

COMBINED SCIENCE

Paper 0653/12
Multiple Choice (Core)

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

General comments: Biology

Candidates performed very well on **Questions 1, 2 and 9**.

Questions 10 and 12 proved to be particularly difficult for many candidates.

Comments on specific questions

Question 1

This question was well answered, with most candidates choosing the correct answer indicating that candidates could correctly apply the signs of life to a non-living example

Question 2

This question was well answered, with most candidates choosing the correct answer. Most candidates could correctly identify the optimum temperature for human enzymes. When candidates went wrong, they chose 27 °C.

Question 3

This question was well answered, with most candidates choosing the correct answer. However, many candidates chose **B** as the answer. This may be because they knew that the spongy mesophyll does photosynthesis. The question asked which layer most photosynthesis occurs in. Candidates could have found this answer by identifying the layer with the most chloroplasts.

Question 4

This question was well answered. When candidates went wrong, they thought that meat provided fibre in the diet. This may be because they did not read the question carefully enough.

Question 5

This question was well answered, with most candidates choosing ingestion as correct answer. Weaker candidates often chose digestion or egestion.

Question 6

Most candidates answered this correctly and could identify that digestion was the breakdown of large insoluble molecules to small soluble molecules. The most common misconception was that digestion is the breakdown of large soluble molecules to small insoluble molecules.

Question 7

This question was well answered with most candidates correctly identifying the xylem. Weaker candidates incorrectly identified the phloem as the tissue that transported water from the roots to the leaves.

Question 8

Most candidates correctly identified the pulmonary vein as a vein carrying oxygenated blood but some chose the vena cava or the aorta. Those choosing the aorta may have incorrectly read the question and not identified that the question was asking for a vein. Those choosing the vena cava may have thought that they were identifying the left side of the heart.

Question 9

This question was well answered with most candidates identifying the larynx. The spread of incorrect answers was roughly equal.

Question 10

Many candidates found this question challenging. Glucose and oxygen was chosen by many candidates but others picked carbon dioxide and oxygen or carbon dioxide and water. Candidates should be aware of the difference between reactants and products. Some may have simply been confused with the reactants in aerobic respiration and photosynthesis.

Question 11

Many candidates were able to interpret the table and identify the correct answer. However many picked option **D** as the answer. Candidates needed to know that in sexual reproduction the offspring are genetically different.

Question 12

Only the strongest candidates answered this question correctly. Many picked graph **A** or graph **C**. Neither graph could be correct as the thickness of the inner lining at day 28 was not the same as the thickness of the inner lining at day zero.

Question 13

Most candidates correctly identified the original source of energy in food chains and food webs as the Sun. When candidates picked the wrong option they chose respiration. These candidates were identifying respiration as the source of heat in the farmer, but they needed to have read the question more carefully.

General comments: Chemistry

Candidates performed very well on **Questions 14, 18 and 26**.

Questions 15 and 23 proved to be particularly difficult for many candidates.

Comments on specific questions

Question 14

Candidates understood that molecules of oxygen are gaseous at room temperature, and they were able to deduce the packing and movement of these molecules.

Question 15

Candidates chose the incorrect option, **C**, more often than the correct answer, **B**. Some stronger candidates chose the incorrect option, **A**. It is clear that many candidates were not familiar with the use of burettes.

Question 17

Stronger candidates often chose the incorrect option, **B**, rather than the correct answer, **C**. They knew what the electrolyte was, but incorrectly identified the electrode name.

Question 18

Candidates knew the characteristics of exothermic reactions and endothermic reactions very well.

Question 20

Some stronger candidates chose the incorrect option, **C**, more often than the correct answer, **D**. Although they understood that filtration is needed to remove excess solid copper oxide, they did not recognise that the copper nitrate produced is aqueous and that crystallisation is therefore required to produce a solid sample of the salt from the reaction mixture.

Question 21

Some candidates chose the incorrect option, **A**, rather than the correct answer, **B**. They confused the light-blue colour of the precipitate formed by copper(II) cations with the green colour of the precipitate formed by iron(II) cations.

Question 23

Candidates chose the incorrect option, **A**, more often than the correct answer, **B**. They did not realise that helium has two, not eight, outer shell electrons, and they were not familiar enough with the term "monatomic".

Question 26

Most candidates were able to distinguish between the fossil fuel, petroleum, and the other two fuels, hydrogen and wood.

General comments: Physics

Candidates performed very well on **Questions 29** and **36**.

In the physics section, candidates only found **Question 37** particularly difficult.

Comments on specific questions

Question 29

Stronger candidates found this question on gravitational potential energy very straightforward, but many other candidates opted for **B**, which represented the greatest value rather than the smallest.

Question 31

Here many candidates believed air to be a good thermal conductor.

Question 35

In this question on echoes, as many candidates chose option **B** as the correct option **D**, making the common mistake of failing to double the distance to the building.

Question 36

Although a large majority of candidates answered this electrostatics question correctly, a number thought that opposite charges repel, leading them to option **C**.

Question 37

Only the strongest candidates answered this question correctly. There was widespread confusion over the effect on the current in, and resistance of, a resistor when the potential difference across it is decreased; all options provided were popular.

COMBINED SCIENCE

Paper 0653/22
Multiple Choice (Extended)

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

General comments: Biology

Candidates performed very well on **Questions 2, 6, 7, 8, and 10**. Candidates found **Question 13** particularly challenging.

Comments on specific questions: Biology

Question 1

This question proved challenging for many candidates. Most chose option **D** indicating that the feature that assisted palisade mesophyll cells to photosynthesise was the fact that they had many chloroplasts. The fact that the cells are columnar also assists with light harvesting and stronger candidates recognised this and chose **B**. A number of candidates chose **A** as the answer, but this does not answer the specific focus of the question, which features help them absorb the maximum light.

Question 2

This question was well answered and most candidates chose 37 °C. When candidates went wrong, they usually chose 27 °C.

Question 3

This question was answered well by most candidates. However, a significant number chose option **A**. Candidates need to be prepared to identify a photosynthesis limiting factor graph. There are a number of factors that will have a similar effect on photosynthesis and produce a graph with a similar shape.

Question 4

This question was answered well by most candidates. The spread of incorrect answers was roughly equal.

Question 5

This question was well answered with most candidates choosing correctly and identifying the xylem. Not surprisingly when students went wrong, they identified the phloem as the tissue that transported water from the roots to the leaves.

Question 6

This question was usually answered correctly. The spread of incorrect answers was roughly equal.

Question 7

Almost all candidates answered this question correctly. Some weaker candidates selected **A** or **C**.

Question 8

This question was answered very well. A small number of candidates thought that water controls phototropism and gravitropism.

Question 9

Many candidates were able to interpret the table and identify the correct answer. However, many picked option **D** as the answer. Candidates needed to know that in sexual reproduction the offspring are genetically different.

Question 10

This question was answered correctly by almost all candidates.

Question 11

Most candidates correctly identified the primary consumers as **C**. However, a significant number chose **D** as the primary consumer. **D** would be the producers in this graph.

Question 12

Most candidates correctly identified the original source of energy in food chains and food webs as the Sun. When candidates picked the wrong option, they chose respiration. These candidates were identifying respiration as the source of heat in the farmer, but they needed to have read the question more carefully.

Question 13

Most candidates found this question challenging and chose row **B** as the answer. The correct answer was row **D**. Decomposition increases in both, this is correct. The decomposition is caused by bacteria and during the decomposition the bacteria respire so the overall rate of respiration increases. This reduces the oxygen concentration in the body of water.

General comments: Chemistry

Candidates performed very well on **Questions 14, 18, 19, 21, 25, 26** and **27**. Candidates found **Question 15** particularly challenging.

Comments on specific questions

Question 14

Candidates understood that molecules of oxygen are gaseous at room temperature, and they could easily deduce the packing and movement of these molecules.

Question 15

Stronger candidates were familiar with the use of burettes to measure a liquid volume to a high resolution. Other candidates did not recognise the limitations of the use of measuring cylinders.

Question 18

Candidates knew the characteristics of exothermic reactions and endothermic reactions very well.

Question 19

Candidates understood very well how different factors affect the rate of a chemical reaction.

Question 20

Many candidates knew the precipitate colours associated with the cations. However, there was some evidence that weaker candidates confused the light-blue colour of the precipitate formed by copper(II) cations and the brown colour of the precipitate formed by iron(III) cations with the green colour of the precipitate formed by iron(II) cations.

Question 21

Candidates knew the trends in the physical and chemical properties of the Group VII elements very well.

Question 25

Candidates were very familiar with carbon dioxide and methane as greenhouse gases.

Question 26

Most candidates were able to distinguish between the fossil fuel, petroleum, and the other two fuels, hydrogen and wood.

Question 27

Candidates understood the characteristics of members of the same homologous series.

General comments: Physics

Candidates performed very well on **Question 29**. Candidates found **Question 32** particularly difficult.

Comments on specific questions

Question 28

Although this question on speed-time graphs was generally well answered, weaker candidates often multiplied the maximum speed by the final time, arriving at option **D**.

Question 29

The topic here was acceleration. Almost all candidates realised that the vehicle was slowing down but several weaker candidates failed to identify that the deceleration was not constant.

Question 31

In this question on thermal properties many candidates believed air to be a good conductor.

Question 32

Only the strongest candidates answered this question correctly. The popularity of option **D** suggested that candidates confused wavelength, which changed, with frequency, which did not.

Question 35

Here a significant number of candidates forgot to convert the time given to seconds, leading them to the incorrect option, **C**.

Question 36

A common mistake in this question on factors affecting resistance was to believe that the effect of halving the length of the wire was cancelled by doubling its cross-sectional area, rather than both changes having a similar effect; option **C** was often chosen.

Question 39

Although weaker candidates generally recognised that the current in the battery was the same as that in each lamp, many also thought that the p.d. across the battery was equal to the p.d. across each lamp separately, leading them to choose option **A**.

Question 40

In this question on series and parallel circuits weaker candidates treated all four resistors as being in series, and so chose option **D**. Conversely, some of the stronger candidates treated all the resistors as being in parallel with each other, leading to option **A**.

COMBINED SCIENCE

Paper 0653/32
Core

Key messages

Candidates should make sure that scientific terms are spelled accurately, and that handwriting is clear enough to avoid confusion, for example the spelling of 'alkane' should be clearly written to avoid confusion with 'alkene'.

Candidates should be reminded to read the instructions in the questions carefully.

Care should be taken to produce accurate drawings using a pencil. Arrows should be placed on ray diagrams to show the direction of the light ray.

General comments

There were some excellent responses by some candidates who had prepared well for the examination. However, there was some evidence that candidates were not fully aware of the contents of the syllabus. Care should be taken that candidates are familiar with the knowledge and understanding required for the examination. The use of space on the paper was good. Very few candidates wasted space by repeating the question and the vast majority of responses were written within the allocated response lines in the paper.

Comments on specific questions

Question 1

- (a) (i) The majority of candidates identified the parts of the cell correctly. The most widely-seen incorrect answers were chloroplast and chlorophyll.
- (ii) Candidates had to read the question carefully to answer this question correctly. Their response required reference to the figure. Therefore, answers which referred to the functions or the colours of the organelles were not accepted.
- (iii) Most candidates recalled the test for starch correctly.
- (b) (i) Candidates across the ability range found this question challenging. The range of incorrect answers included maltose, amylase, hydrogen and oxygen.
- (ii) Candidates had to refer to molecular size in their answers to this question. This was achieved by stronger candidates. Other candidates found this question difficult and many responses repeated the information in the question.
- (c) Some candidates put the correct number of ticks in the boxes. However, some candidates incorrectly ticked only one box for each organism instead of the required two boxes in some cases.

Question 2

- (a) (i) The majority of candidates gave the correct name of another fossil fuel. Incorrect answers included biogas, wood and methane.
- (ii) Stronger candidates correctly gave fractional distillation. Incorrect responses included distillation on its own, or purification. Some candidates did not respond to this question.

- (iii) Very few candidates responded to this question. Candidates are reminded that uses of the fractions obtained from the fractionating column are listed in the syllabus.
- (b)(i) While some candidates gave the correct answer to this question, incorrect responses included naming the specific hydrocarbon shown, pentane, or writing its formula.
- (ii) This question was challenging for most candidates. Many candidates did not attempt the question, while others described the incorrect colour change.

Question 3

- (a) Very few candidates placed their **X** on the correct part of the graph. As the ball is moving upwards its speed is decreasing, so the **X** must be placed within the first two seconds of the graph.
- (b)(i) A number of candidates interpreted the graph correctly to conclude that it took four seconds from the time the ball was thrown until it was caught. The most widely seen incorrect answer was two seconds.
- (ii) Many candidates misinterpreted the graph and confused the shape of the graph with the height of the ball. The responses of these candidates stated that the ball was moving upwards at three seconds and it suddenly came down at four seconds. This indicated that the candidates thought that the ball was thrown upwards at two seconds, and rapidly came down at four seconds, therefore explaining why so many gave two seconds as their answer to (i).
- (c) The majority of candidates did the calculation correctly. The most frequently seen mistake was when candidates divided the mass by the gravitational field strength, instead of multiplying it.
- (d) Only stronger candidates named chemical energy as the energy in the boy which is transferred to the ball. However, most candidates correctly gave gravitational potential energy as the energy of the ball at its maximum height. Incorrect responses included muscular energy present in the boy.

Question 4

- (a)(i) The one-way valve labelled **A** in the figure was named correctly by most candidates. Several candidates wrote 'aorta'. The function of the valve was correctly described by many of the candidates who identified it in the first part of the question. Incorrect responses included the function of the aorta instead of the valve.
- (ii) The vena cava was correctly identified by many candidates. Generally, incorrect responses gave the other blood vessels leading to and from the heart.
- (b)(i) Acceptable responses had to include reference to the oxygenation of the blood at the lungs. Numerous responses repeated the information in the question and so did not achieve credit.
- (ii) A minority of candidates obtained full credit in this question. Incorrect responses included various descriptions of the pathway of oxygen from the lungs, through the heart, and around the body, but did not mention the red blood cells or haemoglobin.
- (c)(i) Adrenaline was correctly identified by a number of candidates. Incorrect responses included increased blood pressure and increased blood glucose as the cause of the increased pulse rate.
- (ii) Most candidates gave a suitable type of exercise as their response. Situations similar to that described in the question were not accepted.

Question 5

- (a)(i) Most candidates answered this question correctly. The most frequently seen mistake was the number 23 written for either the number of electrons or the number of neutrons.
- (ii) The electronic structure of the sodium ion was written correctly by stronger candidates. Incorrect responses included diagrams where there were two or eight electrons shown in the outer orbit. Some candidates changed the electronic structure of the inner shells of the atom, something that does not occur during electron transfer.

- (b) Most candidates gave the first three responses correctly. The products of the electrolysis were more challenging for candidates of all ability. A minority of candidates correctly identified chlorine as the product at the positive electrode. Candidates are reminded that the chloride ions are changed into chlorine molecules at the anode, so chloride was not accepted as an answer. The product at the cathode, hydrogen, was rarely seen in the responses. Sodium was given by some candidates. This is only produced when there is no water present so this answer was not acceptable.
- (c) (i) Candidates had to show that they understood what an exothermic reaction is, so they had to say that heat (thermal energy) was given out. Therefore, the use of a thermometer to measure the temperature of the water in the bowl before and after adding the sodium was the simplest way to do this. Most candidates did not mention the use of the thermometer. Others incorrectly stated that the production of bubbles or hydrogen gas was sufficient to show that the reaction was exothermic.
- (ii) Very few candidates gave the correct responses to this question. Responses such as the colour changes were not detailed enough to be acceptable.

Question 6

- (a) (i) Many candidates answered this question well. However, some candidates drew a series circuit, or an incorrect symbol for the fuse.
- (ii) Candidates had to apply the fact that the current in the main part of the circuit is the sum of the current in the two branches. Therefore, the total current is 3.1A, and a 3A fuse is clearly inadequate. Many candidates gave 3A as their response. The correct answer, 10A was rarely seen.
- (b) (i) Many candidates gave the correct answer, conduction, because the thermal energy is passing through a solid. Others either left it blank, or stated convection, condensation or heating.
- (ii) Candidates had to conclude that the method of thermal energy transfer was convection because it was occurring through a gas. The most widely seen mistake was radiation.
- (c) Candidates of all abilities found this question challenging. It required the explanation of evaporation in terms of the most energetic molecules leaving the surface of the water.
- (d) Some candidates gave the correct prediction that the gap disappears. Few candidates gave the correct explanation in terms of expansion of the wood. Many candidates did not attempt this question.

Question 7

- (a) (i) The majority of candidates identified the petal and sepal correctly.
- (ii) The arrow showing pollination was drawn correctly by many candidates. Careful drawing was required in order to show the intended structures accurately at both ends of the arrow. In some cases the ends of the arrows did not touch the anther and stigma. The arrow head should indicate that the pollen lands on the top of the stigma, not below.
- (iii) The ovule was the location required, as specified in the syllabus. Ovary was stated by some candidates, and although the ovule is inside the ovary this response was not specific enough to gain credit.
- (b) Many candidates correctly stated that the temperature in dish **E** is too low for germination to take place. Answers implying that germination would take place slowly were not awarded credit because it is far too cold for this to happen. Most candidates stated that germination would not take place because there is no light. Providing all other conditions are favourable, germination takes place without light in cress seeds because the energy source is stored inside the seed. Once germination is over the seedlings must have light to carry out photosynthesis.
- (c) This question was answered correctly by most candidates.

Question 8

- (a) (i) An acceptable definition was given by stronger candidates. Several responses referred to a compound being a mixture of different elements. This was not allowed because the different elements in a compound are combined chemically. A number of candidates did not respond to the question.
- (ii) The three common pollutants stated in the syllabus are sulfur dioxide, carbon monoxide and oxides of nitrogen. Most responses did not name any of these. Carbon dioxide was frequently stated as a pollutant. This gas occurs naturally so it was not accepted.
- (b) (i) This question was answered correctly by stronger candidates. Incorrect responses included nitrogen, carbon dioxide and hydrogen.
- (ii) The most straightforward method of increasing the rate of this chemical reaction is to increase the temperature. Some candidates stated this and gained credit. Other ways of increasing the rate of reaction include increasing the concentration of the reactants. Therefore, increasing the humidity of the air was accepted.

Question 9

- (a) Many candidates gained full credit for this question. Some of the other candidates did not attempt this question.
- (b) Many candidates correctly stated it must be a parallel circuit and provided a suitable explanation. Incorrect responses included series and electric.
- (c) (i) Most candidates gave a correct description a wavelength. A few candidates gave the definition of frequency.
- (ii) Candidates had to know that visible light has a higher frequency than infra-red radiation, and also that both types of electromagnetic radiation travel at the same speed. Some candidates gained full credit for this question. Others chose the wrong options, mainly that the frequency of the sodium lamp is less than the frequency of infra-red radiation, and the two types of radiation travelled at different speeds.
- (d) The ray diagram was drawn correctly by most of those candidates who attempted the question. However, some candidates omitted the arrows from their ray diagrams.

COMBINED SCIENCE

Paper 0653/42
Extended

Key messages

Candidates who were the most successful:

- wrote their answers clearly, using correct scientific terms to describe relevant scientific ideas
- avoided writing too much unnecessary detail which did not contain the answer to the question that had been asked
- were able to deal with calculations involving data in standard form.

General comments

The majority of candidates showed that they had been appropriately entered for the Extended Theory Paper. Only a very small number may have been better suited to the Core Paper 3. Many candidates gave excellent answers that showed mastery of all sections of the syllabus and good examination technique. Candidates usually showed a good balance of knowledge with understanding of all of the science disciplines. Questions which explored key science concepts in relatively unusual contexts proved to be challenging even for stronger candidates. Examples of this included all parts of **Question 6**.

Candidates across the ability range were well-prepared for the types of calculation that appear in these papers. They usually identified the appropriate formula to use, although some candidates went on to make mistakes when substituting values in standard form into the formula. Candidates usually wrote answers of appropriate length and used the number of marks and the space allocated for answers to inform the detail required. There was no evidence that candidates had any difficulty in completing the paper in the available time.

Comments on specific questions

Question 1

- (a) (i) All of the candidates completed this correctly.
- (ii) Most candidates gained credit for their food web. The most common error was the absence of arrows indicating the direction of energy flow.
- (iii) All of the acceptable answers shown in the mark scheme were seen. The most popular was a reference to respiration. Candidates should be advised that 'heat loss' is considered an alternative to respiration and not as an additional marking point. If the process of excretion was suggested, only those candidates who qualified their answer by referring to the 'excretion of waste products' (or a named waste product) gained credit. Some candidates used the term excretion when referring to the process of egestion. Some candidates gave quantitative statements about energy losses along a food chain without describing reasons for the losses. No credit was available for answers like these.
- (b) (i) All candidates answered this correctly.
- (ii) Most candidates correctly stated or implied that dietary fibre prevents constipation. A common mistake was the suggestion that fibre is important in the process of digestion.
- (iii) Most candidates correctly identified the fibre-rich food to be apple.

- (c) Many candidates had learned that vitamin C deficiency leads to scurvy. However, some candidates simply wrote 'vitamin C' rather than referring to a lack of this vitamin. The other most common incorrect suggestion was vitamin D deficiency.
- (d) (i) Most candidates identified person **B** correctly. Credit was given for the explanation and any wording that implied the greater level of physical work done by a gardener compared to an office worker gained credit. The answer '**B** does more work than **A**' was not considered enough to gain credit.
- (ii) The answer required here was much simpler than many candidates realised. Most candidates identified that **C**, the boy, needs more energy. Credit was given for the explanation, which was simply that (on average) males need more energy than females. This is the extent of the syllabus requirement. The idea that all boys engage in higher levels of physical activity than all girls was very frequently suggested but was not accepted.

Question 2

- (a) (i) The process of fractional distillation and its explanation in molecular terms had been very well learned by the majority of candidates. Candidates should be advised that references to volatility and boiling point are alternatives rather than separate ideas. In this case, candidates needed to make sure that they clearly compared the properties of the two fractions, e.g. 'the molecules in **O** are larger rather than **O** has large molecules'.
- (ii) Most candidates answered this question correctly.
- (b) Many candidates correctly deduced that $x = 3$ and $y = 6$. The most common incorrect answer was $y = 14$ which was suggested with a variety of values for x .
- (c) Most candidates were familiar with the dot-and-cross bonding diagram of ethene and gained full credit. Any clear representation of shared electron pairs, correctly located, was accepted.
- (d) Most candidates appeared to be familiar with the concept of an homologous series and those who had practised how to describe one properly gained full credit. These candidates avoided mistakes such as suggesting members of the series all have the same chemical formula rather than having a general formula. These candidates also avoided suggesting that members of an homologous series all have the same physical properties.

Question 3

- (a) Many candidates placed **X** at the correct point on the graph. Many others suggested points on the graph corresponding to speeds of both 8 m/s and 6 m/s.
- (b) (i) Many stronger candidates worked through to the correct answer. Weaker candidates often simply multiplied the numerical values given in the question. Partial credit was given if candidates clearly identified that the weight of the ball is 1.2N.
- (ii) Candidates usually realised that they had to make use of the relationship $P.E. = mgh$. Candidates gained more credit if they realised that they needed to calculate the gain in P.E. and so had to use the gain in height in their calculation. Partial credit was given for use of the expression for P.E. even if candidates did not get the final answer.
- (c) (i) The expression $\frac{1}{2}mv^2$ for kinetic energy was familiar to almost all candidates.
- (ii) Candidates usually used the K.E. expression to work through to the correct answer. Partial credit was given for an error arising from misreading of the value for speed from the graph. A number of candidates who had gained credit in (i) for knowing the K.E. expression did not gain credit in this question because they did not calculate the square of the speed.

Question 4

- (a) Candidates were very familiar with the function of heart valves in preventing the backflow of blood during passage through the heart. The majority gained at least partial credit for stating this. The strongest answers also stated that backflow was prevented from the ventricle to the atrium.
- (b) (i) Many candidates gained credit for knowing that blood entering the right side of the heart comes from the body. A smaller number gained full credit for a reference to respiration and/or body cells. Candidates who suggested 'because the blood is deoxygenated' showed relevant knowledge but this did not answer the question. Another answer showing relevant knowledge but which could not be credited was 'because it diffuses in' without any reference to body cells or respiration.
- (ii) Credit was gained by the majority of candidates, with many giving some excellent answers. Some weaker candidates gave the answer 'because it is oxygenated' which simply restated the information in the question and could not be credited.
- (c) (i) Many candidates had learned how to describe coronary heart disease and gained full credit. Most answers referred to blockage of arteries and the strongest answers identified coronary arteries. Reference to fat, plaque or cholesterol was accepted as an alternative to the simple idea of blockage.
- (ii) Almost all candidates were familiar with the lifestyle choices that reduce the incidence of CHD. The most common answers that could not be credited were 'eat a balanced diet' and 'eat a healthy diet'. Candidates should be advised to avoid answers such as 'eat no fat at all'.

Question 5

- (a) (i) Most candidates realised that the answer 'transition elements' (metals) was required here. The most common mistake was to list the names of metals.
- (ii) Most candidates successfully used the Periodic Table to deduce that an iron atom contains 26 electrons.
- (b) Most candidates answered this correctly, either by referring to the rusting of pure iron or by stating that alloys are stronger.
- (c) (i) Some candidates were familiar with the production of iron in the blast furnace and had learned that the fuel used in the process is coke. The answer 'coal' was not accepted in answer to this question. Quite a few candidates gave either petroleum or petroleum products suggesting that they may have been distracted by the idea of a fuel in the blast furnace.
- (ii) The deduction of the formula for iron(III) oxide, Fe_2O_3 , was done correctly by many candidates and it was clear that many others simply knew the formula. A small number suggested either Fe_3O_2 or FeO .
- (iii) The majority of candidates were familiar with redox and many wrote perfect answers. The strongest candidates made it clear that it was iron(III) oxide that is reduced rather than iron. Similarly the strongest answers stated that it was carbon monoxide that is oxidised rather than carbon. Candidates should be advised that when answering questions like this one they should use the names of the substances shown in the chemical equation. Candidates who answered correctly in terms of electron transfer gained credit.
- (iv) Many candidates correctly stated that the blast furnace is not used to extract aluminium from its ore because aluminium is more reactive than carbon. Candidates needed to say more than simply 'aluminium is very reactive'. A minority of candidates correctly described how aluminium is extracted using electrolysis but no extra credit was available for this.
- (v) Generally candidates were very aware of the environmental threat of increasing carbon dioxide levels and most gained credit here. A few candidates did not mention either global warming or a consequence of it. Candidates should be advised to avoid simply writing a list of all the environmental threats they can remember in answer to specific questions like this one.

- (d) Many candidates correctly suggested a pair of reactants that would produce iron(III) sulfate. Common incorrect answers included 'iron and sulfur' or 'iron and sulfate'.

Question 6

- (a) Candidates who gained full credit here realised that the question was not primarily concerned with the role or action of fuses in an electrical circuit. These candidates understood that the current through two identical heaters would have the same value and that this adds to give the current in the main circuit and hence through the fuse. Only a minority of candidates gained full credit although many gained partial credit for stating that the current through the fuse would be 8A. It was not enough for candidates simply to state 'because the heaters are identical'. Credit was gained for any explanation that implied the current through each heater would be the same and that this adds to give the main current. Many candidates answered this question in terms of the role of a fuse.
- (b) (i) Only the strongest candidates answered this question fully correctly. Candidates needed to find the words to express two key ideas, namely that molecules vibrate more quickly when heat energy transfers into them and that this increased vibration is passed on from molecule to molecule. Any wording that conveyed these ideas was accepted. Some candidates wrote answers that combined the features of conduction and convection and others suggested that mobile electrons were involved. Candidates needed to avoid statements such as 'molecules start to vibrate when heated'. They needed to make it clear that the vibration of molecules increases.
- (ii) Some stronger candidates gained partial credit for describing that air molecules in contact with the wood gained kinetic energy and that this eventually caused the air density to decrease. The question asked candidates to describe convection in terms of molecules and so a general description of convection currents was not enough to gain full credit.
- (c) A majority of candidates understood what was happening in the context of this question and gained at least partial credit for describing that the gap would reappear. Some gained full credit for stating that on cooling the wood contracts. Some of the explanations that did not gain credit included 'when heating is stopped nothing else happens', or 'the gap disappeared when heated and so comes back when cooled'. Candidates should be advised to ensure that answers asking for explanations should include scientific ideas.

Question 7

- (a) Most candidates were familiar with the adaptation showing the flower to be wind-pollinated, and large numbers gained at least partial credit. However, some candidates gave unclear answers, e.g. 'the stamen hangs outside so the wind can carry it away'.
- (b) Most candidates identified pollen grain F. Candidates needed to give the reason for their choice and needed to find words that implied that grain F would be more easily carried by the wind. The idea that it had to be F because G has the characteristics of pollen from an insect (or animal) pollinated flower was also accepted. Reasons that were not sufficiently details for credit included 'because it is light' or 'because it is smooth' without any reference to the ease with which they are moved by the wind.
- (c) The difference between pollination and fertilisation was very familiar to many candidates who gained at least partial credit. The most common reason not gaining full credit was that candidates described fertilisation as the fusion of male and female gametes rather than as the fusion of cell nuclei.
- (d) (i) The function of palisade cells was familiar to many candidates. Palisade mesophyll was accepted.
- (ii) Most candidates identified the presence of either chloroplasts or chlorophyll as the adaptation associated with photosynthesis. The most common answer that was not accepted referred to the location of the palisade cells near the upper surface of a leaf.
- (iii) Most candidates gained credit for identifying phloem.

Question 8

- (a) (i) Most candidates located **X** correctly. However, some candidates thought they needed to indicate the time at which the reaction had just stopped. In their attempt to do this they did not gain credit because they placed **X** significantly earlier than the start of the horizontal part of the graph.
- (ii) Many candidates knew how to answer this question and nearly all of them drew a line that was above the original line. The most common reason why credit was not given was for missing that the new line had to level off at the original hydrogen volume.
- (iii) Most candidates gained at least partial credit for stating that the reaction rate is greater at higher temperature. Credit for stating that the same volume of hydrogen would be formed was less frequently awarded. Many candidates wrote extensively about the reasons for higher rate in terms of the collision theory which was not necessary in this question.
- (b) Most candidates correctly calculated the magnesium mass.
- (c) Most candidates identified chlorine. Chloride was not accepted.

Question 9

- (a) The use of the relationship, $E = VI t$, was familiar to many candidates who gained at least partial credit. Those successfully working through to the correct final answer realised that time in this expression had to be in seconds and that eight street lamps in total were involved. Missing one or both of the latter points was the main error seen.
- (b) (i) The speed of electromagnetic radiation was familiar to many candidates.
- (ii) The relationship $v = f \lambda$ was stated and used by many candidates. However, some candidates who knew the formula made arithmetic mistakes handling the exponents.
- (c) The strongest answers clearly related the movement of the vibrations in the waves to the direction of propagation of the wave. It was clear that many candidates could visualise the difference between longitudinal and transverse waves, but their answers often contained vague descriptions such as 'to and fro' or 'from side to side'. Answers that referred to compression and rarefaction were accepted provided it was clear that these phenomena were observed with longitudinal and not with transverse waves. Answers that showed relevant knowledge but which could not be accepted included, 'longitudinal waves require a medium' and 'transverse waves travel through a vacuum'.
- (d) (i) Any region of the electromagnetic spectrum beyond ultraviolet was accepted as an alternative. However, credit was awarded for the reason and this had to make use of the data in the table of wavelengths. Many candidates appeared to misunderstand what the question was asking for and simply used the words 'not visible' from the table. Few candidates made use of the wavelength data in their reasoning, suggesting reasons such as '(gamma) because this has a very short wavelength' or '(X-rays) since their frequency is very great'.
- (ii) Since a variety of answers for the region of the spectrum were allowed in (i) suggestions here needed to be a known danger associated with the answer given for this part. If candidates had stated ultraviolet in (i) then they needed to specify 'skin cancer' rather than just 'cancer' here. Credit was given for a correct match even if the answer in (i) was incorrect. Some candidates attempted to answer in terms of the dangers of mercury vapour.

COMBINED SCIENCE

Paper 0653/52
Practical

Key messages

In the planning questions the bullet points in the question are there to help the candidates focus their attention on the headings under which the question will be assessed.

Candidates should be advised to read the questions carefully so that their answer relates to exactly what is being asked in the question.

General comments

All candidates completed the paper. The reading of the instruments was good. Candidates did not always recognise that negative numbers were to be plotted on the graph.

Comments on specific questions

Question 1

- (a) (i) Candidates read the thermometer scales correctly but some omitted the .0 for 24.0.
- (ii) Candidates identified the seedlings and gave a reason.
- (b) (i) Candidates measured the seedlings correctly.
- (ii) Most candidates calculated the mean correctly but some rounded their answer incorrectly.
- (c) Candidates knew the starch test.

Question 2

Most candidates attempted this planning question and almost all gained some credit with stronger candidates gaining full credit. Some candidates gave a basic description of the method. Some candidates gave the apparatus required but many measured with a scale rather than with a ruler. Many methods were very brief and almost no candidates discussed blotting the cylinders dry before weighing, repeating the experiments or discussed the safety precautions of using a knife. Many candidates described length changes or mass changes but few discussed both. Only the strongest candidates discussed how they would process the results obtained.

A significant number of candidates discussed the theory of osmosis at some length but this could not be credited as it did not answer the question set.

Question 3

- (a) (i) Most candidates measured the temperatures and recorded increasing temperatures for sodium carbonate and decreasing temperatures for ammonium nitrate.
- (ii) Values were subtracted correctly and some candidates gave the signs.
- (b) (i) Many candidates found drawing this graph very difficult. Some didn't allow for both positive and negative numbers to be plotted and so the change in temperature scale given was often not

appropriate as it only allowed positive values to be plotted. Most of these candidates went on to plot the negative numbers as positive numbers.

- (ii) Most candidates drew the best-fit line for their points.
- (iii) Most candidates drew the best-fit line for their points.
- (c) Most candidates could use their graph to determine the change in temperature but some did not gain credit as they did not show on their graph how they reached their answer.
- (d) Most candidates gave one improvement.

Question 4

- (a) (i) Most candidates measured the length in mm.
 - (ii) Most candidates measured the longer length in mm.
 - (iii) Some candidates gained credit. Common incorrect responses included: view parallel to the spring and wait until it stops moving.
- (b) (i) Most candidates subtracted correctly.
 - (ii) Many candidates determined the weight correctly. Common incorrect responses included 30 and 3000.
 - (iii) The majority of candidates calculated the value correctly.
- (c) (i) Most candidates calculated the value correctly.
 - (ii) Most candidates calculated the value correctly, but some did not give their answer to an appropriate number of significant figures or rounded incorrectly.
- (d) (i) The majority of candidates calculated the two values correctly.
 - (ii) Most candidates calculated the value correctly.
- (e) Only the strongest candidates answered this question correctly. Many candidates did not recognise that values within 10 per cent are within experimental error.

COMBINED SCIENCE

Paper 0653/62
Alternative to Practical

Key messages

In the planning questions the bullet points in the question are there to help the candidates focus their attention on the headings under which the question will be assessed.

Candidates should be advised read the questions carefully so that their answer relates to exactly what is being asked in the question.

General comments

Although this is an Alternative to Practical paper, candidates are expected to be familiar with experimental technique, to have carried out experiments similar to the ones shown in the paper and to be able to draw apparatus. Candidates should have used standard laboratory apparatus and be able to read values from a variety of measuring instruments and record the values to the requested accuracy. Undertaking practical work helps the candidates to interpret and evaluate experimental methods and results.

Candidates generally demonstrated good understanding of practical knowledge and techniques. The reading of the instruments was good. The standard of graph drawing was generally high but candidates need to remember that axes need to be linear and to cover at least half of the grid. Knowledge of identification tests for ions was limited and many found drawing diagrams of apparatus very difficult.

Comments on specific questions

Question 1

- (a) (i) The majority of candidates read the thermometer scales correctly to the nearest 0.5 C. Common incorrect responses included 0.15, 2, 0.0, 0.1, 20.4 and 25.
- (ii) Most candidates gained credit but a small number did not include a reason.
- (b) (i) The majority of candidates measured the seedlings correctly. A small number gave the measurements in cm. Some measured 1 and 2 correctly but gave 66 for 3.
- (ii) The majority of candidates calculated the mean correctly but a significant number rounded their answer incorrectly.
- (c) Most candidates knew the starch test. However, some candidates found the Benedict's test more difficult and no protein, no sugar (reducing omitted), no carbohydrate and no change were common incorrect responses.

Question 2

Most candidates attempted this planning question and almost all gained some credit with stronger candidates gaining full credit. Most candidates gave a basic description of the method. Some candidates gave the apparatus required but many discussed measuring with a scale rather than with a ruler. Many methods were very brief and almost no candidates discussed blotting the cylinders dry before weighing, repeated the experiments or discussed the safety precautions of using a knife. Many candidates described length changes or mass changes but few discussed both. Only the strongest candidates discussed how they would process the results obtained.

A significant number of candidates discussed the theory of osmosis at some length but this could not be credited as it did not answer the question set.

Question 3

- (a) (i) Most candidates measured the thermometer scales correctly to the nearest 0.5 C. However, a significant number did not include the .0 for 30.0 and 10.0. 16 and 17 were also quite common in place of 16.5.
- (ii) Most candidates subtracted the values correctly and included the sign. A few candidates gave + 8.
- (b) Only the strongest candidates answered this question correctly. Common incorrect responses included: to react more quickly, to dissolve more quickly, more molecules collide and make heat, to get molecules evenly dispersed and increased kinetic energy of particles increases the rate.
- (c) (i) Many candidates found drawing this graph very difficult. Many didn't allow for both positive and negative numbers to be plotted and so the change in temperature scale given was often not appropriate as it only allowed positive values to be plotted. Most of these candidates went on to plot the negative numbers as positive numbers.
- (ii) The majority of candidates drew the best-fit line for their points.
- (iii) The majority of candidates drew the best-fit line for their points.
- (d) (i) Most candidates could use their graph to determine the change in temperature but many did not gain credit as they did not show on their graph how they reached their answer.
- (ii) Many candidates found this question challenging. Some used the sodium carbonate graph. Many did not recognise that a quantitative answer was required and so "increase", "decrease" and "stays the same" were all common responses. A significant number of candidates omitted the question.
- (e) Only the strongest candidates answered this question correctly and a significant number of other candidates omitted the question. Most equated the graph to one following the rate of reaction. Therefore common responses included: all reactants reacted, reaction is finished, it has reached the end point, all the potassium carbonate is used up and water is in excess.

Question 4

- (a) (i) Most candidates measured the length correctly but a few gave 23.
- (ii) Many candidates gained credit. Common incorrect responses included: view parallel to the spring, wait until it stops moving and use tape.
- (b) (i) Most candidates subtracted correctly.
- (ii) Many candidates determined the weight correctly. Common incorrect responses included 0.3, 30 and 3000.
- (iii) The majority of candidates calculated the value correctly.
- (c) (i) Most candidates calculated the value correctly.
- (ii) Most candidates calculated the value correctly but some did not give their answer to an appropriate number of significant figures.
- (d) The majority of candidates calculated the two values correctly.
- (e) (i) Many candidates calculated the two values correctly.
- (ii) Many candidates found this question challenging and a significant number omitted the question. Some candidates did not recognise that values within 10 per cent are within experimental error.

- (f) (i) Stronger candidates answered this question well but a significant number did not answer the question. Common answers included: fewer decimal places, gives whole numbers so more accurate and easier to calculate.
- (ii) Many candidates found this challenging. Common answers included: still accurate and still parallax.