COMBINED SCIENCE

Paper 0653/01
Multiple Choice

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

Comments on individual questions (Biology)

General comments

No question in the biology section proved excessively difficult, but three questions, and one in particular, did cause the candidates some difficulty.

Comments on individual questions

Question 1

This was the easiest question in the biology section, but with 81% selecting the correct answer, the level of difficulty was acceptable. Those who failed to select the correct option included those who were confused over the presence of a cell wall surrounding the cell membrane in plant cells.

Question 5

There can be some sympathy for those who opted for 'tearing' as a function of 'front teeth'. Te
however, more a description of what might happen to certain foods, rather than a description of the fu
of the teeth. The more precise and accurate 'cutting' was more than twice as popular.

Question 8

This was a difficult question with a good deal of guesswork employed by those offering an answer. The able candidates had no problems, but it is a little puzzling that those who knew that zygotes (rather than gametes) would be formed, then felt that the zygotes would be genetically identical to the parents.

Question 9

A basic misunderstanding was exposed by this question, since twice as many believed that gaseous *exchange* occurs in the umbilical cord, rather than between the placenta and the mother.

Question 10

This question proved very difficult. The topic of plant fertilisation always reveals those who believe that the pollen grain *is* the male gamete, rather than *contains* it. No doubt for this reason many opted for **A**, but the very high figure who selected this option suggests that many do not realise that the male gamete travels down the pollen tube, and would thus be in the pollen tube at the stage shown in the diagram.

Comments on individual questions (Chemistry)

The chemistry questions performed well, seeming slightly more difficult for candidates than the biology and physics questions.

Questions 17, **21** and **27** proved to be easiest, and were answered correctly by well over half the candidates. **Questions 18**, **22**, **23** and **26** proved to be the most difficult.

Comments on individual questions

The following responses were popular **wrong** answers to the questions listed.

Question 15 Response **B**. Candidates did not know that the lower of the two numbers before the element symbol indicates the atomic (proton) number.

Question 18 Response **C**. More candidates chose this response than the correct one. They clearly counted the sodium and the oxygen but forgot about the sulfur.

Question 20 Response **D**. Presumably candidates chose this alternative because sulfur is yellow. They apparently did not know about flame tests.

Question 21 Response **C**. Candidates knew that carbon monoxide and sulfur dioxide were pollutants and then guessed wrongly.

Question 22 Responses **A** and **B**. Weaker candidates chose these responses in preference to the correct answer. Candidates clearly guessed, having realised that strontium would react like calcium, but going no further with their reasoning.

Question 26 Response **B**. This was more popular than the correct response. Weaker candidates confused the meanings of the words monomer and polymer.

Comments on individual questions (Physics)

Physics questions which caused some difficulty for candidates were **28**, **31**, **32**, **33**, **34**, **35**, **36**, **39** an

Comments on individual questions

In **Question 28** many candidates chose option **A**, which was very close to the correct value. Although the density equation was reasonably well known for **Question 30**, several candidates forgot to subtract the mass of the empty box. Widespread confusion between speed and acceleration was evident in **Question 31**, with **C** being the most popular response. **Question 32** showed that convection was not generally understood clearly, but rather more widespread knowledge was evident of the meaning of wavelength in **Question 33**. Candidates found **Question 34** on lenses very taxing, with all distractors working well, and nearly half of the candidates failed to identify the correct equation for resistance in **Question 35**. Similarly just over half the responses to **Question 36** were incorrect, many lacking the knowledge that the current at every point in a series circuit is the same. The torch circuit diagram was more widely known, however, in **Question 37**, and **Question 38** on electrical safety was answered correctly by the majority of candidates. Although **Question 39** was a very common type of transformer item, it was not well answered, with many choosing option **A**, in which the numbers at first glance looked similar to the voltages. Candidates should be reminded to look at the ratios rather than the actual values. The most common misconception in **Question 40** was to confuse the penetrative abilities of alpha and beta-particles.

COMBINED SCIENCE

Paper 0653/02

Core Theory

General comments

There was evidence that the candidature did better this year. A number of very good scripts were seen, suggesting that, this year, more of the candidates than usual might have been better entered for Paper 3. However, there was still a substantial number of candidates scoring very low marks, leaving many questions unanswered or producing answers which suggested that they were unfamiliar with both the syllabus content and examination technique. The three Science disciplines generally provided challenge, although there was clear evidence that the candidates found the Chemistry questions harder. As usual, calculations in Physics were done well and candidates coped successfully with data interpretation. Candidates are still finding it difficult to produce clear answers to questions on environmental issues.

Comments on specific questions

Question 1

(a) This was well known by many candidates and full marks were very often awarded. Some candidates incorrectly gave the answer as *carbohydrates*.

(b) (i) In answering this question, candidates should have focused on describing what an enzyme is rather than concentrating on the finer detail of the function of specific enzymes. Key ideas which scored marks were that an enzyme is a protein which occurs inside the body and which acts like a catalyst.

(ii) Candidates needed to make a clear statement that people without amylase could not digest starch. Many talked too generally about food rather than starch. Many simply reworded the question without discussing processes such as absorption and respiration which would have gained marks.

(iii) Candidates should have discussed DNA, genes, chromosomes or mutation. It was insufficient to refer simply to inheritance, and references to bloodlines and disease were also not credited.

(iv) Candidates needed to relate their answer back to starch. Many gave good but irrelevant descriptions of the characteristics of carnivores or gave answers such as *dogs eat only meat* but to gain credit it had to be stated that dogs do not require starch in their diet.

Question 2

(a) (i) Most candidates correctly identified hydrogen as the element.

(ii) Candidates in general did not emphasise the role of sulfur dioxide in acid rain formation, or the fact that a chemical reaction with water is involved. Many simply listed all of the gases shown in the accompanying diagram and made vague statements about them all reacting together. It is important that candidates avoid using the term *mixing* when *reacting* is more appropriate. Hence phrases like *gases mix with rain* were not credited.

(b) (i) There was no real alternative to the required answer, *covalent*, and the question posed no problems for better candidates.

(ii) The displayed formula of carbon dioxide is one of those mentioned specifically in the syllabus and as such is always possible as a recall question. Many showed the required carbon and two oxygen atoms but with a central oxygen.

Question 3

(a) There was no particular pattern in the incorrect responses.

(b) This was well answered by many candidates. The most frequent incorrect response was the opposite idea that alpha *would* penetrate the paper. Some candidates overlooked that the question was about alpha specifically and discussed the characteristics of radiation generally.

(c) It was clear that many candidates had found the word *radiation* confusing and gave answers in terms of electromagnetic radiation. There were large numbers of vague references to *harm* or *illnesses*. Candidates needed to give details such as *radiation burns, cell damage and cell/DNA mutation and cancers.*

(d) Many candidates lost marks here because of answers which were too general and/or vague. Single phrases such as *safety equipment* or *use overalls*, do not convey enough knowledge of the specific problems associated with the handling of radioactive sources. There were very many references to the wearing of *radioactive suits*. Marks for answers containing this phrase were awarded if there was sufficient additional explanation that the suits were for protection or that they had to provide a barrier or shield. Suggestions that the technician simply *should not use sources* or that they should *keep them in a lead box at all times* or that they should not even be *in the same room as the source* are still regularly seen in answer to this type of question.

Question 4

This is a fairly common question and candidates continue to leave too much for the Examiner to read in to their answers. When asked to comment on how deforestation could affect soil erosion or species diversity, candidates should be advised that they will not receive full marks for simply stating that erosion will be increased or diversity decreased. Many candidates lost marks in this question because they did this.

(a) (i) Although some candidates mentioned these factors such as lack of leaf protection for the soil from rain and lack of support from tree roots, many answers were too vague or confused. The details of causes of increased erosion were generally not well expressed.

(ii) Marks were awarded here for references to disruption or destruction of habitat and food chains. Most candidates gained some credit.

(b) (i) This question was answered well and the majority of candidates gained some credit. Quite a large number of candidates drew detailed pictures of the organisms. This is not necessary and a questionable use of time in an examination. The most common error was the inversion of energy flow.

(ii) This was also answered very well. The most common errors were the idea that the rats were both producer and consumer, or the omission of either the rats or the owls.

Question 5

(a) (i) This general equation was not very well known. The most common error, of the many which were seen, was to suggest the term *base* as a product.

(ii) Any reasonable indication of hydrogen was accepted here, with H and H^+ both being accepted as alternatives. This question was not well answered.

(b) (i) A surprisingly large proportion of candidates did not give iron as the answer to this question. The incorrect answer which occurred most frequently was *carbon*.

(ii) Only a minority of candidates gained full marks here, despite the fact that this was a question requiring only recall. Some stated that a barrier of another metal was involved, although to gain credit they needed to specify zinc. Some gave descriptions of sacrificial protection which is beyond syllabus requirements but which was accepted as an alternative. The common errors included suggesting that galvanising increased the strength of steel or that it was done for cosmetic reasons.

(iii) Candidates needed to make a direct reference to a chemical process occurring be material of the tank and acids. General references to *damage* or *destruction* were not cred

(c) (i) The majority of candidates gave the required answer.

(ii) This is a fairly common question in this paper but was not answered as well as had been expected. Commonly seen answers, which did not score, included statements such as "because it is made by fractional distillation and because it burns to make carbon dioxide".

(iii) Only a very small minority of candidates understood what this question was asking them and many did not offer any suggestion. The question suggests that a simple diagram might help candidates to answer, but of those who attempted to do this, most drew confused versions of displayed polymer formulae which are beyond the syllabus. Any answer which suggested that the candidate knew that propene molecules join into long chains gained credit. Incorrect displayed formulae which implied this were credited where possible.

Question 6

In general, candidates understood the use of speed/time graphs very well and the majority did well in all parts of **(a)**.

(a) (i) The answer could be read with precision and so no margin of error was allowed in this case.

(ii) As in part **(a)(i)** no margin of error was allowed as the value could be easily read with precision.

(iii) Candidates could either state the graph sections **C** to **D** and **G** to **H** or state the numerical times, 60 s to 80 s and 140 s to 160 s.

(b) This question proved to be very challenging for the majority. The two marks were for reference to constant speed/velocity (*steady speed* was accepted), and that the relevant forces were balanced (*cancelled out* was accepted). The question asks for the motion of the *moving* motorcycle and so answers which suggested that it would be at rest were not accepted. Attempts to describe balanced forces using vague statements such as *the push is equal to the pull* could not be accepted. Nor could statements which stated that the forces were equal (a repetition of the question) without the essential qualification that they were equal *and opposite*.

(c) (i) A much lower number of candidates than anticipated gained any marks here. The two marks were for reference specifically to carbon monoxide and that this is a poisonous gas. The statement that the exhaust gases could *harm workers* was insufficiently specific to gain marks. Many candidates suggested that a build up of exhaust gases would cause an explosion or prevent the motorcycle engine from running.

(ii) Candidates did well with the energy transformations in this question. Relatively few failed to score and large numbers scored full marks. The term *potential* was not credited as an alternative to *chemical*. As a rule, candidates should be advised to specify the context of any potential energy type.

Question 7

In general, candidates had learned their plant cells very well and many scored high marks on this question. The most challenging part was **(c)(i)** and a common error in part **(b)** was to reverse the answers to parts **(i)** and **(ii)**.

(a) Candidates should be advised that labelling lines for the stoma should not stop on a guard cell.

(b) (i) Candidates should be advised to avoid phrases such as *the nucleus is the brain or headquarters of the cell* without going on to explain what they intend this to mean.

(ii) This posed no problems for those candidates who had learned the text-book answer. Some candidates suggested that the cell membrane *protects* the cell in various ways but no credit was awarded for this.

(c) (i) A reasonable number of candidates correctly made reference to the need for light in photosynthesis. This idea was then developed to the production of glucose or the combination of water and carbon dioxide. The role of water in providing turgor or support was an alternative answer but rarely seen.

(ii) The most common suggestion instead of the required answer, *xylem*, was *root hair cell*.

(d) (i) Most candidates answered this correctly, with *liquid* as the most common incorrect response.

(ii) The most common suggestions instead of the accepted answers, *diffusion* or *transpiration,* were *evaporation* and *osmosis*. This had been learned quite well across the ability range.

Question 8

(a) (i) The most common incorrect suggestion was *heat transfer*.

(ii) Candidates needed to make a direct, relevant and scientific reference to the properties of plastic in order to score the mark. Thus detailed discussions of the properties of metal or common knowledge statements such as *so it does not burn your hand* did not score. Any reasonable reference to poor heat energy transfer to or through plastic was sufficient.

(b) In matching the diagrams to states of matter in both parts of this question, candidates needed to focus on the particle arrangements. Discussion of assumed particle motion did not contribute to the award of marks. In general, candidates did well with both parts of the question. Weaker candidates interpreted the atom symbols as the vegetables which were cooking.

(c) (i) Many fully correct workings of this calculation were seen. The formula, density = mass/volume, was well known and clearly stated in many cases. Hardly any candidates gave the triangular proportionality mnemonic or used non-standard symbols, both of which had caused so many to lose marks in previous years. The use of the term *weight* instead of *mass* was penalised. An error carried forward from an incorrect calculation of volume was allowed.

(ii) Only a minority of candidates gave the correct answer. The most common type of incorrect answer contained order of magnitude errors.

Question 9

Marks were generally much lower for this question than any other on the paper. This is perhaps not surprising in that many marks required application of knowledge rather than factual recall.

(a) (i) Candidates often gave either **W** or **Y**, but both were required for credit. The carbonate test was reasonably well known and many correctly discussed the formation of carbon dioxide.

(ii) Many correctly identified rock **Y**, but only a minority stated the link between colour and the transition metal/copper. It was insufficient to give the simple statement *because it is green*.

(b) (i) Many candidates correctly suggested heating the mixture, but many others suggested processes unconnected with the diagram.

(ii) This question required candidates to bring different parts of the syllabus together and this was too challenging in most cases. Candidates tended not to pick up on the identity of black solid **Q** which rendered the question somewhat inaccessible. Candidates who suggested answers which were chemically correct or feasible were credited.

(iii) Very few candidates recognised redox as the reaction type. *Displacement* was accepted as an alternative but in this case the second mark required a sound discussion of relative reactivity.

(iv) Candidates did not find this question straightforward. It was essential that candidates clearly included the stage **2** product in their circuit diagrams, or at least implied it was there somewhere. In order to gain full marks, candidates had to give a circuit which would actually show that the stage **2** product was a conductor. Many omitted to include a cell in their circuit. Only a minority scored full marks.

COMBINED SCIENCE

Paper 0653/03
Extended Theory

General comments

Although some candidates showed good knowledge and understanding of most parts of the syllabus that were examined in this paper, there was also a large number who appeared to know very little at all. It was not uncommon for a candidate to earn marks of ten or below, most of which were given for very basic knowledge. Many of these ill-prepared candidates left large numbers of questions entirely unanswered.

Amongst those who were appropriately entered and well prepared for this paper, there were no particular questions that caused special difficulties. In general, they were able to understand the questions and to express themselves sufficiently clearly for the Examiners to be able to interpret their meanings. However, it is important that candidates understand that as this is a science examination, they should use appropriate terminology in their answers. For example, in **Question 7(a)**, the statement that animals would lose their 'homes' if the forest was cut down was not credited; the correct term 'habitat' was expected.

Numerous candidates spent time (and used up space) by rewriting the question before beginning to answer it. For example, an answer to **Question 2(b)** might begin: "An alpha source cannot be used to monitor the thickness of a paper sheet because...". This is not good examination technique. Candidates should understand that the answer space provided is for their answer, and there is no need to repeat the wording of the question.

In several places on this paper, candidates were asked a question that required a comparative answer. For example, in **Question 2(c)**, they were asked which sample would have the *highest* count rate, and in **Question 3(a)(ii)** why plume **A** would be *more* damaging. It is important that answers to such questions also include comparative statements. In **Question 2(c)**, for example, it is not enough to state that polonium-120 has a half-life of 138 days. The explanation needs to say that is has a *longer* half-life than the other isotopes.

Comments on specific questions

Question 1

(a) (i) Quite a few candidates failed to answer this question, possibly because they did not see it and went straight to the first set of answer lines. Most, however, were able to correctly label a palisade cell. The most common incorrect answer was a label to an epidermal cell, but xylem, phloem and guard cells were also sometimes chosen.

(ii) Many answers correctly stated that palisade cells need water because they photosynthesise, but few went further than that. Some also said that they required water for support, or to keep them turgid. However, many thought that palisade cells had something to do with water transport.

(b) (i) This was generally correctly answered, although many incorrectly suggested root hair cells.

(ii) Once again, this was usually correct. Wrong responses included transpiration, transportation, and active transport.

(c) (i) This was not well answered. Few candidates appeared to understand how and why affects the rate of transpiration. Many answers were in terms of how transpiration helps suggesting that the plant purposefully transpires more on a hot day to keep itself cool. Oth answers along the lines of 'Temperature makes the plant transpire more', without refer higher or lower temperature. Those who were credited for stating that higher temperatures resu higher rates of transpiration generally went on to use up the rest of the answer space by saying the same thing in reverse (that is, lower temperatures result in lower rates of transpiration) rather than attempting to give an explanation for this effect.

(ii) Similar problems occurred here. Answers commonly did not relate a rise or fall in temperature to an increase or decrease in the rate of water transport and, once again, those who did manage to do this then simply repeated the same idea in reverse rather than offering any explanation. Very few understood the role of transpiration in creating a pressure gradient that causes water to move up the plant. Many answers related to the *need* of the plant for more water at high temperatures, rather than explaining the cause of the faster rate of transport. Quite a few candidates wrongly equated high temperature with dry conditions, saying that the soil would dry up and so there would be less water to be transported.

Question 2

(a) Relatively few candidates were able to list these steps in the correct order.

(b) This was well answered, most candidates knowing that alpha radiation cannot pass through paper.

(c) (i) Many candidates correctly identified polonium-210. However, not all of these were able to give a valid reason for their answer. As explained above, it was not enough to say that polonium-210 has a half-life of 138 days; the candidate needed to make clear that this half-life is *longer* than those of the other isotopes in the list.

(ii) Many knew that alpha radiation is the most ionising, and therefore chose either polonium-210 or radon-222. However, some thought that gamma is the most ionising. Some gave answers in terms of the radiation given out, rather than the isotope, for example stating 'alpha because it is the most ionising'. This type of answer was given some, but not full credit. However, the answer 'alpha because it gives out the most ionising radiation' was not credited.

Question 3

(a) (i) There were numerous good answers to this question, but many candidates were unable to express themselves sufficiently clearly for the Examiners to be able to award credit. For example, answers such as 'Hydrogen is an element because it contains only one element' could not be credited, as you cannot explain the meaning of a term using an explanation that includes that term. Better answers stated that hydrogen is made up of only one type of atom, whereas the compounds contain more than one type of atom bonded together.

(ii) Relatively few candidates answered this well. It was very common for most of the components of volcano **A**'s plume to be listed, with no attempt to pick out a particular gas or gases that might be damaging to plants. Many suggested that carbon dioxide would harm plants, indicating a significant lack of knowledge or understanding. Once an answer homed in on sulfur dioxide, however, credit was often gained for reference to acid rain, and some candidates were also able to explain how acid rain is formed. Here, once again, a *comparative* answer was required, that is an answer that said clearly that there was *more* sulfur dioxide in the plume from volcano **A** than in the others. A significant number of candidates thought that SO_2 was sodium oxide.

(b) (i) Some answers showed the correct numbers of shared electrons, but the total number of electrons was often incorrect. Some did not show the chemical symbols of the elements, and of those that did there was sometimes one oxygen atom and two carbon atoms.

(ii) Most answers were correct.

(c) Most candidates were able to draw this atom correctly.

Question 4

(a) (i) This was generally well answered, though a wide range of incorrect suggestions we including fatty acids, amylase, starch, proteins, amino acids and bile.

(ii) This was poorly done, with most candidates incorrectly suggesting the stomach.

(b) (i) This was not easy, but many candidates were able to use the information given to explain that, when the allele is present with another allele, amylase is produced. Many, however, wrongly chose the last sentence of the paragraph as their reason, which does not provide any evidence that the allele is recessive.

(ii) This was very poorly answered. Although many were able to repeat the information that this person would not be able to digest starch, very few then moved on to give an explanation of why they would not be able to *obtain energy* from starch. Reference to absorption or respiration was rare. However, those who did understand the significance of digestion often gave excellent answers.

(iii) Many candidates were able to give at least partially correct answers here. Few were able to identify the child who does not produce amylase as the question asked. Candidates who chose the wrong genotype for the second parent lost credit, but could then gain marks for correctly deriving gametes and offspring genotypes from the two parents.

Question 5

(a) (i) Where candidates understood that the question was asking what the candidate would 'observe', they often gained credit for mentioning bubbles, effervescence or a gas. The statement that 'carbon dioxide is given off' was not credited, as the candidate would not know that the gas was carbon dioxide. Incorrect answers often suggested a colour change, or that salt and water would be formed.

(ii) Many candidates knew that transition metals form coloured compounds, and correctly chose **Y** and gave this reason. Some, however, thought that the metal itself was coloured green. Common incorrect responses chose rock sample **W** or **Z**, saying that metals are usually grey.

(b) (i) Relatively few answers were correct. Very many added oxygen as a reactant. It was also common for there to be no carbon dioxide on the right hand side of the equation.

(ii) Some candidates correctly suggested carbon. However, these were in the minority, and a very wide range of metals and non-metals, most of which are not black, were offered.

(iii) Most candidates who had given carbon as their answer in **(ii)** were able to get some credit for their balanced equation in this part. Wrong responses to **(ii)**, such as iodine, could be brought forward to here and earn marks if the candidate demonstrated that they could write a balanced equation involving a reasonable set of reactants and products. However, many wrote equations that bore no relationship to their answer to **(ii)**, involving a totally different substance which was often not an element at all.

(iv) In order to gain marks here, the candidates were required to give a statement that copper ions have a positive charge, and that negative charges must therefore be gained in order to produce an atom with no charge. Answers wrongly stating that they would lose or gain electrons to complete their outer shell were very common.

(c) The majority of candidates had great difficulty in following through any line of rea series of questions, and offered answers that bore no relationship to the information give

(i) Some candidates did at least offer answers that included sulfur, but relatively few correctly sulfuric acid.

(ii) The suggestions generally gave the appearance of being guesses. Many were not metals, such as carbon or sulfur. Many suggested copper. A wide range of metals was accepted, apart from alkali metals or any that are less reactive than copper.

(iii) Most answers gave one of the possible correct responses.

(iv) Most who had given a correct response in **(ii)** were able to state that the metal was more reactive than copper. However, this was relatively rare.

Question 6

(a) (i) Most appeared to be trying to read the correct value, but not all could read the scale on the graph and many gave incorrect answers. This was very clear on the graph, and answers such as 14.5 s were not credited.

(ii) This was also generally answered well. However, quite a few wrongly gave 50 s.

(iii) Most answered this correctly, generally using the letters on the graph, although some made it more difficult for themselves by giving the times.

(iv) The majority of candidates attempted to calculate the area under the graph. Some succeeded and were also able to state the correct unit. Many, however, could not carry out the calculation correctly. Some tried to use the equation distance = speed × time, which gave an incorrect answer. Some gave the unit as km instead of m.

(b) This was not well answered. Relatively few candidates were able to say that there was no resultant force, or that the two forces were equal and opposite, or that the two forces were balanced. Statements that there was 'no force' were not credited, and those that said the forces 'cancelled out' needed to offer a little more explanation. Many then suggested that the motorcycle would be stationary, rather than that it would travel at a steady speed. Some just said that its 'motion would be constant', which was not credited.

(c) This proved to be very difficult. Knowledge and understanding of centres of mass appeared to be very poor and in many cases completely lacking. Of those who did have some appreciation of the principles involved, most scored a mark for saying that the centre of mass is high and the area of the base small. It was very rare to give credit for an explanation of why this makes the motorcycle unstable.

(d) This, too, was not well done. Some had an idea that reciprocals were involved somewhere, but they often wrote that $R = 1/R_1 + 1/R_2$. If they did get the equation correct, they often failed to add the two fractions correctly, or to give the final answer for R rather than for 1/R. Some had learned the equation $R = R_1 \times R_2 / R_1 + R_2$ and this was credited, although just writing down "product / sum" was not. Some got this upside down. Many just added the two resistances. Some navigated their way successfully through all of this but then failed to give a unit with their answer.

Question 7

(a) (i) Many did have the idea that tree roots would no longer be present to hold the soil in place, and some also explained that rain would now be able to hit the soil directly, or that water would now be able to wash away the soil more easily. However, many answers were too vague to be credited, with no reference to roots, rain or water.

(ii) Many said that animals would lose their 'homes', but the Examiners were lookin scientific statement, such as reference to habitats or the requirement for a particu environment in which to live. Some candidates also correctly referred to the need of p types of food for animals, which might no longer be available, or to effects on food chains.

(b) (i) Many candidates were able to gain some credit here, for example by suggesting that not all the rats would eat the poison, or that other animals (including humans) might be harmed by it, or that the rats might develop resistance to the poison. However, very few were able to come up with more than one idea, often repeating the same idea in different words for their second suggestion. A very common incorrect answer was that the poison would 'damage the soil'. Some suggested that the oil palms might be harmed by it, and this was not credited. Candidates are expected to have some knowledge of the general problems associated with pest control using pesticides, and should have used this knowledge to make appropriate suggestions here.

(ii) The syllabus does expect candidates to learn about problems associated with biological control, and they should have been able to use this knowledge in this particular context. However, many appeared to be making wild guesses. Common answers that were not credited were that owls would eat the oil palms or that they would frighten the workers or make too much noise at night. Some did gain credit for suggesting that the owls could become pests themselves by feeding on other prey, or that the owls would not kill all of the rats.

Question 8

(a) This was quite often answered correctly, but radiation and convection occurred frequently.

(b) Credit was given here for calculating the volume of the block correctly, and for some candidates this was all that they did. Others were able to state the relationship between density, mass and volume and calculate a correct value, but of these many could not then give a correct unit. Some got the formula upside down, dividing volume by mass. Some put the decimal point in the wrong place.

(c) This was often answered well, quite frequently with the use of diagrams. However, some candidates did not make clear that they would measure the *volume* of water displaced, using terms such as 'amount'. If a measuring cylinder was used, then the Examiners were prepared to assume that it would be measuring volume. Some candidates were clearly trying to find density rather than simply measuring volume.

Question 9

Few candidates did well on this question. In some cases, this may have been at least partly because of a shortage of time, but in general the impression was that many candidates had little or no knowledge of this part of the syllabus.

(a) Some were able to draw two ethene molecules and then a section of a poly(ethene) molecule. In general, marks were more often awarded for the diagrams than for the written explanations, which often did not convey any points particularly clearly. However, very many did not follow the instruction to draw *two* ethene molecules. Most were completely unable to do so, and had no idea what a poly(ethene) molecule might look like.

(b) Some answers did refer to a colour change, although it was relatively rare for the original colour to be stated. Even fewer answers gave an explanation, which required reference to unsaturated compounds or to a double bond.

COMBINED SCIENCE

Paper 0653/04

Coursework

There were too few candidates to provide a meaningful report.

COMBINED SCIENCE

Paper 0653/05

Practical Test

General Comments

The overall standard of achievement was similar to previous years. Some candidates, presumably those with limited practical experience, had insufficient time to complete the questions, although many were not affected. Supervisors are asked to read the instructions carefully and ensure that all materials, particularly solutions, are prepared in strict accordance with the instructions.

Specific Comments

Question 1

Providing the specimens had been fully destarched, candidates had no difficulty with parts **(a)** to **(d)**. Marks were sometimes lost because drawings were poor, especially those drawn with a pen rather than a pencil. Labels were occasionally missing despite the instruction to label chlorophyll and starch. Some thought that water was missing in tube **B**, presumably failing to appreciate that it contained a solution of sodium hydroxide. A small minority stated the absence of carbon dioxide in tube **C** despite the labelling in Fig. 1.1. The majority either knew or deduced why sodium hydroxide solution was placed in tube **B**.

Question 2

For many this was a straightforward exercise and good marks were scored. For others it appeared difficult, with many failing to construct five suitable drawings. Nevertheless, many of these produced five sets of readings with no clue as to how these readings had been obtained. There were other instances of five sets of readings that did not correspond to the drawings. Penalties were applied in such instances. A surprising number did not state the refractive index. Graphs were generally very good and rarely were unsuitable scales chosen. The most important readings were for the two largest angles of incidence as these enabled a curve to be seen, although many still failed to draw a curve. Despite the instruction to draw a smooth curve many simply joined the points. Hardly any candidates included the origin. The majority were able to read off correctly.

Question 3

Answers to part **(a)** were very poor indeed. Far too many candidates thought a drop was in excess of 0.1 cm^3 and many reported volumes in excess of 1 cm^3. A drop from a dropping pipette should be 0.1 cm^3 or less. It was surprising to find such a variety of drop numbers, even within the same Centre. If the solutions were made exactly as instructed, the values should have been x cm^3, x/2 cm^3 and x/4 cm^3 . Even if the droppers were not producing drops of identical size, one would expect the values to be very close to those provided by the Supervisor. It was not uncommon for values for solution **A** to be in excess of 50, even greater than 100 in some cases, suggesting that the instructions for Supervisors were not carried out. In part **(d)** some explained their answer by saying it took a long time for **A** to become colourless. This was not an acceptable answer. If the experiment was carried out correctly, iron(II) would have been converted into iron(III) and the precipitate in **(e)** a definite brown, not green. Most reported a green colour in part **(f)** but it was essential to include the word precipitate. The required answer to part **(g)** was iron(II).

COMBINED SCIENCE

Paper 0653/06

Alternative to Practical

General comments

As usual, the answers to this examination revealed a wide range of abilities and practical experience amongst the candidates. Papers from those groups who had been well prepared by their teachers stood out as a result, especially in **Questions 1**, **2** and **5**. There were, however, whole Centres of candidates whose preparation did not include much laboratory work. These candidates were at a serious disadvantage compared to others who had spent time doing, or watching, experiments designed to show important scientific principles. Answers to the chemistry questions were rather disappointing.

Comments on specific questions

Question 1

(a) (i) Some candidates omitted to label the area of starch.

(ii) Answers of blue, black or blue-black were all credited.

(b) Few candidates mentioned the importance of the chlorophyll contained in the leaf. There was also much confusion about the photosynthesis reaction, which was variously said to cause the production of carbon dioxide, the breakdown of glucose and the breakdown of chlorophyll. The sodium hydroxide solution in tube **B** also caused some problems and some candidates wrote that no water was available so photosynthesis was impossible. Few candidates obtained full marks.

(c) (i) Tube **B** contained sodium hydroxide solution, the others contained water as a control substance. Few candidates gave the correct answer, showing that the idea of the control experiment is not well understood.

(ii) The next stage in the test was extraction of chlorophyll using alcohol. Many candidates said that the leaf was boiled “to remove the chlorophyll”. This was not accepted as an answer, since its real purpose was to break down the cell walls to facilitate entry of both the alcohol and the iodine solution.

Question 2

Confusion was caused by the inclusion of the data printed on the lamps which gave the recommended voltage and wattage for their use. Another problem arose in part **(c)** when candidates used the word “power” rather inaccurately in comments like “The lamp was supplied with too much power”. Despite the problems, many candidate gained full marks for this question.

(a) Most candidates were able to read and record the values, even though interpolation had to be used.

(b) (i) The equation $V = IR$ had to be rearranged to find R. This was difficult for a few candidates. If they failed to do this and suggested a wrong formula, this error was carried forward to parts **(ii)** and **(iii)**.

(ii) The numbers were not easy to divide without a calculator, so many candidates spent valuable time here.

(iii) Most candidates were able to gain all the marks for this part, and those who could not complete the calculations still gained some credit.

(c) Some candidates were able to suggest that the lamp filament had burned out beca... voltage had been applied, or its resistance was too low. Many candidates could not s... answer this question.

(d) (i) This was found to be the hardest part of the question.

(ii) A commendable number of candidates answered this correctly, showing that they understood the relationship between voltage, current and resistance.

Question 3

Most candidates gained a few marks for their answers to this question, but high marks were very rare.

(a) (i) To make a fair comparison of the three solutions, the same volumes must be used. A clue was given in the diagram of the experiment which showed a measuring cylinder. Despite this, a high percentage of candidates said that the same number of drops of solution **X** must be added each time.

(ii) To make all the reacting particles come into contact, the mixture must be stirred or shaken.

(iii) The description of the reaction of solution **X** with potassium permanganate is given in the first four lines of the question. A candidate who did not read this could not answer how the experimenter would know when to stop adding the drops of solution **X**, i.e. when the mixture became colourless. Some candidates wrote "when the mixture becomes clear", which could not be credited.

(iv) A surprising number of candidates chose the lowest number of drops to identify the most concentrated permanganate solution.

(b) Many candidates, who presumably had no laboratory experience, suggested delivering one drop into the 10 cm^3 measuring cylinder and reading off the volume.

(c) (i) The test for a sulfate was described and an observation asked for. This part was not answered well.

(ii) Any mention of "green" gained credit.

(d) (i) There were very few correct answers to this question, although "iron(III)" was sometimes given as the answer.

(ii) Some candidates were able to answer that the iron(II) ions are oxidised or they lose electrons.

Part **(d)** was even more poorly answered than part **(c)**

Question 4

(a) This was usually well done.

(b) The poorer candidates found it hard to locate the points on the vertical and horizontal axes because each subdivision did not correspond with the units of temperature or time. Two plotting errors were allowed before marks were deducted. There were many points to be plotted, and less able candidates lost time here.

(c) (i) Reference to the steeper gradient was needed, although other explanations were accepted.

(ii) The Examiners looked for the term "conduct" or "conduction" here. Surprisingly, some candidates wrote that copper is a good insulator, or a bad conductor.

(d) The answer needed here must refer to the experimental results, especially as the introduction to **Question 4** begins with a reference to elephants' ears. Those who ignored this made many allusions to the use of ears in listening for enemies and poachers, shading the body from the hot

sun and causing cooling breezes by flapping. This question was well answered candidates.

(e) Ways to make the experiment a fair test could include using the same volumes and temperat the hot water used and the same amount of insulation. A few other suggestions also gai marks.

Question 5

Many candidates were able to score well in this question, revealing that this was an experiment that they had seen or had carried out.

(a) (i) Candidates who had seen or had done this experiment found no difficulty in drawing the path of the light ray. Others did not first draw both of the straight lines through the positions of the locating pins, so the ray through the block was at an incorrect angle to the normal.

(ii) A normal must then be drawn at the point where the ray enters the block. Strictly, this should be at exactly 90° to the block, but the Examiners were less concerned about a slight inaccuracy.

(iii) Candidates who followed the example diagram found labelling easy.

(iv) Those who had drawn a poor diagram, and had no protractor, guessed at the dimensions of the angles, using the other data provided. However, if the candidates' data did not match the actual values of the angles on their diagram, no marks were awarded.

(b) Marks were lost if the scales of the axes were not correctly labelled, if the units (degrees or °) were missing, if any of the points were plotted incorrectly, or if the line through the points was unsatisfactory. Reversal of the axes was also penalised. Some candidates extended the line to the origin although instructed not to do so. Despite these errors, many candidates scored well here.

(c) The construction had to be shown on the graph to earn full marks. This instruction was ignored by many candidates.

Question 6

Even if a candidate had not used a Bunsen burner, most parts of the question could be answered by reference to the chemical reactions of alkanes.

(a) (i) Candidates should have been able to identify the soot as carbon and then suggest that this is caused by incomplete combustion of the butane. This question was badly answered.

(ii) Very few candidates were aware of the structure of the flame.

(b) (i) All that was needed was a statement that the sodium nitrate melts.

(ii) In flame **C**, the sodium nitrate decomposes. This was almost never given as the answer. Most candidates suggested that the sodium nitrate boils or vaporises, and did not go back to change this answer even if they answered part **(c)** correctly.

(c) Many candidates scored full marks for correctly describing the test for oxygen.

(d) The air hole introduces sufficient oxygen for complete combustion of the butane, so the maximum heat energy is liberated. Some candidates simply wrote that a blue flame is hotter than a yellow flame, for which no marks were awarded.

The answers to this question were disappointing. It is this kind of question that poorly-prepared candidates find most difficult.