COMBINED SCIENCE

Paper 0653/11
Multiple Choice 11

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

Comments on individual questions (Biology)

All questions made a significant contribution to the candidates' overall performances, with none proving either unacceptably difficult or easy. Some areas of fundamental confusion were, however, exposed.

Question 1 the significance of the total permeability of the cell wall as opposed to the partial permeability of the cell membrane was not appreciated by a third of the candidates.

Question 2 problems here were associated with applying knowledge of chemistry to a biology question, since over 60% of candidates appeared to believe that either starch or chlorophyll (or both) are soluble in water, and thus diffusible within plant tissues.

Question 3 there is always a confusion between the tests for oxygen and for hydrogen. This is a possible explanation for almost half the candidates believing that the gas released when catalase breaks down hydrogen peroxide is hydrogen.

Question 5 this question exposed those candidates who had not learnt the functions of the two vitamins mentioned in the syllabus – C and D. Over a third felt that vitamin C is needed to prevent deformity of bones.

Question 6 candidates are required to know the functions of cilia, but this question suffered from a quarter of them, including a number of candidates who, otherwise, performed well on the paper, failing to recognise the extensions on the cells shown as cilia.

Question 11 the ways in which different forms of birth control operate was a disturbingly hazy area for a quarter of the candidates, who thought that the rhythm method prevents ovulation and that a condom prevents sperm *release*.

Comments on individual questions (Chemistry)

Questions 15, **19**, **20**, **21** and **24** proved to be the most difficult with less than half of the candidates selecting the correct answer.

Question 16 proved particularly straightforward with the majority of candidates selecting the correct answer.

Question 14 many candidates took note of mixture but did not realise that these diagrams showed compounds.

Question 15 a number of candidates remembered that, in general, ionic compounds have high melting points but failed to realise that other compounds also have high melting points.

Question 19 a significant number of candidates clearly linked purification of water with distillation, though it would be far too costly to distil the relatively pure water from reservoirs.

Question 22 candidates clearly though a bulb was necessary as they had used one and so picked the beaker.

Question 26 soot is, sometimes, seen but the purpose of the apparatus is to condense and collect water.

Question 27 a number of candidates appeared to have counted gasoline and petrol as two separate fuels (ignoring the brackets).

Comments on individual questions (Physics)

Question 28 required a volume calculation, also changing from centimetres to metres, this caused difficulty for some.

Question 29 was direct recall, although many candidates believed weight to be measured in kilograms.

Question 30 almost one in three responses was **A**, these candidates not noticing that the speed did not start at zero.

Question 31 the most popular distractor was **B**, probably because a great deal of energy is released quickly in an explosion. This item needed careful thought, and was found very difficult by many.

Question 32 was better answered, with the most common mistake being the choice of option **C**, which would have been correct had the water been pumped up into the section where it was trapped.

Question 33 the most popular distractor was **C**, these candidates failing to appreciate that identical resistors in parallel would have less resistance than a single resistor.

Question 35 on transformers was found more difficult than **Question 34** which was on fuses.

Question 36 was on kinetic theory and states of matter, was well answered.

Question 37 showed evidence of widespread guessing, many candidates being unaware that heat can only be transferred through a vacuum by radiation.

Question 38 candidates were required to spot a ray whose direction could not be predicted after refraction; many opted for **C**.

Question 39 showed oscilloscope traces, many candidates chose option **B**, presumably linking high pitch to a high amplitude rather than to close spacing on the x-axis.

Question 40 was well known.

COMBINED SCIENCE

Paper 0653/12
Multiple Choice 12

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

Comments on individual questions (Biology)

All question made a significant contribution to the candidates' overall performances, with none proving either unacceptably difficult or easy. Some areas of fundamental confusion were, however, exposed.

Question 1 the significance of the total permeability of the cell wall as opposed to the partial permeability of the cell membrane was not appreciated by one fifth of the candidates.

Question 3 problems here were associated with applying knowledge of chemistry to a biology question, since a half of candidates appeared to believe that either starch or chlorophyll (or both) are soluble in water, and thus diffusible within plant tissues.

Question 5 there is always a confusion between the tests for oxygen and for hydrogen. This is a possible explanation for 40% the candidates believing that the gas released when catalase breaks down hydrogen peroxide is hydrogen.

Question 6 candidates are required to know the functions of cilia, but this question suffered from a third of them, including a number of candidates who, otherwise, performed well on the paper, failing to recognise the extensions on the cells shown as cilia.

Question 7 this question exposed those candidates who had not learnt the functions of the two vitamins mentioned in the syllabus – C and D. More than a fifth felt that vitamin C is needed to prevent deformity of bones.

Question 13 the ways in which different forms of birth control operate was a disturbingly hazy area for 40% of the candidates, who thought that the rhythm method prevents ovulation and that a condom prevents sperm *release*. Significantly, it was those who showed themselves to be less able that were uncertain of their facts.

Comments on individual questions (Chemistry)

Question 14 proved particularly straightforward with the majority of candidates selecting the correct answer.

Questions 18 and **23** proved to be the most difficult with less than half of the candidates selecting the correct answer.

Question 18 candidates clearly linked purification of water with distillation, though it would be far too costly to distil the relatively pure water from reservoirs.

Question 21 candidates correctly chose a method of extracting a metal from its oxide but chose the wrong one.

Question 25 candidates realised that combustion was involved but became confused concerning the second process.

Comments on individual questions (Physics)

Question 28 was on kinetic theory and states of matter, was well answered.

Question 29 showed evidence of widespread guessing, many candidates being unaware that heat can only be transferred through a vacuum by radiation.

Question 30 the most popular distractor was **B**, probably because a great deal of energy is released quickly in an explosion. This item needed careful thought, and was found very difficult by many.

Question 31 was better answered, with the most common mistake being the choice of option **C**, which would have been correct had the water been pumped up into the section where it was trapped.

Question 32 the most popular distractor was **C**, these candidates failing to appreciate that identical resistors in parallel would have less resistance than a single resistor.

Question 34 on transformers was more difficult than **Question 33** which was on fuses.

Question 35 almost one in three responses was **A**, these candidates not noticing that the speed did not start at zero.

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COMBINED SCIENCE

Paper 0653/13
Multiple Choice 13

Question Number	*Key*	*Question Number*	*Key*
1	**B**	21	**C**
2	**D**	22	**C**
3	**B**	23	**D**
4	**B**	24	**C**
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8	**C**	28	**C**
9	**A**	29	**A**
10	**C**	30	**D**
11	**A**	31	**D**
12	**D**	32	**B**
13	**C**	33	**D**
14	**D**	34	**D**
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16	**D**	36	**C**
17	**B**	37	**B**
18	**C**	38	**A**
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Comments on individual questions (Biology)

All question made a significant contribution to the candidates' overall performances, with none proving either unacceptably difficult or easy. Some areas of fundamental confusion were, however, exposed.

Question 1 the significance of the total permeability of the cell wall as opposed to the partial permeability of the cell membrane was not appreciated by one fifth of the candidates.

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Question 38 showed oscilloscope traces, many candidates chose **B**, presumably linking high pitch to a high amplitude rather than to close spacing on the x-axis.

Question 39 required candidates to spot a ray whose direction could not be predicted after refraction; many opted for **C**.

Question 40 was well known.

COMBINED SCIENCE

Paper 0653/21

Core Theory 21

General comments

Almost all candidates appeared to have been appropriately entered for this Paper, with only a very small number indicating that they may have capable of a fair performance on Paper 3. Many had poor English language skills, which often meant that they did not understand what a question was asking, or were unable to express their answer in a way that an Examiner could understand.

Many candidates left numerous question sections unanswered.

Comments on specific questions

Question 1

(a) It was quite rare for all three answers to be correct. 'Community' and 'habitat' were often confused, as well as 'habitat' and 'ecosystem'. 'Population' was sometimes confused with 'community'.

(b) This was often well answered. The most frequent error was to include organisms other than those required by the question, such as bream or insect larva. This inevitably led to problems, as there was no information about what these animals eat. Another common error was to show herons eating pike, or pike eating herons. Some candidates drew the food web correctly but then either omitted arrowheads, or showed them pointing in the wrong direction.

(c) Most candidates thought of at least one reason – generally the lack of food – but most then went on to repeat this same idea for their second reason. However, some did also mention lack of oxygen.

(d) (i) Relatively few candidates knew that the cell membrane controls what enters or leaves the cell, with many giving the wrong answer **E** (nucleus). Another common error was to place photosynthesis in the cytoplasm.

(ii) This was a little more difficult than **(i)**, but many candidates were able to give two correct differences.

Question 2

(a) This was not at all well known, and only a very small proportion of candidates gave a correct response. A very common error was to name a metal, such as aluminium or lead, which candidates presumably associated with the three types of radiation (and the ability to which the radiation could penetrate the metal). Others just invented a name, such as 'radiation meter'. Many left this blank.

(b) This was much better known, with most candidates able to state one hazard, and some able to give two. Quite a few, however, did not understand the term 'hazard' and listed two types of radiation, generally taken from the ones named at the start of the question.

(c) (i) This was quite well known. A common error was to put more than one tick in one or both of the rows.

(ii) This, too, was quite well known.

Question 3

(a) (i) The commonest answer was 'hard', which was not credited. The most frequently seen correct responses were that metals conduct electricity or that they have high melting points.

(ii) This was slightly better answered than **(i)**, with many candidates able to say that sodium would be too reactive, or that it would not be strong enough.

(b) (i) Most candidates struggled with this. A small number were able to explain why the equation was balanced, but most did not understand the meanings of the numbers in front of and within formulae.

(ii) A high proportion of candidates did not attempt to answer this question. Of those who did, only a very small number gave a formula, and only a small proportion of those were correct. Some gave Fe, which itself was not credited, but if the answer then went on to explain that oxygen had been removed from something, the second part of the answer could be given a mark.

(c) (i) The most common answer was 'covalent'. Relatively few candidates knew that ionic bonding is found in this compound.

(ii) Very few correct answers were seen to this question. It was often left unanswered. Of those who did attempt it, many read 'electrolyte' as 'electrolysis'. The term 'electrolyte' is italicised in the syllabus, indicating that candidates are expected to be able to define it.

(iii) Most incorrectly answered 'heat' or 'thermal energy'.

(iv) This was better answered, although many suggestions were not metals at all. Quite a few of the weaker candidates gave one of the metals already dealt with in the question, that is iron or aluminium.

Question 4

(a) (i) This was generally well answered, with most candidates able to label and name the brain.

(ii) Many candidates were able to give a suitable word such as 'nerves' to fill the first space, but fewer gave 'effector', 'muscle' or 'gland' for the second space. The most common incorrect response for the first space was 'spinal cord', and the most common incorrect response for the second space was 'brain'.

(b) This was not at all well known, with only very few candidates knowing the term 'endocrine'. Most attempted to name a particular gland, such as pancreas, adrenal gland, ovary or testis.

(c) (i) Relatively few candidates knew where the pancreas is situated. It was commonly shown where the ovaries or testes might be, or on the wrong side of the body.

(ii) This was quite well known.

(iii) This, too, was quite well answered.

(iv) Many candidates were able to associate blood sugar level with energy, but very few mentioned respiration.

Question 5

(a) The expected answer was 'vibrating particles'. However, it was rare to see either of these two words. Some gave no impression of understanding how sound travels, sometimes appearing to confuse sound waves with the ripples that spread out from a disturbance in the water surface. Some gave uninformative answers, such as 'the same way it travels through air'.

(b) (i) This was usually answered correctly. A few of the weaker candidates, especially those who left most answer spaces blank, simply wrote 'yes'.

(ii) This was quite well answered, and many candidates did an entirely correct calculation, showing their working. Some spoilt their answer by writing 'm/s' after their answer; the unit had already been given.

(c) (i) Surprisingly few candidates were able to name a suitable piece of apparatus for measuring the volume of a liquid. The most common answer was 'ruler', with 'beaker' and 'test-tube' also appearing frequently. These latter were acceptable as long as there was some indication that they were calibrated – e.g. 'graduated test-tube'. The expected answer, measuring cylinder, was seen only very rarely.

(ii) Many candidates gave the same answer here as for **(i)**, and once again correct answers were surprisingly rare.

(iii) A reasonable proportion of candidates knew that mass and volume were somehow involved here, but they were often multiplied together, or volume was divided by mass.

Question 6

(a) (i) This was well answered.

(ii) This was very poorly answered. Quite a few candidates did not even name halogens, apparently not having read the sentence at the start of the question. In most answers, names of halogens appeared to have been arranged fairly randomly, with only a very small number indicating any understanding of the relevant part of the syllabus, in which it is stated that they should be able to describe the trend in state of the Group VII elements. Although candidates are only expected to know chlorine, bromine and iodine, answers that included astatine or fluorine could, of course, also be accepted.

(b) (i) This was generally answered correctly, although there were many candidates who thought that electrons are found in the nucleus.

(ii) Most gave the wrong answer '9', but better candidates correctly subtracted 9 from 19 and gave the answer 10.

(c) A high proportion of candidates knew that chlorine 'kills germs', but very few were able to build on this to obtain a second mark, such as saying that this reduces disease.

Question 7

(a) This was usually answered correctly, although a few candidates gave the glasshouse instead of the temperature.

(b) Some candidates did appreciate that convection (specifically required by the question) involves movement of air, and often got at least one mark awarded for the idea that the warm air is trapped inside the glasshouse. However, most answers did not refer to convection or air at all. Almost none made any statement relating to what happened to the air outside.

(c) Only a very few candidates related the presence of bees to pollination (or fertilisation), apparently not having read or understood the information in the first sentence of this question part. Those who did usually gained both marks.

(d) This was quite well answered, with many candidates able to think of at least one possible factor.

Question 8

(a) (i) This was surprisingly poorly known. Few candidates gave two percentages within an acceptable range. Many got them the wrong way round, but most had no idea.

(ii) This was much better answered.

(b) (i) Few candidates were able to write this formula.

(ii) Many correctly mentioned acid rain, and these sometimes went on to describe the problems this can cause. A few were distracted by recent events, and described dust clouds and their effects on aircraft, which was not relevant.

(**c) (i)** This was rather better answered than the other 'bonding' question, **3(c)(i),** but still only a minority of candidates gave a correct response.

(ii) Quite a few answers correctly showed a central carbon with an oxygen on either side, but very few of these showed double bonds between them. Many tried to draw much more complicated diagrams, not using the help that had been provided to them with the formula of the water molecule. Many drew hydrocarbons or other inappropriate molecules.

Question 9

(a) (i) This was well answered.

(ii) This, too, was often answered correctly.

(b) (i) Candidates who knew the formula were generally able to do the calculation correctly.

(ii) A surprising number of candidates struggled with this. Some did correctly give 'kinetic' or 'movement' for the first space, but relatively few gave an appropriate type of energy for the second space. 'Potential' was frequently seen in both spaces.

(c) (i) Only about one third of the candidates knew the term 'series'.

(ii) This was generally answered correctly, although some made things complicated by trying to calculate the sum of the resistances as though they were in parallel.

(d) This was very poorly answered, with only a small minority of candidates showing any understanding of the principle of moments. Most answers related to it being easier to hold the longer spanner.

COMBINED SCIENCE

Paper 0653/22
Core Theory 22

General comments

This candidature for this Paper appeared to have been appropriately entered. Very few candidates gave performances that indicated they would have been able to do at all well on Paper 3. English skills were often weak, and this undoubtedly affected the ability of some candidates to understand and answer the questions appropriately.

Many candidates left most of their papers blank.

Comments on specific questions

Question 1

(a) Most candidates were able to select at least one characteristic, 'excretion' being the one most frequently chosen. However, not many chose the two correct ones.

(b) (i) The term 'tissue' is not at all well known.

(ii) Quite a few candidates gave two correct differences here, stating that these cells have a cell wall and a large vacuole. Others wrongly mentioned chloroplasts. Some, however, just wrote 'cell wall', so that it was not clear whether these cells had one and animal cells did not, or vice versa.

(c) Very few candidates gave answers that indicated they understand that nutrient molecules must be broken down before they can be taken into the body through the wall of the alimentary canal.

(i) This was very poorly answered. Few candidates indicated that they knew the meaning of the term 'digestion', or why this has to happen.

(ii) Better candidates were able to explain that teeth break large pieces of food into small ones, and that enzymes break large molecules into small ones. However, on the whole this was not well answered, with few statements that could be credited at all.

Question 2

(a) (i) This was not well known.

(ii) Most candidates were able to answer this correctly, although quite a few gave the name rather than the symbol of germanium. The most common incorrect answer was sulfur.

(b) Most candidates gave two correct elements, with many getting all three right. Common errors were to give iron in the first space, and nitrogen or xenon in the last space.

(c) (i) This was quite well answered. Many answers referred to the flame, and some also to the clouds of white particles. However, several also mentioned the 'container full of chlorine gas'. Some confused the chlorine gas with the clouds of white particles, thinking that these were a gas – despite the statement that they were 'made of a white solid'.

(ii) Many of the better candidates were able to answer this correctly. Many, however, struggled, and wrote equations that included other reactants such as water or sulfur dioxide. Some gave 'potassium chlorine' as the name of the compound, rather than 'potassium chloride'. Some tried to write balanced equations.

(iii) This proved to be very difficult. Few candidates were able to make any correct statements about the difference between a mixture and a compound, and it was very rare to see any success in relating the answer to the particular example given.

Question 3

(a) (i) This was often answered well. However, many answers included examples that are not electromagnetic radiation, such as alpha radiation or beta radiation.

(ii) Most were able to get one mark here, but it was quite rare to give two marks. Many answers were too vague to be credited, for example saying that the radiation would 'kill cells'.

(b) (i) Surprisingly few candidates knew that the mass would remain the same on the Moon as on Earth.

(ii) Some candidates did know that the weight of the astronaut on Earth would be greater than on the Moon. Some correctly calculated the values, but then sometimes spoilt their answer by giving the units as kg.

(c) Some reference to particles, vibration or rarefaction and compression was expected, but it was uncommon to see any of these.

(d) A good proportion of candidates recognised that they needed to multiply 6 N by 2 metres, and some also gave a formula using recognisable and appropriate symbols.

Question 4

(a) (i) About half of the candidates answered this correctly. The two wrong answers, amount of water and temperature, were chosen by approximately equal numbers.

(ii) Many candidates simply described what happened in each tube, rather than pulling out the required conclusion from the results given. Most of those who did attempt to do the right thing were able to say that water was needed, and many also referred to temperature. It was relatively rare to see mention of oxygen or air. Several wrongly stated that light was required for germination.

(b) (i) This was a challenging question, and relatively few candidates were able to make a suitable suggestion. Of those who did, most related to the ability of the seedlings to photosynthesise, while others gave a description that implied reduction in competition.

(ii) About one third of the candidates answered this correctly.

(c) (i) Where candidates appreciated that species diversity refers to the number of *different kinds of* animals, rather than just more animals, they often gained two marks here. However, this was not often seen, with most simply saying that if there were more plants then they would supply food for more animals.

(ii) This was often quite well answered, although not many gained all three marks. Numerous candidates referred to soil erosion and global warming, with some also mentioning effects on rainfall.

Question 5

(a) (i) Most candidates were able to select a fossil fuel, most choosing coal. The most common incorrect choice was animal dung. Suitable explanations, however, were less frequent. Many said that this was because coal (or methane) is not renewable.

(ii) A small majority of candidates selected the correct molecule, but once again correct explanations were rarely seen. All of the alternatives featured quite frequently, except CO.

(b) This was well answered. The most common error was to use the term 'catalytic cracking' rather than 'fractional distillation'. Weaker candidates often showed that they had no knowledge of this at all, choosing terms such as 'filtered' and 'colours'.

(c) (i) Where a candidate realised that this was asking about the test for carbon dioxide, they generally got both marks. Many, however, did not make this deduction and suggested that the liquid was water. Their observation was generally that 'there were bubbles'.

(ii) This proved very difficult, with only a few candidates getting the mark. The expected answer was that the ethanol has reacted with oxygen. However, many made it much more complicated by attempting to describe the loss or gain of electrons. Some simply said that 'combustion needs oxygen', which is not sufficient. Many thought that it *produces* oxygen.

Question 6

(a) (i) About two thirds of candidates were able to name a suitable piece of apparatus for measuring the length of a cube.

(ii) The great majority of candidates answered this correctly.

(iii) This was also well answered. Errors in **(ii)** could be carried forward to here without further penalty.

(b) Although most candidates could draw a suitable diagram to represent the particles in a gas, correct diagrams for a liquid were hardly even drawn. The particles in a liquid should be shown to be randomly arranged, but with most particles touching. The majority of diagrams showed no touching of particles at all.

(c) (i) This was very poorly known. Most candidates thought that the particles themselves would get bigger.

(ii) This, too, was very poorly answered. Many described how the metal might melt. Some just said that if the metal got very hot it would be dangerous to touch it. Very few suggested a particular problem, such as might be caused by the expansion of railway lines or the metal components of a bridge.

Question 7

(a) This was quite often answered correctly. However, most answers were not entirely correct, often including water instead of hydrogen. Quite a few simply rewrote the reactants in the empty boxes.

(b) (i) About one third of answers were correct, making some reference to the shorter time taken to collect the gas. Of the remainder, many tried to suggest *why* the reaction rate was higher in experiment **2**.

(ii) This was answered less well than might have been expected. Some candidates did correctly suggest increasing the surface area of the magnesium, heating the reactants or using more concentrated hydrochloric acid, but they were in the minority.

(iii) This was rather better answered than **(ii)**. Many had the idea that sodium would be very reactive, and made reference to danger. A surprising number, however, suggested that it would not react at all.

Question 8

(a) (i) Some of the better candidates answered this very well, stating the formula, showing working clearly and giving the correct unit with their answer. Some managed part of this, for example giving the answer with no unit, or giving the correct unit even though the calculation was wrong.

(ii) About two thirds of the candidates answered this correctly. Of the remainder, most simply reversed the positions of ammeter and voltmeter, but some added new branches to the circuit or even drew a different circuit in the space underneath the question.

(b) This was well answered, with many candidates getting all four terms correct.

Question 9

(a) (i) This was not at all well known. Few candidates knew that the muscle contracts, or that it produces the 'pumping' action that pushes blood through and out of the heart. There was much reference to 'protection'.

(ii) Only a very small number of candidates knew the term 'coronary arteries'. About one quarter of candidates made no attempt to answer.

(iii) About half of the candidates correctly identified **A** and **D** as containing oxygenated blood. Some gave combinations of vessels from the left and right sides of the heart. Some gave names instead of letters, as asked.

(b) (i) While some candidates did know the meaning of the term 'transpiration', quite a few confused it with the *uptake* and *transport* of water within a plant. In general, this was very poorly known.

(ii) This was much better answered. Frequent incorrect answers included 'stem' and 'root'.

COMBINED SCIENCE

Paper 0653/23
Core Theory 23

General comments

This candidature for this Paper appeared to have been appropriately entered. Very few candidates gave performances that indicated they would have been able to do at all well on Paper 3. English skills were often weak, and this undoubtedly affected the ability of some candidates to understand and answer the questions appropriately.

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Comments on specific questions

Question 1

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(ii) Quite a few candidates gave two correct differences here, stating that these cells have a cell wall and a large vacuole. Others wrongly mentioned chloroplasts. Some, however, just wrote 'cell wall', so that it was not clear whether these cells had one and animal cells did not, or vice versa.

(c) Very few candidates gave answers that indicated they understand that nutrient molecules must be broken down before they can be taken into the body through the wall of the alimentary canal.

(i) This was very poorly answered. Few candidates indicated that they knew the meaning of the term 'digestion', or why this has to happen.

(ii) Better candidates were able to explain that teeth break large pieces of food into small ones, and that enzymes break large molecules into small ones. However, on the whole this was not well answered, with few statements that could be credited at all.

Question 2

(a) (i) This was not well known.

(ii) Most candidates were able to answer this correctly, although quite a few gave the name rather than the symbol of germanium. The most common incorrect answer was sulfur.

(b) Most candidates gave two correct elements, with many getting all three right. Common errors were to give iron in the first space, and nitrogen or xenon in the last space.

(c) (i) This was quite well answered. Many answers referred to the flame, and some also to the clouds of white particles. However, several also mentioned the 'container full of chlorine gas'. Some confused the chlorine gas with the clouds of white particles, thinking that these were a gas – despite the statement that they were 'made of a white solid'.

(ii) Many of the better candidates were able to answer this correctly. Many, however, struggled, and wrote equations that included other reactants such as water or sulfur dioxide. Some gave 'potassium chlorine' as the name of the compound, rather than 'potassium chloride'. Some tried to write balanced equations.

(iii) This proved to be very difficult. Few candidates were able to make any correct statements about the difference between a mixture and a compound, and it was very rare to see any success in relating the answer to the particular example given.

Question 3

(a) (i) This was often answered well. However, many answers included examples that are not electromagnetic radiation, such as alpha radiation or beta radiation.

(ii) Most were able to get one mark here, but it was quite rare to give two marks. Many answers were too vague to be credited, for example saying that the radiation would 'kill cells'.

(b) (i) Surprisingly few candidates knew that the mass would remain the same on the Moon as on Earth.

(ii) Some candidates did know that the weight of the astronaut on Earth would be greater than on the Moon. Some correctly calculated the values, but then sometimes spoilt their answer by giving the units as kg.

(c) Some reference to particles, vibration or rarefaction and compression was expected, but it was uncommon to see any of these.

(d) A good proportion of candidates recognised that they needed to multiply 6 N by 2 metres, and some also gave a formula using recognisable and appropriate symbols.

Question 4

(a) (i) About half of the candidates answered this correctly. The two wrong answers, amount of water and temperature, were chosen by approximately equal numbers.

(ii) Many candidates simply described what happened in each tube, rather than pulling out the required conclusion from the results given. Most of those who did attempt to do the right thing were able to say that water was needed, and many also referred to temperature. It was relatively rare to see mention of oxygen or air. Several wrongly stated that light was required for germination.

(b) (i) This was a challenging question, and relatively few candidates were able to make a suitable suggestion. Of those who did, most related to the ability of the seedlings to photosynthesise, while others gave a description that implied reduction in competition.

(ii) About one third of the candidates answered this correctly.

(c) (i) Where candidates appreciated that species diversity refers to the number of *different kinds of* animals, rather than just more animals, they often gained two marks here. However, this was not often seen, with most simply saying that if there were more plants then they would supply food for more animals.

(ii) This was often quite well answered, although not many gained all three marks. Numerous candidates referred to soil erosion and global warming, with some also mentioning effects on rainfall.

Question 5

(a) (i) Most candidates were able to select a fossil fuel, most choosing coal. The most common incorrect choice was animal dung. Suitable explanations, however, were less frequent. Many said that this was because coal (or methane) is not renewable.

(ii) A small majority of candidates selected the correct molecule, but once again correct explanations were rarely seen. All of the alternatives featured quite frequently, except CO.

(b) This was well answered. The most common error was to use the term 'catalytic cracking' rather than 'fractional distillation'. Weaker candidates often showed that they had no knowledge of this at all, choosing terms such as 'filtered' and 'colours'.

(c) (i) Where a candidate realised that this was asking about the test for carbon dioxide, they generally got both marks. Many, however, did not make this deduction and suggested that the liquid was water. Their observation was generally that 'there were bubbles'.

(ii) This proved very difficult, with only a few candidates getting the mark. The expected answer was that the ethanol has reacted with oxygen. However, many made it much more complicated by attempting to describe the loss or gain of electrons. Some simply said that 'combustion needs oxygen', which is not sufficient. Many thought that it *produces* oxygen.

Question 6

(a) (i) About two thirds of candidates were able to name a suitable piece of apparatus for measuring the length of a cube.

(ii) The great majority of candidates answered this correctly.

(iii) This was also well answered. Errors in **(ii)** could be carried forward to here without further penalty.

(b) Although most candidates could draw a suitable diagram to represent the particles in a gas, correct diagrams for a liquid were hardly even drawn. The particles in a liquid should be shown to be randomly arranged, but with most particles touching. The majority of diagrams showed no touching of particles at all.

(c) (i) This was very poorly known. Most candidates thought that the particles themselves would get bigger.

(ii) This, too, was very poorly answered. Many described how the metal might melt. Some just said that if the metal got very hot it would be dangerous to touch it. Very few suggested a particular problem, such as might be caused by the expansion of railway lines or the metal components of a bridge.

Question 7

(a) This was quite often answered correctly. However, most answers were not entirely correct, often including water instead of hydrogen. Quite a few simply rewrote the reactants in the empty boxes.

(b) (i) About one third of answers were correct, making some reference to the shorter time taken to collect the gas. Of the remainder, many tried to suggest *why* the reaction rate was higher in experiment **2**.

(ii) This was answered less well than might have been expected. Some candidates did correctly suggest increasing the surface area of the magnesium, heating the reactants or using more concentrated hydrochloric acid, but they were in the minority.

(iii) This was rather better answered than **(ii)**. Many had the idea that sodium would be very reactive, and made reference to danger. A surprising number, however, suggested that it would not react at all.

Question 8

(a) (i) Some of the better candidates answered this very well, stating the formula, showing working clearly and giving the correct unit with their answer. Some managed part of this, for example giving the answer with no unit, or giving the correct unit even though the calculation was wrong.

(ii) About two thirds of the candidates answered this correctly. Of the remainder, most simply reversed the positions of ammeter and voltmeter, but some added new branches to the circuit or even drew a different circuit in the space underneath the question.

(b) This was well answered, with many candidates getting all four terms correct.

Question 9

(a) (i) This was not at all well known. Few candidates knew that the muscle contracts, or that it produces the 'pumping' action that pushes blood through and out of the heart. There was much reference to 'protection'.

(ii) Only a very small number of candidates knew the term 'coronary arteries'. About one quarter of candidates made no attempt to answer.

(iii) About half of the candidates correctly identified **A** and **D** as containing oxygenated blood. Some gave combinations of vessels from the left and right sides of the heart. Some gave names instead of letters, as asked.

(b) (i) While some candidates did know the meaning of the term 'transpiration', quite a few confused it with the *uptake* and *transport* of water within a plant. In general, this was very poorly known.

(ii) This was much better answered. Frequent incorrect answers included 'stem' and 'root'.

COMBINED SCIENCE

Paper 0653/31
Extended Theory 31

General comments

The examination produced a very wide range of marks. At the high end, there were a few excellent scripts from candidates who had clearly mastered all aspects of the syllabus, and who had been very well briefed on details of effective examination technique. Almost 13% of the candidates scored a fifth or less of the available marks, and may have been more appropriately entered for Paper 2. Overall, the candidates had learned the three sciences in equal measure but tended to find some aspects of biology and chemistry to be very challenging. Calculations in physics tended to be tackled successfully even by candidates who found it difficult to score well in most other parts of the paper. However, it was evident that candidates of all abilities found radioactivity challenging. There was no evidence that candidates had any difficulty in completing the paper in the available time. In fact it was noteworthy that many candidates had time enough to write lengthy, answers which often contained far too many unnecessary words and phrases including the quite unnecessary practice of rewriting large sections of the question stem. Colleagues should try to dissuade candidates from doing this. Candidates should be aware that the mark allocation and the number of lines given for each question is a guide to how much they should be writing.

Comments on specific questions

Question 1

(a) Award of full marks was relatively uncommon. Common incorrect answers were ‘population’ and ‘habitat’ for the two answers respectively.

(b) Most candidates scored at least one mark. Common errors were to have the arrows the wrong way round, and to miss the two links available from the heron and pike.

(c) (i) Many candidates correctly identified scarcity of food but the second point about shortage of oxygen was not so well recognised.

(ii) Only the better candidates tended to gain this mark. Some candidates had not learned about terracing or planting trees. There were many guesses for this, including building walls or fences.

Question 2

(a) (i) This was correctly answered by most of the candidates.

(ii) It was important that candidates included both sides of the equation for combining resistors in parallel. Many lost marks because they did not invert their initial (correct) calculation to obtain the required final answer of **2 ohms**.

(b) Most candidates found it difficult to score on this question. ‘To give more leverage’ was frequently suggested, but without further discussion in terms of moments and forces this ‘everyday’ answer was not accepted. When candidates did refer to forces in their answers they often did not distinguish between the force exerted by the hand and the force exerted on the nut. It was important that the role of the spanner as a force multiplier was strongly suggested. Hence answers such as ‘so the person can use less force’ could not be accepted.

(c) The fact that the candidates had to choose which data to use in the calculation proved to be a distractor, with many making the wrong selection. Once again candidates often lost a mark by omitting appropriate units. The required answer was **2500 J**.

Question 3

(a) Most candidates were able to give an acceptable answer. The word 'rust' was used incorrectly on several occasions.

(b) (i) The equation was balanced successfully by the more able candidates. Weaker candidates often tried to balance the atoms by changing the formulae of the reactants.

(ii) This proved to be generally challenging with only a minority of candidates scoring both marks. A common misconception by the poorer candidates was interpreting *reduction* as a loss of quantity of a reactant. Credit was not given to answers where their explanations were not clear. For example, ,iron oxide was reduced because it gained electrons' was not credited whereas 'iron oxide was reduced because it lost oxygen' was credited.

(c) (i) Candidates were generally familiar with the idea that aluminium ions would gain electrons at the cathode. A second mark for knowing that each ion would gain three electrons was not so well understood and only more able candidates tended to gain both marks.

(ii) There were some good answers revealing understanding of the importance of relative reactivity. It was not enough to state simply that 'aluminium is too reactive'. Weaker candidates showed no awareness that reactivity was the key to answering this question, suggesting instead that the reasons might involve physical properties such as melting point.

(iii) There were some excellent responses by the more able candidates who gained both marks with clear explanations of the need for charge balance within ionic compounds. Other answers acknowledging that aluminium is in Group 3 of the Periodic Table and so would have a 3+ charge gained some credit. However, credit is never given for the so-called 'cross and drop' method without explanatory detail.

Question 4

(a) (i) Most candidates gained this mark.

(ii) It was clear from the many incorrect responses which included a wide variety of elements not in Group 7, that many candidates had not read the stem of the question. Thus candidates scored in part **(i)** but not in part **(ii).** Of those who did realise that part **(ii)** should include only halogens, a surprising number clearly had to guess.

(b) (i) Generally answered well by most candidates.

(ii) Many candidates scored this mark but weaker candidates were less familiar with the formula of a fluorine molecule.

(c) (i) This was well answered by the majority of candidates, showing that the rules for drawing covalent molecules are very familiar across all Centres.

(ii) The general response to this was disappointing. Relatively few candidates offered either H^+ or $C\ell$. Many incorrect attempts such as $HC\ell$ were seen.

(d) (i) The combination of solutions was generally answered correctly with the most common error being iodine in place of chlorine.

(ii) Halogen displacement chemistry was not a familiar section of the syllabus. Explanations tended to be confused and often revealed a careless or uninformed approach to the use of the terms bromine and bromide. The choice of potassium bromide because it is the only solution containing bromine was the explanation from many candidates.

Question 5

(a) The great majority of candidates from across the ability range were able to interpret the graph and scored the mark.

(b)(i) and **(ii)** In part **(i)** of this question, candidates needed to focus on the fate of infra red radiation after it has entered the greenhouse. Marks were available for discussing the idea that once absorbed by materials inside the greenhouse, the heat is re-radiated and all of it does not escape. In the second part the emphasis shifts to the effect this phenomenon has on the air inside the greenhouse. In this part the candidates should discuss the idea that any hot air which is convecting inside the greenhouse cannot rise away as it can in the air outside. In general, candidates did better with part **(i)** than part **(ii)** where descriptions of convection tended to be incorrect or vague and very little reference to what happens outside the greenhouse was ever seen.

(c) (i) Large numbers of candidates put the emphasis in their answers on the more suitable nature of the conditions in greenhouse **B**, instead of explaining what was less than ideal about conditions in greenhouse **A**. As a consequence this tended to be a low scoring question generally.

(ii) This was generally well answered. Most candidates suggested two relevant factors. The most common errors were to include temperature (excluded by the question) or to make vague statements about the weather.

(d) (i) This was generally well answered. Marks were lost for the use of the word 'excreted' instead of 'egested'. Several candidates wrongly connected the bright colours of fruits with the bright colours of flowers and made references to insects dispersing the seeds.

(ii) This was very well answered by many candidates who were clearly familiar with the advantages of seed dispersal. Some candidates explained about 'competition' but did not develop their answer to state the resources being competed for.

Question 6

(a) Similarly to the other physics calculations in the paper, this one was dealt with successfully by the majority, and the common reasons for the careless loss of marks were the incorrect writing of the formula and/or the omission of appropriate units. The required answer was **750 m**.

(b) (i) Most candidates gained this mark.

(ii) Generally well answered by the full ability range of candidates. The response 'constant motion' was not accepted.

(iii) Most candidates attempted to find the area beneath the graph. Marks were lost due to incorrect calculations of the area of a triangle, or failure to state the correct units. The required answer was **30 m**.

(c) (i) and **(ii)** The incident and reflected rays were correctly drawn by most candidates. The angles were not always labelled; sometimes the rays, and sometimes the angle of refraction were labelled instead.

Question 7

(a) There were many correct answers but responses without reference to tissues were not credited.

(b) (i) and **(ii)** Both of these questions addressed aspects of biology that candidates found difficult to explain. In part **(i)**, the removal of heat from the skin by the evaporation of water was often not well explained. Candidates should be advised to refer to the evaporation of water rather than sweat. In part **(ii)**, vasodilation of the arterioles to encourage heat loss from the blood was usually not mentioned. Some candidates showed poor examination technique by wasting time describing the changes which would occur in cold surroundings as well as in warm.

(c) (i) and **(ii)** This was generally answered well. The most common error was to write 'pancreas' instead of insulin in part **(ii)**.

(iii) Candidates generally found it difficult to score on this question. Respiration and its importance in releasing energy to the body was quite often omitted, and too many vague and over-dramatic symptoms were described. However, excellent knowledge with understanding of this topic was shown by high end candidates.

Question 8

(a) (i) Any sensible answer was accepted and the great majority of candidates gained the mark.

(ii) Acceptable answers to this question were not as familiar as expected. Common mistakes were to suggest hydrogen, methane or carbon monoxide.

(b) (i) Obviously, those candidates who had direct experience of this experiment had a considerable advantage, but most candidates showed that they had grasped what was going on. It was apparent that some candidates had seen a similar experiment in which the syringes contained oxygen rather than air, and this caused confusion. However, many well-explained and correct responses were seen from the more able candidates.

(ii) There were several completely correct responses to this question from more able candidates. Increased surface area leading to a higher rate of reaction was understood by many, but only a small number referred to the overall increase in the number of collisions in a given time.

Question 9

Radioactivity proved to be the least familiar syllabus topic in almost all Centres, and most parts of this question proved to be very difficult for candidates across the ability range.

(a) (i) Candidates needed to be very specific in stating what it is that comes out of the nuclei of unstable atoms. The unqualified term 'breakdown of a nucleus' was not accepted.

(ii) Only a few of the most capable candidates scored this mark. The most frequent incorrect response rephrased the question without mentioning removal of electrons from atoms or molecules.

(b) (i) Success in answering this question was a little better than in part **(a)**. It was important that candidates stated specifically that gamma carries no charge but alpha does. It was quite common for candidates to try to explain this phenomenon in terms of the masses of the types of radiation.

(ii) This part of **Question 9** was the best answered but it was still only a minority overall that scored the mark. It was evident from the scripts of quite a number of candidates that they had confused the properties of gamma and beta radiation.

(iii) Many candidates answered this well. However, failure to provide at least one comparative statement was penalised. Some candidates showed weak examination technique by discussing the fact that alpha does not normally penetrate the skin but gamma does, and then going on with vague, unsubstantiated statements such as 'and so if it gets inside you it must be more dangerous'.

(c) This question proved to be unexpectedly unfamiliar. Candidates lumped together the radiation referred to in the rest of **Question 9** with electromagnetic radiation, and so very common incorrect responses included all of the common regions of the electromagnetic spectrum.

COMBINED SCIENCE

Paper 0653/32
Extended Theory 32

General comments

The examination produced a very wide range of marks. At the high end, some outstanding scripts were seen from candidates who had clearly mastered all aspects of the syllabus, and who had been very well briefed on details of effective examination technique. Approximately 10% of the candidates scored a fifth or less of the available marks, and may have been more appropriately entered for Paper 2. Overall, the candidates had learned the three sciences in equal measure but tended to find some aspects of ecology and organic chemistry to be very challenging. Calculations in physics tended to be tackled successfully even by candidates who found it difficult to score well in most other parts of the paper. There was no evidence that candidates had any difficulty in completing the paper in the available time. In fact it was noteworthy that many candidates had time enough to write lengthy, detailed answers which often contained far too many unnecessary words and phrases. Candidates should be reminded that the mark allocation and the number of lines given for each question is a guide to how much they should be writing.

Comments on specific questions

Question 1

(a) (i) Candidates tended to go for the correct seed types, **Q** and **R**. The most common error was where **P** was suggested in place of **Q**.

(ii) This was usually answered correctly although ovule was often suggested instead of ovary.

(iii) Most candidates knew that fruit contained seeds and many scored the second mark for referring to the role of fruit in seed dispersal or in colonisation. Several candidates wrote detailed accounts of pollination or the general life cycle of plants, and were unable to earn marks.

(b) (i) Candidates often omitted to refer to attractive, colourful petals as the reason for insect pollination. Incorrect reasons included citing the large numbers of insects which would be present and suggesting that the lack of wind under the canopy meant that wind pollination would not work.

(ii) This question was generally well-answered and the majority of candidates scored at least one or two of the available marks. For full marks, candidates then needed to discuss details of the advantages gained by not clearing other indigenous trees or not using chemical fertilisers and pesticides. Vague answers such as 'clearing trees would harm the rain forest' did not gain marks, whereas discussing advantages like avoiding soil erosion or maintaining habitat were credited. Similarly, having mentioned the avoidance of chemicals, it was not enough to develop the idea by simple statements such as 'the soil is not poisoned'.

Question 2

A significant minority of candidates gave wildly incorrect answers to **(a)(i)** and then went on to give perfect or near perfect answers to **(a)(ii)**. Candidates generally did very well on part **(b)** which dealt with the theory of electrolysis.

(a) (i) This was correctly answered by most candidates.

(ii) The electronic theory of ionic bonding had been very well learned by large numbers of candidates. It was not uncommon to award all four of the available marks to candidates across the ability range. Marks were available for discussion of electron transfer, subsequent ion formation, attainment of complete octets, increase in stability and attraction between oppositely charged ions.

(b) (i) Some excellent answers were given for this question. With only one mark available, candidates who reversed the polarity of potassium ions and the cathode regrettably could not be credited.

(ii) It was not uncommon to see perfectly correct and excessively detailed answers to both **(i)** and **(ii)**.

Question 3

(a) (i) This question presented few problems for candidates. The most common mistake was the suggestion of alpha and / or beta radiation.

(ii) The answer to this question needed to be plausible and specific. Candidates often lost marks by suggesting answers such as 'it kills your organs' or 'it ionises your cells'. The most common correct answers included references to skin burns, cell or DNA damage, mutation and reference to cancer.

(iii) The value of the speed of light was not all that well recalled. In order to score the mark candidates needed to include appropriate units. Weaker candidates rather missed the point and responded with things such as 'it is constant', 'it is the speed of light'.

(b) (i) and **(ii)** A majority of the candidates knew that the mass is a constant quantity. Some cut their losses and gave the same answer for both parts, while others gave clear quantitative answers for part **(ii)**. Regrettably some candidates attempted quantitative answers for part **(ii)** but used inappropriate values and / or units which cost them the mark.

(c) (i) With a single mark available, only a qualitative sketch was required and a line anywhere above the given line was credited. Some stronger candidates suggested curved lines with later reference to the effects of air resistance on the Earth, and others carried out Newton's Laws calculations to locate the theoretical position of the line on the supplied grid.

(ii) A straightforward reference to the greater gravitational field or force on Earth was required, and many candidates, even those who had not responded at all to part **(i)**, scored the mark.

(d) (i) The majority of candidates correctly stated the formula used in their calculation and also gave full working as required in this type of question. The required answer was **12 J**. As in **(a)(iii)** far too many candidates lost a mark by failing to write in the appropriate unit.

(ii) Similarly to part **(i)** this calculation was done well and it was usually the case that candidates picked up some or all marks for part **(d)**, even when their total scores on the rest of the paper were low.

Question 4

(a) (i) The most common type of mistake made by candidates was to state the anatomical name of one of the shaded parts.

(ii) Candidates had to avoid discussion of the way that the heart supplies oxygenated blood to the body in general. They needed to name the coronary arteries as the key blood vessels involved and then develop the idea of how oxygen is carried by blood. There was a tendency for candidates to write phrases such as 'blood vessels like capillaries give oxygen to the heart', without any reference to blood itself.

(iii) Most candidates gained this mark although a minority gave the names of the vessels which was not credited.

(b) (i) The mechanism of water movement through xylem was not well understood. Some candidates scored a mark for appropriate use of the term 'transpiration', but only a minority were able to develop the idea further in order to gain the second mark. Large numbers of candidates thought that osmosis was the main driving force for water movement throughout the plant. Although the idea of "suction" may be a useful one in establishing initial understanding, it was not accepted as a markworthy explanation on this extension science paper. Candidates needed to show that they understood how water loss at the leaf lowered (vapour) pressure or water potential at the top of the plant and that water then moved as the result of this phenomenon.

(ii) Virtually all candidates had learned that sugars moved through phloem. Hardly any, however, stated that the sugars were in solution or that the sugars were in the form of sucrose.

Question 5

This question was obviously the most difficult one on the paper, proving accessible to only those candidates at the top end of the ability range. Most candidates seemed to have only a superficial knowledge of addition polymerisation, and may not before have encountered the linking together of fractional distillation and cracking into a single diagram.

(a) Most candidates had a clear idea of the answer to this question but often dropped the mark through careless or vague expression. The answer 'because it is non-renewable' was not accepted.

(b) (i) The only responses accepted were 'crude oil' or 'petroleum' and most candidates gained this mark.

(ii) and **(iii)** Candidates had to answer both of these questions comparatively. Therefore it was not enough simply to state for example that 'there would be a difference in boiling point'. Part **(ii)** was answered slightly more successfully than **(iii)**, where many candidates suggested answers based on usefulness rather than the chemical differences between the mixtures.

(iv) The majority of candidates had not learned or understood the basic ideas involved in addition polymerisation. There was evidence that they were familiar with the term 'chain length' in the general context of hydrocarbon chemistry, and that polymers had something to do with chains. Some thought that the molecules in mixture **M** in the previous question might already be polymers since they had learned that molecules prior to cracking had longer chain lengths. This then led them into further confusion when they tried to explain why it is that molecules from the mixture at **M** could not be polymerised. It should be added, however, that several outstanding, perfectly correct responses to this question were seen from high end candidates.

(c) (i) Although the chemical tests for water had been well learned by many candidates, there was a similar number who lost the mark by suggesting fixed-point or pH measurement. The question asks candidates for a 'suitable' chemical test and so those who suggested reaction with alkali metals did not score.

(ii) Even if candidates found it too difficult to balance an unfamiliar equation, they could pick up one mark for knowing that the formula of the missing reagent was going to be O_2.

Question 6

(a) Candidates from across the ability range were very familiar with this type of calculation. The required answer was **2.7 g/cm^3**. Once again many candidates lost a mark for failing to give appropriate units.

(b) (i) Alomst every candidate could draw a suitable representation of a gas but not a liquid. In liquid diagrams most of the particles should be shown touching and be sufficiently randomly arranged to differentiate from the corresponding diagram of a solid.

(ii) A majority of candidates unnecessarily wrote at length about solids as well as liquids and gases. Most candidates gained at least one mark, the mark being missed was usually for not specifying that attractive forces were involved. Some candidates used the term 'intermolecular forces' and this usually gained them both marks.

(c) Candidates needed to state explicitly that expansion occurs as the result of an increase in spacing between particles. An alternative was to explain that heating caused particles to 'increase' their vibrational motion. Candidates who suggested that heating caused particles to *start* to vibrate were not awarded the mark.

(d) A real example rather than a general principle was required in answer to this question. Thus those who discussed deforming structures such as bridges or rail tracks or sagging of overhead power lines gained the marks. Those who wrote about undefined metal 'objects' not fitting into 'spaces', did not earn marks. Some candidates failed to pick up the marks because they suggested non-metallic examples and others thought that this question was about the dangers of touching hot objects or structures melting.

Question 7

(a) (i) A majority of candidates gained the mark. A common mistake was to give the name of a particular organ.

(ii) A majority of candidates had learned the differences between plant and animal cells and scored both marks. The question specifically asks candidates to restrict their answers to the cells shown in the question, and so references to chloroplasts could not be credited.

(b) (i) Labelling of a partially permeable membrane needed to be done very carefully and unambiguously. Some candidates labelled a point where membrane and cell wall met and were not given the benefit of any doubt. By far the most common mistake was to label the cell wall.

(ii) It was clear that candidates were familiar with the broad idea that osmosis involved movement of particles through a partially permeable membrane. They also knew that as a result of osmosis, concentrations of solutions on both sides of the membrane seek to equilibrate. However, they generally had difficulty in using their knowledge to explain correctly what had happened to the onion cells in this question. The on-going challenge for candidates answering questions about osmosis lies in the use of the term 'concentration'. If a candidate uses the unqualified term 'concentration' it is always assumed that they are referring to the concentration of the solute, sugar in this case. If they mean 'concentration of water molecules' then this must be written clearly. This often leads to answers which may be correct in the candidate's mind but which are not credited. The best candidates avoided the problem by answering in terms of water potential. Many candidates scored two marks for a correct description of osmosis. A third mark was available for describing what had happened inside the cells following the loss of water. Of the minority of candidates who went on to attempt this, some suggested that the cells had shrunk or become flaccid, but these answers were not credited.

(c) This was answered quite well and many candidates gained all three marks. Candidates were penalised if they suggested a list of places where starch is digested which included the stomach. Candidates needed to specify that the enzyme involved in starch digestion is amylase. The general term carbohydrase was not accepted.

Question 8

(a) (i) Most candidates gained this mark. The most common mistake was failure to include a direct reference to the data.

(ii) Most candidates gained this mark.

(iii) The majority of candidates were familiar with the influence of concentration on reaction rate and most gained at least one mark, with award of full marks not uncommon. For full marks they needed to refer to the meaning of concentration in terms of numbers of particles and that reactions occur as the result of collision. The best answers clearly stated that the key phenomenon was the frequency of effective collisions between hydrogen ions and the magnesium surface.

(b) The marks were divided between clear working and the correct answer, with error carried forward being allowed in certain cases. This was fortunate for some candidates who gave correct working and then made careless mistakes in carrying out the calculation. Candidates were penalised if they wrote **95 g** but if they wrote **95 g/mol** the units were ignored.

Question 9

(a) (i) and (ii) Candidates were generally able to complete both of these part questions successfully. It was important that rays were shown with direction arrows and that the angles of incidence and reflection looked reasonably similar. A recurring mistake was the drawing of the reflected ray returning to the eye of the observer.

(b) (i) This very simple Ohm's Law calculation presented few problems for the majority of candidates. The required answer was **10 ohms**. Although quite a number of candidates arrived at an answer of 10 they did not gain full marks either because they had not written the Ohm's Law formula properly or at all, and/or they had omitted the units. No error carried forward is allowed from an incorrect formula.

(ii) This question was much simpler than some candidates thought. The anticipated answer was that the lamp did not obey Ohm's Law because the line on the graph did not show direct proportionality. A variety of responses was seen from candidates across the ability range, and marks were awarded for logically sound statements. A mark was available if a candidate discussed the change in resistance of the lamp.

COMBINED SCIENCE

Paper 0653/04
Coursework

(a) Nature of tasks set by Centres.

4 Centres submitted coursework for the June examination.

Most have provided coursework in previous years and have acted on advice given. All the tasks set were appropriate to the requirements of the syllabus and the competence of the candidates.

The standard of candidates work was comparable with previous years.

(b) Teacher's application of assessment criteria.

In all Centres the assessment criteria were understood and applied well for all of their activities. All produced marking schemes specific to the task given.

No Centre tried to assess both skill C1 and C4 in the same investigation.

(c) Recording of marks and teacher's annotation.

Tick lists remain popular with particularly skill C1.

The use of annotation on candidates' scripts has not been adopted by all Centres. Most Centres justify marks awarded by a summary comment.

(d) Good practice.

Some Centres made very useful comments about individual candidate's performance. Many produced assessment task booklets complete with instruction to candidate.

COMBINED SCIENCE

Paper 0653/51
Practical Test 51

General comments

All questions were readily accessible and allowed candidates to demonstrate their practical ability. However, candidates do need reminding of the need to carefully read and follow instructions. Some Supervisors failed to adequately complete a set of results. All parts of questions requiring measurements are of importance and failure to record this information may penalise candidates.

Comments on specific questions

Question 1

Drawings were generally satisfactory although a few confused the two types of leaf. A common error in part **(ii)** was to record the length of the actual leaf rather than the length of leaf on the drawing. A case of not reading the instruction and this careless error cost two marks. Part **(b)** was poorly answered. The common response was simply 'more photosynthesis'. Three lines were given for an answer and a more detailed response was required explaining why there is more photosynthesis.

Although the majority constructed a table, some were poorly presented. The use of a ruler would greatly improve the appearance of tabular work.

Question 2

Although all candidates gave measurements for the tube, there was a very wide variation, even within a Centre. It was assumed for the purpose of marking that all tubes were similar to that used by the Supervisor. Some candidates do not appear to be able to differentiate between cm and mm. The calculation was well done. Although Table 2.1 was nearly always complete, the figures recorded were often strange and suggested poor technique. All $\mathbf{d_2}$ values should have been less than $\mathbf{d_1}$ and in many cases they were not. The main criticism regarding graphs concerned the scales used. Far too many used a very small part of the grid. Part **(d)** was poorly answered, the most common mistake was not heeding the instruction to 'indicate on the graph' the values chosen.

Question 3

Surprising how few candidates appreciate the volume of a drop from a dropping pipette. Indeed, there appears a lack of ability to estimate a volume of anything. Candidates are expected to estimate small volumes in chemistry exercises. Answers in part **(b)** varied greatly. Precise instructions were given for preparing the solutions and if followed, the number of drops for solution **X** should have been between 20 and 30. Many were outside this range. Values for **Y** and **Z** should have been **X**/2 and **X**/4 respectively. Some tried to explain their answer to **(c)** in terms of time taken. This was not accepted. Part **(d)** was very poorly answered. Some Centres remarked that insufficient gas was given off. Testing for any gas requires some expertise that can only come with practice. There is little point in using a splint before a reasonable reaction has taken place. In this case evolution of bubbles was the sign of a reasonable reaction. As ever, far too many are either unaware of the meaning of the word 'precipitate', preferring to use non scientific terms to describe the appearance of a solid from a solution. Reference to the notes for Chemistry would show the importance of the word precipitate. Finally, the name of the acid was required and the deduction 'chloride' was not accepted.

COMBINED SCIENCE

Paper 0653/52
Practical Test 52

General comments

Questions 1 and **2** were very straightforward whilst **Question 3** required a certain amount of practical dexterity. Candidates with little practical experience may have found the latter question a little more difficult. Supervisors in some cases were not as helpful as they might have been. It is important that each of the three questions is answered completely and failure to do so may well affect candidates. Ambient temperature is a very good example as it is not possible for Examiners to know the conditions of the day in so many different countries. There was no evidence of a shortage of time.

Comments on specific questions

Question 1

Parts **(a)** and **(b)** were nearly always completed correctly. A very small number did not record in millimetres and a few failed to show their working when calculating the average length. A mall number of candidates did not draw an outline of their leaf in part **(d)** making it impossible to count the appropriate number of squares. A further small number failed to 'write the letters **C** and **P**' as required. Clearly marks were lost in such cases. Some did not heed the instruction to use letter **P** for any incomplete squares that have an area of half a square or more. The majority gained one or two marks for part **(e)**, the most common answer being a variation in light leading to a different rate of photosynthesis.

Question 2

The vast majority followed the instruction to record the mass to the nearest gram. However, far too many candidates did not record the temperatures to the nearest 0.5 ^{o}C. A whole number required a zero as the first decimal place e.g. 26 ^{o}C was not accepted. The correct figure being 26.0 ^{o}C. Similarly 26.3 ^{o}C was not accepted. Most realised that the mass of water was equal to the volume. Part **(e)** was generally satisfactory. The tolerance of +/- 1 $Jg^{-1}\,{}^{o}C^{-1}$ of the Supervisor's value was thought to be generous.

Question 3

The majority of candidates completed the four experiments with reasonable results although candidates at some Centres appeared to lack sufficient expertise to produce a sensible collection of results. If the acid was made correctly and the stated amount of magnesium ribbon provided, the volume of gas should not have exceeded 100 cm^3. Indeed, a simple calculation will show that to be so. The most common error in constructing the graph concerned the scale for the x-axis. Many were caught out by the sequence 0.4, 1.2, 1.6 and 2.0, thereby missing out the 0.8 value and consequently the scale was not uniform. Although many scored one mark for stating that the higher the concentration of acid the higher the rate of reaction, hardly anyone was able to explain this from their results. The most common and simplest explanation in part **(e)** was 'the magnesium was used up'. A simple 'the acid was used up' was not acceptable.

COMBINED SCIENCE

Paper 0653/61
Alternative to Practical 61

General comments

The Examiners were pleased to see many scripts from good candidates who have thoroughly grasped the practical aspects of the three sciences that make up the syllabus. These candidates are a credit to the Centres who entered them for this examination.

Three of the six questions are based on corresponding items in the Practical examination paper 51.

It was disturbing to see that a few candidates did not possess a ruler and a calculator. Both of these items are necessary to answer the questions. A Supervisor at one Centre even banned the use of a calculator by the candidates. The Examiners draw the attention of Supervisors to the requirements of the Mathematical Requirements in the Syllabus, which states that 'calculators may be used in all parts of the assessment' and 'candidates should be able to use mathematical instruments (ruler, compasses, protractor, set square).'

Comments on specific questions

Question 1

Diagrams are provided of three choice chambers in which woodlice have been placed for 15 minutes. The chambers are divided into four sections; dry and dark, damp and dark, damp and light, dry and light.

(a) (i) All candidates counted the woodlice and accurately recorded the numbers in each section of two of the three choice chambers.

(ii) The average numbers of woodlice in each condition must be calculated. Many poorer candidates simply found the total numbers and did not divide by three each time.

(b) A bar chart had to be drawn, showing the average number in each section. The Examiners looked for correct labelling of the y-axis (average number of woodlice), correct height and equal width of all four bars, and correct labelling of the conditions on the x-axis. There were many excellent answers to this part of the question.

(c) (i) Candidates were asked to list the two external conditions preferred by the woodlice; damp and dark. Instead, many candidates listed the two sections of the choice chambers preferred by the woodlice. This slight error was not penalised.

(ii) One preferred condition had to be chosen and suggestions made about how this would help the woodlice to survive. There were many anthropomorphic comments such as 'woodlice do not have to worry about being seen in the dark' did not gain a mark.

Question 2

This was about the use of a ticker-timer to find a value for **g**, the acceleration due to gravity. A labelled diagram of the apparatus was shown.

(a) (i) The term *alternating current* was incorrectly answered by most candidates. Some candidates described the sine wave shape of the e.m.f./time plot, but were unable to say that the current reverses direction.

(ii) Why does the alternating current make the iron bar of the timer vibrate? A complete answer includes the reversal of the poles of the magnetised iron bar so that it is alternately attracted and repelled by the permanent magnet that surrounds it. There were some good answers to this question, but they were rare. Most candidates wrote about the 'force of the current causing vibration'.

Fig. 2.2 showed part of the strip of paper that was accelerated through the timer as the weight fell.

(b)(i) Candidates had to measure, in centimetres, the distance of the last three points on the paper from the 0 point and record them in a table. Most candidates could do this accurately, but those without a ruler could not do so at all.

(ii) The distances had to be converted to metres and as all the other distances given in the table provided an example the majority of candidates gained this mark.

(iii) Data from the table of times and distances had to be used to prove that the paper had accelerated as the weight fell. Some candidates said that the distance from the 0 point had increased each time; this was not enough to gain the mark, since even a steady speed would give this effect. Candidates were expected to state that the distances in each 0.02 sec interval had increased.

(c) A formula was given to calculate **g**, the acceleration due to gravity, using data from the table. Many candidates were able to substitute data in the formula and then obtain a value for **g** which lay between 9.0 and 10.00 m/s^2. The most frequent error was to omit to square the time of fall.

There were some very good answers, but a majority of candidates lost marks in part **(a)** of this question.

Question 3

The question is based on a simple neutralisation reaction between an acid and an alkali. Then the acid must be identified, and details of an experiment to find the most concentrated of three acid solutions must be given.

(a)(i) The colours of the indicator at pH 5 and pH 9 are red and orange respectively. Candidates had to state the colours in acid and alkali solution. This comparatively easy test was failed by many candidates. Some reversed the colours, but a surprising number gave 'red and blue' as the colours; they thought that all indicators are blue in alkali.

(b)(i) and **(ii)** Candidates had to choose the most concentrated solution, and were given the number of drops of alkali that were used to change the colour of the indicator of each acid solution. Some candidates did not read the description of the experiment carefully enough and chose the least number of drops.

(c) The answer was given by a minority of candidates was 'cleaning the pipette and beaker', suggesting that they had never performed experiments using a pipette.

(d) Not many correct answers were given to this part.

(e) (i) and **(ii)** There is a white precipitate when silver nitrate is added to the acid. Few candidates could name the white precipitate and the acid used.

(f) Candidates had to design an experiment using magnesium ribbon and the three acid solutions, to find out which one is most concentrated. The Examiners were looking for the use of equal volumes of acid and equal lengths or masses of ribbon. The volumes of gas produced in equal time, or the amount of magnesium dissolved, should be measured in some way. It was rare that all three marks could be awarded.

This question demanded a working knowledge of practical chemistry rather than reproduction of facts. As usual in this paper, the general standard was disappointing but there were some good answers, very much depending on the teaching at particular Centres.

Question 4

The experiment on which this question is based could be unfamiliar to most of the candidates. A test-tube, weighted with sand, is floated in water and in salt solution, and the depth of the tube below the surface is measured using a ruler. The experiment is repeated using tubes carrying different masses of sand. The density of the salt solution can then be found.

(a)(i) When the tubes, and the ruler used to measure them, are viewed through the side of the beaker, they appear larger. Poorer candidates merely stated that the ruler was 'magnified'. An answer referring to the refraction of light, or the curved sides of the beaker acting as a lens, was needed. Some candidates wrote that magnification occurred because the water and glass are denser than air; this was an acceptable answer.

(ii) 'Use the scale of the ruler to calculate the depth $\mathbf{d_1}$ of the tube floating in water'. This instruction was often misunderstood, and candidates used their own ruler to measure the depth on the diagram. Occasionally this was because the table in which the answer was to be written was printed on the previous page; candidates filled in the space in the table before they had read the question! Some misread the scale on the ruler and others could not convert centimetres to millimetres.

(iii) Similarly, the depth $\mathbf{d_2}$ of the same tube floating in salt solution must be found.

(b) A graph grid was provided with the axes labelled and units inserted. When $\mathbf{d_1}$ values have been plotted against the corresponding $\mathbf{d_2}$ values, a straight line must be drawn passing through the origin. Most candidates were able to do this.

(c) The gradient of the line had to be found, and the values used to do this must be shown on the graph. The latter instruction was often ignored. The Examiners looked for the y- and x-dimensions indicated as vertical and horizontal lines on the graph and used to calculate the gradient. However, many candidates calculated an acceptable value for the gradient; this corresponded to the density of the salt solution used in the experiment.

(d) Finally, an alternative way of finding the density of the salt solution was asked for, using a pipette or burette, a beaker and a balance. The correct description of measurement of the volume of a weighed sample of the salt solution, followed by the formula density = mass/volume, was necessary to gain both marks. Both marks were awarded to fewer than half of the candidates.

Candidates must read through the question before launching into writing numbers, and must know standard techniques used to find density of both liquids and solids.

Question 5

This question was based on differences between leaves of a dicotyledonous plant grown in sun and shade.

(a)(i) Diagrams of a 'sun leaf' and a 'shade leaf' were shown. The instruction clearly stated that the candidate must 'measure the maximum length of each leaf, excluding the petiole (stalk)'. Far too many candidates did not read this instruction but proceeded to measure and record the total lengths, for which no marks were awarded. A few candidates recorded the lengths in centimetres, for which only one mark out of two could be awarded. A smaller number could not change centimetres to millimetres!

(ii) Most candidates could suggest an advantage to the leaf with the larger area.

(b) Given cross-sectional diagrams of the sun- and shade- leaves, candidates had to construct a table to compare them. Many candidates actually measured and stated the thickness in centimetres, forgetting that the diagrams of the leaves were as viewed through a microscope. Despite this, the mark was awarded. The actual number of palisade cells did not have to be counted, merely stated as 'two rows' or 'one row'. The size of the air spaces could be compared as 'small' or 'large'. Many candidates were awarded all four marks for their answers.

(c) One of the features of the sun leaf in the diagram must be chosen and its adaptation explained as good for photosynthesis. This was usually done quite well, with the many chloroplasts of the palisade cells mentioned as key to photosynthesis in the leaf.

(d) The thicker cuticle of the sun leaf was pointed out to the candidates, who were asked what advantage this has for the leaf. The answer is 'it prevents dehydration'. However, many candidates opted for the reverse reason, that it serves to prevent the ingress of moisture, which was not an acceptable answer for the mark.

Many candidates scored very well on this question, but too many lost marks again because they did not read the instructions carefully enough.

Question 6

The final question on the paper showed the diagram of an experiment in which carbon dioxide is produced by a chemical reaction, changed into carbon monoxide and then used to reduce copper oxide to copper.

(a) A solid and a liquid which will react to give carbon dioxide must be named. This was found to be surprisingly hard for many candidates to do.

(b) The carbon dioxide was passed into a heated steel tube containing charcoal. Candidates had been told in the introduction that the carbon dioxide was converted into carbon monoxide. They had to complete the symbol equation ..... + ... → 2CO. A majority could not do this, which the Examiners found very disappointing.

(c) The residue from the reaction of copper oxide with carbon monoxide was a powder. This was placed in a container. Probes from a circuit containing a voltmeter, a lamp and an ammeter were inserted. What observations could be made which show that the residue is a metal? Most candidates seemed unable to interpret the word 'observations', and wrote vaguely about a metal conducting electricity, being shiny and hard or even being attracted by a magnet. The better candidates, however, concentrated on the items in the circuit diagram and correctly wrote that the bulb would light and that there would be a reading on the ammeter. There would be a reading on the voltmeter even if the residue did not conduct, so this observation did not earn a mark.

(d)(i), **(ii)** and **(iii)** The residue was weighed. Candidates had to record the reading on the balance window, then calculate the mass of the copper(II) oxide and of the loss in mass during the reaction. Most candidates were able to do this.

(iv) Removal of oxygen is reduction. This mark was often earned.

(e) To earn this mark, candidates had to write that carbon monoxide is poisonous, toxic or dangerous.

The responses of candidates to this question were often very disappointing. This may sometimes have been because they were running out of time at the end of the one hour examination.

COMBINED SCIENCE

Paper 0653/62

Alternative to Practical 62

General comments

The Alternative-to-Practical paper is an alternative to the Practical examination and *not* an alternative to the study of practical science which must form part of the course of study leading to this IGCSE qualification. The Examiners were disappointed to see that many candidates could not draw simple apparatus and answer questions on experiments that they should have experienced.

However, there were many excellent answers to the questions and Centres should be congratulated on the results obtained by their hard-working candidates.

Three of the six questions are based on corresponding items in the Practical examination paper 52.

The Examiners draw the attention of Supervisors to the requirements of the Mathematical Requirements in the Syllabus, which states that 'calculators may be used in all parts of the assessment' and 'candidates should be able to use mathematical instruments (ruler, compasses, protractor, set square).'

Comments on specific questions

Question 1

This study of variation in leaves provided candidates with a rather lengthy exercise in simple mathematics, with which most coped well.

(a) Most candidates measured the leaves with acceptable accuracy.

(b) Candidates had to find the total of all the lengths and divide by 20 to arrive at the average length. Those who did not show the working (total length/20) lost a mark here.

(c) (i) The number of leaves in each of six ranges had to be counted and recorded.

(ii) A bar chart was then drawn using the data from **(c)(i)**. The most common error here was incorrect labelling of each range. Beneath each bar, the range must be clearly stated as 30 – 34, 35 – 39 and so on. Many candidates who merely wrote a number at each bar line lost a mark here. The bars also had to be of the same width.

(d) A reason was sought for the variation in the lengths of the leaves. The answer 'genetic differences' did not earn a mark since they were all from the same species. Conditions of growth had to be specified, such as light intensity, nutrient availability and age of the leaf.

Question 2

This question concerned the properties of ammonia gas. References to this gas can be found in the syllabus and in the 'Notes for use in qualitative analysis'. A lamentable ignorance of the facts was displayed by candidates from some Centres. The question began with the reaction between ammonium chloride and calcium hydroxide.

(a) (i) Ammonia gas was variously said to be white, blue, red and some other colours!

(ii) Although given information about the substances reacting, many candidates could not work out that the solid product was calcium chloride.

(b) Three diagrams were provided of the collection of gases; upward delivery, downward delivery or over water.

(i) Most candidates wrote that the best way to collect ammonia gas was over water, forgetting that ammonia dissolves in water.

(ii) A method had to be chosen as the way NOT to collect the gas. More candidates correctly stated that downward delivery cannot be used, but their explanations were often woolly and inaccurate.

(c) (i), **(ii)** and **(iii)**. A table to be completed contained the reactions of ammonia with zinc and copper sulfate and with litmus. Candidates whose lessons had included these practical exercises scored well here.

(d) A diagram was shown of filter paper, soaked in concentrated hydrochloric acid, being lowered into a gas-jar of ammonia, resulting in a cloud of white fumes. Candidates were invited to explain how the white fumes are formed, but most merely repeated the wording of the question. Some correctly stated that ammonium chloride was the solid formed. However, the Examiners were looking for the idea that two gases, hydrogen chloride and ammonia, were reacting. Sublimation occurs, just as it does when ammonium chloride is heated and the resulting gas mixture is cooled. Disappointingly to report, no candidates gave this part of the explanation.

Question 3

This question is based on a simple experiment in which steam contained in a 2 dm^3 bottle is allowed to condense, forming a weighed amount of water.

(a) (i) The masses of the bottle before and after water has condensed into it, are read from the balance scale. This presented few problems with the majority of candidates gaining the marks.

(ii) The increase in the mass is found by subtraction.

(b) (i) and **(ii)** Candidates had to name the processes by which water is turned into steam and back again. 'Boiling' was not accepted as a correct answer for process **A**. Most candidates earned at least one mark.

(c) (i) Told that 1 g of water has a volume of 1 cm^3, candidates had to state the volume of water produced 'when the 2 dm^3 of steam had cooled'. This should not have caused any problems; but a significant number of candidates were unable to do this.

(ii) The volume of steam produced from 1 cm^3 of water was correctly calculated using simple proportionality by a minority of candidates.

(d) The final question was to explain why a powerful force is produced by a steam engine. What was needed was the idea that the expansion of the water to a large volume produces this force; candidates could also refer to the large increase in kinetic energy of the molecules. Answers were often not convincing.

The answers to this question were rather disappointing, based as it is on a simple element of physics.

Question 4

Inhaled and exhaled air must form some part of the practical biology studied by candidates for this examination.

(a) Candidates were asked to draw a diagram of the way in which a gas-jar of exhaled air can be collected. The diagrams were almost always disappointing. Many candidates had no idea about the shape of a gas-jar, despite having answered **Question 2**! Those who used a delivery tube to transfer the air from the mouth then placed a stopper in the container, so no air could possibly be blown into it. When the air was collected over water, the method preferred by the Examiners, tubes often entered through the side of the trough.

(b) A candle was burned in the two samples of air, and the time of burning noted.

(i) The stop-watch had to be read and the times recorded. Most candidates were able to do this.

(ii) The average time for three similar experiments had to be calculated. A majority of candidates could do this; however, having recorded all other times to the nearest 1st decimal place, a similar accuracy was expected to be shown. Therefore answers of '7' and '5' gained only one mark instead of two.

(c) (i) and **(ii)** The marks were awarded to the majority of candidates.

(iii) Candidates had to place the times taken for the limewater to change appearance against the descriptions 'before exercise' and 'after exercise'. This was often wrongly answered; after exercise, there is more carbon dioxide in the exhaled air.

(iv) An explanation of why exercise changes the carbon dioxide content of exhaled air was asked for; the answer must refer to an increase in the rate of respiration to gain the mark.

An investigation into the carbon dioxide content of exhaled air is easy to do but many candidates gave the impression that they had never done such experiments.

Question 5

Magnesium reacts with dilute hydrochloric acid; a well-known fact. This question is based on an attempt to relate the speed of the reaction to the concentration of the acid.

(a) The inverted measuring cylinders showing the volumes of gas produced in the first 40 seconds must be read. Most candidates gained all three marks.

(b) Comparison of the figures in the table of results would enable candidates to write the three missing concentrations of the acid. Some candidates failed to do this correctly.

(c) The graph of concentration of acid against volume of hydrogen had to be drawn. Many candidates plotted the points well. However, some failed to draw a straight line, extended to pass through the origin.

(d) (i) In marking the answers for why the same length of magnesium ribbon should be used, the Examiners did not accept the use of the phrase 'the same amount of magnesium'. The same surface area of magnesium and the same mass of magnesium are the two correct answers here.

(ii) The straight line passing through the origin shows that the concentration of the acid and the volume of hydrogen are proportional. No other answer was accepted.

Many candidates drew the graphs well, which was pleasing to the Examiners, but part **(d)** was less well answered.

Question 6

Hot water is poured into a metal food can and the change in temperature is noted. The mass of the can and the mass of water are also found.

(a) The temperatures of the water, the mass of the can and the volume of the water are read from appropriate scales. Most candidates were able to do this successfully.

(b) (i) and **(ii)** The increase in temperature of the can and the decrease in the temperature of the water were found by subtraction. Candidates were not always careful to choose the correct temperatures to use in these calculations.

(iii) Given the formula, the specific heat of the can could be found using the data already recorded or calculated. Again, candidates' choice of data was not always accurate, but many managed to arrive at the correct answer.

(c) The teacher has set up an alternative experiment to find the specific heat of the food can, using an electric heater to deliver a measurable amount of heat energy. Candidates had to state two quantities that must be used to find the energy delivered by the heater, besides the e.m.f. in volts.

These were the current in amperes (amps) and the time in seconds. The word ‘current’ was most often missing, and many candidates wrote 'the ammeter in amps'.

This question contained both easy and more difficult items, like all questions in this paper. Many candidates scored well but a completely correct answer was rare.

COMBINED SCIENCE

Paper 0653/63
Alternative to Practical 63

General comments

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However, there were many excellent answers to the questions and Centres should be congratulated on the results obtained by their hard-working candidates.

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Comments on specific questions

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(a) The inverted measuring cylinders showing the volumes of gas produced in the first 40 seconds must be read. Most candidates gained all three marks.

(b) Comparison of the figures in the table of results would enable candidates to write the three missing concentrations of the acid. Some candidates failed to do this correctly.

(c) The graph of concentration of acid against volume of hydrogen had to be drawn. Many candidates plotted the points well. However, some failed to draw a straight line, extended to pass through the origin.

(d) (i) In marking the answers for why the same length of magnesium ribbon should be used, the Examiners did not accept the use of the phrase 'the same amount of magnesium'. The same surface area of magnesium and the same mass of magnesium are the two correct answers here.

(ii) The straight line passing through the origin shows that the concentration of the acid and the volume of hydrogen are proportional. No other answer was accepted.

Many candidates drew the graphs well, which was pleasing to the Examiners, but part **(d)** was less well answered.

Question 6

Hot water is poured into a metal food can and the change in temperature is noted. The mass of the can and the mass of water are also found.

(a) The temperatures of the water, the mass of the can and the volume of the water are read from appropriate scales. Most candidates were able to do this successfully.

(b) (i) and **(ii)** The increase in temperature of the can and the decrease in the temperature of the water were found by subtraction. Candidates were not always careful to choose the correct temperatures to use in these calculations.

(iii) Given the formula, the specific heat of the can could be found using the data already recorded or calculated. Again, candidates' choice of data was not always accurate, but many managed to arrive at the correct answer.

(c) The teacher has set up an alternative experiment to find the specific heat of the food can, using an electric heater to deliver a measurable amount of heat energy. Candidates had to state two quantities that must be used to find the energy delivered by the heater, besides the e.m.f. in volts.

These were the current in amperes (amps) and the time in seconds. The word ‘current’ was most often missing, and many candidates wrote 'the ammeter in amps'.

This question contained both easy and more difficult items, like all questions in this paper. Many candidates scored well but a completely correct answer was rare.