COMBINED SCIENCE

Paper 0653/11
Multiple Choice

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

Comments on specific questions

Biology

Question 4

This question demanded the ability to accurately interpret a graph, and to support the interpretation with some factual knowledge. Candidates performed extremely well.

Question 7

In order to arrive at the correct answer, candidates were required to call upon more than one area of knowledge, and the specific piece of knowledge that proved the stumbling block was the direction of movement of materials in the xylem and in the phloem. A basic misunderstanding was shown by those who believe that water travels in both directions in the xylem.

Question 9

Slightly more candidates opted for structures in order of their *decreasing* diameter than of their *increasing* diameter as the question asked suggesting that they had not read the question carefully.

Question 11

The knowledge of what happens to a hormone after it has performed its functions in the body was lacking for many of the less able candidates, making this the least well answered question in the biology section of the paper. Guesswork was clearly evident.

Chemistry

Question 14

This question involved simple recall of fractional distillation. The majority of candidates answered this correctly.

Question 17

Simple application of understanding of the factors affecting the speed of reaction were required here, and the majority answered correctly.

Question 25

Option **C** was a popular distractor, with more candidates choosing this option than the key, **A**. In choosing **C**, candidates mistakenly thought that gasoline is used as a fuel for diesel engines. The uses of several fractions are specified in the syllabus and should be taught and learned.

Physics

Question 28

This question concerned distance/time graphs. Weaker candidates confused these with speed/time graphs, often choosing option **B**.

Question 29

Less confident candidates were often unsure of the appropriate units for mass and weight, with distractor **D** being particularly popular.

Question 30

Some candidates of all abilities were unaware of the link between higher power and shorter time to do work, causing them to choose option **D**.

Question 31

The most common misconception here was to believe that evaporation causes the temperature of the remaining liquid to rise.

Question 34

This question concerned wave motion in water, and the majority of candidates, of all abilities, chose **C**. In teaching this topic it is well worth discussing the concept of water in the wave peaks having been displaced from the troughs, so that waves cannot involve water rising above the ‘calm water’ level without causing troughs below this level.

Question 35

This straightforward recall question on the properties of the image formed by a plane mirror caused difficulty, with many candidates choosing option **D**.

Question 36

Weaker candidates were unable to identify the electromagnetic waves with the smallest wavelength and the highest frequency. Candidates should be aware that the same name can appear in both columns of a table.

Question 38

Weaker candidates chose distractor **A**, apparently believing that electrons carry a positive charge.

Question 39

This question was not well answered. Fuses are fitted to circuits to stop the cables overheating, but perhaps the subtlety of the difference between this and 'to prevent a short circuit from occurring' made it a particularly demanding distractor.

COMBINED SCIENCE

Paper 0653/12
Multiple Choice

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

Comments on specific questions

Biology

Question 2

A significant minority, mostly less able candidates, believed that transpiration is a characteristic of living organisms. It may be that there was confusion between sweating and transpiration and, if so, it indicates the need to be aware of the biological meaning of syllabus terms.

Question 5

This question demanded the ability to accurately interpret a graph, and to support the interpretation with some factual knowledge. Candidates performed extremely well.

Question 6

In order to arrive at the correct answer, candidates were required to call upon more than one area of knowledge, and the specific piece of knowledge that proved the stumbling block was the direction of movement of materials in the xylem and in the phloem. A basic misunderstanding was shown by those who believe that water travels in both directions in the xylem.

Question 8

Slightly more candidates opted for structures in order of their *decreasing* diameter than of their *increasing* diameter as the question asked, suggesting that they had not read the question carefully.

Question 12

The knowledge of what happens to a hormone after it has performed its functions in the body was lacking for many of the less able candidates, making this the least well answered question in the biology section of the paper. Guesswork was clearly evident.

Chemistry

Question 14

This question required simple application of understanding of factors affecting speed of reaction. The majority of candidates answered correctly.

Question 25

Option **C** was a popular distractor, with more candidates choosing this option than the key, **A**. In choosing **C**, candidates mistakenly thought that gasoline is used as a fuel for diesel engines. The uses of several fractions are specified in the syllabus and should be taught and learned.

Physics

Question 28

Some candidates of all abilities were unaware of the link between higher power and shorter time to do work, causing them to choose option **D**.

Question 29

This question concerned distance/time graphs. Weaker candidates confused these with speed/time graphs, often choosing option **B**.

Question 30

Less confident candidates were often unsure of the appropriate units for mass and weight, with distractor **D** being particularly popular.

Question 32

The most common misconception here was to believe that evaporation causes the temperature of the remaining liquid to rise.

Question 34

This straightforward recall question on the properties of the image formed by a plane mirror caused difficulty, with many candidates choosing option **D**.

Question 36

This question concerned wave motion in water, and the majority of candidates, of all abilities, chose **C**. In teaching this topic it is well worth discussing the concept of water in the wave peaks having been displaced from the troughs, so that waves cannot involve water rising above the 'calm water' level without causing troughs below this level.

Question 37

Weaker candidates were unable to identify the electromagnetic waves with the smallest wavelength and the highest frequency. Candidates should be aware that the same name can appear in both columns of a table.

Question 38

Weaker candidates chose distractor **A**, apparently believing that electrons carry a positive charge.

Question 40

This question was not well answered. Fuses are fitted to circuits to stop the cables overheating, but perhaps the subtlety of the difference between this and 'to prevent a short circuit from occurring' made the latter a particularly demanding distractor.

COMBINED SCIENCE

Paper 0653/13
Multiple Choice

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

Comments on specific questions

Biology

Question 4

This question tested the ability to accurately interpret a graph, and to support the interpretation with some factual knowledge. Candidates performed extremely well.

Question 7

More than half of the candidates answered this correctly. The only real problem for candidates here was to identify the appearance and the position of xylem in a leaf, and a significant number confused it with phloem.

Question 11

This question identified an area of confusion, namely the nomenclature of the reproductive parts of a flower. Many of the less able candidates thought that the stigma is a component of the stamen.

Question 13

This was an easy question, but a few candidates either did not realise that *all* food chains *start* with a producer, or saw an accurate description of the first two organisms in the food chain and, without sufficient careful thought, selected 'producer and herbivore' as their answer.

Chemistry

Question 14

This question involved simple recall of fractional distillation. The majority of candidates answered correctly

Question 15

This required simple interpretation of formulae and was answered well.

Question 17

Simple application of understanding of factors affecting speed of reaction was required for this question, which was answered correctly by the majority of candidates.

Question 19

A significant minority of candidates chose the key, **C**, but more than half chose distractor **B**.

Question 20

The majority of candidates answered this question about electrolytic circuits correctly.

Question 22

This question involved interpretation of experimental data for speed of reaction, and was answered correctly by the majority.

Question 25

Roughly equal numbers of candidates chose the key, **D**, and distractor **A**. Those who chose the distractor thought that a transition element has a low enough density to enable it to float on water.

Question 27

Candidates had to interpret pie charts related to the composition of clean air. The majority answered correctly.

Physics

Question 29

This question concerned density and a large proportion of the weaker candidates opted for **D**, confusing doubling the length of the cube sides with doubling the mass.

Question 34

This question concerned wave motion in water and many candidates, of all abilities, chose **C**. In teaching this topic it is well worth discussing the concept of water in the wave peaks having been displaced from the troughs, so that waves cannot involve water rising above the 'calm water' level without causing troughs below this level.

Question 35

This straightforward recall question on the properties of the image formed by a plane mirror caused difficulty, with many candidates choosing option **D**.

Question 39

This question was not well answered, particularly by more able candidates. Fuses are fitted to circuits to stop the cables overheating, but perhaps the subtlety of the difference between this and 'to prevent a short circuit from occurring' made the latter a particularly demanding distractor.

COMBINED SCIENCE

Paper 0653/21
Core Theory

Key Messages

Candidates across the ability range need to carefully read the rubric above the question, as well as the question itself, before answering each question.

Particular attention should be given to any words in bold print.

Candidates should be encouraged to allow time at the end of the examination to check their answers and rectify any mistakes.

General Comments

There were some very good responses seen in this paper, with several candidates showing a good understanding of the Core syllabus.

Some questions were left unanswered. When they have completed all the questions that they are sure of, candidates should be encouraged to return to unanswered questions.

A number of answers had been written and then crossed out. If nothing else had been written after this, the crossed out answer, if legible was marked, and was sometimes correct. It is important, therefore, that when deleting an answer, it is struck through with a single line.

Where a second, incorrect answer was written, the crossed out answer was ignored.

There was little evidence that candidates had a problem in completing the paper, in the time allotted.

In the Physics questions, where a formula was required, there are still a few candidates using a triangle of the variables. This is **not** equivalent to the actual formula and does not gain credit.

Comments on Specific Questions

Question 1

(a) This was well answered across the ability range. Some candidates used the out-of-date symbol for a lamp. Others lost credit, despite using the up-to-date symbols, by continuing the circuit line through the symbol.

(b) (i) Many candidates omitted the term *potential difference* when referring to the number of volts on the lamps, and so lost credit. Very few explained why it is important to use no more than 1.2V.

(ii) This was well answered across the ability range.

(iii) Most candidates gave the correct answer.

(iv) Almost all candidates answered this correctly.

Question 2

(a) All candidates attempted this question. Most correctly gave **B** as the first stage.

(b) This was generally well answered, with more candidates correctly writing *element* and *mixture* in the first and third rows respectively than the other two rows.

(c) (i) Many candidates across the ability range gave answers which were too. Although *used in cars* is not wrong, many things can be used in cars; the word *fuel* had to be included for credit to be awarded.

(ii) Candidates across the ability range found this challenging. Some confused “alkanes” with “alkalis”.

(d) (i) This question proved challenging and many candidates gave *carbon* and *hydrogen* as their answer.

(ii) Some candidates who had understood the ratio of carbon to hydrogen atoms in the question, incorrectly placed a 3 **before** the formula.

Question 3

(a) (i) Almost all candidates attempted this question, with most correctly linking *fat* to *providing energy as a fuel*.

(ii) This question was less well answered. Many candidates gave answers referring to fibre as being an *aid to digestion* or for *building up muscles*.

(b) (i) This question was attempted by all the candidates. Although credit was not always awarded, many showed a good understanding of why meal **2** was better than meal **1**. Some candidates lost credit for referring to *too much fried food* rather than *too much fat.*

(ii) This proved slightly more difficult for some who gave answers indicating that adding, for example, a salad to meal **1**, would **offset** the large amount of fat in the meal, instead of explaining that, for example, a salad, would **add** fibre or vitamins to the meal.

Question 4

(a) (i) Apart from the most able candidates, many misinterpreted the question and gave the colours of Universal Indicator, rather than the pH value of both liquids.

(ii) Those candidates who had given the Universal Indicator colours in part **(i)** then gave the pH values as answers to this question.

(b) (i) Very few candidates answered this question correctly. Of those candidates who did, some referred to using indicator paper rather than the liquid. Very few described using the results of the first experiment to obtain a neutral solution, instead of the indicator solution.

(ii) Some candidates who described heating the solution needed to make reference to this process removing the water in order to gain credit. Many used the term “crystallisation” and again were not credited.

Question 5

(a) (i) Although the label line had been drawn to the inner of the two lines surrounding the cell, many candidates gave *cell wall* as their answer, rather than the correct *cell membrane.*

Many candidates described the vacuole as the *nucleus*.

(ii) This was particularly well answered by the higher achieving candidates. Some referred to the green area being green because of the presence of chlorophyll. For full credit they needed to add that the white area contains cells without chlorophyll.

(iii) Some candidates lost credit for labelling the outer area as *white* rather than the correct *brown.*

(b) (i) Only the more able candidates gave the correct term, *denatured,* when referring to what happened to the amylase. Although many candidates knew that this happened in the acidic conditions of the stomach, reference had to be made to the actual pH not being optimum or appropriate.

(ii) This was a well answered question, with the *stomach* given as the most common answer. A few suggested the *liver* or *large intestine*.

Question 6

(a) (i) All candidates attempted this question and most gained credit for giving **R** as the weight of the aircraft.

(ii) Many candidates showed that they understood that the forward and backward forces are equal. They needed also to state that the forces are opposite. Very few candidates attempted to explain that unbalanced forces are necessary to move the aircraft.

(b) (i) This was fairly well answered. Some candidates gave *potential energy* as one answer. This could not be credited as *chemical (potential) energy* was required.

(ii) This question was very well answered across the ability range.

(iii) This was also well answered.

(c) Most candidates attempted this question. The most common error was to draw a *horizontal line*, which would have been correct if it had been a speed/time graph.

Question 7

(a) (i) Many candidates incorrectly referred to the energy that respiration provides for animals. Others stated that without respiration the carbon cycle stops, which was not sufficient for credit to be awarded.

(ii) This proved a challenging question for many candidates and some did not attempt it. The two reactants needed to be recalled, as well as the product *water.*

(iii) This was very well answered by almost all candidates. A few did not use organisms from Fig. 7.1, as required, but they gained credit for the correct use of arrows.

(iv) Many candidates either repeated the word in the question with “they decompose dead bodies” or said “they destroy or get rid of dead bodies”. These were not allowed. *Answer they feed on dead bodies and release carbon dioxide (during respiration).*

(b) (i) Many candidates gained credit in the first part for stating that the burning of fossil fuels produces carbon dioxide.

For the second part, many candidates explained that grasses use up or consume carbon dioxide“. The term *photosynthesis* was required for credit to be awarded.

Others gave sensible answers involving increased soil erosion, but these did not refer to the change in the amount of carbon dioxide in the air, and therefore were not credited.

(ii) Some candidates incorrectly referred to carbon dioxide destroying the ozone layer. If this answer was given, then these candidates could not gain credit for any additional correct answer, such as *increasing global warming.*

Question 8

(a) All candidates attempted this question and many gained credit for correct placing of *evaporates* and *molecules.* Many candidates wrote *ultraviolet* rather than *infra-red,* in the first space.

(b) Many candidates gave answers referring to mercury molecule/particles expanding as they get hot. Other answers which were not credited referred to the heat coming from the sunlight. Answers which referred to mercury particles vibrating more or faster when they get hot did not gain credit.

(c) Although most candidates attempted this question, most only gained credit for the correct position of X-rays.

(d) Some of the more able candidates referred correctly to there being a vacuum between the Sun and Earth and that sound needs a medium through which to travel. Many others gave answers referring to the great distance between the Earth and the Sun, or the frequency of the Sun's sound waves being outside the human hearing range.

Question 9

(a) (i) The higher achieving candidates generally gave good answers here. Many candidates gained credit for the reactants *copper oxide* and *carbon.* However, further credit was often lost for giving *oxygen* as one of the products rather than *carbon dioxide*.

(ii) Credit was lost here by many candidates who referred to copper (rather than copper oxide) losing oxygen, or being reduced.

Very few candidates referred to carbon being oxidised.

Explanations such as *oxidation and reduction took place* were not credited.

(b) This proved a challenging question for most candidates across the ability range. Of those who predicted that the copper and hydrochloric acid would not react, few gave the correct reason that copper is below hydrogen in the reactivity series, instead saying that copper was a very unreactive metal.

(c) Some candidates incorrectly referred to sulfur dioxide destroying the ozone layer. Other candidates described sulfur dioxide as a greenhouse gas, and then went on to describe the greenhouse effect and global warming, for which no credit was awarded.

Of those who described sulfur dioxide dissolving in rain/producing acid rain, many went on to describe how this damages fish and/or vegetation, and so gained credit.

A few candidates gained credit for referring to the bad effect on breathing or people's lungs.

COMBINED SCIENCE

Paper 0653/22
Core Theory

Key Messages

Candidates across the ability range need to carefully read the rubric above the question, as well as the question itself, before answering each question.

Particular attention should be given to any words in bold print.

Candidates should be encouraged to allow time at the end of the examination to check their answers and rectify any mistakes.

General Comments

There were some very good responses seen in this paper, with several candidates showing a good understanding of the Core syllabus.

Many questions were left unanswered. When they have completed all the questions that they are sure of, candidates should be encouraged to return to unanswered questions.

A number of answers had been written and then crossed out. If nothing else had been written after this, the crossed out answer, if legible was marked, and was sometimes correct. It is important, therefore, that when deleting an answer, it is struck through with a single line.

Where a second, incorrect answer was written, the crossed out answer was ignored.

There was little evidence that candidates had a problem in completing the paper, in the time allotted.

In the Physics questions, where a formula was required, there are still a few candidates using a triangle of the variables. This is **not** equivalent to the actual formula and does not gain credit.

Comments on Specific Questions

Question 1

(a) This was a challenging question for many candidates. Some lost credit for stating that copper (rather than copper oxide) loses oxygen and is reduced.

Another answer which quite often seen was *oxidation and reduction has taken place*. This was not considered sufficient as the chemicals to which this happened had to be stated.

Some candidates described copper oxide losing *oxide*, rather than losing *oxygen.*

(b) (i) This question was well answered. Almost all candidates correctly labelled the electrolyte. Some candidates, who knew the names of the electrodes, reversed them.

(ii) This was not well answered. Many candidates named the electrodes, repeating their answer to the previous question, rather than giving the products of electrolysis as required. Some who attempted to name the products, gave *bromide*, rather than the correct *bromine.*

Question 2

(a) (i) This was well answered across the ability range. Some candidates lost credit for using the triangle of variables, rather than the correct formula.

(ii) This proved a difficult question for many candidates. Credit was available for converting the seconds into hours and for converting the metres into kilometres. However, working had to be set out methodically to earn this credit.

(b) Many candidates spent time adding numerical data to the axes. This was not required as the question had asked for a sketch of the shape of the graph. Many candidates drew a diagonal line showing an increase in speed with time.

(c) (i) This question proved challenging for candidates across the ability range. Some did not attempt to answer it. Others gave the correct magnitude of the force, for which no credit was available, but then could not then clearly explain why it was the same as the forward force.

(ii) A common error was to write *potential* in the box of *energy in the rider*. Although the full correct description was *chemical potential, chemical energy* was accepted, but *potential* on its own was not.

Question 3

(a) The name of structure **A** was given correctly by many candidates. Structure **B** was less well answered, with many giving answers such as *bronchus*, or *bronchi* which were not credited.

(b) Some candidates gave good explanations of why the breathing changes. Descriptions of the actual changes were required.

(c) (i) Generally only the most able candidates gave a correct answer here, namely that there is more carbon dioxide in exhaled air than in inhaled air.

Some candidates referred to inhaled air containing oxygen, but exhaled air containing carbon dioxide. This was not credited because a comparison of carbon dioxide content was needed.

(ii) Most candidates did not draw a conclusion from the data, as the question asked, and instead stated the decrease in time for the limewater to turn cloudy.

Some candidates used the data from the previous table, Table 3.1, rather than Table 3.2 as required in the question. These candidates referred to the limewater turning cloudy faster because there was more exhaled air entering the flask after exercise than before. This was not credited.

(iii) Most candidates attempted this question. Generally only the high achievers correctly stated that there was not enough carbon dioxide to turn the limewater milky. Some candidates misinterpreted the diagram and suggested that the inhaled air did not pass through the limewater in flask **P**.

Question 4

(a) (i) This was quite well answered, and only a few candidates did not attempt to draw the circuit. Credit was awarded for drawing a series circuit even if the symbol for the cells was not correct. Some candidates lost credit for drawing cells in a parallel arrangement.

Credit was available for four cells drawn with the correct symbol, connected in series. Candidates need to be more accurate when drawing cells. For example if a line had been drawn straight through all the cells, this was not credited.

(ii) Most candidates drew the correct symbol for the voltmeter. Many drew it in series with the cells and lost credit. Some drew the voltmeter in parallel with both the cells and the electric bell and again were not credited.

(b) (i) This was quite well answered by the higher achieving candidates. Many referred to the *loudness of the sound*, the *wavelength of the sound*, or *the pitch of the sound*. None of these were credited.

(ii) Some of the more able candidates gave good answers showing a complete understanding of the difference between the two variables. Others confused the two and related the pitch to the amplitude and the frequency to the loudness of the sound.

(c) (i) Most candidates gained credit for the correct numerical answer. Far fewer gave the correct unit. Some, who used the Greek symbol, Ω, for the unit, were not accurate enough in their drawing, to gain credit. The most frequent incorrect unit given was R.

(ii) This question proved challenging for most apart from some of the higher achievers. Credit was most frequently given for stating that the current increased. A few referred to the resistance decreasing. Many candidates incorrectly described the effect in terms of voltage.

Question 5

(a) (i) This question proved challenging for all but the most able candidates. A common error was to give 12 for the number of neutrons in the nucleus. Answers also indicated that candidates were not clear that **only** electrons are present outside the nucleus.

(ii) Few candidates referred to the particles in the carbon atom when answering this question. The majority of answers referred to carbon being a non-metal or carbon not conducting electricity. Where candidates did refer to the particles inside the atom, they often said that the number of neutrons and protons is equal. Some candidates did not attempt to answer this question.

(b) (i) Credit was most commonly awarded for the answer *natural gas.* The word *natural* was essential; some candidates omitted this and lost credit.

(ii) Some candidates attempted to write a formula equation, which was only credited if it was perfectly balanced. When a word equation is asked for in the question, candidates should be encouraged to use words. More candidates gained credit for the products *carbon dioxide* and *water,* than they did for the reactants *methane* and *oxygen.* A significant number did not attempt to answer the question.

(c) (i) This question was particularly well answered by the higher achieving candidates.

(ii) This was not well answered and some did not attempt to answer. Some gave *ionic* for an answer, and others *hydrogen*.

(iii) Very few candidates gained credit here. Most candidates gave the answer as four electrons.

Question 6

(a) Most candidates gave the incorrectly gave *ultraviolet* or *heat* as the answer.

(b) Most candidates attempted to answer this question, but many found difficulty in giving an explanation in terms of molecules, so did not gain any credit. Reference had to be made to the increased energy and speed of the warm molecules and then to this increased energy allowing these molecules to escape.

(c) Most candidates incorrectly referred to the distance from the Sun to the Earth being too great for conduction and convection of heat to occur.

(d) This was quite well answered, although very few successfully indicated the angles of incidence and refraction and so did not gain full credit. Candidates needed to be more accurate when drawing emergent rays.

Question 7

(a) (i) This was answered quite well by the higher achieving candidates. Others described how the plant was responding by bending towards the light, but did not name the response as required. Some candidates gave the term “photosynthesis”.

(ii) Most candidates attempted this question. Many gave answers such as *because the plant needs light to make its own food*, which was not credited. An explanation was required that by bending, the plant collected **more** light and then could perform **more** photosynthesis.

(iii) This was quite well answered. Some candidates referred to the plant needing sunlight/water in order to grow, and were awarded some credit because of the reference to *growth.*

Some candidates referred to *sense* or *sensibility* which were not credited.

(b) (i) Most candidates showed understanding of the results, and some of the higher achieving candidates gave a clear description of them.

(ii) Most candidates found this question challenging. The *tip* of the plant had to be identified as the part which *detects the light*. Candidates who referred to the shoot responding to the light lost credit.

(c) Most candidates showed knowledge of the end result of the input of adrenaline into the blood, but many answers were not precise enough. Many answers referred to adrenaline giving energy instead of explaining that *it gives more glucose into the blood* or *it makes more energy available from respiration.* Similarly, an answer of *pumps up the blood* did not adequately describe the increased pulse rate or heart rate.

Some candidates referred to adrenaline increasing response rate or making a person feel braver. These types of answers were not credited.

Question 8

(a) Most candidates correctly drew a filter funnel with filter paper, and then went on to draw a vessel to collect the filtrate. Additional credit was available for a clear indication of evaporation of the solution. In some answers, candidates referred to evaporation of the original mixture and did not gain credit. Many candidates drew diagrams of heating equipment, but did not explain that the solution was being evaporated. Some candidates did not attempt an answer or a diagram.

(b) This was attempted by almost all, with the more able candidates scoring well. Some candidates only drew three lines from the descriptions of materials to the types of materials; the question had asked for lines to be drawn from all four of the descriptions.

Most candidates gave the correct type of material, *element,* to the description *contains one type of atom.* Far fewer matched *element* to *cannot be broken down into simpler substances.* Some candidates did not show an understanding that *compounds are chemically bonded* whilst *mixtures are not chemically bonded.*

(c) (i) This question proved challenging for all but the higher achievers. Some referred to covalent bonding. They needed to show an understanding that negative ions are formed when atoms gain electrons and vice versa. Some referred to ions losing or gaining electrons.

(ii) This question was quite well answered by the higher achieving candidates. Some candidates lost credit for writing a 2 in front of the A*l* symbol.

Question 9

(a) (i) Almost all candidates labelled the *vagina* correctly. The labelling of the *cervix* required more precision and many lines were not drawn to the area just above the vagina.

(ii) This was quite well answered across the ability range. Some candidates did not attempt to indicate the ovary.

(b) (i) This question was less well answered. Many candidates stated the ovary or the cervix.

(ii) This was quite well answered, although many candidates who correctly named the *uterus* lost credit for not mentioning the *lining.*

(c) Most candidates attempted this question and it was quite well answered across the ability range. The most common answer referred to sharing needles. Some candidates lost credit for answers such as *blood contact* without referring to actual mixing of blood by blood transfusions, for example.

COMBINED SCIENCE

Paper 0653/23
Core Theory

Key Messages

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General Comments

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Several questions were left unanswered. When they have completed all the questions that they are sure of, candidates should be encouraged to return to unanswered questions.

A number of answers had been written and then crossed out. If nothing else had been written after this, the crossed out answer, if legible was marked, and was sometimes correct. It is important, therefore, that when deleting an answer, it is struck through with a single line.

Where a second, incorrect answer was written, the crossed out answer was ignored.

There was little evidence that candidates had a problem in completing the paper, in the time allotted.

In the Physics questions, where a formula was required, there are still a few candidates using a triangle of the variables. This is **not** equivalent to the actual formula and does not gain a mark.

Comments on Specific Questions

Question 1

(a) (i) This was generally well answered. Some candidates placed the number 3 in front of the Fe symbol.

(ii) This question was challenging for many candidates. Some did not realise that it was the oxygen in the air which had reacted with the iron filings, and lost credit for describing the reactants as *iron* and *air*. Others explained that the cotton wool had absorbed some of the water (vapour). Very few attempted to explain with reference to *the water rising to take the place of the oxygen.*

(iii) Very few gave the correct answer. The most common incorrect answers were 20 or 70.

(iv) Many candidates did not realise that if the iron had reacted with oxygen, then the main gas remaining was nitrogen. There were several incorrect answers seen, iron oxide and oxygen being quite common.

(b) Most candidates understood and stated that the iron does not rust and so the liquid level would not rise. Many gave an explanation that *the oil is more dense than water*, so lost credit. Others lost credit for stating that *oil stops iron rusting*.

(c) This was very well answered, with candidates giving a good answer for the coating and explaining well how it works.

Question 2

(a) (i) This was very well answered, particularly by the highest achieving candidates.

(ii) Most candidates gave the correct answer explaining that the balance of the current and the propulsion force are equal. Some answers, such as *all the forces were equal*, were not precise enough

Very few attempted to explain that unbalanced forces are needed to move an object.

(b) This was answered very well. Some candidates drew a horizontal line, having possibly misread the *y*-axis label as *speed*.

(c) (i) This was not well answered. Many candidates gave *kinetic energy* or *potential energy* rather than the correct *chemical energy.* Whilst *potential energy* is accepted to mean *gravitational potential energy*, it is not accepted for *chemical potential energy*.

(ii) Very many candidates gave the correct answer, *kinetic energy.* Movement energy was also allowed.

(iii) This was quite well answered. Very few gave the alternative answer, *kinetic energy of water.*

(d) The correct numerical answer was often given. Some candidates lost credit for omitting, or giving an incorrect formula, instead using the triangular arrangement for time, speed and distance.

Question 3

(a) This was quite well answered. The most common incorrect answers were *incisor* or *K9*. It should be noted that had canine been the correct answer, credit would not have been awarded for *K9*.

(b) (i) All candidates attempted this question. Some answers explained why the tooth had decayed instead of why the person had toothache.

(ii) Although most candidates gave long answers to this question, few gained any credit. Answers referred to sugar attacking the teeth or teeth not being cleaned regularly. The correct answer should have referenced the presence of bacteria/plaque, feeding on sugar, secreting acids, which attacked teeth. A few candidates did note that acid attacks teeth, but then gave the source of the acid as sweets which was not credited.

(c) Almost all candidates correctly referred to the risk of babies choking on lumps. Few candidates then went on to describe the increased surface area of the food which would speed up the enzyme action on the food.

(d) This proved a challenging question for candidates across the ability range. Many did not refer to large molecules being broken into smaller molecules. Most continued to explain food being broken down (by chemicals). Very few candidates attempted to explain the absorption into the blood.

(e) Many candidates stated that the protease would not continue to digest proteins, but few gained credit for referring to the pH of the environment of the small intestine. Instead they referred to there being more alkaline conditions there, which was given in the question, so did not gain any credit. Reference was needed to *the pH not being optimum.*

Many candidates wrote that the *enzyme was destroyed*. The correct term, *denatured*, was required.

Question 4

(a) This was very well answered. The switch had to be drawn in parallel with the motor or heater to gain full credit.

(b) This was a challenging question across the ability range. Some answers referred to *wet hair molecules*, rather than *water molecules.* Many candidates used the term *evaporation*. As this was included in the question it did not gain credit.

(c) This was quite well answered, usually by the higher achieving candidates.

(d) (i) This was well answered, although some candidates gave the term *voltage*, which was not credited, since it is not a unit.

(ii) This also was well answered. Most candidates gave the correct numerical value. Some gave R for the unit, rather than the correct unit, *ohms* or Ω.

(e) (i) There were several acceptable answers given by many candidates. Any correct references to *the* fuse overheating was credited.

(ii) This was a challenging question for many candidates. Some gave the answer of 5A because that had been the size of the original fuse. This did not gain credit, since the original size of the fuse had not been given. Some candidates referred to a 10A or 15A fuse as being too large, so letting through too much current to be safe.

Question 5

(a) (i) Very few candidates gave the correct term, *geotropism.* Many referred to *gravity*. Some candidates described how the radicle was growing downwards towards, soil, etc. Some candidates did not attempt to answer.

(ii) Many candidates referred to the radicle growing downwards rather than the *roots* growing downwards. Many candidates gained credit for explaining that mineral ions/water/nutrients could then be absorbed. Very few mentioned that the roots anchor the plant.

(iii) Most candidates drew the radicle turning to the right, but it had to be continued straight down to gain credit.

(b) (i) Many candidates showed good understanding of this question, describing the conditions necessary for the runner to grow into a plant. Some of the answers did not gain credit because they referred to asexual reproduction only requiring one plant, instead of one parent.

(ii) This was quite well answered, with candidates referring to aspects of the fertilisation process. Some candidates used the term *germination* rather than *pollination.*

(iii) Some candidates correctly used the term *clones* to describe the genetic likeness of fruits from runners.

Question 6

(a) This was well answered. It should be noted that the test is to use a lighted spill or a flame, with the result that there is a pop.

(b) (i) Some candidates earned credit either for referring to measuring the mass of the flask or for measuring how long the reaction lasted. A few candidates, mainly the higher achievers, gained both. Many candidates omitted to answer this question.

Some candidates incorrectly referred to measuring the **amount** of zinc, which was not precise enough.

(ii) This question appeared to have been misinterpreted by some candidates, who referred to the effect of the reaction on the temperature and suggested using a thermometer. This did not gain credit.

(iii) Some candidates only stated that temperature affects the rate of reaction without any explanation. Reference was required to the higher the temperature, the faster the reaction.

(c) (i) Many candidates gave the answer *metals* instead of *transition metals* which was not credited.

(ii) Some candidates correctly answered that there would be no reaction. Many, however, gave as their explanation that copper is less reactive than zinc, which was not precise enough. It had to be said that it is because copper is less reactive than hydrogen that they do not react.

Question 7

(a) (i) This was very well answered across the ability range. Most candidates correctly wrote visible light in the first space and ultraviolet in the second or third space. The most frequent incorrect answer was *sound* rather than the correct answer, *radio waves*, in last space.

(ii) This was not well answered, with many incorrectly giving the answer *visible*.

(b) (i) This was a challenging question across the ability range. Many candidates gave *pitch*, which was not credited. Others gave the imprecise answer that it is a measure of sound.

(ii) This was not well done. Candidates need to be aware of the order of the regions in the electromagnetic spectrum and relate this order to trends in frequency and wavelength across the spectrum.

(c) This was very well answered, in particular by the highest achieving candidates.

Question 8

(a) (i) Most candidates correctly referredto the increased time, but a few incorrectly stated that the acid would have further to travel. Very few candidates referred to the increase/change in the rate.

(ii) This was generally well answered, although some candidates gave 17 minutes, instead of the correct 20 minutes for the 12 mm length.

(iii) Some candidates found it difficult to transfer the previous information from the experiment to cells and answered in terms of acid moving. Of those who did refer to cells, many stated that it would be harder to get through to the centre, which was not credited.

Some wrote that it would take a long time to get to the centre, without clearly stating that it was oxygen or food which was moving to the centre.

(b) This was a challenging question for many candidates. Most correct answers referred to the large surface area of the cell. Some candidates referred to the lack of a nucleus allowing more oxygen to be carried by the cell, which was not credited.

Question 9

(a) (i) This was generally well answered particularly by the higher achieving candidates. Some knew the names of the electrodes, but gave the answers in the incorrect order.

(ii) This question was omitted by some. Of those who attempted the question, many correctly named **X** as copper.

(iii) This was not as well answered. A few candidates, who correctly identified **Y** as chlorine, also described its bleaching effect on the damp blue litmus paper.

(b) Most candidates attempted this question. The most common incorrect answer was to identify copper chloride as a mixture.

(c) (i) The core of the correct answer to this question was that elements contain one type of atom, whilst compounds contain more than one. This was not often given. Many candidates only described **either** an element **or** a compound.

(ii) There were two possible correct answers to this question. One answer is that compounds have a fixed ratio of elements, whilst mixtures do not. No candidates gave this answer. The second answer, which was given by some candidates, was that the atoms/elements in a compound are difficult to separate, whilst in a mixture they are not.

COMBINED SCIENCE

Paper 0653/31
Extended Theory

Key Messages

Those candidates who scored well on this paper ensured that

- they had read the questions carefully and avoided giving irrelevant information in their answers,
- they used correct symbols and not units in Physics equations e.g. **I** for current and not **A**,
- they paid attention to detail in chemical equations, writing subscripts properly and avoiding mistakes such as CL instead of C*l* for chlorine,
- they answered questions inviting comparison by using comparison words instead of absolute states e.g. writing that, as the result of heating, molecules move *faster* rather than giving the simple statement that, as the result of heating, molecules move *fast*.

General Comments

Many scripts were seen from candidates of high ability who had mastered most parts of the syllabus and who were very well-prepared for examinations of this type. Some of the candidates who were less successful might have been better suited for entry to the core paper.

The majority of candidates successfully completed the paper in the time allowed. There is still a tendency among some candidates to copy lengthy sections of the question into their answers. Colleagues may wish to remind candidates that this is almost always unnecessary and can make it difficult to fit answers into the available answer space. Candidates are reminded to write as legibly as they can so that Examiners are better able to award as many marks as possible.

It is recommended that this report and the published mark scheme are read together.

Comments on specific questions

Question 1

(a) Candidates gained credit for accurate drawing of the three circuit symbols involved with extra credit available if the circuit was correct. Common mistakes included drawing the lamp symbols in series and drawing an additional wire in parallel with correctly drawn parallel lamps.

(b) (i) Candidates who answered this incorrectly did not realise that a complicated calculation was not required.

(ii) Candidates generally were more successful in their answers to this part of the question. The majority correctly stated Ohm's Law and could apply it. Several candidates were distracted by the fact that the battery consisted of four cells and were led to think that the overall potential difference would therefore be 24V. Others worked with an overall potential difference of 30V. Some candidates over-complicated the calculation and attempted to apply the formula for resistors in parallel.

(c) Most candidates could predict the outcome of the situations described in this question and large numbers of correct answers were seen.

Question 2

(a) The order of processes involved in fractional distillation had been well-learned by candidates across the ability range. The majority of candidates gained at least partial credit for their answer.

(b) (i) This laboratory demonstration of cracking seemed unfamiliar to the majority of candidates, with few knowing the role of aluminium oxide.

(ii) Candidates were a little more successful in this part of the question and gained credit for knowing that a powdered solid has a large surface area. Some did refer to the idea of *more collisions* but they needed to use words that express the idea of increased collision frequency.

(iii) All possible orders of the three materials involved in this question were frequently seen and in many cases the suggested order was the reverse of the correct one. This mistake continues to be made when questions testing fractional distillation are set, and is likely to arise because candidates associate height in the fractional distillation tower with higher boiling point.

(iv) Candidates were more succesful here than in part **(b)(iii)**.

(v) In this questions candidates had to show that they knew the causal relationship between molecular size of hydrocarbons and their boiling points. Full credit was then gained if they could also explain the relationship. Misconceptions emerging from candidates' answers included: the reversal of the cause and effect relationship, confusion between boiling point and the time taken to boil, the idea that high boiling point is the cause of larger molecular size, and the idea that boiling involves molecular decomposition.

Question 3

(a) (i) The majority of candidates from across the ability range gained full credit in this question.

(ii) Candidates generally found it difficult to gain partial or full credit. Many missed the requirement to state an appropriate type of food. The importance of dietary fibre was given in part **(a)(i)** and so the terms *fibre* or *roughage* alone were not enough for credit. Candidates in general did not show that they understood how their chosen food type (or fibre) would ease constipation. Many confused the avoidance of constipation with improved digestion. Hence answers such as '*Eating spinach makes you digest your food better*' were quite common.

(iii) In contrast to part **(a)(ii)**, candidates were more successful in answering this part. It was encouraging to see how many candidates could identify foods to avoid and the reasons for this. A minority lost credit because they strayed away from the context and discussed the connections between,for example, fried potatoes in the diet to coronary heart disease, rather than obesity.

(b) (i) The majority of candidates from across the ability range gained full credit for their correct interpretations of the data in the bar graph. In a minority of cases, candidates gave value judgements about the attitudes of men and women rather than simply describing the information contained in the data.

(ii) This proved to be a challenging question for all candidates although many gained partial credit. The most frequently seen ideas that were rewarded were the need for more information about diet, the dangers of drawing conclusions based on small sample size and the fact that the data shows only a snapshot and so cannot show long-term effects of exercise.

Question 4

(a) (i) Candidates generally gave correct pH values. A minority answered with the indicator colours instead of the numerical pH values.

(ii) The performance in this question was very similar to that in part **(i)**.

(b) (i) This was well answered with correct formulae of the products being given by candidates across the ability range. Very few candidates lost credit for carelessly written chemical formulae. Candidates towards the lower end of the ability range tended to be unfamiliar with the idea of a salt and water as products, and constructed a range of incorrect rearrangements of the element symbols shown in the reactants.

(ii) Some candidates answered this question very well and often gained full credit. In general, this proved to be a challenging question. Of those who made sensible suggestions, credit was frequently gained for recognising that the procedure should be repeated in the absence of indicator.

(c) **T**he more able candidates scored at least partial credit, but most candidates found this question challenging. Many candidates demonstrated a partial understanding in that they knew the high melting point of potassium chloride had something to do with forces of attraction; the correct expression of the key theoretical ideas proved to be more difficult. Some candidates described crystallisation rather than the reasons for high melting point.

Question 5

(a) The large majority of candidates from across the ability range gained full credit for their answers to this question.

(b) (i) This question was answered almost as successfully as part **(a)(i)**. A very few candidates confused the variegated leaf with one they had seen that had been partially covered to vary light intensity across the leaf. Most candidates stated the colours correctly, although some lost the credit by making no attempt to shade or otherwise indicate the blue-black region on the leaf diagram.

(ii) The three marks for this question should suggest to candidates that a detailed answer is required. More able candidates gained partial credit for a discussion of photosynthesis leading to starch formation. These candidates usually stated that chlorophyll or chloroplasts found in the green parts would be where these processes would occur, but they missed a key point that light energy is taken in to enable photosynthesis.

(c) The need for optimum conditions for enzymes to work properly is generally well-known by candidates who are entered for this paper. Some candidates strayed from the context and discussed optimum temperature rather than pH. To gain full credit, candidates needed to use an appropriate form of the term *denatured.* In this case, *killed* or *destroyed* were not accepted. A common misconception was that amylase does not work in the stomach because it does not need to work there, either because all the starch has been digested or that there are other enzymes in the stomach that take over the role of digestion. Another common mistake was to suggest that amylase is an alkali and so would be neutralised by stomach acid.

Question 6

(a) (i) This was generally answered correctly by candidates from across the ability range.

(ii) Large numbers of candidates recognised force **R** but did not associate this force with the weight of the aircraft. Very few candidates gained credit for stating that the force was the weight.

(iii) Only a minority of candidates drew a correctly shaped curve. Most suggested a straight line and others had their graphs reaching a plateau.

(b) (i) In this case candidates could gain credit for stating *gravitational* or *potential* energy as one of the useful energy forms.

(ii) More able candidates gained credit for identifying at least one form of wasted energy. Others simply stated that the energy was *lost* or better, *transferred,* without stating the form to which it is transferred.

(c) (i) Conversion from km/h to m/s appeared to be an unfamiliar calculation for many candidates.

(ii) Large numbers of candidates had learned the formula for kinetic energy and gained credit for this. Fewer substituted into the equation successfully. A significant minority of candidates appeared to struggle to implement the square in the equation. Some candidates attempted to substitute the value of 720 km/h into the formula.

Question 7

(a) (i) The question guides candidates towards processes that take place during a short time period. Candidates giving detailed and often accurate descriptions of fossil fuel formation from organic remains thus could not be rewarded. Very few candidates described digestion of starch by the sheep but some did gain credit for a discussion of respiration leading to the release of carbon dioxide. These points were also rewarded if related to respiration in the wildcat. Candidates needed to be careful that their answers did not suggest that they were confusing respiration with exhalation. In many cases, answers dealt with processes such as photosynthesis which occurred before the leaf was consumed. Some candidates attempted to explain the appearance of carbon dioxide in the air as the result of the exhalation of carbon atoms which then combined with aerial oxygen. In general, the question proved challenging for most candidates.

(ii) Candidates were more successful in this part, recognising decomposers although some candidates suggested that organisms **X** were themselves dead organic remains. Despite suggesting this, many of these candidates did go on to describe correctly the actions of these organisms. Candidates should be advised to avoid stating that decomposers *eat* the dead remains. Although the word *respiration* was often written in answers, credit could only be gained if it was clear that it was respiration within organisms represented by the **X** that was important.

(b) (i) Candidates needed to describe how the composition of the atmosphere would change when fossil fuels were burnt. It was not enough to state simply that carbon dioxide enters the atmosphere. Carbon dioxide was the most commonly discussed gas and many candidates also referred to the decrease in oxygen.

(ii) Candidates were generally aware of the apparent link between carbon dioxide and global warming. They did not gain credit unless the environmental consequence suggested in part **(ii)** matched the gas discussed in part **(i)**. The most common answer gaining credit, after carbon dioxide and global warming, was sulfur dioxide and the connection with acid rain.

Question 8

(a) (i) Many candidates had learned an acceptable definition of frequency. It was essential that candidates referred to the number of waves occurring or passing a point per unit time. Many candidates stated that frequency was the same thing as the pitch of sound. This idea could not be credited in this context.

(ii) The electromagnetic spectrum had been very well learned and most candidates gained full credit.

(b) (i) It was important that candidates answered this question using comparative words or phrases. For example for the third of these three points, candidates needed to state that molecules move *faster*. It was not acceptable to state that molecules move *quickly* or that they *begin to move*. Most candidates gained at least partial credit for their answers.

(ii) Many candidates discussed evaporation of molecules and gained credit. No candidate referred to the absorption of IR radiation. Candidates from the higher end of the ability range tended to gain credit for stating that water molecules gained kinetic energy or moved faster when heated by the sun.

(c) (i) Only a minority of candidates gained credit for this question. Commonly-seen incorrect answers were that the sound from the sun could not be heard because the frequency of the sound lies outside the range of sounds audible to humans and that the sun is too far away for us to hear sounds coming from it.

(ii) The constancy of the speed of electromagnetic radiation has not been tested in quite this way before and only a small minority realised that this was the underlying science. A relatively large number of different times were suggested, ranging from nanoseconds to weeks. Very many candidates made a connection between either frequency or wavelength and the travelling time.

Question 9

(a) (i) This question proved challenging. *Endothermic*, *redox* and *combustion* were commonly seen wrong answers.

(ii) In this case it was essential that candidates used the specific term *chemical* or *chemical potential* rather than simply *potential* as the form of energy on the left side. A number of candidates gave the correct energy forms but in the reverse order. Candidates from the lower end of the ability range often did not attempt this question or gave answers that were not forms of energy.

(iii) To gain the credit here, candidates needed to state clearly which substance was oxidised and which was reduced. It was not enough to state a standard definition of oxidation and reduction without reference to the context used for this question.

(iv) Candidates from the higher end of the ability range tended to understand that the thermite reaction shows aluminium to be more reactive than iron and consequently the reaction does not work in reverse.

(b) (i) Most candidates showed some knowledge of the processes involved in electrolysis. The question guided candidates towards a detailed discussion of the particles involved when aluminium ions are discharged by electron gain from the cathode. Imprecise references to aluminium *particles* or *atoms* or statements such as '*the aluminium is positive and so goes to the cathode*'could not be awarded credit.

(ii) The question asks candidates to name the other substance formed by the electrolysis and consequently the only answer accepted was oxygen. Many candidates gave carbon dioxide but this was not accepted since it is not the product of electrolysis.

COMBINED SCIENCE

Paper 0653/32
Extended Theory

Key Messages

Those candidates who scored well on this paper ensured that

- they had read the questions carefully and answered concisely, excluding irrelevant material,
- they produced Scientific answers.

General Comments

Many scripts were seen from candidates of high ability who had mastered most parts of the syllabus and who were very well-prepared for examinations of this type. Some of the candidates who were less successful might have been better suited for entry to the core paper.

The majority of candidates successfully completed the paper in the time allowed. There is still a tendency among some candidates to copy lengthy sections of the question into their answers. Colleagues may wish to remind candidates that this is almost always unnecessary and can make it difficult to fit answers into the answer space. Candidates are reminded to write as legibly as they can so that Examiners are better able to award as many marks as possible.

It is recommended that this report and the published mark scheme are read together.

Comments on specific questions

Question 1

(a) Most candidates gained some credit for this question. A common mistake was to suggest *iron* instead of *iron oxide*. Candidates who wrote more than one term in an answer box could not be awarded credit.

(b) (i) This was correctly answered by the majority of candidates across the ability range. Carbon oxide was not accepted.

(ii) Candidates towards the higher end usually gained full credit. Candidates needed to state clearly that iron or iron oxide was reduced and that carbon or carbon monoxide was oxidised. A definition of oxidation and reduction without reference to the given context did not gain full credit.

(iii) Some good answers were seen for this question. Reference to global warming gained credit but if candidates simply discussed the greenhouse effect, they had to qualify their answer by emphasising that it is the *increasing* greenhouse effect that is the problem. While some candidates gained credit for writing about melting of polar ice, others were not credited for their discussion of the melting of icebergs. Candidates continue to make statements that attribute ozone destruction to carbon dioxide.

(c) (i) A minority of candidates gained full credit for this question. Part **(i)** is concerned with observations and not explanations and consequently correct Chemistry concerning redox or reactivity could not be credited.

(ii) Few candidates answered this question in terms of the interchange between atoms and ions. Many gained credit for their explanation in terms of the reactivity series.

Question 2

(a) The majority of candidates answered this question successfully. Candidates could gain partial credit if they converted 135 km/hr to 135000 m/hr. Many attempted to do this but stated that the speed would be 135000 m/s.

(b) Most candidates gained at least partial credit for their graphs. It was important for candidates to make some attempt to extend the short section of the graph that had been given. Candidates needed to take care in drawing the graph, drawing the relevant sections with a ruler.

(c) (i) Candidates generally recognised that unbalanced forces would be operating during the first stage when the cyclist was accelerating. A misconception that was seen a few times was that the driving force would need to be greater during the second stage because the cyclist was moving forward.

(ii) Most candidates got at least part of this question correct, with the third part being the part most commonly wrong. Potential on its own was not accepted for the first energy form. Candidates had to specify chemical (potential) energy (in the rider).

Question 3

(a) Trachea and bronchiole were recognised by the majority of candidates. The most common mistake was to suggest bronchus instead of bronchiole.

(b) Many candidates correctly described the alveoli as having a large surface area. Many also attempted to discuss the thin walls of the alveoli but used imprecise language such as '*the alveoli are thin*' which could not be credited. The other key idea, that alveoli are well supplied with blood, was not seen so frequently. Some candidates simply described the diagram using phrases such as *there is a capillary near to the alveoli.* Several candidates correctly stated that the alveoli surfaces were moist but the question asked for features that were visible in the diagram

(c) (i) Most candidates had no difficulty in calculating the volumes of air.

(ii) Many candidates gained somecredit here. The most commonly-seen point was the need for increased oxygen and this was often accompanied by a correct or implied reference to an increased rate of respiration. Very few candidates referred to muscle contraction and the need to remove carbon dioxide. A significant number gave extensive discussion of the build-up of an oxygen debt with detail which was neither an answer to this question nor on the syllabus for this examination.

Question 4

(a) (i) Partial credit was gained by many candidates. The most commonly-seen mistake in the drawn circuit was an incorrect connection of the bell / buzzer symbol. Candidates could include a single cell symbol or a battery of several cells in series.

(ii) Many candidates included a second independent battery, when the question specifies a second push-switch. A few candidates correctly placed their second push switch in parallel with the first.

(b) (i) The majority of candidates had learned a correct definition of frequency. A minority of candidates suggested responded to say that frequency referred to the pitch of the sound. While there is a connection, answers like this could not be credited in the context of this question.

(ii) The relationship between wave speed, frequency and wavelength and its application had been very well learned and many gained full credit. Of the variety of incorrect versions of the formula, one that was commonly seen was wavelength = frequency / speed.

(c) (i) This was a very straightforward use of Ohm's Law and the majority of candidates gained credit. The most common mistake was to substitute 1.5 V instead of 6 V into the formula.

(ii) Many answers gaining at least partial credit were seen. Less well performing candidates suggested a variety of units including watts and coulombs. Candidates were not penalised twice if they had also used 1.5 V instead of 6 V in this part.

Question 5

(a) (i) This was answered very well by the majority and large numbers of candidates gained full credit.

(ii) Only the weakest candidates did not gain full credit here. Candidates needed to relate the connection between Group number and number of outer electrons. The most common mistake was to give the total number of electrons.

(b) (i) The dot and cross diagram of a methane molecule had been learned very well by candidates across the ability range and many gained full credit.

(ii) The balanced equation in this question was familiar to the better-scoring candidates.

Question 6

(a) (i) Many gave the correct answer here. Incorrect suggestions included *ultraviolet, rays, solar, radiation, heat*.

(ii) It was not enough for candidates to state simply that '*black absorbs heat*'; It was important for candidates to emphasise that black is a *better* absorber of heat than any other colours that the base could be painted.

(b) The description of the change of state from liquid to gas proved to be fairly challenging for many candidates. The question directs candidates to discuss the process in terms of what happens to molecules. Many answers contained correct statements but did not refer to molecules and so could not gain credit. Some excellent answers were seen from candidates towards the top end of the mark range.

(c) The ray diagram was answered quite well with the majority of candidates gaining at least partial credit. Most candidates drew their rays carefully using a ruler. Those who drew carelessly, defining ambigous or curved paths, could not gain credit. Some candidates drew the refracted ray correctly but the totally internally reflected ray was missing or drawn so that the incident angle was not equal to the reflected angle. Candidates are advised to draw accurate normals on these diagrams if one has not been provided, as in this case.

Question 7

(a) Phototropism was recognised by most candidates.

(b) (i) Many candidates found this a challenging question. Candidates needed to make use of the information given in the question ie. that auxins are produced at the tip of the shoot and so must move down to reach the rest of the stem. Candidates often gained credit for describing the increased concentration of auxins on the side away from the light. A very small minority correctly used the term *cell elongation*. A slightly larger number wrote a credit-worthy description of differential growth.

(ii) Candidates needed to use the idea of the movement of auxins again to answer this question. Very few correct answers were seen. A commonly-seen idea was that the plastic insert shielded the plant from light preventing photosynthesis.

(iii) This proved to be the most challenging part of **Question 7(b)** and only a very small number of candidates gained credit. Many did not spot that shoot **Z** was kept in the dark and so ended up trying to manufacture reasons why shoot **Z** had not grown as much as shoot **X**.

(c) The best candidates realised that they should be discussing the biological effects of adrenaline and many gained some credit, usually for a description of increased pulse rate or increased glucose levels in the blood. Large numbers of candidates based their answers on emotional responses to situations, and discussed '*fight or flight*' responses, or the need for athletes to be '*fired up for the race*'. Some misconceptions that were seen in answers included the idea that adrenaline produces energy or that adrenaline breaks down to produce energy.

Question 8

(a) The better candidates either knew how the mixtures could be separated or could use the information given about the substances to deduce which method to use. Candidates need to be familiar with the purification techniques specified in the syllabus.

(b) (i) Those candidates who supported their answer with reasonably clear diagrams tended to gain more credit. It was clear that some candidates had experience of carrying out paper chromatography and these candidates easily gained full credit. A reasonable number gained partial credit. Commonly-seen errors included suggesting that the chromatography paper is fully immersed in the solvent and omitting any description of the movement of solvent and dyes through the paper.

(ii) Just over half of the candidates correctly identified **A** and **C**. Weaker candidates gave answers such as '*those that contain the poison dye*'.

(iii) The weaker candidates suggested answers based on health and safety considerations which, although sensible, were not accepted on this occasion. Other candidates wrote answers which used phrases such as '*because you can see it from the chromatogram*'. Answers referring directly to distance travelled by components gained credit.

Question 9

(a) (i) A large number of candidates realised that combustion was responsible for the acid gas emissions but not all of them specified the involvement of fossil fuels, hydrocarbons or sulphurous/nitrogenous materials. Weaker candidates responded with suggestions such as '*chemical reactions that are carried out inside the power station*'. Some candidates strayed away from the question and gave descriptions of environmental consequences which they then had to repeat in the next part.

(ii) Candidates were more successful in this question than in part **(i)**. It was important that they specified that acidic gases react with or dissolve in water or rain.

(b) (i) Candidates generally found it challenging to come up with credit-worthy ideas. Many gave imprecise responses, including unqualified references to a wide range of sources of pollution. These could gain credit if the candidate made a reasonable attempt to justify that the pollutant would have an impact on pH. Only answers relating to the overall river pH rather than short-term localised inefficient mixing effects were accepted. The most commonly-seen answer that gained credit was the idea that rainfall would vary in amount and location.

(ii) Very few candidates gave the correct answer. Many missed that only ten different species were involved in the study and answers included numbers up to 40, produced by adding the numbers of species represented by each of the bars in the chart.

(iii) This part was answered very well. Candidates were very familiar with the need for optimum pH and understood and used the term *denatured* correctly. Once they had used the term *optimum* some were distracted into a discussion of temperature but could still gain credit for discussing denaturation.

COMBINED SCIENCE

Paper 0653/33
Extended Theory

Key Messages

Candidates should be aware of the command words contained in the question when considering their answers. For example, the word 'describe' requires a different type of response from the word 'explain'. A question stating 'describe and explain' needs both a description then an explanation. **Question 6(b)(ii)** is an example of this type of question.

Pay attention to detail in answers. An example of this is that when iron rusts it reacts with the oxygen in the air, not just the air. This also applies to aerobic respiration requiring oxygen, not just air. In questions about collision theory, descriptions involving increasing rate of reaction require the rate or frequency of collisions to be described. It is not enough to simply state that there would be more collisions.

General Comments

There were some excellent scripts seen from candidates who had mastered all aspects of the syllabus and who demonstrated good examination technique. In general, candidates had prepared themselves equally well for all of the Science disciplines, and they usually suggested sensible answers to questions that were set in unfamiliar contexts and required understanding of Science rather than straight recall of facts.

The majority of candidates used the available space on the examination paper appropriately. Centres should continue to make it clear to candidates that the space allocated for a response, along with the available credit, indicates the length of response and level of detail expected.

There was no evidence that candidates had difficulty in completing the paper in the required time. In some scripts legibility of handwriting could have been better; these candidates risk losing credit if key words in a response cannot be read clearly.

It is recommended that this report and the published mark scheme are read together.

Comments on specific questions

Question 1

(a) (i) The reaction of oxygen in the air with iron to cause rusting was the conclusion required in this question. It was clear from candidates' responses that many had not seen anything similar. Incorrect responses included references to water being produced during rusting.

(ii) Many candidates correctly concluded that rusting had not taken place due to the lack of reactivity of helium.

(b) (i) This question was generally well answered by candidates or all abilities. A few responses incorrectly included descriptions of the reactivity of the atoms rather than a comparison of their electron arrangement.

(ii) The majority of candidates completed the diagram of the electronic structure of sodium accurately.

(iii) Most candidates gave accurate descriptions of the loss of an electron when a sodium atom becomes an ion.

(iv) The fact that the sodium ions in sodium chloride have gained a stable and therefore unreactive configuration was explained well by most candidates. A minority stated incorrectly that a reaction would occur, and continued to explain the ionisation process.

(c) There were many correct answers showing a range of uses. Many candidates chose helium and its use in balloons. Candidates should be aware that helium is not used in hot air balloons. The use of neon in coloured lighting should have been followed by an explanation that neon glows when under the influence of a high voltage. Many candidates omitted this explanation.

Question 2

(a) (i) Most candidates responded correctly with the letters **R** and **T**. The majority of candidates who chose to write the names instead of the letters for the forces were unsuccessful. Upthrust was the only acceptable response for **R**, with *floating*, *drag* and *buoyancy* seen as common mistakes.

(ii) Many candidates successfully identified force **T** as the force of gravity acting downwards producing the weight of the man and the canoe. Some candidates incorrectly gave **R** as the answer.

(iii) The graph was drawn successfully by many candidates. The main incorrect answers were graphs attempting to represent acceleration by drawing a straight line with upward gradient, followed by a downward gradient, then the horizontal line showing steady speed.

(b) There were many correct answers indicating a valid energy transfer. Responses such as *the energy is wasted* and *the energy goes into the air* were not specific enough to be given credit.

(c) The equation for kinetic energy was well known by candidates across the ability range who therefore gained full credit. Some candidates incorrectly used the formula for momentum ($m \times v$) and others did not square the velocity when substituting the correct equation.

Question 3

(a) (i) Most candidates labelled the cervix and placenta correctly. The most frequent incorrect answer was labelling the amnion at the bottom of the uterus as the cervix.

(ii) The majority of candidates correctly wrote *glucose* in the first space. Several candidates wrote *bacteria* or *viruses* in the second space. Careful reading of the paragraph would have excluded these answers, since they are not molecules.

(iii) Most candidates named the amniotic fluid and described its function correctly. A minority of candidates described the function of the amniotic fluid as supplying nutrients, obviously confusing it with the placenta.

(b) (i) Those candidates who left any of the boxes blank could not be given credit since they did not make it clear whether the blank was intended to be cross or a non-response.

(ii) The detailed knowledge of the digestive enzymes is beyond the bounds of this syllabus and many candidates made incorrect statements, such as that amylase is only found in the mouth and is destroyed in the stomach and protease is only found in the stomach. Many candidates gave such as that starch is a small molecule so it is broken down in the small intestine and protein is a large molecule so is broken down in the large intestine. The functions of the areas of the digestive system for digestion and absorption, and the sizes of the large molecules of starch and protein were poorly understood.

(c) This was answered well by the majority of candidates who understood the effects of HIV on the immune system.

Question 4

(a) The circuit diagram was generally well answered. Careful reading of the stem was required to ensure that all components were included and the correct circuit design drawn. Several candidates omitted the switch and others drew a series circuit. The symbols for the motor and heater were given. Failure to copy these correctly by drawing a line through the centre of the component caused some candidates to lose credit.

(b) Most candidates answered this question in terms of particles, correctly describing the effect of the warm air on the water molecules. Some candidates did not provide enough detail about the additional energy given to the water molecules enabling more of them to have enough energy to escape from the surface of the water. The significance of the current of air removing the evaporated molecules of water was not described by the majority of candidates.

(c) Most candidates correctly described warm air as being less dense than cold air. Fewer candidates were able to explain this by describing the molecules becoming further apart from each other. Incorrect statements described the molecules of air becoming lighter.

(d) (i) The majority of candidates identified the unit as watts.

(ii) This was answered correctly by most candidates who correctly substituted the numbers into the formula to confirm that the current is 5A.

(e) (i) Candidates gave a variety of acceptable reasons for the current to increase in the circuit causing the fuse in the hairdryer to blow.

(ii) This question required the choice of the 10A fuse, followed by an explanation of the choice. Many candidates incorrectly chose the 5A fuse. An appreciation of the safety implications of choosing the 15A fuse was omitted or poorly explained by many candidates.

Question 5

(a) (i) The majority of candidates correctly identified the growth response as geotropism.

(ii) Many candidates answered this well, understanding the role of the roots in acquiring water and minerals.

(b) A few candidates were able to describe the inhibitory effect of auxin on root cells. Instead many candidates wrote that it causes expansion of the root cells, as it does in the shoot. This could not explain the diagrams in Fig. 5.1. Candidates should provide sufficient detail in their answers. For example, a response stating that the hormones make the root grow downwards did not giv e enough detail.

(c) (i) Many candidates knew that lack of oxygen would lead to a reduced rate of aerobic respiration. Lack of air was not considered to be precise enough to gain credit.

(ii) The important concept in this response was the use of the energy released by respiration for growth. Few candidates stated this. Answers stating that energy is produced during respiration were not credited.

Question 6

(a) Most candidates successfully completed the word equation, although some incorrectly wrote hydrogen instead of water.

(b) (i) Many candidates identified the loss of carbon dioxide as the cause of loss of mass. A common misconception was that the disappearance of calcium carbonate as it reacted caused the loss of mass.

(ii) There were many responses which interpreted the graph well and gained full credit for this part of the question. An explanation in terms of the reduction of reactant particles was also needed, and many candidates did not gain credit for this.

(c) (i) Many candidates correctly stated that 203 g is the final mass at the higher temperature.

(ii) This was answered well by the majority of candidates. Candidates must take care when they explain the increase in reaction rate in terms of the collision theory; they must describe an increase in the collision rate, not just more collisions.

Question 7

(a) (i) This question was well answered by the full range of candidates.

(ii) Most candidates identified reflection as the property of electromagnetic waves than enables us to see the Moon.

(b) (i) The majority of candidates identified the part of the electromagnetic spectrum where X-rays are found.

(ii) Many candidates stated that it takes the same length of time for light and X-rays to reach the Earth because they travel at the same speed. One misconception stated by many candidates was that light reaches Earth faster than X-rays because nothing can travel faster than light.

Question 8

(a) Many candidates successfully identified the relationship between the rate of photosynthesis and light intensity. The information from the graph had to be translated so that the light intensity was interpreted as the distance of the lamp from the plant, and changes in the number of bubbles indicated changes in the rate of photosynthesis.

(b) The fact that plant **P** could photosynthesise more quickly than plant **Q** was stated by most candidates. Acceptable explanations were based on the greater intensity of light reaching **P** than **Q**. The explanation that **P** is closer to the Sun was not credited. Further credit was awarded for valid reasons why the light did not reach **Q**, such as shading by other organisms.

(c) (i) The increase in minerals provided by the fertiliser would cause the surface plants to grow. Many candidates successfully gave this response. Several incorrect answers described the surface plants being unaffected because the fertiliser would sink to the bottom of the pond.

(ii) Many candidates could follow the consequence of the greater number of surface plants preventing light from reaching plant **Q**. Some candidates incorrectly stated that plant **Q** would grow better because it had more minerals and carbon dioxide produced by bacteria, disregarding the lack of light.

Question 9

(a) (i) Most candidates correctly defined the element as consisting of one type of atom. The definition of a compound was also well answered. When candidates stated that a compound contains two or more different elements they needed to add that the elements are bonded together.

(ii) The difference between a mixture and a compound is most easily described by the ratio of components of each, the compound having a fixed ratio of atoms, and the mixture having a variable ratio of components. Many candidates made statements such as *in a compound the elements are bonded but the substances in a mixture are not bonded*. This could not gain credit because many of the components of a mixture are compounds and have bonds. Unless it was made very clear that a particular component in the mixture did not contain bonds between itself and other components, credit could not be given.

(b) Many candidates gained full credit by producing the correct formula and an explanation for balanced charges within it. The 'swap and drop' method usually produced the correct formula, but, on its own, did not gain credit for an explanation of charge balance within the compound.

(c) This question was generally well answered by the higher-achieving candidates. There were some excellent descriptions of the attraction of aluminium ions to the cathode and their subsequent reduction to aluminium. Common reasons for losing credit were confusing the charges on the cathode and anode and referring to the aluminium ions as just aluminium.

(d) There were many correct answers, explained well in terms of the activity series and the ability of carbon to displace copper, but not aluminium.

COMBINED SCIENCE

Paper 0653/04

Coursework

(a) Nature of tasks set by Centres.

All the assessments set were appropriate to the requirements of the syllabus and the competence of the candidates. The nature of the tasks was well understood. The standard of candidates work was comparable with previous years with candidates covering the whole mark range.

(b) Teacher's application of assessment criteria.

The assessment criteria were understood and applied well for all of their activities. Skills C1 and C4 were not assessed in the same investigation

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

The use of annotation on candidates' scripts to indicate or justify where marks have been awarded has been encouraged for the last few examination periods.

Tick lists were used for skill C1.

(d) Good practice.

Annotations written on the script at the point where the marks are awarded is good practice.

COMBINED SCIENCE

Paper 0653/51

Practical Test

Key message

The ability to recognise a graphical relationship as proportional or inversely proportional is essential in this paper and is part of the Mathematical Requirements in the syllabus.

General comments

The exercises worked well and all candidates were able to complete this paper in the time allowed. Although there were graphs in both **Question 1** and **Question 3**, different skills were being tested.

Comments on specific questions

Question 1

A significant number of candidates did not record temperatures within the limits set in the question or to the nearest degree in part **(a)**.

Many candidates were awarded full credit in **(b)**. Common errors were recording the height in centimetres or in the wrong column.

Graphs were generally well plotted; there were still a small number of candidates who chose awkward scales, resulting in plotting errors. A significant number of candidates assumed that the line should be straight when a curve clearly fitted the points better. Straight lines or curves were accepted as appropriate but undulating curves that joined all of the points were not creditworthy. Labelling was usually included and correct.

For part **(d)** a range of gases was suggested, but most identified the gas as carbon dioxide.

Statements in **(e)** were usually good enough for the mark however the most common error was to discuss the amount of gas or foam, rather than the yeast activity.

Question 2

The accepted observations in part **(a)** were adjusted according to Supervisor's comments. Commonly-seen errors were the use of the word transparent instead of colourless, and the confusion of the terms residue and filtrate.

In part **(b)** many candidates recorded the white precipitate or the final colourless solution and concluded the presence of the zinc ion. Fewer candidates noted the white precipitate and the colourless solution for each reagent. Some incorrectly described the precipitates as 'cloudiness'.

For the first part of **(c)** a colour of the solution was always recorded but very few candidates recorded the presence of bubbles or effervescence. Simply saying that a gas is evolved is not an acceptable observation. The colours of the following filtrate and residue were accurately recorded.

Most candidates obtained a blue precipitate and were able to conclude the presence of the copper ion but some simply gave the colour without the word precipitate or its abbreviation, ppt.

Question 3

There were many excellent sets of readings seen for part **(a)**. A common error was the recording of current values in the voltage column and vice versa. Less common errors were recording values with no decimal places, not using the length values given in the question and recording resistance values to an inconsistent number of significant figures. Where candidates recorded exact values, e.g. 1.00/0.20 = 5, these were accepted.
Many answers for part **(a)(iv)** referred to the danger of electrical shocks which was not creditworthy.

Most candidates chose a scale for the graph which allowed ease of plotting and made good use of the grid. Plotting was done well and many good straight lines were seen. Some non-linear scales were seen, resulting in no marks for the graph.

Very few candidates described the relationship as proportional although this is a skill required in the Mathematical Requirements section of the syllabus.

COMBINED SCIENCE

Paper 0653/52

Practical Test

Key message

When asked to describe colours in a question it is important to do so and not to use responses such as 'no change'.

General comments

The exercises worked well and all candidates were able to complete this paper in the time allowed. Candidates found the Biology experiment challenging.

Comments on specific questions

Question 1

This experiment required a considerable amount of care to be taken however it gave acceptable results for most candidates. Table 1.1 was sometimes filled in with comments that were not colours and this could not be credited.

Candidates needed to develop an argument using data and knowledge in part **(b)**; many candidates found this challenging. It is perfectly acceptable to repeat observations providing they are linked to what is happening biologically or chemically. Candidates performed better in their answers to **(c)** but some still struggled to make the connection between denatured amylase and starch still being present.

Question 2

The temperature changes allowed depended on the Supervisor's results which were supplied efficiently from all Centres.

Candidates were required to record the temperatures to the nearest 0.5^{o}C which required values to end in .0 or .5. The signs for temperature changes were done well which represents an improvement from past papers.

The identification of the copper ion in part **(c)** did not cause many difficulties except that the blue ppt. was not always reported. The use of sodium hydroxide solution to identify the copper ion was well known. In the last part, the most common error was to describe the white precipitate as cloudiness.

Question 3

Measurements in this spring question were carried out well.

Some candidates used different values of the masses added to the spring; these were only accepted if the Supervisor had explained why the values specified in the question paper were not suitable.

The concept of extension was well understood. Very few candidates gave non-linear scales on the graph and the plotting was mostly accurate. Despite a best fit straight line being specified, a number of candidates drew curves and many did not realise that the origin was the most accurate point and that the line should have passed through the origin.

Very few candidates described the relationship as proportional although this is a skill required in the Mathematical Requirements section of the syllabus.

COMBINED SCIENCE

Paper 0653/61
Alternative to Practical

Key Messages

Although this is an Alternative to Practical paper, candidates are expected to be familiar with experimental techniques and to have carried out experiments similar to the ones shown in the paper. Candidates should have used standard laboratory apparatus and be able to read values from measuring cylinders, thermometers, stopwatches etc.

General Comments

Candidates from many Centres demonstrated good understanding of practical knowledge and techniques. Candidates should be reminded to take care when rounding calculated values. The standard of graph drawing was high.

Comments on Specific Questions

Question 1

This experiment investigated the effect of temperature on yeast activity.

(a) Most candidates read the temperature correctly.

(b) Many candidates marked *h* correctly from the top of the foam to the bottom of the tube. Some candidates did not mark the bottom of the measurement.

(c) Most candidates plotted the points correctly and drew two lines of best fit. A small number of candidates had non-linear scales or joined each point to the next by a ruler. A significant number didn't draw any lines or drew two straight lines unconnected to the points.

(d) When planning an investigation, candidates need to consider the range of the independent variable, identification of the control variable(s) and how the dependent variable will be measured. A significant number of candidates rewrote the method given earlier in the question.

Question 2

This experiment details a series of tests used to identify a solid.

(a) While many candidates drew the filter paper carefully and clearly, some drew it as a plug at the neck of the funnel or had a gap in the filter paper at the neck of the funnel. Very few candidates did not draw the filter paper. Some candidates labelled the filtrate and the residue correctly, however some candidates reversed them. A significant number didn't label them at all.

(b) Many candidates identified the white precipitate but few stated the precipitate redissolved in excess ammonia.

(c) (i) More able candidates realised that the gas given off was carbon dioxide and so gave a correct limewater test. Many candidates incorrectly used lighted or glowing splints.

(ii) The most able candidates realised a blue precipitate was formed and that the precipitate redissolved into a blue solution. White precipitate was a common incorrect answer.

(d) Most able candidates appreciated that an insoluble brown precipitate was formed. Some candidates had a red brown colour produced with no mention of precipitate or solution and a significant number had a white precipitate forming.

Question 3

This was an investigation into the relationship between the length of a wire and its resistance.

(a) Most candidates read both dials correctly.

(b) Most candidates calculated both resistances correctly with only a few candidates entering the values to more than one decimal place.

(c) (i) Many candidates correctly chose suitable scales for both axes, correctly plotted the points and drew a line passing through the origin. Some candidates reversed the axes, a few had non-linear scales and some didn't extend the line through the origin.

(ii) Most able candidates described the relationship as proportional or directly proportional but most linked increasing length to increasing resistance.

(d) Very few candidates appreciated that the wire would heat up. A number of candidates believed that keeping the power on would make the current become larger or that the resistance would become charged.

(e) More able candidates appreciated that the current would be greater or the resistance lower but many candidates thought that the resistance would be higher.

Question 4

This experiment was measuring vital capacity.

(a) Many candidates realised that air should be blown into the rubber tubing with some appreciating that the air would go into the bell jar. Most did not appreciate that a large breath should have been taken in first and all the air in the lungs blown in to the jar or that the volume of the air should be measured.

(b) More able candidates realised that reliability is checked by repetition but only a few realised that the results would need to be compared for consistency.

(c) (i) Whilst many candidates specified that candidates of different heights should be used, only a few specified what should be measured. Only the most able gave a factor that should be controlled such as age or gender.

(ii) A graph of height vs vital capacity was seen from the more able candidates. However, most drew a table of results. In order to see a pattern if a table is used then the results needed to be in height order and not random.

(d) Many candidates appreciated that the candle would burn for longer in inhaled air as it contains more oxygen or that the candle would go out more quickly in exhaled air as it contains more carbon dioxide. A significant number of candidates appeared to believe that inhaled air is all oxygen and exhaled air is all carbon dioxide.

Question 5

This was an investigation into the boiling and freezing points of a liquid.

(a) (i) Most answered in terms of the liquid bubbling, with only the most able candidates stating that the temperature remains constant at the boiling point.

(ii) Many candidates thought that the thermal energy had reached its peak or that it was being lost. A few candidates knew that evaporation was occurring and that it is caused by thermal energy.

(iii) Most candidates read the temperature correctly.

(iv) Condensation was well known but the loss of energy less so.

(b) (i) Many candidates appreciated that a solid was formed. A significant number of candidates did not give an observation, referred to the process as freezing or stated that ice was formed, and were not awarded credit.

(ii) The question asked for the temperature to be read to the nearest 0.5 and gave answers to this precision. However there were many answers of 16 and 17 which were not creditworthy.

(iii) The most able candidates appreciated that the thermal energy given out is used to stop the temperature falling. Many candidates thought that the thermal energy stayed the same because the temperature stayed the same.

Question 6

This experiment was about measuring the height of a cliff.

(a) (i) Many candidates transferred the times correctly however some gave the full timer reading rather than using the example of the readings already in the table.

(ii) Many candidates appreciated the continuous nature of the experiment and so correctly entered the times into the table, the main error was entering the time for the rock to fall into this row.

(iii) Most candidates correctly subtracted the values in the table.

(b) (i) Most candidates substituted into the formula correctly although some used 3.2 instead of 3.3 and some didn't square 3.3. Overall the calculation was performed well, but many incorrect rounding were seen.

(ii) Few candidates discussed the decreasing effect of errors when using averages and most discussed reliability.

(c) Of the two parts to this question, the time taken for the sound to travel to either student **B** or to both students and the consequence of this to the recording of the times; many candidates addressed one part so were unable to gain full credit.

COMBINED SCIENCE

Paper 0653/62
Alternative to Practical

Key Messages

Although this is an Alternative to Practical paper, candidates are expected to be familiar with experimental techniques and to have carried out experiments similar to the ones shown in the paper. Candidates should have used standard laboratory apparatus and be able to read values from measuring cylinders, thermometers, stopwatches etc.

General Comments

Candidates from many Centres demonstrated good understanding of practical knowledge and techniques. The reading of the instruments was of an excellent standard but candidates need to take care when rounding calculated values.

Comments on Specific Questions

Question 1

This was an investigation into enzyme activity.

(a) (i) Iodine as the reagent to test for starch was well known but Benedict's was a common incorrect answer.

(ii) The majority of candidates discussed colours but many gave just the starting or ending colour, however both were required for credit to be awarded. Some went on to explain that the starch was broken down, but very few stated that it was amylase.

(b) (i) and **(ii)**
Candidates needed to state that starch was still present for part **(i)** and then explain that this was because the amylase had been denatured (due to it being boiled). Many candidates answered in terms of the colour remaining blue-black and not changing.

(c) Most candidates identified a possible source of error in the experiment.

(d) Candidates found planning the investigation very challenging and many only rewrote part of the method already given. When planning an investigation, candidates need to consider the range of the independent variable, identification of the control variable(s) and how the dependent variable will be measured.

Question 2

This experiment involved the energy changes on dissolving.

(a) Candidates gained credit for realising that the salt was powdered to increase the rate of dissolving. Many candidates gave an explanation in terms of increased surface area increasing the rate of reaction.

(b) (i) The majority of candidates read both thermometers correctly.

(ii) The majority of candidates correctly calculated the temperature changes but some candidates either omitted or reversed the signs.

(c) More able candidates gained full credit. A few candidates reversed the terms. A significant number of candidates named an energy type usually heat, chemical or kinetic.

(d) This question required candidates to look at the diagram and suggest changes to improve the accuracy of the experiment. Improvements such as putting the thermometer into the body of the solution, use a thermometer or use a stirring rod were not creditworthy as they were already given in the diagram.

(e) The vast majority of candidates found this question challenging.

Question 3

This experiment involved Hooke's Law and an application of it.

(a) (i) The majority of candidates read both rulers correctly.

(ii) Many candidates appreciated the proportional relationship between the load and extension.

(b) The majority of candidates read both rulers correctly.

(c) (i) The majority of candidates correctly calculated the density, however a significant number of candidates made rounding errors.

(ii) The majority of candidates gave mass.

(iii) The majority of candidates gave volume, however a small number gave velocity.

(d) The possible causes of inaccuracy was not well answered with few candidates gaining full credit.

Question 4

This was an experiment looking at a product of respiration.

(a) (i) Many candidates appreciated that limewater in flask **2** was testing for carbon dioxide and to confirm that it had been removed.

(ii) The more able candidates realised that if there was no carbon dioxide the limewater would remain colourless. A significant number thought the limewater would go milky.

(b) (i) and **(ii)**
Many candidates repeated their answers for **(a) (i)** and **(a) (ii)** without considering that the limewater was now testing the air after it had been past the insects. More able candidates appreciated that the limewater would go milky or cloudy due to the carbon dioxide given off from the insects.

(c) Few candidates appreciated that a control for this experiment would be to have no insects in flask **3** as this would then confirm that the carbon dioxide had come from the insects. Many candidates thought the control meant a control variable and so discussed factors to keep the same.

(d) (i) Many colours were given by the candidates but the majority incorrectly gave either green or blue. The most able gave red / orange / yellow.

(ii) More able candidates appreciated that the change was due to carbon dioxide, few knew that the carbon dioxide was acidic and almost no candidates realised that the carbon dioxide was dissolving in the water.

(e) Respiration was known by many candidates.

Question 5

In this experiment metals were being identified by a series of reactions and tests.

(a) (i) Hydrogen was well known.

(ii) The test and result for hydrogen gas was well known. However a significant number suggested using a glowing splint and were unable to be awarded credit.

(b) (i) Many candidates realised that the white precipitate was calcium carbonate. Incorrect answers of calcium, calcium oxide or calcium hydroxide were frequently seen.

(ii) Calcium hydroxide known only by the most able candidates. Calcium, calcium oxide or carbon dioxide were common incorrect responses.

(c) The majority of candidates named metal **A** as magnesium.

(d) (i) The majority of candidates knew that a white precipitate was formed. Only the most able knew that the white precipitate redissolves in excess.

(ii) Very few candidates appreciated that the green precipitate was $Fe(OH)_2$.

(e) Very few candidates knew that a white (silver chloride) precipitate would be formed. A significant number just wrote ‘silver’ or ‘no reaction’, and were unable to be awarded credit.

Question 6

This was an investigation of the Law of Reflection.

(a) (i) More able candidates measured the two angles correctly. ‘30 and 30’ was a common incorrect response.

(ii) Many candidates stated that the normal needed to be perpendicular to the mirror. A significant number used imprecise terminology such as ‘the normal was not straight’ and were unable to be awarded credit.

(iii) Many candidates gave creditworthy responses by stating that the law was not obeyed and explaining why.

(b) (i) The rays were generally drawn well.

(ii) More able candidates measured the two angles correctly. ‘55 and 65’ was a common incorrect response.

(iii) Many candidates found this part on identifying the mistakes challenging.

(c) Only by the most able candidates knew that these particles were electrons.

COMBINED SCIENCE

Paper 0653/63
Alternative to Practical

Key Messages

Although this is an Alternative to Practical paper, candidates are expected to be familiar with experimental techniques and to have carried out experiments similar to the ones shown in the paper. Candidates should have used standard laboratory apparatus and be able to read values from measuring cylinders, thermometers, stopwatches etc.

General Comments

Candidates from many Centres demonstrated good understanding of practical knowledge and techniques. The reading of the instruments was of an excellent standard but candidates need to take care when rounding calculated values. The standard of graph drawing was high.

Comments on Specific Questions

Question 1

This experiment involved a variety of food tests.

(a) Many candidates knew the colours of the positive tests for reducing sugars and protein but a significant number had the colours reversed or wrote blue for both.

(b) The majority of candidates gained credit for at least one correct test. Protein was the most well-known, and reducing sugar the least well known.

(c) Only the most able candidates gained full credit. Some candidates appreciated the need for the volumes of **D** and **E** to be the same; others stated the need to keep other factors constant or the conditions of the Benedict's test. Many thought that the speed of colour change or the darker shade of colour would indicate a more concentrated solution rather than red / orange being more concentrated and yellow / green being less concentrated.

(d) The majority of candidates incorrectly thought that the grease spot test was the test for liquid fats. Of those that correctly added ethanol many didn't then add water but still gave the result as cloudy.

Question 2

This experiment followed a series of reactions of a compound.

(a) (i) Some good diagrams were seen. However, many candidates drew a bung in both tubes or had the delivery tube not in the limewater in the second tube.

(ii) The majority of candidates knew that the limewater would go cloudy.

(iii) Carbon dioxide was known by the majority of candidates.

(iv) Many candidates correctly identified the compound as a carbonate, but oxide and chloride were common incorrect answers.

(b) (i) The majority of candidates identified the solution as alkaline.

(ii) More able candidates identified copper(II) hydroxide. Copper and copper oxide, were common incorrect answers.

(c) (i) Many candidates discussed the solid melting, oxidation or no change being seen without referring to the chemical reactions and were unable to be awarded credit.

(ii) Many candidates repeated the earlier part of the question, with the solid dissolving and forming an alkaline solution. Only the most able candidates identified the formation of magnesium hydroxide.

Question 3

This was an experiment about energy changes on mixing.

(a) A popular incorrect answer was a ruler; only the most able knew that a measuring cylinder would be required.

(b) The majority of candidates read both thermometers correctly.

(c) The changes in thermal energy were known by the majority of candidates.

(d) (i) Most candidates calculated 27 correctly, common incorrect responses were 32 or 59.

(ii) Most candidates calculated 32 correctly, common incorrect responses were 27 and 59.

(e) (i), **(ii)** and **(iii)**
The majority of candidates correctly calculated the energy changes.

(iv) The majority of candidates correctly calculated the specific heat capacity, however a significant number of candidates made rounding errors and were unable to be awarded credit.

Question 4

This was an experiment about photosynthesis of pond weed.

(a) Most candidates drew an arrow from the bulb to the centre of the beaker. A significant number of candidates drew the arrow to edge of the beaker.

(b) Completion of the chart was performed correctly by the majority of candidates. Occasionally the value for 20 cm was incorrectly given as 100.

(c) Most candidates correctly assigned suitable scales to both axes, correctly plotted the points and drew a curve of best fit. A small number of candidates had non-linear scales or joined each point to the next by a ruler. Candidates who had not read the axes labels carefully enough were awarded partial credit.

(d) The majority of candidates correctly read the value from their graph, however a significant number of candidates did not show on the graph how this was done.

(e) (i) Photosynthesis was known by the majority of candidates with a small number suggesting respiration.

(ii) Only the most able candidates gave the relationship correctly. A number of candidates discussed either amount of light or number of bubbles produced, which were not the variables listed in the question.

Question 5

This experiment followed the energy changes of reactions.

(a) The majority of candidates read both thermometers correctly.

(b) Most candidates correctly assigned labels and suitable scales to both axes, correctly plotted the points and drew curves of best fit. A small number of candidates had non-linear scales, did not include units or joined each point to the next by a ruler.

(c) (i) The majority of candidates identified copper sulfate with a correct reason, however a significant number gave no reason, and were unable to be awarded credit.

(ii) Many candidates knew that the temperature rise would be greater and most gave the correct reason.

(d) More able candidates identified the solid as copper and the solution as zinc sulfate.

Question 6

This was an investigation of the density of solids.

(a) (i) The majority of candidates correctly calculated the volume of the block.

(ii) The majority of candidates read both scales correctly.

(iii) The majority of candidates correctly calculated the two densities but a number of candidates made rounding errors.

(iv) More able candidates were able to choose the greater relative atomic mass as being the significant factor in making the density the largest.

(b) (i) Almost all candidates gave values to the nearest cm, and wrote whole numbers, although the question asked for values to the nearest mm. Candidates should be reminded to check that the precision of their answers matches the precision required by the question.

(ii) The majority of candidates correctly calculated the volume.

(c) (i) Water being absorbed by the wood was given by the majority of candidates.

(ii) The most able appreciated that the balsa contained more air spaces. Many candidates thought that the balsa contained more or less carbohydrates.