

COMBINED SCIENCE

Paper 0653/12
Multiple Choice (Core)

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

General comments

Biology

There were some questions in the biology section of the paper that candidates found difficult. This was usually where candidates had not fully read the question correctly. Some candidates were not secure in their knowledge of relatively basic facts. **Question 12** was particularly challenging for many candidates.

Chemistry

Candidates performed very well on **Questions 18, 25 and 26**. No questions proved to be particularly challenging for the candidates.

Physics

Candidates only found **Question 34** particularly difficult in the physics section.

Comments on specific questions

Question 1

Most candidates correctly identified **D** as the answer. There were several candidates who showed a common misconception: confusing breathing and respiration. Whilst respiration is a characteristic of all living organisms, breathing is not.

Question 2

The majority of candidates correctly identified the net movement of carbon dioxide. Others incorrectly selected **B** and **C**. Candidates needed to recognise that the muscle cells would be respiring and therefore producing carbon dioxide. This would diffuse into the blood moving by diffusion from a high concentration (muscle cells) to a low concentration (blood).

Question 3

This question was answered well. A small number of candidates incorrectly answered that all proteins were enzymes.

Question 4

This question was correctly answered by most candidates. However, some candidates got the protein test confused with the starch test and gave this as the answer.

Question 5

Whilst most candidates answered this question correctly, some thought that water leaves the leaf via the xylem, rather than as water vapour from the stomata.

Question 6

Bile is stored in the gall bladder and this was usually recognised. Some candidates, however, answered **D** – the pancreas. This could be because they misidentified the pancreas thinking that it was the gall bladder, or that they thought that the pancreas is where the bile is stored.

Question 7

The candidates who correctly identified **A** as the answer understood the concept of water loss. Water loss had decreased between X and Y indicating that either the temperature, sun or humidity had dropped or that the stomata had closed.

Question 8

The pulmonary artery was correctly identified by most candidates. Most candidates who answered incorrectly had identified the pulmonary vein. The pulmonary artery is clearly seen coming from the right side of the heart and the pulmonary vein to the left side. Some candidates struggled with identifying the correct side of the heart in the diagram.

Question 9

Many candidates answered correctly. Most worked out that **D** was incorrect and very few gave this as the answer. Where candidates were incorrect it was shared between **B** and **C**, very slightly favouring **C**.

Question 10

This question was answered well. When candidates chose the incorrect answer they favoured **B** – gravity.

Question 11

This question was answered well. Where candidates answered incorrectly they favoured the stigma as where the female sex cells are made.

Question 12

Many candidates needed to read the question more carefully. Candidates appeared to miss a number of words in the question that may have assisted them in answering the question. Candidates may not have noticed that the question was asking for the arrow that represented the **process** that releases **oxygen** into the atmosphere. They may not have recognised from the diagram that the box at the top right stated **carbon dioxide in the air**. It may also be that they answered the question indicating the direction of the loss of gas into the atmosphere. They should have indicated the arrow that indicated the process (photosynthesis) which removes carbon dioxide from the atmosphere.

Question 13

Most candidates recognised that sewage was not a valuable resource to be conserved. However, where candidates answered incorrectly, they did not think that species were an important resource to conserve.

Question 15

A small proportion of the stronger candidates chose the incorrect **D** instead of the correct answer, **C**. It was clear that ink **S** did not contain the colour yellow, so these candidates may have not read the chromatogram carefully enough.

Question 18

Candidates recognised the formula of sulfuric acid. Some weaker candidates chose the incorrect **B**, suggesting that they thought that sulfuric acid contains the sulfate ion rather than the sulfite ion.

Question 22

More candidates chose the incorrect option **C** rather than the correct answer, **A**. Whilst they knew that both magnesium and magnesium oxide reacted with dilute hydrochloric acid to make magnesium chloride, they thought that magnesium carbonate did not.

Question 25

Candidates knew that chlorine is added to the water supply to kill bacteria. Of those who did not choose the correct answer, **B**, most chose the incorrect option **D**, suggesting that they had confused chlorination with filtration.

Question 26

Candidates knew that rusting involves iron, oxygen and water.

Question 28

A large proportion of weaker candidates opted for **C**, failing to notice, or to understand the significance of the fact that this was a speed-time graph with a horizontal line not on the time axis.

Question 32

The topic here was work done in lifting a metal box, many weaker candidates chose option **D** instead of the correct option **C**. Apparently these candidates were unaware that the weight of the box affects the amount of work done.

Question 34

This question involved two statements about infra-red radiation. Many candidates knew that this is electromagnetic, but a large majority of candidates of all abilities were unaware that it transfers thermal energy through a vacuum.

Question 36

In this question on refraction of light many of the weaker candidates opted for **B**, indicating the incorrect angle of incidence and the wrong direction of refraction in the glass block.

Question 37

Only the strongest candidates answered this question correctly.

Question 38

Many candidates believed that the purpose of a fuse is to maintain a constant current.

Question 30

Stronger candidates had little difficulty with this question on circuits but others found all three of the incorrect choices more appealing than the correct answer **A**.

Question 40

A large majority of weaker candidates here simply added all three resistances together to obtain answer **D**, treating the arrangement as a simple series circuit.

COMBINED SCIENCE

Paper 0653/22
Multiple Choice (Extended)

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

General comments

Biology

Some candidates needed to read the questions more carefully before selecting their answers.

Chemistry

Candidates found **Questions 15, 19, 20, 22, 25, and 27** accessible. Many candidates found **Question 17** more challenging.

Physics

Candidates found **Questions 28 and 38** the most difficult in the physics section.

Comments on specific questions

Question 1

Whilst most candidates correctly identified the correct answer as **D**: movement, there were many who believed that all organisms breathe.

Question 2

This question was answered correctly by most candidates.

Question 3

Almost all candidates selected the correct answer for this question.

Question 4

Most candidates knew that the result of a positive biuret test gives the colour purple. However, some weaker candidates thought that protein would also turn a Benedict's test red.

Question 5

Most candidates were able to identify that increasing the light intensity had the effect of increasing the rate of gas production. Some candidates, however, were not able to identify the correct gas that was being produced and favoured carbon dioxide over oxygen.

Question 6

This question was answered well. Where candidates did not identify the gall bladder, they indicated that bile was stored in the liver, possibly confusing where the bile was made with where it was stored.

Question 7

The candidates that correctly identified **A** as the answer understood the concept of water loss. Water loss had decreased between X and Y indicating that either the temperature, sun or humidity had dropped or that the stomata had closed.

Question 8

This question was answered very well, with most candidates selecting the correct answer.

Question 9

This question was answered well. Where candidates answered incorrectly they answered that one molecule of oxygen is used to produce one molecule of water. However, the question asks how many molecules of oxygen are produced and how many molecules of water are produced per molecule of glucose respired.

Question 10

Most candidates identified that auxin caused cell elongation. The difficulty came when they had to decide which way the auxin moved. Weaker candidates thought that the auxin moved towards the light.

Question 11

This question was answered very well by many candidates.

Question 12

Many candidates needed to read the question more carefully. Candidates appeared to miss a number of words in the question that may have assisted them in answering the question. Candidates may not have noticed that the question was asking for the arrow that represented the **process** that releases **oxygen** into the atmosphere. They may not have recognised from the diagram that the box at the top right stated **carbon dioxide in the air**. It may also be that they answered the question indicating the direction of the loss of

oxygen into the atmosphere. They should have indicated the arrow that indicated the process (photosynthesis) which removes carbon dioxide from the atmosphere.

Question 13

This question was answered very well. However some candidates thought that the bacterial population of the lake increased.

Question 15

Candidates recognised the mixture of two elements from the diagrams.

Question 17

Most candidates chose the incorrect option **B** more often than the correct answer, **C**. They did not understand the difference between the number of bonds in methane and the multiple (triple) bond between the two nitrogen atoms in a molecule of nitrogen gas.

Question 18

Candidates determined the cathode reaction during the electrolysis of aqueous copper (II) chloride.

Question 19

The incorrect option **B** was chosen more often than the correct answer, **C**. Candidates clearly knew that the rate of the reaction decreases as the concentration of the acid decreases, but many did not understand that the rate of the reaction is not necessarily affected simply by the endothermic nature of bond breaking.

Question 20

Candidates identified the role of carbon as the reducing agent, and that it is oxidised, in its reaction with copper oxide.

Question 21

Some candidates chose the incorrect option **C** rather than the correct answer, **A**. They thought, incorrectly, that the evaporation of the solution would result in the removal of unreacted sulfuric acid.

Question 22

Most candidates chose the correct answer, **A**. The most frequently chosen incorrect answer was **C**. Candidates knew the test for carbonate ions better than the test for ammonium ions.

Question 25

Candidates knew the role of chlorine in the treatment of the water supply.

Question 27

Candidates knew that rusting involves iron, oxygen and water. However, some of the stronger candidates chose the incorrect option **A**, considering the mass of only the elemental iron present rather than the mass of all the iron present as both element and as the compound iron oxide.

Question 28

In this question on interpreting distance-time and speed-time graphs, a common mistake was to believe that diagram 2 was the correct choice. This showed a constant value, but not constant acceleration.

Question 29

Weaker candidates were often unaware that the mass of an object does not change with location. They confused mass with weight and selected **C**.

Question 30

The topic here was extension of a spring, and the most common mistake was to forget to subtract the original length of the spring from its length with the load applied, leading to option **D**.

Question 37

Many weaker candidates chose option **B**, believing that sound travels more slowly in water than in air, perhaps confusing it with light.

Question 38

In this question on electrical power both options **A** and **B** were as popular as the correct choice **C**. Option **A** involved failing to convert the time to seconds, and option **B** involved multiplying this incorrect time by the voltage. Clearly there was confusion over this topic for many candidates.

Question 40

This question concerned series and parallel circuits and the most common error was to choose option **B**. This involved the ammeter short-circuiting the two lamps and it may have been confused with a voltmeter.

COMBINED SCIENCE

Paper 0653/32
Core

Key messages

- Candidates are reminded to read the questions carefully and to answer the question as it has been set.
- When one response is asked for in a question, candidates should only give one. A correct answer may not be awarded credit if an incorrect answer is also written.
- Candidates should be reminded to apply labels to diagrams accurately.

General comments

Many candidates showed a good understanding of all three areas of the syllabus.

Candidates used the space provided for answers sensibly. There was little evidence of repeating the question in the answer. Consequently, candidates confined their responses to the spaces provided.

There was no indication that candidates ran out of time.

Comments on specific questions

Question 1

- (a) (i) Most candidates identified the cervix and vagina correctly. Candidates needed to make sure that their label lines touched the structure concerned, with no space left between the end of their line and the structure they were labelling.
- (ii) Only a few candidates answered this question well. The events in the question referred to the early development of the zygote from fertilisation until the implantation in the uterus. Many candidates described the development of the fetus after implantation so could not be awarded credit for this.
- (b) There were many correct answers here from candidates who knew the difference between haploid and diploid.

Question 2

- (a) (i) The process of electrolysis was known by the majority of candidates.
- (ii) The labels were added to the diagram correctly by the vast majority of candidates. The most common error was confusion of anode and cathode.
- (iii) In this question copper chloride and copper sulfate gained credit, but copper oxide and copper carbonate were not accepted.
- (iv) Since the process for extraction is carried out at room temperature, the solid has to be dissolved. Many candidates wrote “melting” as their response. This would increase the temperature so it did not gain credit.
- (v) Most candidates found this question challenging. There is a chemical change because new substances are formed, one of which is copper metal.

- (b) (i) Carbon or hydrogen were both acceptable responses. Oxygen and chlorine were the most frequently seen incorrect answers.
- (ii) The term “reduction” was known by many candidates. Redox was acceptable as an alternative response because the reduction of copper oxide is accompanied by the oxidation of carbon in this reaction.
- (c) (i) Many candidates correctly identified the production of coloured compounds by transition metals as the property. Incorrect responses included properties already in the stem of the question, for example “high density”. General properties of metals were also excluded by the question, so “good conductors of heat” or “electricity” could not gain credit.
- (ii) Most candidates answered this question correctly. Correct responses had to refer to the rate of the reaction, so “a catalyst increases the reaction” was not accepted.

Question 3

- (a) Most candidates named gravitational force correctly. Only a few candidates incorrectly stated “gravitational potential energy”.
- (b) Almost all candidates successfully knew the equation $distance = speed \times time$. In order to use this equation, the time of 90 minutes had to be converted into hours. However, some candidates failed to make this conversion.
- (c) Most candidates succeeded in doing this calculation. There was less success in providing the correct unit. Candidates are reminded to use the mass and volume units in the question to arrive at the correct unit for density.
- (d) (i) Only the strongest candidates understood that the first energy conversion was that of radiation from the Sun to electrical energy in the solar cells. The second conversion was known by more candidates who correctly stated that chemical energy was stored in the batteries.
- (ii) The diagram to show the particle arrangement in a solid was challenging for some candidates. It was important that the particles were in a regular arrangement and all touching. The particles also had to be of a similar size. However, many candidates left spaces between their particles and some drew random arrangement.

Question 4

- (a) The vast majority of candidates successfully defined the term “herbivore”.
- (b) (i) The roles of growth and repair in the body were the most common responses to this question which enabled full credit to be awarded.
- (ii) Many candidates were able to do this calculation which illustrated the quantity of bamboo shoots needed to provide as much protein as 100 g of beef.
- (iii) Most candidates stated that pandas must eat large quantities of bamboo shoots to satisfy their needs since bamboo shoots are low in protein.
- (c) This question was an application of the general effects of deforestation on the animals in a habitat. Therefore, loss of habitat and lack of food were the most frequently seen correct answers.

Question 5

- (a) (i) Candidates needed to be aware that hydrocarbon compounds contain **only** carbon and hydrogen. Omission of the word “only” does not exclude other elements in the compound.
- (ii) The word equation was successfully completed by stronger candidates. Candidates generally knew that oxygen was the reactant in combustion. There were several incorrect answers for the products, including ethanol, ethene and hydrogen.

- (iii) The majority of candidates answered this question correctly.
 - (iv) The use of bottled refinery gas for cooking was the most popular correct answer given here. The general answer of “fuel” was not credited because most of the products of fractional distillation of petroleum can be used for fuel. The important fact about bottled refinery gas is that it is portable and is therefore widely used for cooking or heating.
- (b) Candidates had to describe the oil and grease forming a protective barrier to water and oxygen. Answers with insufficient detail did not make the point that water and oxygen are kept away from the iron by the barrier.

Question 6

- (a) (i) Most candidates incorrectly gave “radio” as the type of wave. Person **A** was speaking into handset **A** so the waves had to be sound waves.
- (ii) Candidates had to identify the places where electromagnetic waves would be used. Many candidates found this question challenging. Some candidates could identify the path to the communications satellite dish, or vice versa as one place where microwaves or radio waves are used. Fewer candidates realised that the path between the handsets and base stations had no wires, so microwaves or radio waves were also used in this case.
- (b) Most candidates added microwaves and radio waves to the electromagnetic spectrum successfully.
- (c) This question was challenging for most candidates. The increased infra-red radiation from the Sun landing on the satellite during the day causes it to become warm, and the reverse happens at night when the infra-red radiation leaves the satellite. Some responses referred to the Sun warming up the satellite but did not mention the infra-red radiation. Many incorrect answers referred to increased usage of the communications satellite during the day warming it up.
- (d) The lack of a medium between Earth and the communications satellite was given as a correct response to many candidates who stated that sound waves need a medium.

Question 7

- (a) A small number of candidates gained full credit for this question. The two facts about photosynthesis were correctly identified by most candidates. Many candidates missed the fact that respiration produces smaller molecules (carbon dioxide and water) from the larger molecule glucose.
- (b) (i) Generally, the xylem was correctly identified by stronger candidates.
- (ii) The absorption of water by the root hair cells was known by almost all candidates. The response “root cells” was not considered to have enough detail to gain credit however.
- (iii) There were several possible acceptable answers to this question. However some candidates stated that water helps in photosynthesis. This answer did not reflect the idea that water takes part in reactions of photosynthesis reaction so it was not accepted.
- (c) The function of phloem as a transporter of organic compounds was not widely known. Transport of minerals was given by many candidates and this was not accepted as minerals are transported in the xylem.

Question 8

- (a) (i) Most candidates correctly stated the numbers of electrons, neutrons and protons in the atom of chlorine.
- (ii) The relative charges on the subatomic particles were known by most candidates. Fewer candidates knew the approximate relative masses, and incorrectly referred to the chlorine atom, just giving numbers as in (i).

- (b) Many candidates answered this question correctly identifying the two types of bonding and why they occur. The most frequently seen incorrect answer was a metallic bond between sodium and chlorine.
- (c) Only the strongest candidates scored full credit in this question. There were two solutions that reacted with chlorine and many candidates gave only one. Chlorine can displace both bromine and iodine from their salts, so there should be two solutions in the answer.
- (d) Only a few candidates recalled the test for chlorine.

Question 9

- (a) (i) The majority of candidates drew a complete series circuit. However a number of candidates did not gain full credit as the ammeter symbol had a line going through the middle. There should be no gaps in the circuit and the symbols shown in the syllabus should be used for the components.
- (ii) Many candidates successfully added the voltmeter symbol in parallel with the bulb in their circuits.
- (b) (i) The majority of candidates successfully applied the equation and gave the correct units.
- (ii) Many candidates stated that the resistance of the circuit is increased by the addition of an extra bulb. Only stronger candidates stated that since the voltage was the same, the current must decrease. Incorrect responses included reference to the current being shared between the bulbs. Candidates are reminded that the current is the same through all parts of a series circuit.

COMBINED SCIENCE

Paper 0653/42
Extended

Key messages

Candidates should be reminded to:

- avoid giving imprecise answers;
- avoid writing too much unnecessary detail which does not contain the answer to the question that had been asked;
- use the correct units of time in calculations.

General comments

The majority of candidates showed that they had been appropriately entered for the Extended Theory Paper. Candidates usually showed a good balance of knowledge with understanding of all the Science disciplines. Questions which explored key Science concepts in relatively unusual contexts proved to be challenging even for stronger candidates. This was seen in responses to **Questions 3(c)(ii) and (iii) and 9(d)**. All candidates were very well prepared for the types of calculation that appeared in the paper. 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) Most candidates successfully answered this question. Candidates did not have to use the words ovulation and fertilisation although most did. Clear descriptions of these processes were often seen.
- (ii) Candidates needed to notice that the label line for structure **C** stops precisely on the amnion. Many candidates described the protection given to the fetus by the amniotic fluid rather than stating that the amnion contains the fluid.
- (b) (i) Candidates could either name or state the chemical formula of carbon dioxide. Candidates should be advised that chemical formulae should be written carefully, paying attention to the case of the letters and the size and position of the subscript. Candidates giving imprecise answers such as Co_2 or cO_2 could not gain credit.
- (ii) Candidates had to refer to respiration occurring in the fetus as the source of carbon dioxide moving across the placenta. Well-prepared candidates avoided any suggestion that the fetus has functioning lungs and so would be producing exhaled air while breathing. Although carbon dioxide is a waste product, candidates needed to state more than this and include a reference to respiration. Some candidates suggested answers such as “it is from glucose” but without the reference to respiration, and no credit could be given for this.
- (iii) Candidates generally knew the role of the umbilical cord and gained credit here.

- (c) Some candidates made suggestions that were too extreme for credit to be awarded. For example, some stated that if the mother smoked then all oxygen would immediately be cut off from the fetus which would then die. Some candidates thought that blood in the mother's circulatory system flowed through the fetus via the umbilical cord. This was a common mistake.

Question 2

- (a) (i) Most candidates recognised that electrolysis involves a chemical change. Relatively few candidates suggested the simple answer that substances are being converted into different ones. Many over-complicated answers were seen which sometimes did not quite explain why the change involved was a chemical one. Credit was given for the idea that an irreversible process was occurring, but this is not encouraged as a safe reason why a change should be considered to be chemical.
- (ii) Many candidates gained full credit for very well-expressed answers. A common mistake was to identify the non-metallic ion as a chlorine ion rather than a chloride ion. Candidates who chose to identify ions by their formulae needed to ensure that these were stated accurately.
- (b) (i) Most candidates identified the reaction type as reduction or redox. Oxidisation alone was not accepted, but the term "displacement" was.
- (ii) Many candidates were able to construct a balanced equation. Partial credit was awarded for other correctly balanced equations of chemically feasible reactions involving copper oxides and carbon.
- (c) Candidates who read the question carefully realised that there was only a very limited number of possible metallic properties that could be suggested. Some advanced ideas including multiple ion formation, variable oxidation states and oxidation numbers were seen and credited. Some candidates gave a long list of properties when only one had been requested. In this situation only the first one given was marked.

Question 3

- (a) Candidates were asked to name the effect of the gravitational field on a mass. Many chose to write detailed descriptions of the physics involved in the context. Unless they also included the term "weight", credit could not be awarded. The term "gravity" does not strictly answer the question and so did not gain credit.
- (b) Most candidates successfully applied the relationship $distance = speed \times time$ to obtain the answer, 42 000 km. Partial credit was awarded if the only mistake was the use of incorrect time units.
- (c) (i) Most candidates successfully applied the relationship $mass = density \times volume$ to obtain the answer $5.97(24) \times 10^{24}$ kg.
- (ii) The context of this question produced a variety of responses. Although some candidates gained partial credit for stating that the average density of the core and mantle is greater than that of the crust, very few went on to gain full credit for the explanation. Candidates had to make use of the numerical data in this and earlier parts of the question, rather than make statements such as "density increases with depth or the atoms are more crushed together at greater depth".
- (iii) Candidates needed to use their knowledge of particle arrangements in liquids and solids in their answers. Many candidates discussed differences in the relative size of attractive forces between atoms in the inner and outer core. These answers did not gain credit since explanations for differences in arrangement were not requested. A common misconception stated by many candidates was that atoms are not close packed in the outer core or that there are large spaces between atoms and the outer core. Some candidates had difficulty transferring their knowledge into the context and suggested that the outer core would not have a fixed shape or that it would take the shape of the container. Candidates needed to remember that they were asked to discuss the arrangement of individual atoms rather than the properties of a bulk material. No candidate used the term "randomly arranged" in their description of the atoms in the outer core.

- (d) Most candidates gained partial credit for correctly identifying the second energy type as a chemical. A much smaller number stated that the first energy type is electrical. The most common suggestions for the first energy type were “light” or “solar”.

Question 4

- (a) Most candidates gained credit for correctly labelling the nucleus in one of the cells. Many also identified the location of the xylem as being in the upper half of the vascular bundle as shown in the diagram.
- (b)(i) The majority of candidates included both ideas in their answers: that cell **P** is closer to the surface and is therefore able to capture more light than cell **Q**.
- (ii) The majority of candidates gained credit for recognising that **P** contains more chloroplasts than **Q**. Many went on to discuss that the amount of chlorophyll or amount of light absorbed is greater in **P**.
- (c) Many candidates stated the key ideas of trapping light and conversion of this light energy into chemical energy in their answer to this question. A common mistake in wording was to suggest that light energy itself is converted into carbohydrate. Other phrases which candidates should be advised to avoid include “chlorophyll stores light”, “chlorophyll attracts light”, “chlorophyll traps the sun”. Candidates should also be encouraged to refer to chemical energy rather than vague terms such as plant food.

Question 5

- (a)(i) Candidates generally knew how to identify the numbers of subatomic particles from the chemical formula.
- (ii) The relative charges of the subatomic particles were far more familiar to candidates than the relative masses. A minority of candidates gained full credit. Candidates should be advised to avoid the suggestion that the electron has zero mass.
- (b) The majority of candidates recognised and described ionic and covalent bonding and many scored full or partial credit. Very few reversed ionic and covalent and some extensive answers showed detailed knowledge.
- (c) Most candidates answered this question correctly. The most common incorrect answer seen from a minority was chlorine.
- (d)(i) Most candidates correctly gave the electronic structure of an argon atom. Some correctly stated that the outer shell or all the shells in an argon atom are filled, but answers that did not include the electronic structure 2,8,8 did not gain credit.
- (ii) A wide variety of uses for argon were given. A small number of candidates suggested the answer “argon is used as the filament in bulbs” which could not be credited.

Question 6

- (a) Candidates needed to describe an electric current as the flow of charges or charged particles and then to identify the charged particles in this context as electrons. Candidates tended either to discuss charges or electrons and so most scored only partial credit.
- (b)(i) It was important for candidates to identify a stage in the communications system shown in this question. Consequently they needed to state, for example, “between person **1** and the handset”, rather than suggesting the answer, “when the person speaks”. The term “longitudinal wave” was accepted as an alternative answer to “sound wave”.
- (ii) Most candidates identified a valid stage in the communications system and many scored full credit by stating either radio or microwaves. The term “transverse wave” was accepted as an alternative answer for the type of wave.
- (c) Credit was given for the general ideas that waves have an associated speed and that waves take time to cover distance. Some candidates realised that one or both of these ideas were required.

Some attempted to answer in terms of an effect caused by the medium needed for sound waves or blamed technical problems in the network. Some candidates made imprecise statements which added no new information such as “transferring the message takes time”.

Question 7

- (a) (i) The role of iron was familiar to many candidates. However they needed to discuss the importance of iron in relation to haemoglobin rather than to red blood cells or the blood.
- (ii) Any valid symptom of low iron was accepted. The unqualified term “weakness” did not gain credit.
- (b) (i) Most candidates correctly suggested that the initial heating removes bacteria from the milk before yoghurt making is started. However, many candidates made unconnected statements about avoiding the denaturation of enzymes or providing optimum conditions for making yoghurt. The key idea they needed to state was to avoid killing live microorganisms that are to be introduced to start yoghurt making.
- (ii) Some candidates realised that the answer to this question concerned the reproduction of microorganisms. Common answers that did not gain credit included the ideas that excess added yoghurt would somehow spoil the milk or that excess added yoghurt would not taste very nice.
- (iii) Many candidates answered this question correctly. Quite a number gave the answer “yes he can” but did not gain credit because they did not go on to supply a valid explanation.
- (c) Most candidates found this a challenging question. Some gained partial credit for stating that milk proteins would be denatured. Stronger candidates discussed denaturing of proteins rather than enzymes and also avoided the idea that the proteins would be broken down. A small number used the term “coagulation” which was accepted, but the explanation in terms of the deformation of protein molecules due to the low pH was not seen.
- (d) (i) The majority of candidates understood the importance of fibre in the alimentary canal. The idea that fibre is essential in food digestion was not accepted.
- (ii) Any foodstuff containing fibre was accepted. Answers that were not accepted were “add fibre”, “add food containing fibre” and “add cellulose”.

Question 8

- (a) This question was answered very well by many candidates. Relatively few reversed the properties of fractions **P** and **Q**. However, weaker candidates made the unqualified statement that **P** is a gas and **Q** is a liquid. A minority of candidates wrote answers that discussed the bonding in **P** and **Q** when they may have meant to refer to intermolecular forces of attraction.
- (b) The process of cracking was familiar to the majority of candidates.
- (c) (i) Most candidates were able to state that a powdered catalyst has a higher surface area.
- (ii) Many candidates wrote good answers that gained full or partial credit. Candidates needed to refer to “increased kinetic energy” rather than just “increased energy” caused by a rise in temperature. They needed to avoid the phrase “there are more collisions” and should have referred to an increased collision frequency. Valid implication that more of the collisions would exceed the activation energy gained credit although this concept was not required in this syllabus.
- (d) The majority of candidates gained credit here. A small number of candidates reversed the types of hydrocarbon and a few gave the names of compounds.
- (e) (i) This was generally answered well. The instruction was to state the chemical formula and this had to be written carefully. The words “carbon dioxide” did not gain credit.
- (ii) Candidates were very familiar with the link between carbon dioxide levels and global warming. The most common incorrect suggestions included the idea that carbon dioxide is a toxic gas and that increased carbon dioxide levels would lead to insufficient oxygen for humans to breathe.

Question 9

- (a) Only stronger candidates recognised that the reason for using a 20 A fuse in a circuit that normally conducts up to 14 A was to allow a safety margin for fluctuations in current above 14 A. Most candidates who understood the function of a fuse in a circuit, concentrated on what could happen if the current exceeded 20 A.
- (b) Resistance calculations of this type were very familiar to candidates and most candidates gained full or partial credit. Candidates usually used the relationship $resistance = voltage \div current$ to produce the answer 17.1 Ω .
- (c) The use of the relationship $electrical\ energy = voltage \times current \times time$ was more familiar to stronger candidates. Many candidates gained partial credit because they used incorrect time units in the calculation.
- (d) Few candidates answered in terms of convection and only a very small number could explain why the top heater would warm up a small volume of water quickly without mixing all the water in the tank. Many candidates did not recognise that the context involved heater 1 alone and assumed that both heaters would be switched on. Partial credit was given for any valid description and explanation of convection.

COMBINED SCIENCE

Paper 0653/62
Alternative to Practical

Key messages

- Candidates need to read questions carefully so that they answer the question as it has been set.
- Candidates should be reminded to draw diagrams with a ruler and to label them.
- The data added to a column in a table should be to the same number of significant figures as the rest of the data in that column and should be rounded correctly.

General comments

Although this is an Alternative to Practical paper, candidates are expected to be familiar with experimental techniques and to have carried out experiments similar to the ones shown in the paper. Many candidates demonstrated good understanding of practical knowledge and techniques. The reading of the instruments was of an excellent standard and food tests were well known. Candidates should use standard laboratory apparatus and be able to read values from a variety of measuring instruments and record the values to the requested accuracy. The standard of graph drawing was generally high although some candidates did not label the axes.

Comments on specific questions

Question 1

- (a) (i) The results were generally well described by candidates but many gave no explanations.
- (ii) Many candidates discussed the rate of reaction rather than the results. A significant number thought the enzyme would be denatured.
- (b) The Benedict's test was well known. Although many candidates gave a safety precaution, only a very small minority explained it.
- (c) (i) This was generally well answered. A significant number of candidates thought that starch broke down to protein.
- (ii) Common incorrect responses included the reaction being too slow or not yet reacted.

Question 2

- (a) Candidates found this quite challenging. 20 cm^3 and 10 cm^3 or just 10 cm^3 in the first column were common incorrect responses.
- (b) (i) The times were recorded well by many candidates. A significant number did not round to 28 and so 27 was a common incorrect response.
- (ii) The relationship was described well. Some candidates discussed concentration and rate.
- (iii) The calculations were performed well but a significant number of candidates either rounded the values incorrectly or gave their answer to one significant figure.
- (iv) Comparing the wrong ratios or not comparing them were common incorrect responses.
- (c) (i) Stronger candidates gained credit here. Dangerous, harmful and explosive were common incorrect responses.

- (ii) Candidates found this challenging with many discussing reaction time. Parallax error and concentration of acid were also common incorrect responses.

Question 3

- (a) (i) The majority of candidates read the meters correctly. A significant number gave only two significant figures for the voltage.
- (ii) Units were generally well known. Voltage, current and watts were common incorrect responses.
- (iii) This was quite well known. "Prevention of electric shock" or "short circuit" were common incorrect responses.
- (b) (i) Many candidates plotted the points correctly. Some candidates did not label the axes.
- (ii) The majority of candidates drew a line of best fit.
- (c) The majority of candidates gained credit for this question.
- (d) Candidates found this question challenging. "Values too low", "inaccurate", "not reliable" and "low voltage" were all common responses.

Question 4

- (a) (i) This was a challenging question for many candidates. "Indicator" and "not yet reacted with the acid" were common incorrect responses.
- (ii) Few candidates could name an alkali. Common incorrect responses included phenolphthalein, cobalt chloride and alkali. A significant number of candidates did not answer this question.
- (b) The vast majority of candidates drew correct diagrams but some omitted the labels.
- (c) The most common incorrect response was 10 and 20 and many omitted the values.
- (d) Most candidates read the stopclocks correctly.
- (e) (i) Only the strongest candidates answered this question well. Many other candidates discussed surface area or said that the large cube was larger than the smaller cube.
- (ii) The stronger candidates gained credit for this question. A significant number omitted the question. Some candidates did not explain their answer.
- (iii) This question was challenging for many candidates. Concentration or volume of acid were common incorrect responses. Quite a large number omitted this part.

Question 5

- (a) (i) Most candidates measured correctly.
- (ii) Few candidates appreciated that aqueous ammonia was being added to a copper salt. White or brown precipitate were common incorrect responses.
- (b) (i) Only stronger candidates were able to answer this well. "To see the effect of water" and "as amount of water increases amount of ammonia decreases" were the common incorrect responses.
- (ii) This question was challenging for many candidates. "Different volumes of water" was the most common incorrect response.
- (c) Candidates found this very challenging and either said "the precipitate got higher" or answered without considering the experiment as a whole. Few appreciated that the precipitate dissolved.
- (d) (i) "Ammonia reacts differently to sodium hydroxide" was a common non-creditworthy response.

- (ii) A wide variety of numbers seen but 17, 20 and 28 were most common incorrect responses.

Question 6 – Determining Density

- (a) (i) Most candidates measured correctly but some gave the answer to the nearest centimetre.
- (ii) The majority of candidates multiplied correctly.
- (iii) Many candidates gained credit. Parallax and measurement error were common non-creditworthy responses.
- (iv) Most candidates read the scale correctly. A small number gave 1.2.
- (v) Many candidates calculated the value correctly. However, some did not multiply by 100.
- (b) (i) Most candidates read the scale correctly. A small number gave 80.3.
- (ii) Many candidates calculated the value correctly. Some used V_2 or 40.
- (c) (i) Many candidates found this difficult. “Method 2 as measurements accurate” or “calculations easier” were common non-creditworthy responses. Some thought Method 1 as the meter was accurate or the volume was measured directly.
- (ii) The strongest candidates were able to answer this correctly. However, many thought that the results were repeated and averaged to give greater accuracy. A significant number omitted the question.