface area of the alveoli would decrease.

Question 2

(a) (i) This was usually well answered, although some candidates suggested that this was related to the different numbers of electrons in the atoms.

(ii) This, too, was generally well answered, with most candidates appreciating that the atom has a full outer shell. Some tried to work out the numbers of electrons in the shells, and this was ignored as long as the idea of a full outer shell was implied.

(iii) This proved more difficult than **(i)** and **(ii).** Better candidates explained that the elements are grouped according to their properties.

(b) (i) This was answered correctly by some candidates, but many either did not attempt it or arrived at an incorrect answer. Some gave 0.4 rather than 0.04.

(ii) This question also caused problems, though less so than **(i)**. Once again, numerous candidates did not attempt it, and many who did arrived at incorrect answers.

(iii) This was dependent on answers to **(i)** and **(ii)**, and candidates were allowed to carry errors forward. There was a mark for appreciating that twice as many moles of hydrochloric acid are required as moles of magnesium. The second mark was for using this idea, and the answers to **(i)** and **(ii)**, to determine whether or not there was sufficient acid. Many candidates misunderstood the principles here, and wrote the numbers of moles present beneath the equation, then multiplied the number of moles of acid in the solution by two, and said that there was enough.

(c) (i) The charge on the fluoride ion had been given in the question, so candidates only needed to say that it would move to the positive anode because the opposite charges attract. Many did so. Some candidates said that 'fluorine is negative', which is not correct. Some suggested that it would move to the cathode, because it is a negative ion and needs to be given electrons.

(ii) This was generally well answered, with most candidates able to use their knowledge of the halogens to state that fluorine is very reactive, or that it is poisonous.

(iii) Most candidates earned at least one mark here, recognising that gold and platinum are unreactive, and that the low temperature will also reduce the rate of reaction.

Question 3

(a) (i) While better candidates had no difficulties with this, there were a surprising number of wrong answers. Common errors were to begin with an incorrect formula (for example, work = distance x time), to give an incomplete formula (for example, distance x force), or to use an incorrect value for force in their calculation (often 1200 or 1200 x 10). Yet another pitfall was to fail to give a unit or to give incorrect units (such as newtons).

(ii) For those who knew the formula, this was easier than **(i)** as there was only one step in the calculation.

(b) (i) The most common error here was to give the formula: acceleration = speed / time, rather than specifying *change* in speed. Some misread the graph, and decided that the time involved was 5 seconds rather than 4. Several gave incorrect units. Some took a perfectly correct alternative route, calculating the gradient of the graph.

(ii) This involved calculating two distances and adding them. Many did this entirely correctly, while others calculated only the reaction distance or the braking distance.

Question 4

(a) This was generally well answered, although some candidates appeared to be describing a mutant oganism rather than a mutation.

(b) (i) Almost all candidates correctly stated that an increase in the X-ray dosage caused an increase in the number of mutations, but relatively few commented on the increasing slope of the graph at higher X-ray doses.

(ii) Only the better candidates explained that X-rays are ionising, and this could damage DNA within cells.

(c) This proved to be much more difficult than expected, and it was relatively rare to see a correct answer. There was a wide range of wrong answers. Some candidates did not use the information in the question, and gave answers such as 45.

(d) Better candidates explained that a mutation in a gamete could be passed on to offspring, in which *all* of their cells would contain the mutation, and in some cases explained that in the original fly the mutation would be in only one cell and therefore unlikely to cause harm. Many others made one of these points.

(e) (i) Although many candidates were able to earn one mark here, generally for stating that the pesticides might harm organisms other than the pests (including humans), relatively few went on to give a second piece of information, such as the potential damage to pollinators, or to natural predators of the pest, the possible development of resistance by the pest, or the harm done to food chains. Many incorrectly suggested that the pesticides might cause eutrophication.

(ii) This was a difficult question, and it was good to see many of the better candidates able to make good suggestions, such as the lack of fertility of the X-rayed males, and the likelihood that their offspring might not survive for long. This method really works because of competition for females between the mutated males and the wild ones, but only a few candidates made this suggestion.

Question 5

(a) (i) This was generally answered correctly.

(ii) Better candidates understood that starch is a polymer, and the number of monomers in the chain is variable. Many, however, stated that it is just a different form of glucose, and so would have the same formula.

(b) (i) This was generally well answered, although some candidates incorrectly stated that the glucose moved by osmosis, rather than diffusion. Most realised that iodine solution could diffuse out through the partially permeable membrane, and that the reaction between iodine and starch produced the blue-black colour.

(ii) Many candidates had already answered this in their answer to **(i)**, and simply had to reiterate that starch molecules are too big to go through the membrane, so the solution would not go blue-black inside the tubing.

(c) (i) There was apparent misunderstanding here about what a 'displayed formula' is. The question had been designed to help candidates with this, by giving them a displayed formula in the stem of the question. Many candidates did not show a complete monomer molecule, showing it with only a single bond between the carbons, and with free bonds on either side.

(ii) There were many good answers here, with diagrams showing intermolecular forces between the polymer molecules. In some, however, it was not clear that these were cross-links, rather than bonds within the polymer chain itself. Some gave entirely incorrect answers, often in terms of saturated and unsaturated molecules.

Question 6

(a) This was almost always correctly answered. The most common incorrect answer was 0.1.

(b) As always, this calculation caused difficulties for many candidates. Some simply added the resistors as though they were in series. Some began with a wrong formula, for example $R = 1/R_1 + 1/R_2$. Some used the correct formula, but were unable to calculate 1/40 + 1/60. Some did this correctly, but forgot to turn their fraction upside down to find R. Nevertheless, there were many entirely correct and clearly worked answers.

(c) (i) There was an easy mark here for stating that a current was produced, but many candidates did not even state that in their answer. The second mark required an explanation in terms of the changing (or moving) magnetic field interaction with the coil. Some unnecessarily tried to explain why the needle went to the left rather than to the right.

(ii) There were many very poor answers here. Some candidates did not attempt it. Many described a motor, with either the diagram or written answer stating that there was an electrical input. Many redrew the diagram Fig. 6.2. Relatively few candidates were given four marks, but better candidates often correctly described a coil rotating within a magnetic field (or a magnet rotating within a coil), powered by some external source of energy such a turning bicycle wheel.

Question 7

(a) Most candidates simply described the pyramid, rather than *explaining* why it is this shape. Answers that simply stated there were few oak trees, many caterpillars and so on did not score any marks. Better candidates explained that one oak tree has a large biomass and so can support many caterpillars, or that hawks need to eat many small birds, or discussed energy loss as you move up the pyramid.

(b) Almost all candidates were given at least one mark here, for a mention of photosynthesis. However, their descriptions showed a great deal of confusion. A common error was to suggest that sunlight changed to glucose. Many did not state that carbon dioxide reacts with water. Relatively few mentioned the role of chlorophyll in absorbing energy from sunlight. Many said that 'photosynthesis creates energy'. Many stated that glucose *is* energy. It is important that they should understand photosynthesis as a process in which sunlight energy is transferred into chemical energy in glucose.

(ii) Again, most candidates got one mark, usually for a mention of xylem. A few mentioned osmosis, but many suggested that the movement into the root hairs, or across the root, is by active transport. Some described the role of transpiration in reducing pressure at the top of the xylem vessels.

Question 8

(a) Many candidates were able to state two processes, usually filtering and chlorination. Several suggested distillation, but this is not a process that would be used for river water.

(b) (i) This was answered correctly only very rarely. Some came close by giving the symbol Ca, but did not give the charge on the ion.

(ii) Most answers correctly stated that the results show that boiling reduces hardness. Relatively few suggested that the water must contain both temporary and permanent hardness, or that the water must contain calcium hydrogencarbonate.

(c) (i) This was generally well done. However, many candidates drew the two particles with a covalent bond, sharing their electrons. Some just redrew the diagrams from earlier in the question, with an arrow going from one to the other, which was not a correct answer to this question.

(ii) As expected, this was the most difficult part of the question. Oddly, however, candidates who had drawn a covalent bond in **(i)** often went on to describe ionic bonding here. Very few described the strong attraction between positive and negative ions, which requires a great deal of energy to break. Some did mention that the ions form a giant ionic structure.

Question 9

(a) (i) Many correctly mentioned particles and vibrations, or compressions and rarefactions. Some thought that sound is made of particles.

(ii) This proved more difficult than expected, with only relatively few stating that the sound would get louder. Many said that it would be 'higher', which could in some cases have been simply a wrong use of a word.

(iii) A value within the hearing range of most people was expected. Many candidates gave entirely inappropriate values, such as 3 gigahertz or 10 hertz. Some gave answers in decibels.

(b) (i) Many candidates correctly gave speed, or the ability to travel through a vacuum, or transverse waves. The most common incorrect answer was that they could *not* travel through a vacuum. Others said that they are longitudinal waves.

(ii) The most common incorrect answer was that you can see blue light but not radio waves. This is a property of our eyes, not of the waves. Other incorrect suggestions were that they travel at different speeds, that light is a longitudinal wave while radio waves are transverse waves (or the other way around), or that you can hear radio waves.

(iii) Most answers were correct – some candidates clearly knew the answer and worked back from it. The most common error was to begin with the formula speed = frequency/wavelength.

(c) (i) Many answers began irrelevantly with an explanation of why the temperature of the air in the tyre increases. A pleasing number, however, correctly explained that there would be more frequent collisions of particles in the air with the wall of the tyre. Some weaker candidates simply said that the air would expand and push out on the tyre, with no mention of particles.

(ii) This proved very difficult. Many struggled to give a formula – there was sometimes no formula at all, or it was incorrect. Very few appreciated that the temperatures needed to be converted to Kelvin. If the formula was correct, they could be given an error carried forward mark for an answer correctly calculated using ºC.

CO-ORDINATED SCIENCES

Paper 0654/04

Coursework

General comments

(a) Nature of tasks set by Centres.

Coursework was submitted by 22 Centres for the June examination session. Many Centres have established a portfolio of well-tried practical tasks, while others have acted on advice given. New Centres were well prepared and offered a suitable selection of practical tasks. This is testament to the success of the Distance Learning Pack. In most Centres all the tasks set were appropriate to the requirements of the syllabus and the competence of the candidates. The standard of candidates' work was of a similar standard to previous years.

(b) Teachers' application of assessment criteria.

In all 22 Centres the assessment criteria were understood and applied well to all activities. There has been a sustained improvement in the Centres' application of assessment criteria. Distance learning seems to act as a good preparation for coursework assessment. For the second year no Centres tried to assess both skills C1 and C4 in the same investigation.

(c) Recording of marks and teachers' annotation.

Most Centres provided thorough summaries to support the mark given to each candidate. There has been a small increase in annotations on the scripts to indicate the point at which marks have been awarded. This is to be encouraged as there is still scope for further improvements to annotations by some Centres. Tick lists remain popular particularly with skill C1 and increasing with other skill areas.

(d) Good practice.

Many Centres have developed a booklet of tasks and dedicated assessment criteria.

CO-ORDINATED SCIENCES

Paper 0654/05
Practical

General comments

All three questions were answered well and many candidates scored high marks. Despite one or two comments concerning the construction of a key in **Question 1** suggesting this was not within the syllabus, the majority of candidates were able to carry out the task and score very well. The question was carefully constructed by guiding the candidates with an example, and was meant to test Assessment Objective C i.e. using a technique following a sequence of instructions. Supervisors were able to handle local difficulties and acted sensibly towards those who may have had problems with faulty apparatus. It would be helpful if the person designated to carry out the practical work would answer the questions fully and not just any measurements required. The more information the Examiners have, the less likely candidates are to suffer when the unexpected answer appears.

It is worth mentioning again that measuring cylinders are not required when measuring small approximate volumes. Similarly spatulas are never listed because there are so many different ways of using small quantities of solids that it is best left to individual Centres to use their own method.

Comments on specific questions

Question 1

In most cases the drawing of the leaf was adequate both in terms of quality and size. Sometimes the veins were just vague squiggles and in a few cases the letter **T** was not used. Most candidates correctly reported that the top side of the leaf was darker green but many failed to score the second mark for failing to explain in terms of **more** chlorophyll on the top side. Around 50% of candidates did not report observing any bubbles being produced from the underside of the leaf. Many of these reported colour changes in the two surfaces and attributed these to the removal of the waxy surface by the hot water. Another comment suggested that the chlorophyll had been destroyed by the heat. Those making the correct observation, that is to say, bubbles on the lower surface, usually gave a correct explanation. Part **(c)** was answered reasonably well with the majority making good drawings of the leaves. Attempts at producing a key varied although the vast majority were able to score some marks and many scored all six marks. There was no set answer and each was treated on its merits. Differences such as 'long' and 'short' or 'wide' and 'not wide' were not allowed on the grounds that such differences are not specific enough. A very small number decided to follow the example closely and made up a key starting with arthropods.

Question 2

Disappointing that so many lamps appeared to be far from similar. It was often difficult to decide if it was the fault of the two lamps being so different or the fault of the candidates making the measurements. There were certainly many examples of very strange measurements. Some misread the meters, and currents were not infrequently recorded in excess of 2 amperes. Others seemed to find that the current in the circuit increased after adding the second lamp. Supervisors results were vital in this question and although absurd figures were penalised, sensible values scored the marks. The main reason for loss of a mark in part **(c)** was due to inconsistency in reading the meter. Most candidates used the correct formula to calculate the value of R. However, many used the current from part **(a)** to calculate R_1 whilst using the correct value from (**b**) for R_2. This of course led to problems in (**ii**). Had this error not been made, maybe more would have had similar values for R. Very few concluded that within experimental error the bulbs were similar even when their values were clearly very similar. There were many correct parallel circuit diagrams although the ammeter was sometimes omitted. Correct explanations were very rare. Few appreciated that the total resistance had decreased. Too many wrote about voltages flowing, both lamps getting equal voltage and the current not being divided.

Question 3

Note the earlier comment regarding the use of measuring cylinders and spatulas. Candidates should be taught to estimate small volumes and not rely upon measuring cylinders. Most candidates described solids **X** and **Y** as black although dark brown and grey were accepted. The second mark was given for noting some difference in the appearance of the solids, such as one finely powdered and the other granular. This mark was given to a smaller number of candidates. Solid **X** should have produced a small amount of bubbles and many reported this. Solid **Y** however bubbled very much more and was clearly releasing oxygen at a fast rate. Although hydrogen was sometimes reported, the majority identified oxygen. There is only one test for chlorine and that is stated in the notes on page 12. Litmus turning red was not allowed even though a small number of Supervisors reported that the litmus did not bleach. A comment not supported by the candidates. Various other gases were recorded, such as ammonia, carbon dioxide and hydrogen. The question must be asked as to whether or not candidates are taught to use the notes provided. If litmus turns red, it is hard to understand why some conclude ammonia. Both blue and green were acceptable colours for the filtrate. The colour depending upon the concentrations of chloride and copper ions. There is only one reaction between copper ions and sodium hydroxide, again described in the notes. A blue precipitate insoluble in excess is stated and is the answer expected. Many candidates fail to appreciate the meaning of the word precipitate and the term insoluble in excess. In the same way the reaction of copper ions with aqueous ammonia is described in the notes. Referring to the notes might prevent all manner of incorrect descriptions and an unnecessary loss of marks. Part **(e)** asks for the name of the solid and the mark was awarded only for those who answered copper oxide. The copper easily deduced from test (**d**) and confirmed by most candidates in test (**f**), and by reference to the second sentence of the question, that states both solids are oxides. Finally, part **(f)** asks candidates to carry out a test. Some did not do this as indicated by observations far removed from the behaviour of copper ions. Others simply wrote about what would happen if the test were carried out.

COMBINED SCIENCE

Paper 0653/06
Alternative to Practical

General comments

It is emphasised every year that this paper contains questions that require knowledge of laboratory procedures appropriate to the syllabus. It is expected that candidates will have such knowledge through carrying out, or at the very least, seeing experiments demonstrated. It is clear from the answers they give that this is not always the case.

Another problem is the clear evidence that candidates are not reading the questions properly and sometimes appear to be answering a completely different question. This is not a matter of failing to reproduce scientific knowledge, but simply poor examination practice.

Having said this, it is good to see an increasing number of high quality scripts and there is evidence that a number of Centres clearly take notice of these reports and act on them.

Comments on specific questions

Question 1

(a) (i) As is usual, one of the questions on the paper asks for candidates to draw something from a photograph. This year the photograph was of a leaf. It was expected that candidates would draw a similar sized diagram showing faint lines to correspond to the veins in the original. Many candidates were unable to draw a similar sized diagram and drew very thick lines to represent veins.

(b) Most were able to name the stomata as being the “holes” from which the trapped air escaped.

(c) This part required candidates to use the information they were given and adapt it to make a new key. Most managed very well and it was interesting to see the many different ways they came up with.

Correct biological terms were neither expected nor required. So long as the terms used were clear and not well-known terms for something else (e.g. petals), most were accepted; leaflets, separate sections, leaves and, indeed, leafs were all given credit.

A small minority failed to adapt the given key and used the terms given in the example.

Question 2

Many candidates lost marks by not reading the question.

(a) The candidates were told to take measurements from the mid-point of the rays. Any errors here were taken into account when calculating the distance from the centre.

(b) Most candidates knew the law of reflection and a pleasing number of candidates noted the experimental error built into the question, although this was not required.

(c) and (d) The pathways were not well known.

Question 3

In general this question was answered very poorly. Only basic chemistry, was required.

(a) (i) Many interesting safety aspects were mentioned, overalls, gloves, goggles, etc. but it was surprising that many missed the important fact that the magnesium ribbon should have been held with tongs. Extra precautions were not penalised, but only tongs (or similar) and viewing through blue glass gained credit. Few, if any, mentioned blue glass.

(ii) The addition of water to magnesium oxide to produce an insoluble (or sparingly soluble) mixture was not well known.

(iii) Many thought that Universal Indicator turning blue signifies acid.

(b) (i) The number of candidates who realised that the magnesium oxide reacts with (or neutralises) the acid was unfortunately very few, some even saying that the magnesium oxide is too strong or too reactive to react with acid. At this point it is worth reminding candidates that the full name for chemicals is required. Magnesium should not be given when referring to magnesium oxide or magnesium sulphate.

(iii) A simple drawing to represent filtration was required. A number gave a series of diagrams of the whole process; others just drew a diagram of the crystallisation in part **(c)**. Although a labelled diagram was not specified, labels should always be given as the filter paper had to be obvious from the diagram to score, a simple label would have given candidates more chance of attaining this mark.

(c) The reasons for evaporation of a small amount of water or to concentrate the solution was not well known.

Question 4

Most candidates realised the theory behind this question and scored well.

(a) Some candidates failed to read the question and instead of trying to explain the colours of the bicarbonate indicator, tried to use Universal Indicator colours.

(b) Candidates should be encouraged to use the correct term. In this case “control” as “wordy” answers, as given by many candidates, usually failed to score.

(c) All that was expected were very similar diagrams to those given in the question, with the leaf removed and some sort of ledge for the woodlice to live on. Many candidates did not use the bicarbonate indicator and/or the control. Some woodlice were left to hang in mid-air or drown in the indicator.

Question 5

(a) Candidates still need practice in reading scales.

(b) The test for oxygen is that a glowing splint relights. Candidates should question themselves when they write “a lighted splint relights”.

(c) The behaviour of enzymes seemed well-known, but not the name given to inorganic examples, “catalysts”.

(d) (i) This was answered reasonably well although a few candidates gave chloride instead of chlorine.

(ii) Many candidates realised that the ion was copper.

(iii) The question asks how the presence of the metal ion in the blue solution could be confirmed using aqueous ammonia. A number of candidates started by saying that the solution would “turn blue” – again a failure to read the question.

Question 6

(a)-(c) Answered very well by most candidates

(d) (i) Again some candidates failed to read the question. Although told to omit the voltmeter from the diagram, many kept it in.

(ii) Vague answers were not credited. More energy, electricity, etc. were not accepted. Current, voltage and/or resistance were required in their correct usage.