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COMBINED SCIENCE

Paper 0653/12
Multiple Choice (Core)

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

General comments

Candidates performed very well on **Questions 2**, **7**, **11**, **25** and **39**.
Questions 5, **13**, **15**, **17**, **24**, **30** and **34** proved most challenging.

Comments on specific questions

Question 1

Many candidates identified **D** as the correct answer. Other candidates generally chose either option **A** or **C**. Candidates need to be reminded that egestion is not a characteristic of all living organisms.

Question 3

Many candidates correctly chose diffusion as the process. Some candidates chose osmosis. Candidates need to be reminded that osmosis is the movement of water and involves a partially permeable membrane.

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Question 4

Most candidates correctly identified that amino acids are used to make proteins. The most common incorrect response was glucose.

Question 5

This question proved challenging. Many candidates incorrectly selected option **D**. Candidates need to be reminded that while cold water would reduce the rate of enzyme activity, it would not destroy the enzyme.

Question 6

Some candidates found this question challenging. The most common incorrect response was digestion. Candidates need to be reminded of the difference between absorption and digestion.

Question 8

Most candidates correctly identified the aerobic respiration equation. Some candidates incorrectly chose the equation for photosynthesis.

Question 9

This question was correctly answered by many candidates. Candidates who gave an incorrect response often chose either **B** or **C**. This indicated that they realised that adrenaline causes either blood glucose concentration or heart rate to increase but did not recall that adrenaline causes them both to increase.

Question 10

Many candidates correctly chose option **C**. A common incorrect response was option **D**. This may be because candidates incorrectly read the question and thought that the phototropism column was asking about the shoot, rather than the root.

Question 13

This question proved challenging. Many candidates incorrectly chose option **B**. Candidates need to be reminded that all living organisms respire and that respiration adds carbon dioxide to the atmosphere.

Question 14

Most candidates answered this question correctly. The most common incorrect response was option **A**.

Question 15

This question proved challenging. Candidates chose the incorrect option, **D** more often than the correct answer, **C**. They knew how to determine the number of neutrons in the sodium ion, but they identified the number of electrons in a neutral sodium atom rather than in the sodium ion.

Question 16

Many candidates answered this question correctly. Option **A** was a common incorrect answer.

Question 17

This question proved challenging. Candidates are expected to be able to describe the electrode products for both molten lead(II) bromide and concentrated aqueous sodium chloride, including knowing at which electrode each product is formed as well as the physical state of each product.

Question 18

Some candidates chose the incorrect option, **B** rather than the correct answer, **C**. They knew that melting is an endothermic change, but did not realise that there are other endothermic changes such as evaporating and boiling.

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Question 24

This question proved challenging. Candidates are expected to be able to describe the use of carbon in the extraction of copper from copper oxide, which includes the role of carbon in the reduction of copper oxide.

Question 25

This question was well answered. Many candidates understood how water supplies are treated in terms of filtration and chlorination.

Question 28

Many candidates chose option **B** rather than the correct answer **A**, failing to notice that the left-hand end of the line was aligned with the 13.1 cm mark.

Question 30

This question proved challenging. Options **B** and **D** were more popular than the correct option **A**. Candidates needed to study the equation given ($W = m \times g$) to work out the unit for g.

Question 31

Some candidates incorrectly multiplied the side length of the cube by its mass, and so chose option **D**.

Question 33

Many candidates knew the melting point and boiling point of water.

Question 34

This question proved challenging; only some candidates chose the correct option **D**. Many candidates chose either option **B** or **C**.

Question 36

Most candidates knew that twice the distance to the cliff should be used in the calculation, but many did not realise that a short, sharp sound is needed to be able to hear an echo.

Question 37

Most candidates knew that the particles involved were electrons, but many thought that the rod had gained them.

Question 38

To calculate resistance, many candidates thought that current should be divided by p.d., instead of the other way round.

Question 40

Some candidates thought that thicker insulation would reduce the amount of heat produced in connecting wires, possibly confusing connecting wires with objects inside the oven.

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COMBINED SCIENCE

Paper 0653/22
Multiple Choice (Extended)

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

General comments

Candidates performed very well on **Questions 1**, **6**, **8**, **11**, **13**, **14**, **15**, **23** and **33**.
Questions 17, **19**, **21**, **39** and **40** proved most challenging.

Comments on specific questions

Question 2

Most candidates chose the correct option **C**. Some candidates chose cold water as a way of destroying the enzyme. Cold water would reduce the rate of enzyme activity, but it would not destroy the enzyme. The rate of enzyme activity in cold water is lower as the frequency of effective collisions is reduced.

Question 3

Most candidates chose the correct answer **B**. The most common incorrect response was option **D**.

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Question 4

Most candidates answered this question correctly. Some candidates chose mechanical digestion.

Question 5

Most candidates correctly identified that a low humidity and high diffusion gradient for water would result in the highest rate of transpiration. Some candidates got this the wrong way round.

Question 7

Most candidates correctly linked the tar found in cigarettes to lung cancer. Some candidates chose option **B** or **C**.

Question 9

This question was correctly answered by many candidates. Some candidates chose option **B**. This indicated that they realised that adrenaline causes the heart rate to increase but did not recall that adrenaline causes blood glucose concentration to increase as well.

Question 10

Most candidates correctly identified that shoots were negatively gravitropic and positively phototropic. Where candidates chose the incorrect option, they thought that shoots were positively gravitropic.

Question 12

Most candidates correctly identified the protective effect of amniotic fluid. The most common incorrect answer was amniotic sac.

Question 17

This question proved challenging. Candidates chose the incorrect option, **D** more often than the correct answer, **C**. They knew how to determine the number of neutrons in the sodium ion, but they identified the number of electrons in a neutral sodium atom rather than in the sodium ion.

Question 19

This question proved challenging. Candidates were expected to know that in the test for sulfate ions, barium ions combine with sulfate ions to form a white precipitate, and that sodium chloride is soluble in water. They also needed to be familiar with ionic equations, including state symbols.

Question 21

Some candidates chose the incorrect option, **C** rather than the correct answer, **A**. Candidates needed to know that during combustion, a fuel gains oxygen atoms and is therefore considered to have been oxidised.

Question 25

This question was well answered. Candidates understood the role of carbon in the extraction of metals from metal oxides by reduction.

Question 27

This question was well answered. Candidates knew the products of the complete combustion of a hydrocarbon. The most common incorrect answer was option **B**.

Question 28

Distance-time graphs and speed-time graphs were well understood and many candidates answered this question correctly. The most common incorrect answer was option **B**.

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Question 29

Many candidates answered this question correctly. The most common incorrect answer was option **C**.

Question 31

It was very widely understood that gravitational potential energy was transferred to kinetic energy, but some candidates thought that the final transfer was to elastic potential energy.

Question 32

Some candidates thought that tidal power is only available if it is windy.

Question 35

Although most candidates knew that twice the distance to the cliff should be used in the calculation, some did not realise that a short, sharp sound is needed in order to be able to hear an echo.

Question 37

Some candidates found this question challenging. Option **A** and option **C** were common incorrect answers.

Question 39

This question proved challenging. A popular incorrect choice was option **D**, possibly as a result of thinking that current is ‘used up’ in the circuit.

Question 40

This question proved challenging. A number of candidates thought that thicker insulation would reduce the amount of heat produced in connecting wires, possibly confusing connecting wires with objects inside the oven.

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COMBINED SCIENCE

Paper 0653/32
Theory (Core)

Key messages

Candidates should ensure they,
- read all source information for each question carefully
- include equations and working for questions involving calculations
- use a ruler for drawing ray diagrams.

General comments

Many candidates 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) A few candidates correctly identified **X**, the coronary artery. Most incorrect answers stated that **X** was the pulmonary artery. Candidates should be aware that the blood vessel labelled **X** is on the outside of the heart where it divides to provide a blood supply to the heart muscle. The pulmonary artery is visible at the top of the diagram, where it splits to allow the blood to go to each lung.

(ii) Some candidates identified the vena cava correctly. Incorrect responses included 'pulmonary vein' and 'vein'.

(iii) Many candidates gave the correct answer. Incorrect responses included all of the structures of the heart. Candidates should be aware that the blood travels in only one direction through the heart due to the action of one-way valves.

(iv) There were many correct responses to this question. Candidates explained that the walls of the vein are thinner than the artery's and that the lumen is wider than in the artery. Responses referring to the presence of valves in veins or the lower pressure in veins were not accepted. Answers needed to refer to **Fig. 1.2** for credit to be awarded.

(b) Many candidates scored full credit for this question. Unacceptable responses for the similarity included observations that did not refer to pulse rate. Such responses included 'exercise started at the same time', and 'they both exercised for the same length of time'.

Most candidates could describe two differences successfully. Others stated a difference between the pulse rates, for example 'they had different pulse rates during exercise'. These responses did not gain credit because the student with the higher or lower pulse rate was not identified. Candidates should take care not to make the same point twice. An example of this was the response, 'student **A**'s recovery time is longer than student **B**'s'. The same point was then made by stating, 'student **B**'s recovery time is shorter than student **A**'s'. Only partial credit was awarded in this situation.

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Question 2

(a) (i) Many candidates scored full credit for this question. Candidates who gained partial credit usually identified element **Y** correctly, and confused **X** with **Z**. These candidates did not recognise that Group VII elements are coloured, and being non-metals, have low melting points. The transition elements usually have a high melting point.

(ii) A few candidates correctly stated that the trend of melting points decreases going down Group I. The most common incorrect answer stated that the melting point increases going down the group. Other incorrect responses referred to the trend in reactivity or density.

(b) (i) Some candidates answered this question well. The information in **Fig. 2.1** had to be read carefully so that candidates could take into account the reactivity of the metals in water, dilute acid, or in the case of metal **P**, in both.

(ii) Many candidates answered this question well. Increasing the concentration of the acid and increasing the temperature were the correct answers most frequently seen. Credit was not awarded for any responses that stated just 'temperature' or 'concentration' without further detail about how these variables could be changed. Credit was also not awarded for references to increasing the quantities of the reactants, for example 'use more acid'.

(iii) Most candidates scored full credit in this question by stating hydrogen. The most common error was carbon dioxide.

(iv) Most candidates answered this question well. Other candidates gave examples of reactions that they knew gave off heat.

Question 3

(a) (i) Almost all candidates calculated the volume of the iron bar correctly.

(ii) The conversion of kg to grams was done successfully by most candidates. The most common error occurred when 94 was divided by 1000 giving the answer of 0.094 g.

(iii) Many candidates calculated the density correctly. Candidates are reminded to state the formula that they use in calculations and to show their working. This can allow partial credit to be awarded if there is a mistake in a candidate's final answer.

(b) Many acceptable responses referred to the atoms being closer together, or in a more regular arrangement in solid iron. Responses describing the movement of atoms were not credited, as the question asked for differences between the arrangement of atoms.

(c) Only responses describing the decreasing speed of movement of the atoms were accepted in this question. Answers describing the closer proximity of atoms in the solid were not accepted.

(d) There were several acceptable responses to this question and candidates gave a wide range of answers. It was important that candidates described the unsuitability of the materials in the thermometer, not the range of the scale on the thermometer. The most common acceptable responses described the glass melting or breaking.

Question 4

(a) (i) Most candidates gave the missing labels in the diagram correctly. The most common error was 'stomata' instead of 'guard cell'.

(ii) Many candidates confused chloroplast with chlorophyll and responded that the function of the chloroplast is to trap light. Chlorophyll is present in the chloroplast and it does trap light energy but this trapped light energy is used for the process of photosynthesis in the chloroplast.

(iii) A small number of candidates answered this question correctly. Incorrect responses included the transport of minerals, and starch. The term 'food' was not considered to be precise enough to gain credit.

(b) (i) The most popular correct response given to this question was starch. Other candidates gave glycogen for credit. Incorrect responses included sucrose, maltose and carbohydrate.

(ii) This was often answered correctly. However, it was apparent from other responses that some candidates were not familiar with the term 'permanent' as written in the syllabus.

(iii) Most candidates successfully named the three elements that make up carbohydrates. Incorrect responses included water and nitrogen.

(c) Most candidates identified the correct order of the statements and gained full credit.

Question 5

(a) Most candidates knew the use of bottled refinery gas. Some candidates gave the response 'for domestic use'. This answer was not considered to be detailed enough to gain credit. Incorrect responses included the variety of uses of the other fractions, for example as fuel for cars or making chemicals.

(b) (i) Many candidates answered this question correctly. Incorrect answers included the names of specific hydrocarbons, namely methane and ethene.

(ii) Many candidates correctly answered that carbon dioxide was the other compound that is produced during the complete combustion of alkanes. Other candidates stated water. Careful reading of the information at the start of the question indicated that water had already been identified so no credit was awarded. A few other incorrect answers stated carbon monoxide.

(iii) A small number of candidates answered this question correctly. Incorrect responses included testing the boiling point and testing the freezing point, which are not chemical tests but physical ones.

(c) (i) Most candidates correctly identified the type of bonding in methane as covalent. The most common errors included 'single bond' and 'ionic bond'.

(ii) There were many correct answers describing the sharing of electrons. Some candidates did not gain credit because their explanations involved gain or loss of electrons, as would occur in ionic bond formation.

(d) (i) Candidates had to state both that there are single bonds in alkanes and that there are double bonds in alkenes. Most responses contained both types of bond, but responses that mentioned only one type of bond were not awarded credit.

(ii) Some candidates could identify the polymer poly(ethene) but many candidates did not attempt this question.

Question 6

(a) (i) This question was answered correctly by many candidates. The most common incorrect answer, seen in either or both boxes, was 'mechanical energy'.

(ii) Candidates needed to explain that most of the energy was lost as thermal energy, and many candidates gained credit here. Unacceptable answers included 'the energy was lost' and 'the energy was changed to different forms of energy'. These responses did not contain enough detail for credit to be awarded.

(b) (i) Many candidates answered this question well. However, some candidates omitted the sizes of the forces on the diagram, or drew the forces at right angles to each other.

(ii) Most candidates gained credit for this question. Candidates who did not gain credit often multiplied the two force values together, or divided 6000 by 5000.

(iii) This question proved challenging. The upward motion of the load was given in the question, so more explanation than this was needed. The fact that there was a net upward force on the load meant that it accelerated upwards.

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(c) Most candidates used the correct equation, time = distance / speed, and substituted the numbers given in the question to calculate the correct answer. Some candidates rearranged the equation incorrectly and the incorrect answer 11 was frequently seen.

Question 7

(a) (i) Most candidates identified the gall bladder correctly.

(ii) Candidates generally stated that the pancreas produces pancreatic juice (containing enzymes) for digestion. They found the consequences of pancreas removal more challenging to describe. Some candidates stated that digestion is affected but did not describe how it is affected. Other candidates described problems with insulin production, which is related to the role of the pancreas in the regulation of blood glucose concentration.

(iii) Many candidates knew that hormones are chemical substances and gained credit for ticking this box. Fewer candidates knew the second correct answer, that hormones alter the activity of organs. The two most common incorrect answers were 'produced by target organs' and 'transported in red blood cells'.

(b) (i) Most candidates identified the squirrel or the deer correctly.

(ii) Most candidates completed the sentences correctly. A few candidates incorrectly stated that the fox is a secondary consumer when it eats the jaguar.

(iii) Most candidates stated two acceptable environmental conditions needed for germination. Light is generally not needed by seeds for germination; therefore it was not awarded credit. Just temperature on its own was not accepted without further detail.

Question 8

(a) Many candidates gave an acceptable response to this question, usually by stating evaporation or crystallisation. Incorrect responses included electrolysis and heating. Heating alone was not creditworthy because it did not contain enough detail. Boiling was acceptable because the action of boiling the water would cause the water to evaporate.

(b) Some candidates drew the two ions correctly. Others either produced incorrect diagrams or left it blank. Candidates are reminded that arrows showing electron transfer should not be drawn on diagrams in this type of question. The question asked for the electronic structure of the ions, and not how the electron was transferred.

(c) Several candidates gave the correct answers, chlorine and hydrogen. Incorrect responses included water, sodium, chloride and oxygen.

(d) Candidates needed to suggest an actual number for the pH value, which had to show an alkaline solution was formed. Therefore, the responses 'basic' and 'alkaline' were not accepted. Many candidates wrote an acceptable number for the pH and accompanied it with a suitable colour of the Universal Indicator.

(e) Some candidates gained credit for this question. Many candidates wrote that litmus turns red. This was not enough. The colour in the litmus paper is bleached white and this was the answer that gained credit. Many candidates were unfamiliar with this test for chlorine.

Question 9

(a) (i) Most candidates successfully wrote visible light and radio waves in the correct boxes in the electromagnetic spectrum.

(ii) Most candidates gave an acceptable definition of frequency. Incorrect responses included definitions for velocity or wavelength.

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(b) The Ohm's Law calculation was done successfully by most candidates. However, some candidates wrote ohms or Ω for the unit.

(c) This question proved challenging. Many candidates did not use a ruler. Some candidates did not add arrows on the rays, or the arrows were in the wrong direction. Some candidates left a space between the incident and reflected ray at the surface of the mirror. Some rays did not start at the lamp or end at the eye. The angle of incidence and angle of reflection were often not equal.

(d) Many candidates successfully completed the circuit diagram. Candidates should be aware that the switch symbol is shown by an open switch. Also, there should be no extra components in the circuit.

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COMBINED SCIENCE

Paper 0653/42
Theory (Extended)

Key messages

- Candidates should be reminded to read the questions carefully and to use the number of marks available for each question and the space provided as a guide to how much detail to include.
- Candidates should ensure they note the number of significant figures used in the data in questions and give their answers to the same number of significant figures.

General comments

Most candidates had a good understanding of most parts of the syllabus and presented answers in a well-organised manner. Performance across the three science disciplines was well balanced. Most candidates showed their working in questions requiring calculations whether instructed to do so or not, which is good practice.

In Biology, candidates had learned proper definitions of mechanical digestion and could use technical terms appropriately to describe osmosis. In Chemistry, they were usually able to explain that breaking of covalent bonds requires energy and that formation of covalent bonds releases energy. They also knew that covalent substances have relatively low melting and boiling points because intermolecular attraction is usually low and they were familiar with halogen displacement reactions. In Physics, they could identify ways energy is wasted when a machine such as a crane is used to raise a load using an electric motor.

There was no evidence that candidates had difficulty in finishing the paper in the time allowed.

Comments on specific questions

Question 1

(a) (i) The food web was completed correctly by most candidates.

(ii) Owl or snake were identified by most candidates. Candidates giving acceptable explanations avoided the mistake of suggesting that the owl or snake fed at the second trophic level. Credit was not awarded for explanations such as ‘they are at the top of the food chain’ or ‘there are two organisms below them’.

(b) (i) The balanced symbol equation for photosynthesis was familiar to most candidates.

(ii) Clear answers for the role of chlorophyll were frequently given. However, candidates sometimes did not include the idea that light is trapped by chlorophyll. Others gave lengthy descriptions of the process summarised in the photosynthesis equation, rather than referring to the transfer of light to chemical energy. Candidates needed to refer to light energy rather than the Sun’s energy.

(iii) The idea of the role of starch as an energy store was familiar, but some candidates suggested that starch is used to store plant ‘food’ (too vague) or that starch provides energy without mentioning the key idea of storage. The idea that starch was the form in which glucose is stored was accepted as an alternative to energy.

(iv) The most common incorrect suggestions included *sucrose, maltose, carbohydrates* and *protein.*

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Question 2

(a) Many candidates drew the correct structure of methanol. The question required that all bonds were shown and so credit could not be awarded if the bond between oxygen and hydrogen was missing.

(b) (i) Some excellent answers were seen and many valid alternatives gained credit.

(ii) Candidates needed to refer to the type of elements involved rather than giving a description of shared electrons. The details of covalent bonding were very familiar to most candidates.

(c) (i) At least partial credit was awarded to most candidates because three correct chemical formulae were given. Many candidates also successfully balanced the equation.

(ii) Candidates who gained full credit worded their answers carefully and clearly used the prompts in the question (energy, bond breaking and bond forming).

(d) The association between increased levels of greenhouse gases and global warming was very well known and most candidates answered correctly.

Question 3

(a) (i) The formula for the volume of a cylinder was well known and most candidates gained full credit.

(ii) Most candidates knew the relationship between mass, volume and density and usually arrived at the intermediate stage of the calculation, 49 360.8 g. Candidates gaining full credit then converted the mass in grams to kilograms and stated the answer to the correct number of significant figures.

(b) Both of the key ideas, relating to the proximity of atoms and the resulting effect on volume, were described by many candidates and so full or partial credit was frequently awarded. Stronger answers compared the relative separation between atoms in solid and molten iron rather than simply making statements such as ‘atoms in solids are tightly packed’. Some good descriptions of reduced density arising from increased volume were seen. Some candidates described the difference in the number of atoms in a given volume, showing good understanding of the context.

(c) Full credit was often awarded. Some candidates missed the connection between metals, shiny surfaces and reflection of electromagnetic radiation. Simple answers such as ‘the metal stops the radiation from touching the body’, while true, were not a reason that was specific to metals and so did not answer the question in this case.

Question 4

(a) (i) Some candidates had learned how to define mechanical digestion. Those who gained full credit avoided the common mistake of stating that mechanical digestion concerned breaking down large *molecules* into smaller ones. Any suggestion of large molecules rather than large pieces of food meant that full credit could not be awarded. The idea that the process did not involve chemical action was familiar and many candidates gained at least partial credit.

(ii) Most candidates referred to chewing. Some candidates wrote lengthy descriptions of what happens during chewing and bolus formation, which was not required in this case.

(b) (i) Answers to this question needed to state a part of the alimentary canal. Stomach and duodenum were acceptable alternatives to small intestine but pancreas and liver were not. The one-word answer *intestine* was not specific enough.

(ii) Many candidates completed the table successfully and gained full credit. Both of the products of fat digestion had to be stated and some candidates omitted glycerol. Polypeptides and peptides were allowed as alternatives to amino acids.

(iii) The required answer, *mouth*, was usually stated. A small number of candidates confused the meanings of ingestion and egestion.

(c) Full credit could not be awarded if more than two of the boxes in the table were ticked. The most popular distractor was *energy released is used to relax muscles*.

Question 5

(a) Some candidates were familiar with paper chromatography. A common mistake was to locate the spot at 0.6 cm rather than 6 cm.

(b) (i) Most candidates knew that copper oxide was reduced but in order to gain credit they also needed to explain their answer using a definition of reduction in terms of oxygen loss. Some candidates gave answers such as 'it is reduced because carbon becomes carbon dioxide', which did not gain credit. Correct explanations in terms of electron gain had to be worded carefully and so suggestions such as 'copper oxide gains electrons' did not gain credit.

(ii) Most candidates correctly made the comparison between the reactivity of sodium and carbon. Only a small number of candidates referred to the reactivity of sodium oxide or made the non-comparative statement that sodium is highly reactive.

(c) (i) Most candidates correctly stated chlorine. However, a few candidates suggested chloride.

(ii) Many candidates described the gain of two electrons by copper ions. However, some candidates described ion formation by electron loss from copper atoms.

(d) It was important that candidates made a clear attempt to compare the properties of copper and bronze and so comparative phrases such as 'copper is not as strong as bronze' gained credit. It was not enough to simply state a correct description of a property of copper without any reference to bronze. Use of the words *rust* or *rusting* could not be accepted.

Question 6

(a) This calculation of acceleration was usually done correctly. However, some candidates gave incorrect units, often m/s.

(b) (i) The relationship between work, force and displacement was very familiar and many candidates gained full credit here. Alternative reasoning could be expressed in terms of the gain in gravitational potential energy. The question stated 'Show your working' and therefore full credit could not be awarded if no working or reasoning was shown.

(ii) The equation *energy = power × time* was successfully used by many candidates. Partial credit was awarded if candidates only omitted the conversion of 5 kW to 5000 W.

(iii) One-word answers such as *heat* or *sound* could not be awarded credit. Important ideas such as 'heat from the motors is wasted' or 'heat is lost to the surroundings' needed to be described. Some candidates discussed general uses of electrical energy. The question referred to useful work on the load and so answers that described other crane operations, such as moving the crane, were accepted.

Question 7

(a) (i) This question was usually answered correctly.

(ii) Many candidates were familiar with the terminology used to describe the processes occurring during osmosis but few candidates gained full credit. The strongest answers described the movement of water down a water potential gradient or from a region of high water concentration to low water concentration. There were sometimes confused phrases such as 'a water potential goes from high to low'. Other candidates described the movement of salt into the potato from high to low concentration.

(b) Candidates needed to be very careful to discuss root hairs and avoid suggestions that could apply only to roots. In general, the advantage of increasing water absorption was familiar and many candidates also described the increased surface area of longer root hairs.

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(c) (i) The role of magnesium in making chlorophyll was very familiar. The most common answers that did not gain credit included 'it makes the plant healthier' or 'it promotes faster plant growth', which were not specific to magnesium.

(ii) The yellowing of leaves through magnesium deficiency was well understood. The idea of reduced levels of photosynthesis was accepted but the statement 'there would be no photosynthesis' was not accepted.

Question 8

(a) The dot-and-cross diagram for the bromine molecule was correctly drawn by most candidates. A small number of candidates included too many electrons and drew the seven outer electrons in each atom and then a further two in each to show the shared pair.

(b) Stronger answers included both key ideas; that during boiling, intermolecular space increases and intermolecular attraction is overcome. Other answers contained descriptions of processes that occur during evaporation rather than boiling.

(c) Candidates familiar with Group VII chemistry recognised halogen displacement and often gained full credit. There were a number of incorrect suggestions including flame test colours, acid-base indicator colours, chloride test results and chlorine gas test observations.

(d) (i) Many candidates answered this question well. Credit was awarded for sensible suggestions of high temperature values and the names of possible catalytic materials. Answers not gaining credit included *a suitable temperature, temperature* and references to *high pressure*.

(ii) The colour change when using bromine to test for alkenes was familiar and many candidates gained credit for this question.

(e) A small number of candidates recognised that the melting point and boiling point were relatively low (compared to ionic compounds) and gained credit. Many other answers focused on the given melting point and boiling point as high temperatures.

Question 9

(a) Almost all candidates correctly compared the speeds of light and sound.

(b) The relationship *wavelength = wave speed ÷ frequency* was very familiar and large numbers of candidates answered this well. The most common error was to use an incorrect formula.

(c) (i) Most candidates correctly identified that a parallel circuit should be used.

(ii) The relationship *current = power ÷ potential difference* was familiar to many candidates. The most common error was to use an incorrect form of the formula. Some candidates attempted to complete a calculation based on Ohm's Law.

(iii) When drawing circuit symbols, candidates should be advised that the correct symbol for a switch shows it in the open position as drawn in the syllabus. The symbol for a lamp does not have the connecting wire drawn through it. These mistakes were common reasons why full credit could not be awarded. Another common error was to connect the lamp and the motor in series with each other. Only a small number of candidates did not gain at least partial credit.

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COMBINED SCIENCE

Paper 0653/52
Practical Test

Key messages

- Candidates needed to include enough detail in their experimental observations.
- In the planning question, the bullet points in the question help candidates focus their attention on the headings under which the question will be assessed.
- Candidates need to be able to read values from a variety of measuring instruments and record the values to the requested accuracy.
- Candidates must read the questions carefully so that they answer what is being asked by the question set.

General comments

Candidates generally demonstrated good understanding of practical knowledge and techniques and were well prepared for this paper. The reading of the instruments was generally good. The standard of graph drawing was high but candidates should remember that axes need to be labelled with quantity and unit and the plotted bars must cover at least half of the grid.

Comments on specific questions

Question 1

(a) (i) Most candidates measured the beans correctly, but some gave the values to an inappropriate precision, including 7.5 mm.

(ii) All candidates gave the correct units.

(iii) Most candidates calculated the averages correctly but some candidates rounded their values incorrectly.

(iv) Some candidates either did not label the *y*-axis at all or omitted the unit. A small number of candidates used less than half of the grid for their plotted bars. Many candidates plotted the bars correctly, but some reversed beans **A** and **B** or did not read their own scale correctly.

(v) Many candidates found this question challenging. 'Human error' and 'using a mm scale' were common incorrect responses.

(vi) Some candidates gave a correct alternative measurement such as mass. Common responses included using a thread, measuring in cm or using a measuring tape.

(vii) This question was usually answered correctly.

(b) (i) All candidates gave the correct observations.

(ii) The starch test was well known and most candidates gave a correct conclusion. A small number of candidates thought bean **B** contained glucose.

(iii) Almost all candidates named Benedict's solution, but biuret was also seen. Very few candidates included heating.

Question 2

(a) (i) Most candidates gave correct colours for the metals, but a small number of candidates gave black for at least one metal. Most candidates gave no reaction for metal **L** and had three different observations for the other metals. Some candidates had at least one of the metals effervescing, which was incorrect.

(ii) Most candidates chose the most reactive metal only.

(b) (i) All candidates gained full credit for the temperatures. The observations proved more challenging and some candidates did not have different observations for all four metals.

(ii) All candidates correctly chose **H** as the most reactive metal.

(iii) Many candidates did not compare to the other metals. High temperature change was not credited but highest temperature change was.

(iv) This question proved challenging. Many candidates changed the reaction including using a different acid, using more concentrated acid, and using more acid.

(c) Many candidates gave a correct order of reactivity. A small number reversed **G** and **J** or gave an order which contradicted their results.

Question 3

(a) (i) Some candidates explained why one oscillation would be difficult to measure accurately. Common incorrect answers included 'difficult to measure' with no further detail and 'human error'.

(ii) Most candidates gave a suitable number of oscillations but found it more challenging to give an explanation. Many discussed accuracy or less error.

(iii) Most candidates gave a valid value for their chosen number of oscillations.

(iv) Most candidates had similar times for their oscillations.

(b) (i) Most candidates calculated the *T* values correctly, but some candidates rounded their values incorrectly.

(ii) Most candidates calculated the average value correctly. A small number summed the values but did not divide by three.

Question 4

No candidate omitted the question and almost all gained at least partial credit.

Methods tended to be very brief and often didn't include moving mass **B** or balancing the beam. The method required the steps needed in order to get the data required. Some candidates placed mass **B** at certain distances from the pivot and recorded if the beam was balanced.

Candidates found the accuracy more challenging. A few candidates suggested repeating several times for each mass.

A very small number of candidates cited the masses to be used, but most did not give values at all.

A small number of candidates gave the table headings and of these some did not include the units.

A small number of candidates attempted to formulate a conclusion.

Some candidates gave a detailed mathematical explanation of balancing moments but gave no experimental detail for a practical.

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COMBINED SCIENCE

Paper 0653/62
Alternative to Practical

Key messages

- In the planning question, the bullet points in the question help candidates focus their attention on the headings under which the question will be assessed.
- Candidates need be able to read values from a variety of measuring instruments and record the values to the requested accuracy.
- Candidates must read the questions carefully so that they answer what is being asked by the question set.

General comments

For the Alternative to Practical paper, candidates are expected to be familiar with experimental techniques, to have carried out experiments similar to the ones shown in the paper and to be able to draw apparatus.

Candidates generally demonstrated good understanding of practical knowledge and techniques. The reading of the instruments was generally good. The standard of graph drawing was high but candidates need to remember that axes need to be labelled with quantity and unit and the plotted bars must be covering at least half of the grid. Undertaking practical work helps the candidates to interpret and evaluate experimental methods and results.

Comments on specific questions

Question 1

(a) (i) Most candidates measured the beans correctly. However, many candidates then gave the values to an inconsistent number of significant figures: 3, 1.65 and 1.55 were common incorrect responses.

(ii) Most candidates gave the correct units, but a small number of candidates omitted them.

(iii) Most candidates calculated the averages correctly. Some candidates added the values but did not divide by three. Some candidates rounded their values incorrectly.

(iv) Many candidates recognised the variation of bean sizes. ‘To give the range’ was the most common incorrect response; ‘to take an average’ and ‘to find the length of the beans’ were also quite frequently given.

(v) Many candidates either didn't label the *y*-axis at all or omitted the unit. A small number of candidates used less than half of the grid for their plotted bars. Most candidates plotted the bars correctly, but some plotted all six results rather than the average lengths and a small number drew line graphs of the two sets of data. Very few candidates left the question blank.

(vi) Some candidates gave a correct alternative measurement such as mass. Other candidates gave ‘use cm’ or ‘use mm’, which was not credited.

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(vii) Many candidates chose a difference that could be seen. Texture, appearance, number of cotyledons, germinating, testa and seed coat were common incorrect responses as these were not visible in **Fig. 1.1**.

(b) (i) The starch test was well known and most candidates gave a correct conclusion. A small number of candidates gave a conclusion only for bean **A** or thought that bean **B** contained some starch.

(ii) The test for reducing sugars was well known and most candidates named the reagent and a correct colour for a positive result. Some candidates omitted heating or put the test in a water bath with no mention of it being hot. A small number of candidates used biuret.

Question 2

(a) (i) Some candidates measured both thermometer scales correctly to the nearest 0.5°C. Other candidates did not include the .0 for 31.0 or gave 30.1. Common incorrect responses for 20.5 were 20.05, 20.1, 20 and 25.

(ii) Most candidates identified the most reactive metal. A very small number of the other metals were seen.

(iii) Many candidates gained full credit. However, some candidates did not compare to the other metals. High temperature change was not credited but highest temperature change was. Some candidates discussed the comparative speed of reaction rather than the comparative speed of bubbling.

(iv) This question proved challenging. Many candidates changed the reaction including using a different acid, using more concentrated acid, using more acid, changing the metal or using a higher temperature. Many candidates discussed using a digital thermometer or a more accurate thermometer, neither of which were awarded credit.

(v) Most candidates recognised that energy is released during an exothermic reaction but many did not answer in terms of the results and so did not discuss the increase in temperature.

(vi) Many candidates chose the anomalous result. The most common incorrect response was **L**.

(vii) Many candidates discussed what might have caused the anomalous temperature to be too high. Common incorrect responses included: too much acid, room temperature changing, faulty thermometer and parallax. Those candidates that chose **L** in **(vi)** discussed metal **L** not reacting, which is the reason why this result is not anomalous.

(viii) The test for hydrogen was quite well known. Common incorrect responses included: using a glowing splint or just a splint, squeaky pop test with no explanation of how this is done and a small number of tests for oxygen or carbon dioxide.

(b) (i) Many candidates followed the pattern in the table and gained credit. All of the other observations in the table were seen, as was the formation of a black solid, blue solid, red solid, brown solid or green solution.

(ii) Many candidates discussed the comparative reactivity of metal **H**. Other candidates stated that the substances react or that there was a reaction.

(c) Most candidates gave a correct order of reactivity. A small number of candidates reversed **H** and **G** or **J** and **L** or gave a totally different order.

Question 3

(a) (i) Many candidates explained why 20 oscillations are timed rather than one. Incorrect responses included: ‘to get an average’, ‘oscillations have different times’ and ‘being difficult to measure’ with no further detail.

(ii) Many candidates gave the correct time. A small number of candidates did not round the value correctly and gave 26.42. A very small number of candidates gave 26.426.

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(b) (i) Almost all candidates calculated the value of *T* correctly. Some candidates gave 1.33.

(ii) Almost all candidates calculated the average value correctly. Some candidates gave 1.32 or summed the values but did not then divide by three.

(c) This question proved challenging. Many candidates suggested placing the white card underneath the bob or to draw many lines on the card or stated 'to make it easier to measure' with no details.

Question 4

Very few candidates omitted the question and almost all gained some credit.

Many candidates either redrew **Fig. 4.1** or described in great detail setting up the apparatus in the figure, neither of which were required in this particular planning question. The method required the steps needed in order to get the data required. Many candidates gained partial credit from this section with some gaining full credit. Some candidates placed mass **B** at certain distances from the pivot and recorded if the beam was balanced and a small number of candidates counted oscillations of the beam.

Candidates found the accuracy more challenging. Repeating several times for each mass was suggested by some candidates and a small number of candidates described how to avoid parallax error. Just saying 'avoid parallax errors' was not sufficient to gain credit. No candidate discussed how to find the centre of mass **B**.

Many candidates used only one or two masses, did not have all the masses used greater than 50 g or did not specify the masses to be used at all.

Many candidates gave the quantity to be recorded in the table of results but did not include the units.

Many candidates gave a conclusion from knowledge rather than explaining how to use the data obtained in the experiment to formulate a conclusion.

Some candidates gave a detailed mathematical explanation of balancing moments but gave no experimental detail for a practical.