

COMBINED SCIENCE

Paper 0653/12
Multiple Choice (Core)

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

General comments

Biology Comments

Candidates performed very well on **Question 2, Question 8 and Question 12**.
Question 3, Question 7 and Question 11 proved most difficult for candidates.

Chemistry

Candidates performed very well on **Question 18, Question 25 and Question 27**.
Question 14, Question 22 and Question 26 proved most difficult for the candidates.

Physics

In the Physics section, candidates found **Questions 28, 30, 32, 33, 35 and 36** the most difficult.

Comments on individual questions

Question 1

Some candidates were distracted by option **B**, indicating some misconceptions about breathing, gas exchange and respiration.

Question 3

The incorrect option **D** was the most common response. Candidates struggled to link the acidic environment of the stomach with enzymes that work best at a low pH.

Question 4

Candidates found this question difficult. Options **A** and **C**, both of which suggested oxygen is required for photosynthesis, were popular incorrect choices.

Question 5

Many candidates incorrectly chose Option **C** suggesting candidates may need more guidance about the functions of the liver.

Question 6

This question discriminated well between candidates. The intake and transport of water were strong distractors.

Question 7

Candidates found this question very difficult and there was evidence to suggest that many were guessing the names of the blood vessels.

Question 9

Candidates found this question about adrenaline quite difficult.

Question 10

Some candidates were distracted by option **C** which suggests some confusion about sexual and asexual reproduction.

Question 11

Candidates found this question difficult. There was some evidence to suggest that many were guessing the stage of the menstrual cycle.

Question 13

Candidates found this question difficult with many selecting carbon monoxide and carbon dioxide as the two gases that contribute most to global warming.

Question 14

The incorrect **C** was chosen more often than the correct answer, **B**. Candidates did not understand well enough that hydrogen molecules contain two atoms and that, in the diagrams, each circle represents an atom rather than a molecule.

Question 16

There was evidence that candidates guessed at the answer. Candidates should understand that the proton number is the same as the number of electrons in a neutral atom, and that the nucleon number is the sum of the number of protons and of neutrons.

Question 22

There was evidence of guessing, with answers being chosen roughly equally often. Candidates did not understand that answers **A**, **C** and **D** are salts, whilst the correct answer **B** is a base that reacts with acids to produce salts.

Question 25

Candidates understood well the relationship between the relative reactivity of a metal and the form of its natural occurrence.

Question 26

The chemical tests for water are not well understood. More candidates chose the incorrect **D**, which has the colour change for copper sulfate the wrong way around, than the correct answer **C**. Many candidates also chose **A** or **B**, which are physical tests for water and not chemical tests.

Question 27

Candidates knew well the products of the complete combustion of hydrocarbons.

Question 28

A large proportion of candidates mistakenly chose option **B** in this average speed question, making the common mistake of not including the time spent resting in their calculation.

Question 29

There was guessing evident in response to this density question.

Question 30

Many candidates also appeared to guess the unit for energy here.

Question 32

Many candidates opted for **D**, correctly identifying the greatest work done but mistakenly combining this with the greatest time taken.

Question 33

There was considerable uncertainty shown here over the topic of convection.

Question 35

The meaning of critical angle caused further guessing in this question, with most candidates being unsure what would happen to the ray.

Question 36

The topic here was uses and frequency ranges of electromagnetic radiation and many resorted to guessing again.

Question 40

This question on a series circuit was not well answered. It was the most able candidates who, although generally knowing that the total resistance would be the sum of the three, believed that the current would be reduced after passing through the resistors.

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Paper 0653/22
Multiple Choice (Extended)

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

General comments

Biology

Candidates performed very well on **Question 1, Question 5, Question 10** and **Question 12**. **Question 9** proved the most difficult.

Chemistry

Candidates performed very well on **Question 16, Question 18, Question 19, Question 22, Question 23, Question 25** and **Question 26**.

No questions were found to be particularly difficult.

Physics

In the physics section, candidates found **Questions 29** and **34** the easiest, with **Questions 36** and **40** proving the most difficult.

Comments on individual questions

Question 2

This question was answered incorrectly by many candidates. Candidates struggled to link the acidic environment of the stomach with enzymes that work best at a low pH.

Question 3

Most candidates knew there was a change in pH but many candidates were unsure whether the pH increased or decreased.

Question 4

Candidates found this question relatively easy which suggests a sound knowledge of the photosynthesis equation.

Question 6

Candidates were confidently able to name the blood vessels described in this question.

Question 7

This question did not discriminate very well between candidates as many of them found this question about respiration rather easy.

Question 8

This question worked well and most candidates were able to name carbon monoxide as the correct answer. Option **B**, nicotine, was incorrectly chosen by many candidates.

Question 9

Candidates found this question about auxins difficult with many selecting option **B** as the correct answer.

Question 11

Candidates also found this question relatively easy although some thought that HIV decreased the number of platelets in the blood.

Question 13

Candidates found this question more difficult with many selecting carbon monoxide and carbon dioxide as the two gases that contribute most to global warming.

Question 17

The incorrect answer **C** was chosen by a few of the more able candidates. They knew what the correct transfer of electrons was for both sodium and chloride ions, but had confused the anode and cathode.

Question 18

Candidates understood the energy changes associated with different processes well, with most selecting the exothermic process, **A**. However, a few of the more able candidates chose the incorrect **C**.

Question 19

Candidates understood the effect of changing temperature on the rate of a chemical reaction well, with almost all choosing the correct answer, **B**.

Question 22

Candidates had very little problem identifying the correct statements about the Periodic Table, with most choosing the correct answer, **D**.

Question 28

This question concerned distance-time and speed-time graphs. In this case, neither of the graphs represented the motion given, but a significant proportion of candidates opted for **A**, probably confusing the two types of graph. It should be made clear to students that there is always a possibility that an option such as **D** (neither of the diagrams) could be the correct answer.

Question 29

Almost all responses to this density question were correct; rearrangement of the standard equation did not cause problems.

Question 30

Weaker candidates found this a taxing question, with options **A** and **B** both being popular. Extension-load graphs seem to be a problem area, although the most able had little difficulty.

Question 31

Distractor **B** was a popular choice here. This was the amount of useful power produced, whereas the question asked for the amount of power wasted; careful reading was needed.

Question 32

Although a large majority of candidates knew that heating would cause the atoms to move more quickly, almost a third believed the state of the substance was liquid.

Question 33

The most able answered this question on power very well, but others often opted for **D**, representing the greatest work done but also the greatest time taken.

Question 35

The topic in this question was waves. Slightly more than half of all candidates, having calculated the frequency correctly, proceeded to multiply the speed by this instead of dividing by it, producing the incorrect value given in option **D**.

Question 36

This was not well answered, with options **A** and **C** both being popular; the element of speed added to the concept of image in a plane mirror is likely to have caused the difficulty.

Question 40

Although it was very widely known how the current would split in the parallel circuit, many believed that the resistors would share the e.m.f. of the battery, confusing this with a series circuit.

COMBINED SCIENCE

Paper 0653/32
Core Theory

Key messages

- Read the stem of the question carefully
- Do not attempt to give formulae if a word equation is requested
- Learn the analytical tests for aqueous ions

General comments

The candidates entered for this component covered the full range of ability. They used the space available for their responses sensibly. There was no evidence that the candidates were short of time.

Most of the responses on the scripts were legible but, in a few cases, marks were lost due to poor handwriting of key words.

It is recommended that this report is read with the examination paper and published mark scheme.

Comments on specific questions

Question 1

- (a) Candidates were instructed to draw three lines between the box on the left and correct boxes on the right. Some candidates drew only two lines and were not able to gain full credit. Candidates are reminded to read the stem of the question carefully. Incorrect responses included 'build up starch molecules from glucose molecules'. Candidates should be aware that starch is found only in plants so it would not be found in liver cells.
- (b) Most candidates correctly labelled the oesophagus. Fewer candidates were able to identify the gall bladder which is one of the organs associated with the alimentary canal.
- (c) Candidates showed a limited knowledge of the two main functions of the small intestine. Each correct answer had to be chosen from the list and an explanation provided for the correct answer. The explanations had to demonstrate how the function of the small intestine was affected. Candidates generally did not do this.
- (d)(i) There were some excellent responses by the better candidates who knew the role of bacteria in producing acid.
- (ii) The fact that increased acidity causes tooth decay was known by most candidates.

Question 2

- (a) (i) Some candidates correctly identified the gas carbon dioxide produced in the reaction, but most gave hydrogen as their answer. Candidates are reminded that hydrogen is produced when dilute acid reacts with some metals and that carbon dioxide is produced if the acid is added to a metal carbonate.
- (ii) Only a minority gave the correct response 'exothermic'. The most frequently seen incorrect answer was 'endothermic', which describes a chemical reaction that takes in thermal energy.
- (iii) The responses had to indicate a change in pH value, rather than just a number. Therefore 'pH7' was not acceptable, but 'pH increases to pH7' was acceptable.
- (iv) Most candidates correctly stated that the bubbles stop being produced when the reaction is over.
- (v) Filtration, the correct answer, was given by most candidates. Crystallisation was written by some candidates, but this stage cannot happen until the solid residue has been filtered, so this response did not gain credit.
- (b) (i) Most candidates correctly responded that the rate of reaction is reduced with less concentrated acid.
- (ii) The majority of candidates successfully described a way of changing the rate of reaction. Most chose increasing the rate of reaction, either by increasing the temperature, or using a catalyst.
- (c) The candidates were not familiar with the test for a chloride. Candidates should be aware that knowledge of the analytical tests is required for the theory examinations.

Question 3

- (a) (i) Generally, candidates knew that the arrows showing the forces should be opposite and vertical. To gain full credit the arrows should be touching the object, in this case the lift.
- (ii) Many candidates correctly answered this question using the idea that the forces must be equal and opposite if there is no movement.
- (iii) Only a few candidates responded correctly with the idea that to move upwards the upward force must increase. This will produce the unbalanced forces necessary to provide movement.
- (b) (i) Most candidates scored full credit in this question. The most frequent error was caused by recalling the formula incorrectly.
- (ii) The majority of candidates correctly identified the energy of the moving lift as kinetic energy.
- (iii) This question was well answered, with the majority stating that the lift gained gravitational potential energy, due to being in a higher position.
- (c) Candidates found this question challenging. Most responses correctly showed the initial gain of speed, but candidates did not include the loss of speed to zero shown by the lift when it stops at the top floor.

Question 4

- (a) (i) The interpretation of an unfamiliar flow chart requires careful study of the direction of the arrows. In the case of photosynthesis, there is only one arrow from carbon dioxide in the atmosphere towards the plants. Incorrect responses included all of the numbers showing carbon dioxide entering the atmosphere.
- (ii) Only a minority correctly identified the three arrows showing respiration. The process of respiration causes carbon dioxide to be produced and given off to the atmosphere. This is shown by the arrows leading from all of the living things shown in the flow chart into the atmosphere.
- (iii) Only a few candidates correctly identified process 6 as eating, the way in which the carbon compounds are transferred from plants to animals.
- (b) The importance of interpreting the flow chart correctly is clearly shown by the incorrect responses to this question. The flow chart shows that there are two methods by which carbon is transferred from animals to decomposers. Death is labelled and the question was seeking any explanation about process 7, excretion or egestion, to gain credit. The vast majority of candidates incorrectly described the detailed role of decomposers, which is found on the supplement of the syllabus.
- (c) The harmful effects of global warming were not widely known. There were several possibilities of a correct response to this question, as shown by the mark scheme.

Question 5

- (a) (i) Many candidates correctly gave 'coal' as their response. The most frequently given incorrect response was 'diesel'.
- (ii) Some candidates correctly gave methane as their response. Other candidates gave nitrogen and oxygen as their response, presumably interpreting natural gas as the air.
- (iii) Most candidates correctly gave oxygen as the correct answer.
- (b) (i) The use of the apparatus to separate petroleum by fractional distillation was correctly identified by many candidates.
- (ii) Several candidates correctly said that a hydrocarbon molecule consists **only** of hydrogen and carbon.
- (c) (i) Most candidates did not know that complete combustion of ethanol produces water in addition to carbon.
- (ii) The diagram was drawn correctly by many candidates.

Question 6

- (a) Some candidates drew the diverging rays from the lamp to the lens. The emergence of parallel rays was not successfully drawn. Candidates are reminded to read the stem of the question carefully.
- (b) Many candidates successfully put visible light and radio waves in their correct places in the electromagnetic spectrum.
- (c) (i) Evaporation was given as the correct response by most candidates.
- (ii) Candidates found this question challenging. The response required was a description of the more energetic water molecules having enough energy to escape from the surface of the water. Candidates incorrectly gave descriptions of the water cycle.
- (d) Only the higher scoring candidates gave the correct responses to this question. Other candidates did not make the connections between frequency and pitch, and amplitude and volume of the sound.

- (e) Some candidates gave a cause of increased temperature, rather than an effect. Others stated 'evaporation' as their response, which had been excluded by the stem of the question.

Question 7

- (a) The majority of candidates knew that the water enters the root. Fewer mentioned the path through the xylem and up the stem to the leaves.
- (b) (i) Some candidates correctly explained that the lamp increased both the light intensity and the heat in the environment of the plant. Candidates should remember that saying phrases such as 'because of the temperature' do not indicate whether the temperature is increasing or decreasing.
- (ii) Only a few candidates gave an answer less than 1.4 cm. The increase in humidity is responsible for slowing down the rate of transpiration because the water vapour gradient between the inside of the leaf and the surrounding air is reduced.

Question 8

- (a) (i) This was generally well answered. The low density of the sodium metal enables it to float.
- (ii) Some candidates correctly used the information in the stem of the question to complete the word equation. Careful reading of the stem would have enabled more candidates to score full credit. Candidates should be aware that formulae should not be given when a word equation is requested.
- (iii) Some candidates knew that the copper would show no reaction. Only a few realised that copper would be denser than water and would therefore sink.
- (b) (i) Candidates were generally not aware that transition metals are widely used as catalysts.
- (ii) Some candidates correctly stated that the inert gases are unreactive.
- (iii) Candidates knew that they had to describe the mass number and atomic number using the subatomic particles. Some responses were correct, others performed calculations using these particles incorrectly.

Question 9

- (a) (i) Many candidates successfully drew the circuit and used the correct symbol for the ammeter. Candidates are reminded that there should not be a line through the centre of the ammeter symbol.
- (ii) Most candidates were unsuccessful both at drawing the symbol for a voltmeter and placing it in parallel across the lamp. Candidates should be familiar with the electrical symbols in the syllabus.
- (b) (i) The application of Ohm's Law was successfully done by most candidates who applied the formula correctly.
- (ii) Candidates found this question challenging. Only a few responses described a reduction in current, with no reference to the increase in the resistance in their answers. Candidates should be aware that adding a second bulb to the circuit increases the overall resistance in the circuit, so the ammeter reading decreases.

COMBINED SCIENCE

Paper 0653/42
Extended Theory

Key messages

Those candidates who scored well on this paper

- read the questions carefully and used the number of marks for each question as a guide to the detail required in their answers;
- avoided giving imprecise answers, particularly to relatively simple questions.

General comments

A large proportion of the entry completed excellent scripts that showed mastery of all sections of the syllabus and good examination technique. Very few candidates would have been more suited to entry for the Core Paper 3. Many candidates showed good knowledge with understanding of the syllabus content in all of the Science disciplines. Fewer candidates were successful in questions that needed them to apply knowledge rather than recall it. Examples are the chemical reaction rate in **Question 2(b)** and the sketch graph in **Question 3(c)**. Both of these questions produced low scores across the full mark range. Most candidates were very well prepared for the types of calculation that appear in these papers. 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) Candidates showed good knowledge of human liver cells and the majority gain marks. The most common distractor was the idea that cell respiration occurs in the nucleus.
- (b) Many candidates knew how to answer this question correctly. Digestion in this context must always refer to molecules. So for example, candidates lost credit if they suggested that large nutrients are broken into smaller ones.
- (c) (i) Candidates needed to state that the optimum temperature for the enzyme giving curve **A** was body temperature or 37 °C. It was not precise enough for candidates to suggest enzyme **A** because *it works between 20 and 40 °C*.
- (ii) The majority of candidates realised that the required answer here was curve **F**. To gain the mark they needed to refer to the optimum pH being 8 or alkaline. Many simply stated that the conditions in the duodenum are alkaline without explaining why this makes curve **F** the correct answer.
- (iii) Most candidates gained a mark for discussing the denaturing of enzymes at 100 °C, but only a very small number used ideas from reaction rate theory to give a detailed reason for the lack of activity at 0 °C. Many candidates wrote vague statements about 0 °C being *too cold for enzymes to work*. Some other were on the right track when they suggested that at 0 °C *enzymes would have no energy*, but a mark was not given for answers like this.

Question 2

- (a) Candidates were not penalised if they drew freehand diagrams, but these had to show apparatus that would work and that would in theory be able to show the volume of gas being collected. The majority of candidates had apparently observed this experimental procedure and so had no difficulty in scoring one or both marks.
- (b) This was possibly the most difficult question on the paper. Some candidates realised that the line on the graph showed the volume of gas being collected but could not relate the shape of the graph to the underlying decrease in reaction rate in terms of collision frequency. It was apparent that they saw the rising line on the graph as somehow showing an increase in rate and then produced molecular explanations of increasing reaction rate.
- (c) Candidates generally answered this question very well. In questions focusing on symbolic representation, candidates should be careful to avoid losing marks for careless mistakes such as *HCL* or *Hcl*.
- (d) The limewater test for carbon dioxide was very well known by most candidates.
- (e) Many correct answers were seen for this. A common mistake was the suggestion of magnesium rather than a base.

Question 3

- (a) (i) This was marked strictly and candidates had to draw a vertical arrow, pointing upwards which was in contact with the elevator. Most candidates gained the mark.
- (ii) Most candidates realised that the other force would be 5000 N and those who referred to the elevator being stationary or at rest gained the mark. The mark was also awarded for referring to the idea that the forces acting on the elevator were balanced, but it was not enough simply to suggest that the forces would be equal. Candidates needed to specify *equal and opposite*.
- (iii) Many candidates stated the correct downward force as 5800 N. The most common incorrect suggestions were 5080 N and 800 N.
- (b) (i) The use of the relationship $\text{speed} = \text{distance} \div \text{time}$ was familiar to very many candidates and both marks were frequently awarded.
- (ii) The form and use of the kinetic energy relationship $\text{KE} = \frac{1}{2}mv^2$ was very familiar to candidates across the whole mark range.
- (iii) The form and use of the relationship $\text{PE} = mgh$ was very familiar to candidates across the whole mark range. A minority seemed to think that this question was more complicated than it was and tried to answer in terms of $\text{KE lost} = \text{PE gained}$.
- (c) Only a minority of candidates gained the mark for this sketch graph. Any shape of graph that started from zero speed, rose to a maximum and then to zero was accepted provided the rise and fall in speed were not instantaneous. It was apparent that candidates generally needed more practice at matching the shape of a graph to the context it describes.

Question 4

- (a) (i) Most candidates recognised photosynthesis. Common mistakes for the compound in the plant included carbon dioxide and chloroplast.
- (ii) Some very good answers to this question were seen, showing that large numbers of candidates understood this part of the carbon cycle. Candidates always need to be very careful to show the examiner that they understand the difference between the terms *respiration* and *breathing*.

- (b)(i) Most candidates correctly stated *decomposers*. Specific types of microorganisms that could be decomposers such as bacteria or fungi were accepted but the unqualified *microorganisms* was not.
- (ii) Most candidates missed the point that process 7 in Fig. 4.1 is a different process from death. Consequently they went on to answer this question in terms of death and decay, for which no marks could be given. The term excretion was occasionally seen although egestion was not. Reference to the general term *waste* was not accepted as an alternative to either urine or faeces.
- (c)(i) Questions on this aspect of ecology are frequently set and yet candidates often give imprecise or confused answers. Candidates need to be advised to revise carefully the differences between global warming, acid rain and ozone depletion. It is also important that candidates are advised to avoid incorrect statements such as *carbon dioxide traps the sun's rays* or *it acts as a blanket which soaks up the sun's heat*. Candidates should instead be stating that greenhouse gases such as carbon dioxide prevent heat radiated from the Earth from escaping into space.
- (ii) Candidates generally did well with this question and many gained both marks. The majority discussed the formation and consequences of acid rain. Credit was also given for reference to the effect of sulfur dioxide on breathing.

Question 5

- (a)(i) The role of carbon monoxide was well known. Despite the wording in the stem of the question a common incorrect answer was carbon or coke.
- (ii) It was clear that the majority of candidates had learned the formula of iron (III) oxide and could express it correctly.
- (b)(i) Many candidates correctly stated that aluminium is more reactive than carbon. The mark was not given for the suggestions *aluminium is too reactive* or *aluminium is more reactive than iron*.
- (ii) The use of electrolysis as the method of extraction of aluminium was well known.
- (c)(i) The mark was given for names or symbols although in the case of chlorine, candidates had to state Cl_2 rather than Cl . The most common mistakes were to suggest symbols of ions or the term chloride.
- (ii) Many candidates gained both marks and the majority could state that copper ions gain electrons.
- (d)(i) The majority of candidates correctly referred to the inert nature of argon or to the electronic structure of the argon atom.
- (ii) Candidates from across the mark range lost this mark by giving imprecise answers such as *bulbs* or *lights* or *filaments in bulbs*. Although this is a simple question requiring only recall, candidates still need to take care in the way they express answers. The answer *to provide an inert atmosphere* does not add significantly to the answer to (d)(i) and so did not gain the mark.

Question 6

- (a) Many correct ray diagrams were drawn; most of them carefully constructed using a ruler. Candidates should be advised to avoid freehand ray diagrams, since these are very likely to be penalised. A small number of candidates did not realise that the lines emerging from the bulb were the start of rays that needed to be continued. Some candidates successfully continued the rays but then brought the rays emerging from the lens to a focal point.
- (b) Many candidates showed excellent understanding of evaporation and condensation in terms of particle theory. Most, but not all, correctly associated increasing particle separation with decreasing intermolecular attractive forces. A small number of candidates did not refer to molecules but instead discussed water droplets and convection currents, as they attempted to explain the formation of fog.

- (c) Most candidates correctly rearranged the relationship and worked through to the correct answer.
- (d) Candidates needed to restrict their answers to the consequences of increased sea water temperature. They therefore had to describe water expansion in some valid way and that this would cause sea levels to rise. Many candidates discussed other phenomena caused by climate change and so lost credit.

Question 7

- (a) (i) Many candidates lost the mark because their answers lacked precision. The most common example was the single word answer *temperature* which means nothing in this context. Other incorrect ideas included *good weather*, *light*, *nutrients* and *pH*. The conditions needed for germination did not seem to be particularly well-known.
- (ii) It was apparent that candidates had learned about the role of auxins in phototropism because their answers to this question about geotropism often referred to light. Only a very small number of candidates correctly discussed the concentration of auxins on the lower surface of the radicle. A very common misconception is that auxins are hormones that promote cell growth. Consequently candidates tended to state that auxins concentrated on the upper surface of the radicle (or the surface facing the light for those confusing phototropism) which then caused that surface to elongate.
- (b) (i) Most candidates assumed that the root hairs do show the same geotropic response as the radicle. Of those who stated that they do not, the majority did not state that the diagram shows the root hairs growing in all directions.
- (ii) An incorrect response to (b)(i) made it difficult to gain the mark in this part, although some did score by discussing the role of root hairs in anchoring the plant.

Question 8

- (a) This was well-answered by many candidates who clearly and accurately described the reasons for the difference in boiling points of methane and butane. Several candidates did not interpret the negative values of boiling point correctly and based their answers on the idea that methane had the higher boiling point. These candidates often went on to state logically correct molecular explanations of the causes of boiling point differences. A few candidates lost credit because their answers suggested that differences in molecular size and intermolecular forces were caused by the difference in boiling point.
- (b) (i) The process of cracking was very well-known by these candidates. The most common incorrect answer which was given by a small number was fractional distillation.
- (ii) The majority of candidates gained this mark. Some did not read the question carefully and stated only that *the reaction rate would increase*.
- (c) (i) Most candidates gained this mark. The question asks for a formula and so no mark was given if candidates wrote only the word *water*.
- (ii) Only one mark was available and this was for the correct representation of all the shared electrons in two double bonds. Mistakes in other electrons, either missing electrons or extra ones, were, in this case, ignored. Not all candidates were familiar with a dot-and-cross diagram and some gave a structural (graphic) representation. Another common mistake was to show only single bonds.
- (iii) Most candidates gained this mark.

Question 9

- (a) Many candidates drew correct circuit diagrams containing the proper circuit symbols. The most common reasons why candidates lost marks included adding extra components, drawing a voltmeter instead of an ammeter, drawing a circle with an **X** in it rather than an ammeter.
- (b) Some very good answers were seen from candidates who realised that the shorter filament has a lower resistance and so the current would be higher as shown by an increased ammeter reading. Some candidates predicted a higher resistance and some did not refer to the resistance of the filament. Candidates had to predict the effect on the ammeter reading and so did not gain the mark if they limited their answers to comments about the brightness of the bulb.
- (c) (i) Candidates in general were able to work through to the correct answer and unit.
- (ii) Many candidates knew which relationship to use for this calculation and worked through to the correct answer and unit. Candidates towards the lower end of the mark tended to be unfamiliar with the appropriate relationship and so could not make any progress with the calculation. An error was allowed to be carried forward from (i).

COMBINED SCIENCE

Paper 0653/52
Practical

General comments

When a compound does not effervesce with added acid then it cannot be a carbonate.

Comments on specific questions

Question 1

The food tests were generally well known and carried out well. In **(c)**, 'suggest and explain' means that a stated safety precaution must be accompanied with the reason for applying it. The test for a liquid fat is now better known but the details for carrying out are still often muddled. The safety precaution of 'no naked flames' is necessary because ethanol is flammable.

Question 2

Filtrate and residue were rarely muddled and the observations were generally accurate. In **(b)(i)** it was acceptable to give a negative response such as 'no bubbles' because the test was for a specific ion. Consequently this observation needed to be accompanied by the conclusion that there was no carbonate present. The test for a chloride in **(b)(ii)** caused few problems whereas the free analysis of the ammonium ion in **(b)(iii)** rarely was credited with all three marks. This was mainly because many candidates omitted to comment on the lack of a precipitate when sodium hydroxide or ammonia solution was added. Occasionally ammonia gas and the ammonium ion were confused.

The presence of a blue precipitate was sometimes recorded in **(c)(i)** meaning that the instruction to add ammonia solution until in excess had not been followed. The cation and oxide were often identified.

Hot nitric acid reacting faster than cold was well understood.

Question 3

There were some rather high voltages but generally the results were as expected. The number of decimal places for the current and the voltage were not always acceptable. Calculation of the resistance of each lamp in **(c)(i)** did not present any problems.

The three units needed to complete the table were usually either all present and correct or all omitted, the latter suggesting that some candidates had not seen the question.

In **(c)(iii)** many candidates did not add the two values of resistance as instructed. Instead they calculated the effective resistance of the two parallel resistors and consequently did not score the mark.

The circuit diagram in **(d)(i)** was often drawn accurately and included all symbols. The most common error was incorrect positioning of the voltmeter.

The candidates in **(e)** were required to compare the closeness of their calculated values of R_S and R_P and to decide whether this agreed with the candidate's statement within experimental error. This was seen rarely.

COMBINED SCIENCE

Paper 0653/62
Alternative to Practical

Key messages

Although this is an Alternative to Practical paper, candidates are expected to be familiar with experimental techniques and to have carried out experiments similar to the ones shown in the paper. Candidates should have used standard laboratory apparatus and be able to read values from a variety of measuring instruments and record the values to the requested accuracy. Candidates should have performed identification tests on the range of substances detailed in the specification.

General comments

Candidates from many Centres demonstrated good understanding of practical knowledge and techniques. The reading of the instruments was of an excellent standard and food tests were well known. The standard of graph drawing was generally high although candidates need to remember to include quantities and units on the axes and to draw smooth curves with a single line. Knowledge of identification tests for ions was limited and many found drawing diagrams of apparatus very difficult.

Comments on specific questions

Question 1

- (a) The majority of candidates gained at least partial credit with many gaining full credit. Some omitted the term reducing or thought iodine tested for carbohydrate or fat.
- (b) The starch test was the best known of the test colours. Many candidates either omitted the boxes where the test was negative or wrote negative test rather than stating the colour.
- (c) Most candidates named a safety precaution, although a significant number just said 'be careful', but few explained why the safety precaution should be taken.
- (d) Many candidates added ethanol but far fewer poured this solution into water. A significant number gained credit for the result but some thought a precipitate was formed. Very few candidates knew the safety precaution. A small number of candidates omitted this question.

Question 2

- (a) The majority of candidates appreciated that filtration was required although a significant number chose evaporation or distillation and most of these could also draw a correct diagram. The most common error in the diagram was to omit the filter paper. Fewer candidates added water to dissolve the salt, many just filtered the mixture.
- (b) (i) A significant number of candidates did not give an observation but discussed carbon dioxide not being produced.
 - (ii) Well answered, a few candidates gave chlorine.
 - (iii) Few candidates gained credit in test 1, many thought ammonia was produced. A small number knew the litmus test but most then identified the ion as ammonia. Many thought the litmus was bleached and identified the ion as chlorine.

- (c) (i) Most candidates gained credit.
(ii) Common errors included blue or dark blue precipitate and blue precipitate in a blue solution.

Question 3

- (a) (i) The majority of candidates gained full credit.
(b) (i) While most candidates performed the calculation correctly many either rounded their answer, most incorrectly, or gave answers to different numbers of significant figures.
(ii) Many candidates gained credit but a significant number used $1/R = 1/R_1 + 1/R_2$.
(c) (i) The majority of candidates put the ammeter and lamps in series but a significant number of these also placed the voltmeter in series.
(ii) Many candidates performed the calculation correctly but 16.25 and 11.9 were common incorrect responses.
(d) Whilst most candidates thought that the student was incorrect, few used the results to justify this and so did not gain credit.
(e) Few candidates gained credit. Common non-creditworthy responses included not getting an electric shock, not wasting electricity, not letting the current build up and for accuracy.

Question 4

- (a) Most candidates gained partial credit, usually for time/mins, but few gained full credit.
(b) (i) Most candidates gained credit.
(ii) Many candidates calculated this correctly but some doubled or multiplied by six.
(c) Some candidates gained full credit but many did not label the axes or drew multiple lines.
(d) The vast majority gained credit.
(e) Whilst most candidates could read the value from the graph correctly many did not score as they did not indicate on the graph how they had arrived at their answer.

Question 5

- (a) Most candidates could give at least one scoring reason but few candidates gained full credit.
(b) (i) Some candidates gained full credit. Common incorrect responses included line 5 and less hydrogen produced.
(ii) Many candidates gained full credit. Common non-creditworthy responses included line 2 and because the rate is higher.
(c) Few candidates gained credit, most thought that the volume would increase.
(d) The majority of candidates gained credit but some gave the terms evaporation or crystallisation with no details about how these could be achieved.
(e) The test was generally well known but some candidates had the pop with no lighted splint and some used a glowing splint.

Question 6

- (a) (i)** Most candidates measured correctly but some gave the answer to the nearest centimetre.
- (ii)** The majority of candidates divided correctly.
- (iii)** Whilst candidates were able to calculate the value, many did not round their answer correctly.
- (b) (i)** Most candidates measured correctly.
- (ii)** Whilst most candidates calculated the value, many did not round their answer correctly.
- (c)** Many candidates gained credit but 55, 54.9 and 54.98 were seen often.
- (d)** Many candidates gained credit although filtering was seen quite often.
- (e)** Candidates found this concept very difficult. Many discussed the ease of measurement.
- (f)** Candidates found this difficult, many discussed the density varying.