COMBINED SCIENCE

Paper 5129/11
Multiple Choice

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

General comments

Candidates performed very well on **Questions 1**, **8**, **9**, **14**, **15**, **16**, **28** and **39**. **Questions 2**, **6**, **12**, **17**, **18**, **19**, **20**, **34**, and **37** proved the most challenging for candidates.

Comments on specific questions

Question 1

Many candidates knew that diffusion of carbon dioxide from the blood into the alveoli occurs because the carbon dioxide concentration is higher in the blood compared to the concentration in the alveoli.

Question 2

This question proved demanding for some candidates. Those candidates who knew that enzymes were made of protein knew that the correct chemical test reagent was biuret reagent.

Question 3

Most candidates knew that carbon dioxide and water are necessary for photosynthesis. Some candidates incorrectly selected option **A**, indicating that they thought that oxygen was also necessary for photosynthesis, rather than being a product of photosynthesis.

Question 4

Many candidates were able to identify the colon on the diagram of the human digestive system. Most of the candidates who did not score this mark thought that the small intestine was the colon.

Question 5

Many candidates were able to correctly identify the four structures of human lungs. Most of the candidates who selected an incorrect option thought that the larynx was the trachea.

Question 6

This question proved demanding for candidates with few knowing that the liver is the organ that breaks down lactic acid. Many candidates thought that the pancreas or the stomach breaks down lactic acid.

Question 7

Many candidates knew that veins have thin walls, valves and carry blood back to the heart and correctly selected option **D**.

Question 8

This was a very well-answered question with most candidates selecting the correct option, **A**.

Question 9

Most candidates knew that the central nervous system is located in the brain and spinal cord.

Question 10

Candidates had to identify the normal site of fertilisation and the site of gamete formation from a diagram of a section through the human female reproductive system. Many candidates were able to identify both sites from the diagram.

Question 11

Most candidates knew that bacteria are used in biotechnology because they reproduce rapidly. Candidates who selected the correction option also knew that the bacteria are used because they are able to make complex molecules.

Question 12

This question proved demanding for many candidates as they thought that all plastic waste is biodegradable. Candidates who selected the correct option knew that plastic waste is a problem because animals could eat the plastic waste and some of it could release toxins.

Question 13

Interpreting the diagram of the carbon cycle proved demanding. Some candidates were able to identify where decomposers were releasing carbon dioxide. Many of the candidates who did not gain this mark thought that the decomposers were releasing carbon dioxide from the tractor or from the plant to the animal.

Question 17

The dot-and-cross diagram of a nitrogen molecule was not well known. Candidates should know that in a nitrogen molecule the atoms share three pairs of electrons. A significant proportion thought that the atoms share a single pair of electrons and selected option **A**.

Question 18

There was evidence of guesswork amongst many candidates. The use of state symbols in equations is not well understood by a large proportion of the candidates.

Question 19

This calculation, involving the stoichiometry of equations and simple proportion, was not well understood. Candidates are expected to be able to use the relative formula mass and the stoichiometry of an equation to calculate the mass of a substance produced in a chemical reaction.

Question 20

There was evidence of widespread guesswork. Candidates should recognise that an endothermic reaction is accompanied by a decrease in temperature of the reaction mixture.

Question 21

The factors affecting the rate of a chemical reaction were not well understood. Candidates should understand the effect of concentration, temperature and particle size on the rate of reaction.

Question 22

The idea that hydrogen ions cause an aqueous solution to be acidic was not well known by a large proportion of the candidates.

Question 23

There was evidence of guesswork particularly by weaker candidates.

Question 24

The reasons why aluminium is used for the manufacture of aircraft parts and overhead power cables were well known by a large proportion of the candidates.

Question 26

The relationship between the position of a fraction in the fractionating tower and the boiling point was not well known. Many candidates incorrectly selected option **A**.

Question 27

The fact that alkenes are able to add to each other to produce polymers was well known by the stronger candidates. There was a misconception that alkenes are saturated hydrocarbons.

Question 28

Most candidates identified option **A** as the correct answer. Some candidates selected option **C** which labelled the other horizontal section, constant speed.

Question 29

The relationship between mass and weight was well known with most candidates correctly choosing the correct answer, option **B**.

Question 30

There was some uncertainty with a number of candidates choosing either option **B** or option **D** rather than the correct answer, option **C**.

Question 31

Stronger candidates correctly selected the correct answer, option **D**. Among the remaining candidates, option **B** was the most popular choice.

Question 32

A significant number of the stronger candidates selected an incorrect answer, option **A** rather than the correct answer, option **B**.

Question 33

There was some uncertainty with a number of candidates choosing either option **A** or option **B** rather than the correct answer, option **C**.

Question 34

There was some uncertainty in correctly choosing an example of a wave type and its subsequent definition. The choice of the stronger candidates was either option **A** or option **C**, the correct answer.

Question 35

There was evidence of guesswork among candidates, including the stronger ones, with each option attracting a significant number of responses.

Question 37

Circuit symbols were not well known, with each option attracting a significant response.

COMBINED SCIENCE

Paper 5129/12
Multiple Choice

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

General comments

Candidates performed very well on **Questions 6**, **9**, **11**, **14**, **22**, **23** and **32**. **Questions 3**, **10**, **15**, **17**, **19**, **21**, **26**, **27** and **34** proved the most challenging for candidates.

Comments on specific questions

Question 1

This question proved demanding for candidates. Most candidates knew that the net movement of molecules was from a higher to a lower concentration. However, many thought that the molecules moved in the same direction rather than having random movement.

Question 2

Some candidates knew that increasing the pH and increasing the temperature above the conditions found in the mouth would reduce the rate of starch conversion to maltose. A number of candidates incorrectly thought that increasing the starch concentration would reduce the rate.

Question 3

This question proved very demanding with only a small proportion knowing that the phloem transports both sucrose and amino acids. Many of the candidates who did not gain this mark knew that the phloem transports sucrose but thought that the xylem transports amino acids.

Question 4

This was a well-answered question with many candidates knowing that physical digestion makes food particles smaller and that it occurs in the mouth.

Question 5

Many candidates knew how the composition of inspired air was different to the composition of expired air. A significant number who knew that the carbon dioxide concentration was larger thought that the nitrogen concentration was smaller and did not gain the mark.

Question 6

Many candidates knew that the process of respiration releases energy from glucose.

Question 7

Most candidates were able to identify the right and left sides of the heart and the valves present to gain this mark. Those candidates who did not gain the mark had incorrectly identified the valves.

Question 8

Most candidates knew that smoking damages the alveoli and this results in a decrease in the volume of oxygen being absorbed. Most of the incorrect responses thought that damaged alveoli would lead to a reduction in the rate of breathing.

Question 9

Most candidates knew that a stimulus in a reflex produces a rapid automatic response.

Question 10

This question proved very demanding and very few knew that a cell with 8 chromosomes undergoing meiosis would produce 4 cells each containing 4 chromosomes. Many who did not score this mark knew that the cells would contain 4 chromosomes but many thought that there would be 2 cells formed rather than 4.

Question 11

The majority knew that the Sun was the main source of energy input to most biological systems.

Question 12

The majority knew that the arrow on the diagram of the carbon cycle was showing the process of feeding. Many of the candidates who did not score this mark thought that the arrow was representing respiration.

Question 13

Most candidates knew that deforestation reduces habitats for wild animals and causes an increase of carbon dioxide in the atmosphere. Fewer knew that farming, mining and human population growth also increase deforestation.

Question 15

There was some confusion between solute and solvent as a significant proportion selected option **D**.

Question 16

The relationship between electronic structure and the Periodic Table was understood by most candidates.

Question 17

There was evidence of widespread guesswork amongst candidates. Ideas about the structure and bonding in an ionic compound were not well understood.

Question 18

Most candidates recognised the state symbols associated with sodium, sodium hydroxide and hydrogen. However, the state symbol associated with water was less well known.

Question 19

Calculations involving the stoichiometry of equations and simple proportion were not well understood. Candidates are expected to be able to use the relative formula mass and the stoichiometry of the equation to calculate the mass of the reactants in a chemical reaction.

Question 21

The factors affecting the rate of a chemical reaction were not well understood by a significant proportion of candidates. Candidates should be aware of the effect of temperature and particle size on the rate of reaction.

Question 22

The test for oxygen was well known. A significant number confused the test for oxygen with the test for hydrogen and selected option **B**.

Question 23

The colour of universal indicator in a neutral solution was well known by the majority of candidates.

Question 26

There was evidence of widespread guesswork even amongst the stronger candidates. The uses of different fractions obtained from the fractional distillation of petroleum were not well known.

Question 27

This question proved to be demanding even for the strongest candidates. A large proportion of the candidates selected option **B** not understanding that the double bond in the monomer, ethene, becomes a single bond in the structure of the polymer.

Question 29

Many candidates forgot to convert the time into seconds and therefore selected option **B**.

Question 34

Many candidates, including the stronger ones, used the distance given (2 wavelengths) and selected option **C** rather than using half the distance given to produce the correct answer in option **D**.

Question 35

Many candidates confused the angles of incidence and reflection with all options attracting a significant number of candidates.

Question 37

Option **C** was chosen by a greater number of candidates than the number selecting the correct answer, option **D**.

Question 39

Many candidates selected either option **A** or option **D** rather than the correct answer, option **C**.

COMBINED SCIENCE

Paper 5129/21
Theory

Key messages

Candidates who performed well on this paper:

- demonstrated knowledge and understanding in all three science disciplines with good recall of scientific terms, phrases and equations
- demonstrated good factual knowledge
- were guided by the command words e.g. describe, explain, calculate, to structure their answers
- were guided by the number of marks available for each question to inform the detail of their answers
- rearranged equations when necessary and clearly showed the steps in their calculations
- interpreted diagrams and data by providing explanations as well as descriptions
- used data, in different forms, provided in the rubric, to explain or justify conclusions.

General comments

The questions required candidates to demonstrate skills of handling information and problem solving as well as knowledge with understanding.

Comments on specific questions

Question 1

Most candidates correctly linked the substances found in plants to descriptions of how those substances are used in plants.

Question 2

(a) (i)–(iii) Most candidates correctly interpreted the distance–time graph to determine the height of the ball when it was thrown upwards, its maximum height and the time taken for it to land in the pool.

(b) Most candidates substituted data from the graph into the speed equation to calculate the average speed of the ball.

Question 3

(a) (i) Most candidates correctly added the relative masses of the atoms in chloric(I) acid.

(ii) Only the strongest candidates calculated that 142 g is the mass of 2 chlorine molecules. Since the equation shows a 1-to-1 relationship between chlorine and water, then, since the mass of a water molecule is 18 g, 2 molecules are required to balance the reaction, hence 36 g of water.

(b) Very few candidates knew that chlorine gas has a yellow-green colour at room temperature.

(c) Very few knew that the presence of chlorine gas is confirmed by bleaching damp litmus paper.

Question 4

(a) Most candidates correctly selected twenty-three from the list of words and phrases to identify the number of chromosome pairs in human cells.

(b) Only a few candidates knew that genes provide the code for making proteins. Many candidates stated, incorrectly, that proteins make genes.

(c) Most candidates knew that the testes produce male gametes. A common error was to identify mitosis rather than meiosis as the type of cell division.

Question 5

(a) Most candidates were able to calculate the volume of the block. Many recalled the equation for density and substituted values of density and volume. A common error was in the conversion of grams to kilograms.

(b) Candidates recalled the equation for weight and multiplied their value of mass from part **(a)** by 10 (gravitational field strength).

(c) Candidates recalled the spring equation and substituted their value of weight from part **(b)** and x = 2.0 cm from the stem of the question. Candidates should note the unit of the answer to assist with recall of the equation. In this example N / cm is on the answer line. This means that their value for N must be divided by the given value of cm.

Question 6

(a) (i)–(iii) Most candidates correctly interpreted the data in this stacked bar chart and its key. The chart showed the different causes of percentage changes in species across four animal groups.

(b) Most candidates knew that deforestation results in fewer trees, that trees use carbon dioxide in photosynthesis, and that with fewer trees less carbon dioxide will be removed from the atmosphere.

Question 7

(a)–(e) In this question candidates were given the formulae of different substances. Most candidates were able to recognise at least one substance and match it to a correct property. Candidates had most difficulty identifying the substance with a low boiling point (H_2) and the substance which conducts electricity (A*l*).

Question 8

(a) This question is another example where candidates should be guided by the unit on the answer line to help with recall of the equation. Here, N m indicates that the force 500 N must be multiplied by the given distance, 0.15 m. Many candidates either calculated a ratio of these values or used the length of the handle from the pivot.

(b) Only the strongest candidates recognised that the value calculated in **(a)** is the anti-clockwise moment about the pivot. The moments are balanced, therefore the value from **(a)** must be divided by the distance of the handle.

(c) (i) Most candidates knew that the human body has a chemical energy store. Very few candidates appreciated that the body applies force to move the bucket or transfers the chemical energy by doing work.

(ii) Most candidates identified at least one of the stores to which energy is transferred. Candidates should know that most energy transfers result in an increase to the thermal store. Candidates should also know that 'potential' energy is not precise enough in this context. They should specify gravitational potential energy since the bucket is rising.

Question 9

In this question candidates recalled their own words to complete sentences about the arrangement of elements in the Periodic Table. Most candidates did well on this question but a common error was stating that atomic numbers show the number of electrons in the nucleus.

Question 10

In this question candidates joined boxes to complete three correct sentences about veins. Many candidates confused the structure and function of veins with arteries.

Question 11

(a) (i)–(ii) Most candidates correctly named the turbine and knew that it rotates.

(b) (i) Very few candidates identified that the machine connected between the turbine and the power lines is the generator.

(ii) Candidates could gain a mark for knowing that energy is transferred in a power line by either electrical energy or current or by electricity. Only a few candidates knew this fact.

Question 12

(a) (i) Most candidates correctly identified the thermometer in the apparatus.

(ii) Most candidates knew that gas changes state to become liquid in apparatus **B**, the condenser.

(b) Most candidates knew that water particles move freely but many had difficulty describing the separation of the particles. Simply, there is no separation as the particles are in contact with each other.

(c) Most candidates gained a mark for knowing that there are two electrons in each covalent bond, one from the oxygen atom and one from the hydrogen atom. Candidates should refer to the Periodic Table to confirm that oxygen, which is in Group VI, has another four unbonded electrons.

(d) Most candidates knew that chlorine is added to drinking water to kill microbes.

Question 13

In this question candidates needed to match labels **A** to **G** from a diagram of the human digestive system to the correct functions of those parts. Most candidates scored well on this question.

Question 14

(a) Only a few candidates knew that the safety switch shown in the diagram is called a trip switch.

(b) Candidates should know that trip switches are activated when an excess current in the circuit is detected.

(c) Very few candidates could explain why the switch is safe to touch when it is reset. Candidates should know that most electrical devices are encased in insulating materials, e.g. plastic, for the safety of users.

Question 15

(a) (i) Few candidates understood that barium removes the chloride ion from ammonium. Water is formed from the hydroxide ions, leaving ammonia (with zero charge) as the other product.

(ii) Candidates should know that hydroxides are basic causing universal indicator to turn blue.

(b) Some candidates were able to determine that there are three different types of atom in $Ba(OH)_2$. Candidates should refer to the Periodic Table on the back page of the exam paper if they are uncertain about the symbols for different elements.

(c) Many candidates found it difficult to determine the concentration of the solution. In this example, candidates should calculate that 1000 ÷ 200 = 5. Therefore, there is 5× the mass (i.e., 25 g) in a volume that is 5× larger.

Question 16

(a) Most candidates correctly named the windpipe, bronchus and alveoli on this diagram of the lungs. A common error was to identify the alveoli as bronchioles.

(b) Candidates found it more difficult to describe the movement of oxygen between the alveolus and the capillary. The first mark could be obtained for knowing the direction of movement into the blood and the second mark either for identifying the process as diffusion or recognising that the wall of a capillary is once cell thick.

Question 17

(a) Only a few of the strongest candidates were able to describe gamma radiation. Candidates should know that it is an electromagnetic wave, it has a very high frequency and is most penetrating. Many candidates gave answers that described what gamma radiation can be used for rather than a description of its nature.

(b) Most candidates knew that medical instruments are irradiated with gamma rays in order to sterilise them.

COMBINED SCIENCE

Paper 5129/22
Theory

Key messages

Candidates who performed well on this paper:

- demonstrated knowledge and understanding in all three science disciplines with good recall of scientific terms, phrases and equations
- demonstrated good factual knowledge
- were guided by the command words e.g. describe, explain, calculate, to structure their answers
- were guided by the number of marks available for each question to inform the detail of their answers
- rearranged equations when necessary and clearly showed the steps in their calculations
- interpreted diagrams and data by providing explanations as well as descriptions
- used data, in different forms, provided in the rubric, to explain or justify conclusions.

General comments

The questions required candidates to demonstrate skills of handling information and problem solving as well as knowledge with understanding.

Comments on specific questions

Question 1

(a) Only the strongest candidates recognised that force arrow **A** showed the direction of friction. Arrow **B** is a contact force between the wheel of the trolley and the ramp.

(b) (i) Most candidates had difficulty understanding that the acceleration is constant because the gradient of the line is constant on this speed–time graph.

(ii) Candidates who showed their working generally gained a mark. Some candidates gave one significant figure answers whereas two significant figures were more appropriate for this data. Stronger candidates easily took correct speed and time readings from the graph.

Question 2

(a) (i)–(iii) Most candidates correctly identified the vacuole. In the flaccid cell, the membrane was detached from the cell wall so some missed this mark. Most candidates knew the function of the nucleus.

(b) Only the strongest candidates recalled the term flaccid to describe the cell in Fig. 2.2.

(c) Most candidates knew that the difference between these cells was due to the movement of water. A second mark was obtained by some candidates for identifying the process of water movement as either osmosis or diffusion or due to a difference in water potential. However, many candidates could not describe a difference, such as the vacuole or the cytoplasm or the nucleus becoming smaller in the second diagram.

Question 3

(a) (i) Most candidates knew that the relative atomic mass of each element must be added to find the relative molecular mass. Some candidates calculated the mass of sodium bromide instead of sodium bromate.

(ii) Candidates should recognise from the equation that Br_2 is in a 1-to-1 ratio with NaBr. Therefore, 160 g (2×80) corresponds directly to 103 g (23 + 80).

(b) Most candidates gave a correct description of the colour of bromine.

(c) Only a very small number of candidates knew the test for bromide ions. Candidates should know that acidified silver nitrate is used and that this produces a cream precipitate.

Question 4

(a) Most candidates could not recall that to calculate the moment, the distance from the pivot is multiplied by the force.

(b) Few understood what is meant by the term 'pivot' as many different parts of the wheelbarrow were labelled. In this diagram, the wheelbarrow will rotate about the centre of the wheel.

(c) Candidates should know that simple machines, such as this wheelbarrow, allow small forces applied at large distances from the pivot to lift much larger forces that those applied closer to the pivot. However, as noted in **(b)**, this relies on an understanding of the term.

(d) Candidates needed to calculate the distance moved by the handles of the wheelbarrow when applying a force of 90 N to lift a weight. This required a rearrangement of the work done equation. Many candidates did this incorrectly and gave a value of 9 m instead of 0.11 m. Several candidates calculated 900 m. Candidates should check that the results of their calculations are realistic.

Question 5

In this question candidates drew lines between boxes to make three correct sentences about the liver. A common misconception was that the liver produces lipase. Candidates should know the liver produces urea.

Question 6

(a)–(e) In this question candidates were given the formulae of some compounds and needed to match them to descriptions. Candidates had most difficulty identifying the compound that is a gas at room temperature (CH_4) – candidates should know that this is methane, and the compound that has a pH below 7 when dissolved in water (HNO_3) – candidates should know that this is nitric acid.

Question 7

(a) (i)–(iii) Most candidates knew that the distance between molecules increases when a solid changes to a gas. They also knew how the movement of the molecules change, although a number of candidates described how the arrangement changes instead. Songer candidates knew that the forces between the molecules get weaker as they move further apart.

(b) Candidates found it difficult to explain why the frozen carbon dioxide becomes a gas at this temperature change. Candidates should know that energy is needed for a change of state to occur. This energy is used to overcome the intermolecular forces of attraction between molecules.

Question 8

(a) (i) Most candidates selected correct words from the list to compare veins with arteries.

(ii) Only the strongest candidates knew that arteries have thick walls to withstand or maintain the pressure of the blood inside them.

(b) Few candidates were able to describe the structure of a capillary. Capillaries have thin walls and a narrow lumen. Candidates stated that capillaries connect arteries and veins, but this is not a description of their structure.

Question 9

Most candidates recalled words and phrases to complete the sentences about the Periodic Table.

Question 10

(a) Candidates should be able to explain convection in terms of density changes. In this situation, the freezer compartment at the top of the fridge cools the air which then sinks to the bottom of the fridge due to its higher density.

(b) Candidates first needed to find the total cost of the energy (133 kWh at 15 cents per kWh = 1995 cents). The next step was to divide this total by the number of days (365) in a year.

(c) There was a common misconception that the insulation in the walls and door of the fridge prevents air from escaping. This insulation helps to maintain the temperature of the fridge and prevents thermal radiation entering the fridge from the surroundings.

Question 11

(a) Most candidates correctly named two other components of the human diet.

(b)(i)–(ii) Most candidates extracted the correct data from the bar chart relating the percentage of vegans in parts of the population over time and which age group had the greatest change over time.

(c) Only a few candidates performed well on this question. Candidates should know that energy efficiency means that some energy is lost when it is transferred from plants to humans or from animals to humans. There are more ways that animals can lose energy (respiration, excretion, egestion etc.) so it is more energy efficient to eat plants.

Question 12

(a) (i) Candidates should be familiar with the names of laboratory apparatus. Only the strongest candidates recalled that apparatus **A** is a condenser.

(ii) Knowing the name of the condenser should remind candidates that condensation occurs in this apparatus where gas changes state to liquid.

(b) Most candidates knew that chlorine is added to drinking water to kill microbes such as bacteria.

(c) Most candidates knew that a chlorine molecule has one pair of bonding electrons. Candidates should refer to the Periodic Table to confirm that chlorine, in Group VII, has another 6 unbonded electrons.

(d) (i)–(ii) Most candidates understood that with an increase in temperature, the volume of a gas increases. Candidates were less likely to understand that a higher pressure decreases the volume of the gas.

Question 13

(a) Most candidates understood that the horizontal and vertical lines they were asked to draw needed to intercept the curve of the graph. Stronger candidates understood that the original counter reading was 80 so a horizontal line drawn at 40 will lead to a vertical line from the intercept crossing the *x*-axis at 1.0 minute.

(b) Candidates should know that the background radiation count adds to the count from the sample. Removing this additional count means that the reading is correct for the sample. The statement that removing the background count increases the accuracy of the sample count was commonly seen. This was not enough for the mark.

(c) Candidates should understand that the use of any forceps of whatever length means that the teacher does not have to touch the source with their hand. In this situation, the long handle increases the distance between the hand and the source.

Question 14

In this question candidates needed to draw straight lines from four boxes describing biological processes to four boxes, from a choice of eight, giving the names of those processes. Candidates generally gained marks

for matching descriptions of diffusion and respiration but were less certain about the descriptions for translocation and mitosis.

Question 15

(a) (i) A few stronger candidates understood that, in this word equation, the hydroxide molecule takes one hydrogen atom from the ammonium ion to produce water and ammonia. This leaves the sodium to bond with the remaining bromide ion to form sodium bromide.

(ii) Most candidates suggested a suitable pH for aqueous sodium hydroxide.

(b) In NH_4Br there is one nitrogen atom, four hydrogen atoms and one bromine atom, but only three different elements. Candidates should refer to the Periodic Table to confirm that there are only three different element symbols in this molecule.

(c) Stronger candidates understood that if 40 g is dissolved in 2000 cm^3, then the same concentration with half the volume (1000 cm^3) will only have half the mass (20 g).

Question 16

(a) Most candidates knew that light is reflected from the surface of an object to produce an image in the camera.

(b) (i) Only the strongest candidates recalled that the coulomb is the unit of charge.

(ii) In this question, candidates were given values for charge and current and asked to calculate the time. Candidates needed to recall the equation $Q = It$. The value of charge is given using standard notation, making the calculation slightly more demanding.

COMBINED SCIENCE

Paper 5129/31
Experimental Skills and Investigations

Key messages

The paper will always have a planning question. The bullet points include all of the areas that need to be addressed by candidates to make sure they access all of the marks available.

When drawing or completing tables, candidates should put the units in the table headings. Units should not be included in the body of the table. Candidates are advised to make sure that they are using the correct unit for the quantity in the table heading.

When drawing graphs, candidates should plot points to cover at least half of the grid and draw a line of best fit as a single smooth line. Candidates need to ensure that the axes are the right way around and are labelled with the correct units.

General comments

Candidates are advised to look at the number of marks available for each part question as this is a good indication of the number of specific points that have to be made in order to gain full marks.

Whenever there is a calculation worth two or more marks, candidates should show their working as marks can be awarded for using correct formulae, irrespective of the final answer.

Comments on specific questions

Question 1

(a) (i) The question required candidates to identify an error that the student had made when presenting their results. Some candidates correctly identified that the units for mass were written in the body of the table. Incorrect answers seen included ‘the mass of the grass with no holes in the bag remained the same throughout the whole of the experiment’ and ‘the time of the experiment started from 0’.

(ii) Many candidates gained one mark for this question. The most common correct answers were temperature and same type of bag

(iii) The calculation of the percentage change in mass proved to be very demanding for candidates.

(iv) Many candidates showed some knowledge as to why the bag with holes would lose mass and were able to state that carbon dioxide gas or water would be lost through the holes. Candidates who missed this mark tended to write general statements with not enough detail such as ‘the grass withers’.

(b) (i) Many candidates were able to calculate the difference in the temperature on the two thermometers and many gave the correct unit for temperature. Candidates who missed the unit mark gave answers such as kelvin or C°.

(ii) Candidates found this question demanding and many wrote about heat being able to enter the bag through the holes in the bag rather than heat being released through decomposition.

(c) This question gave candidates an opportunity to show that they could complete a biological drawing from a photograph of a leaf of a clover plant. Many candidates were able to gain at least two of the three marks, usually for a drawing of a suitable size with no shading and a stalk.

Question 2

(a) (i) This was a well-answered question, with many candidates knowing that either a measuring cylinder, a pipette or a burette could be used to measure the volume of acid required. The most commonly seen incorrect name was beaker.

(ii) Many candidates found this question demanding and had not appreciated that, at the start of the question, they were told that the magnesium carbonate was an insoluble solid**.** Candidates should read all the information given in a question.

(iii) Many candidates knew that filtration should be used to separate the excess solid from the solution. Commonly seen incorrect answers included 'fractional distillation', 'simple distillation' and 'crystallisation'.

(iv) Another demanding question for the candidates, many of whom wrote that seeing the mixture bubble would indicate that the mixture had been heated for long enough, rather than the observation that there would be crystals forming in the flask.

(v) This was a two-mark question and whilst many candidates knew that the mixture would need to be cooled, many did not write about what they would do to the separated mixture after it had been heated, such as drying the crystals.

(b) (i) This question proved to be demanding for candidates. Again, the information provided should have made the candidates think about which two substances needed to be reacted in order to produce insoluble lead sulfate. Candidates needed to choose a soluble solution containing lead and a soluble solution containing sulfate ions. Many candidates chose dilute sulfuric acid and lead metal rather than lead nitrate solution**.**

(ii) Candidates were asked to say why the method used to make magnesium sulfate could not be used to make lead sulfate. Candidates therefore needed to think about the solubility of the two salts and the purity of the product formed if lead sulfate was produced from the reaction between lead carbonate and sulfuric acid. Some candidates described the magnesium being more reactive than the lead while others thought that it could be to do with the salts having different boiling points rather than the solubility and purity.

(iii) Candidates were required to name the method used to make the insoluble salt lead sulfate. There were a range of incorrect answers including crystallisation, distillation and neutralisation.

Question 3

(a) The instructions on what the candidates had to measure were very clear and on Fig.3.1 the unstretched length was indicated by a label. Many candidates were able to correctly read and record this measurement. Most candidates who did not score this mark had not appreciated that the answer needed to be recorded in mm rather than cm.

(b) This question required candidates to calculate the extension of the spring using their own result in **(a)** and the new length of the spring provided. Candidates could access the two marks as an error carried forward from their previous answer.

(c) Candidates were provided with a table of results into which they had to add their calculated extension value, the time period T for 1 oscillation as well as the units and value of T^2. Many were able to record their extension value into the table. The value T proved more challenging, many did not appreciate that they only had to divide the t_{20} value by 20. Only a few candidates provided a unit for T^2.

(d) On this graph, candidates were marked using the following criteria:

- linear scale for plotted points to cover half or more in both dimensions
- points 2–5 plotted accurate to ± half small square

- straight line passing through all points.

Candidates missed marks for using non-linear scales or using complex scales. In general, candidates should use simple scales, with intervals of 10, 5 or 2 divisions on the axes. Many candidates drew an acceptable line of best fit.

(e) Candidates needed to think about a practical reason why the student must not put more than a 5 N load on the spring**.** Many candidates correctly thought that the spring might break, or that the weight would permanently stretch the spring.

(f) This question required candidates to think about why taking a result for 20 oscillations and then finding the average time would be better than recording the time for one oscillation. Some candidates appreciated that there would be slight differences in the reaction time when starting and stopping the stopwatch and this would have less of an impact on the results for 20 oscillations compared to 1 oscillation.

(g) This question required candidates to think about the difficulty in measuring the exact extension of the spring. Many of the incorrect answers used ideas from the previous questions. Some wrote about the spring not returning to its original length or stated that the load was too heavy. There were very few correct responses to this question.

Question 4

The information in the bullet points is to guide candidates in their response. There is at least one mark for each of the sections as set out in the question. Therefore, candidates need to address each of the bullet points to achieve full marks.

This question required candidates to identify the tests needed to determine which solution was aluminium chloride, zinc chloride and potassium chloride. They needed to plan a set of chemical tests that would enable them to correctly identify each cation and state what results they would expect for each solution with each test.

Candidates are provided with the details of the quantitative analysis tests and the results for both cations and anions on pages 14 and 15 of the question paper. Candidates who used these notes were able to use the correct tests to determine which cation was which by quoting the positive and negative results for each test with each cation.

Some candidates gave the wrong tests, such as ‘using damp litmus paper’, but gained a method mark for carrying out the test in a suitable piece of apparatus, such as a beaker or for stating that the student needed to wear goggles.

COMBINED SCIENCE

Paper 5129/32
Experimental Skills and Investigations

Key messages

The paper will always have a planning question. The bullet points include all of the areas that need to be addressed by candidates to make sure they access all of the marks available.

When drawing or completing tables, candidates should put the units in the table headings. Units should not be included in the body of the table. Candidates are advised to make sure that they are using the correct unit for the quantity in the table heading.

When drawing graphs, candidates should plot points to cover at least half of the grid and draw a line of best fit as a single smooth line. Candidates need to ensure that the axes are the right way around and are labelled with the correct units.

General comments

Candidates are advised to look at the number of marks available as this is a good indication of the number of specific points that have to be made in order to gain full marks.

Whenever there is a calculation worth two or more marks, candidates should show their working as marks can be awarded for using correct formulae, irrespective of the final answer.

Comments on specific questions

Question 1

(a) (i) Many candidates found this question challenging. The volume to be measured was 25.0 cm^3 and therefore either a burette or a pipette was the required answer.

(ii) Many candidates correctly identified the flask as a conical flask.

(iii) This was a two-mark question describing the appearance of the contents of the flask. At the start of the question, candidates were told that the copper oxide was an insoluble black powder and were expected to use this fact to deduce the appearance of the contents of the flask with copper oxide in excess**.**

(iv) Many candidates knew that filtration should be used to separate the excess solid from the solution. Commonly seen incorrect answers included fractional distillation and simple distillation.

(v) Most candidates found this question demanding and had not appreciated that the copper sulfate had been heated beyond the point of crystallisation.

(b) (i) Many candidates knew that universal indicator turns red with sulfuric acid. The most commonly seen incorrect answer was blue.

(ii) This question required candidates to know that at neutralisation the universal indicator would change colour to green. Many candidates who missed this mark stated ‘yellow’ rather than ‘green’.

(c) (i) In this question candidates were told that the student mixes silver nitrate with sodium chloride solution and were asked to describe the appearance of the mixture in the beaker. Only a few

candidates were able to state that a white precipitate would be formed. This is one of the tests for anions and is included in the 'notes for use in qualitative analysis' found at the back of the paper.

(ii) Many candidates found this demanding and did not appreciate that washing the residue with distilled water would ensure that the residue was pure. Many candidates thought that either heating the residue or drying the residue would ensure that it was pure.

Question 2

(a) (i) In this question candidates had to draw their own table of results and record the results from data given. Most candidates attempted this question, and many scored at least one mark, usually for recording the correct colour of the solution with the corresponding temperature.

(ii) Many candidates knew the contents of the beaker were stirred to mix the water with the cabbage juice and to distribute heat.

(iii) Candidates were asked to state a conclusion based on the results provided. Many said that, as the temperature increased, the colour of the solution became darker. Other candidates who missed this mark wrote answers which were too general, such as 'different temperatures, gave different colours.'

(b) (i) This question gave candidates an opportunity to show that they could complete a biological drawing from a photograph of a cabbage leaf. Many candidates were able to gain at least two of the four marks, usually for a drawing of a suitable size and for drawing an outline shape with single clear lines with no shading and some veins shown inside the leaf.

(ii) Candidates needed to measure the line on the drawing provided for them. Many candidates gained this mark. Candidates that did not score this mark had often given a value such as 7.5 rather than 75 mm. Candidates are advised to check that the unit on the answer line matches the value given.

(iii) Candidates were provided with the magnification calculation in the stem of the question. As this answer relied on their response to **b(ii)** many of the candidates who did not score the mark in **b(ii)** were awarded the 2 marks here for an error carried forward.

Question 3

(a) In this question, candidates were asked to draw the circuit diagram containing a voltmeter to test each cell separately. Some candidates did not use the correct symbol for a battery.

(b) (i) Candidates had to read and record the value on the voltmeter provided for the first cell. Many of the candidates who did not achieve the mark recorded a value of 1.6 rather than 1.60. Again, candidates needed to look at the other results provided in the table and record their result to the same number of decimal places.

(ii) Most candidates were able to deduce which cells were not new cells from the data provided.

(c) Candidates tended to miss marks as a result of using non-linear scales or using complex scales. Candidates should use standard scales such as intervals of 10, 5 or 2 on the axes. Many candidates drew acceptable lines of best fit. The most commonly seen error was to try to draw the line going through zero.

(d) (i) Candidates were asked to extend their line of best fit until it crossed the *y*-axis and to read the *y*-intercept from their graph. This proved demanding for many of the candidates who tried to force their line to go through zero and consequently had drawn their line away from the line of best fit.

(ii) To gain the mark for this question candidates needed to use their value from **(d)(i)** to calculate a current when there were no lamps in the circuit. Most candidates did not achieve this mark although an error carried forward was allowed.

(e) In this question candidates were asked to suggest one cause of uncertainty in this experiment and an improvement to the procedure. Candidates found this question particularly demanding and had not appreciated that, for example, it was not known if the resistance (of lamps) was constant or if the temperature of the lamps was constant. Many candidates gave generalised answers, for

example, ‘use new cells’ or ‘take several readings and calculate an average’ and therefore missed the available marks.

Question 4

The information in the bullet points is to guide candidates in their response. There is at least one mark for each of the sections as set out in the question. Therefore, candidates need to address each of the bullet points to achieve full marks.

Many candidates gained a mark for using a stopwatch or for stating a variable which needed to be kept constant. Reasons why candidates did not achieve full credit included:

- stating that they would test the egg white in acid and in alkali solutions and not planning to test the egg white with neutral solution
- using generalised comments such as ‘keep the egg white the same’ rather than stating that the mass of the egg white or the surface area of the egg white needed to be constant
- stating that the egg white in the hydrochloric acid would be broken down fastest rather than stating that the time for breakdown in the different solutions should be compared and then, if the acidic solution breaks down the egg white most quickly, the student’s conclusion is correct.