

COMBINED SCIENCE

Paper 5129/11
Multiple Choice

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

General comments

Candidates performed very well on **Questions 2, 3, 6, 9, 14, 13, 15, 17, 24 and 25**. **Questions 1, 5, 8, 16, 18, 19, 21, 28, 29, 37, 38 and 39** proved the most challenging for candidates.

Comments on specific questions

Question 1

Many candidates misinterpreted the graph and thought that the glucose had moved, rather than the water. Candidates needed to look at the information and note that the beaker contained a partially permeable membrane.

Question 2

This question on enzymes was well answered with many candidates identifying the pH at which the enzyme worked most quickly.

Question 3

This was a well-answered question with most candidates knowing that transpiration is the loss of water vapour through stomata.

Question 4

This question tested knowledge of food tests. It was evident that many of the candidates knew one positive result for one food test.

Question 5

Many candidates did not know that the liver is the organ where urea is formed.

Question 6

Most candidates knew that alveoli are the part of the gas exchange system where gas exchange by diffusion occurs.

Question 7

Many candidates had not taken into consideration all of the information given in the question. Many had considered that there was anaerobic respiration or aerobic respiration, but not both. Only the strongest candidates were able to deduce that both types of respiration had occurred.

Question 8

Many candidates did not know that it is the ventricles that contract to send blood out of the heart.

Question 9

Most candidates knew that the function of meiosis is the production of gametes.

Question 10

Most candidates were able to identify the prostate gland on a diagram of the male reproductive system.

Question 11

Many candidates knew that fertilisation occurs when an egg is in the oviduct.

Question 12

This question tested knowledge of energy transfer in ecosystems. Only the strongest candidates knew that the flow of energy decreases along a food chain.

Question 13

Most candidates knew the effects of deforestation.

Question 14

The arrangement and motion of particles in solids, liquids and gases was well understood by most candidates.

Question 15

The relationship between atomic number and nucleon number and the number of protons, neutrons and electrons in an atom of an element was well known by the stronger candidates.

Question 16

There was evidence of widespread guesswork amongst candidates with all options frequently chosen.

Question 17

Most candidates could correctly interpret the dot-and-cross diagram.

Question 18

There was evidence of guesswork amongst some candidates. Candidates are expected to be able to work out the stoichiometry of symbol equations.

Question 19

This proved a demanding question for the vast majority of the candidates. Ideas about the concentration of aqueous solutions was not well understood.

Question 20

Many candidates recognised that thermal energy is transferred to the surroundings during an exothermic reaction. However, a large proportion of these candidates thought that cracking is an exothermic reaction and chose option **C**.

Question 21

There was evidence of widespread guesswork even amongst the stronger candidates. Candidates are expected to know that metallic oxides are basic and react with ammonium chloride to produce ammonia which turns red litmus paper blue.

Question 22

The changes in conditions that increase the rate of a chemical reaction was well known by most candidates.

Question 23

The trend in reactivity shown by elements in Group I was known by many candidates. However, a large proportion of these candidates thought the melting point of elements in Group VII decreases down the group and chose option **C**.

Question 24

This question was well known by most candidates.

Question 25

The properties of copper that make it useful for electrical wiring was well understood by stronger candidates.

Question 26

The processes used to make river water safe to drink was well understood by most candidates.

Question 27

There was evidence of guesswork even amongst the stronger candidates. Candidates are expected to know that alkenes are made by heating alkanes in the presence of a catalyst.

Question 28

There was evidence of guesswork resulting from a common misconception of what is meant by the period (or time for one complete swing) of a pendulum. Candidates needed to determine that the period was 4 s, therefore in 60 s there would be 15 periods completed, making **A** the correct response. The majority of candidates selected options **C** or **D**.

Question 29

Most candidates rejected options **A** and **B** but **C** proved to be a more popular response than the correct answer, option **D** which is the only response that shows a distance-time graph with a decreasing gradient.

Question 30

Many candidates were aware of the displacement technique used to determine the density of an irregularly shaped solid and chose the correct answer, option **B**.

Question 31

This question assessed the ability of candidates to recall and use the relationship, resultant force = mass $\times$ acceleration. Most candidates gave the correct answer, option **B**. A significant number of candidates incorrectly rearranged the equation and selected option **D**.

Question 32

Option **C**, although incorrect, proved popular with many candidates. The student had been asked to plot an extension-load graph and only option **D** meets the requirement of this question.

Question 33

As the ball moves upwards the gravitational potential energy store increases but the kinetic energy store decreases. Most candidates selected the correct answer, option **C**. Some candidates did choose option **B**, which is only correct as the ball falls back towards the ground.

Question 34

Most candidates were aware that fossil fuels are non-renewable and biofuels are renewable. However, there was a common misconception that biofuels do not produce carbon dioxide when burned. The correct answer, option **B**, was only slightly more popular than option **A**.

Question 35

Although the correct answer, option **C**, was the most commonly chosen, many candidates seemed unsure how electrical power is generated from wind or geothermal resources as options **B** and **D** were also popular options.

Question 36

There appeared to be a degree of guesswork with options **B**, **C** and **D** all proving to be popular choices. Marginally more candidates did recall that there is only one region of the electromagnetic spectrum lies between infrared and ultraviolet.

Question 37

Candidates found this item demanding and there was evidence of guesswork as all options were popular choices.

Question 38

It was evident that this question was frequently misread. The only incorrect statement here is **D**, making this the required response. The majority of candidates selected options **A** or **C**, statements which are true facts about electromagnetic radiation.

Question 39

There was evidence to suggest that candidates were unable to recall the relationship linking electric current, charge and time, and those that did omitted to convert the time into seconds. This resulted in an inevitable level of guesswork, and the correct response, option **D**, proved to be the least popular option.

Question 40

The costing of electrical energy and the kWh proved a difficult idea for candidates. Although **D** was commonly rejected, guesswork resulted in all other options being very popular with only a slight majority selecting the correct response, option **B**.

COMBINED SCIENCE

Paper 5129/12
Multiple Choice

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

General comments

Candidates performed very well on **Questions 2, 6, 7, 11, 27 and 33**. **Questions 1, 5, 9, 12, 15, 18, 19, 20, 21, 35, 36, 37, 38 and 40** proved the most challenging for candidates.

Comments on specific questions

Question 1

This question proved demanding. Many candidates did not appreciate the direction of water movement and could not link the correct direction to a reason why water moves in that direction.

Question 2

Most candidates knew that enzymes are made of protein and are not changed in a reaction.

Question 3

This question tested the ability to identify the different layers of the leaf. Most candidates were able to identify the cuticle, epidermis and the mesophyll layers.

Question 4

Many candidates knew that translocation is the flow of sucrose and amino acids inside the phloem. However, there were a significant number of candidates who thought that translocation is the movement of mineral ions in the xylem.

Question 5

This question proved demanding and only the strongest candidates could link the ethanol emulsion test with the breakdown of fats into fatty acids and glycerol.

Question 6

Many candidates knew that the function of the villi is to increase the internal surface area of the ileum. Some incorrectly thought that the function of the villi is to absorb proteins – proteins are broken down into amino acids before being absorbed.

Question 7

Most candidates knew that inspired air contains more oxygen compared to expired air.

Question 8

Many candidates did not know that aerobic respiration releases more energy than anaerobic respiration. Only the strongest candidates knew that the product was lactic acid.

Question 9

This question was not very well answered and there was an even spread of incorrect answers. The majority of candidates did not know the path of blood flow.

Question 10

This question was well answered and many knew that a hormone is the chemical substance produced by a gland that can alter the activity of a target organ.

Question 11

This question was well answered, with many of the candidates being able to identify the ovary from the diagram and link this to the structure that releases eggs.

Question 12

It is evident from the answers to this question that many candidates had misunderstandings in this area. Statements 3 and 4 are benefits of genetically modifying crop plants but they are not related to herbicides so are incorrect statements in this context.

Question 13

Most candidates knew which arrow indicated photosynthesis in the carbon cycle.

Question 14

The bunching and movement of particles in a gas was well understood by most candidates.

Question 15

A significant proportion of candidates thought that air is a compound rather than a mixture and chose option B. The differences between elements, compounds and mixture were not well understood.

Question 16

The fact that the atomic number of an atom indicates the number of protons in the nucleus of an atom and that there are an equal number of electrons in a neutral atom was not appreciated by many candidates.

Question 17

Most candidates were able to identify the dot-and-cross diagram of a molecule of oxygen difluoride.

Question 18

This question proved demanding even for the stronger candidates. Candidates are expected to be able to deduce the formula of a compound given the ions present in the compound.

Question 19

There was evidence of widespread guesswork. Candidates are expected to be able to use a chemical equation to calculate the mass of products in the reaction.

Question 20

Most candidates did not recognise that the reaction between aqueous sodium hydroxide and hydrochloric acid is an exothermic reaction.

Question 21

There was evidence of widespread guesswork even amongst the stronger candidates.

Question 22

Most candidates knew that a hydrogen ion causes an aqueous solution to be acidic but the fact that a hydroxide ion causes a solution to be alkaline was less well known.

Question 23

The trends shown by the elements in Group VII was not well understood by a large proportion of the candidates.

Question 24

The general properties of a metal were well known by the stronger candidates. A significant number of candidates thought that metals are not malleable and chose option **B**.

Question 25

There was evidence of guesswork even amongst the stronger candidates. The processes involved in the treatment of domestic water supplies were not well understood by many of the candidates.

Question 26

A majority of the stronger candidates recognised that the fractionating column is cooler at the top and chose option **D**.

Question 27

Most candidates identified the correct statement about alkenes.

Question 28

Most candidates identified the correct calculation, option **C**, for determining the time for one complete oscillation of the pendulum.

Question 29

Although option **C** proved a popular choice, most candidates had little difficulty in identifying the correct answer, option **B**, where the acceleration of the train is the highest.

Question 30

The fact that the weight of the astronaut in deep space would be 0 N was generally appreciated, and option **A** was the most commonly response.

Question 31

Most candidates seemed aware of the displacement technique used to determine the density of an irregularly shaped solid and chose the correct answer, option **B**.

Question 32

Candidates were required to determine from the graph that a load of 2.6 N results in an extension of 26 cm. The majority of candidates appeared to misread the question and selected option **A**, omitting to calculate 30 cm as the 'unstretched length' of the spring.

Question 33

The work done is the sum of E_P and E_K and although option **C** was popular, the most common response was the correct answer, option **D**.

Question 34

Most candidates appreciated that the 300 g mass needed to be closer to the pivot, or the 250 g mass moved further away from the pivot, and most selected the correct response, option **B**.

Question 35

Candidates needed to recall the relationship between electric current, charge and time, convert the time from hours to seconds and also consider the current stated in both mA and A. This proved difficult and there was evidence of guesswork. The most common choice was option **A**, rather than the correct answer, option **C**.

Question 36

There was clear evidence of guesswork although a slight majority did select the correct answer, option **B**. Most candidates believed that refraction took place at P and all other options, particularly **A** and **C** proved popular.

Question 37

All responses proved equally popular. The initial statement relates frequency of an electromagnetic wave to the danger (hazard of that wave). Candidates needed to recall which of each pair of waves given in the options had the higher frequency and then determine if that wave was described as the more hazardous of the pair.

Question 38

This item proved demanding. Candidates needed to recall that the phrase 'number of vibrations per unit time' is alternatively described as 'frequency'.

Question 39

Most candidates rejected options **A** and **D**. The correct response, option **C**, was most popular although a significant number of candidates selected option **B**, believing that like charges attract and unlike charges repel.

Question 40

Using the voltmeter and ammeter readings, candidates needed to calculate the combined resistance of R_1 and R_2 to be $20\ \Omega$. Option **C** proved to be a popular choice. A slight majority of candidates completed the calculation to determine the resistance of R_2 and selected the correct answer, option **A**.

COMBINED SCIENCE

Paper 5129/21 Theory

Key messages

Candidates who performed well:

- demonstrated knowledge and understanding in all three science disciplines with good recall of scientific terms and phrases
- used the command words e.g. state, describe, explain, calculate, to guide their answers
- recalled equations and showed the steps taken when making calculations
- interpreted diagrams and data by providing explanations as well as descriptions
- used data provided in the rubric to explain or justify conclusions.

General comments

This paper assesses a wide range of content from the separate science disciplines. The style of the questions was unchanged from previous series and therefore familiar to candidates who prepared for the exam using past papers and mark schemes. The paper is designed to give candidates access to the full range of grades and therefore some questions were highly accessible and others quite demanding. The questions required candidates to demonstrate skills of information handling and problem solving (AO2), alongside the greater focus on knowledge with understanding (AO1).

Comments on specific questions

Question 1

Most candidates correctly selected phrases to make sentences about veins. A common misconception was that veins always carry deoxygenated blood. The pulmonary vein carries oxygenated blood from the lungs to the heart.

Question 2

- (a) (b) Most candidates recalled that air contains 78% nitrogen and that the type of bonding in a nitrogen molecule is covalent.
- (c) (i) Most candidates correctly added the relative atomic masses of three calcium atoms and two nitrogen atoms to find the relative formula mass of Ca_3N_2
- (ii) Calcium nitride contains bonds between metal and non-metal. Weaker candidates tended not to recall the term 'ionic' for this type of bond.
- (iii) Many candidates were unclear about the term 'separation' when describing the particles in a liquid. Some candidates may not have appreciated that the reference to melted calcium nitride indicated that the compound was in liquid form. In liquids, the particles are not separated as they are touching. Particles in a liquid slide over each other and, as they are constrained by contact with surrounding particles, they cannot move around freely as do particles in a gas.

Question 3

- (a) (i) Stronger candidates recognised that the ball is released when the time is 0 and they can read the intercept of the line with the height axis to determine this answer. A common error was to record the maximum height of the ball.

- (ii) Many candidates did not correctly use the number of small squares between the scale markers. In this question, there were 5 small squares between 8.0 s and 10.0 s, so each small square was 0.4 s. The intercept was one small square below 10.0 s, giving 9.6 s.
- (b) Only the strongest candidates stated that this is because the line on the graph is curved. The graph is a distance-time graph so any difference in the distance travelled in each unit of time represents a change in speed.
- (c) Most candidates recalled and applied the equation to calculate speed. However, only the strongest candidates consistently converted their calculated values to 2 significant figures correctly.

Question 4

- (a) Nearly all candidates knew that inspired air has more oxygen and expired air has more carbon dioxide.
- (b)(i - iii) Most candidates correctly used the graph to determine the breathing rate during the period of time before exercise began, the duration of the exercise, and the change in breathing rate.
- (iv) Most candidates correctly extended the line of the graph to show a continued decrease in breathing rate, post exercise. However, a common error was to extend the line to zero.

Question 5

- (a) Only the strongest candidates correctly stated the names of the hydrocarbons represented by their structural formulas. A common error was to state alkene and alkane rather than ethene and propane.
- (b) Most candidates gained one mark for recognising that both compounds contain both hydrogen and carbon. Stronger candidates recalled the symbol for the carbon-carbon double bond shown in structure A.
- (c) Those candidates who had recognised the structure of ethene in 5(a) recalled that it could be used to make poly(ethene) or ethanol.
- (d) Candidates should know that a structural formula is a way of showing the arrangement of atoms in a molecule.

Question 6

- (a)(i), (ii) Candidates should know that friction is a force that opposes motion. A common error was to state that it is gravitational force that prevents the block sliding down the slope. The force preventing the block from sliding down the slope to the right is represented by an arrow pointing upwards to the left and parallel to the slope, that is, in the direction opposing the potential motion.
- (b) Candidates should know that an object begins to move, or changes speed, when the forces on it are unbalanced. In this question, the force due to the weight of the block down the slope is more than the force due to the friction between the block and slope in the opposite direction.
- (c)(i) Only the strongest candidates stated that energy is transferred from the gravitational store when the block slides down the slope.
- (ii) Most candidates recognised that energy has been transferred to the kinetic store due to the movement of the block. Candidates that understood the effect of friction also recognised that work opposing this motion results in a transfer of energy to the thermal store.

Question 7

Most candidates correctly selected words from the list to complete sentences in this question about human reproduction.

Question 8

- (a)–(d) Candidates selected from a list of chemical reactions to match the type of reaction described. Few candidates could identify the precipitation reaction or the complete combustion reaction. More candidates could identify the redox reaction.

Question 9

- (a) Only the strongest candidates could recall any of the steps involved in generating electrical power. Candidates should know that fuels are used to heat water, producing steam which is then used to spin a turbine connected to a generator. In this question candidates should also know that nuclear fuels release energy by the process of fission.
- (b) Only a very small number of candidates stated an advantage of using nuclear energy to generate electricity.

Question 10

- (a) This question was about the effects of releasing untreated sewage into freshwater ecosystems. Few candidates could recall any effect other than it causing the death of organisms. Candidates must learn that untreated sewage contains additional nutrients that may cause plants and algae to grow rapidly. Untreated sewage can also spread pathogens.
- (b) This question was about the effects of releasing non-native species into ecosystems. Very few candidates recalled how this affects food chains due to competition for food and other resources.

Question 11

- (a) A few candidates deduced the physical state of copper at 2000°C (liquid) but could not explain why. Candidates should use the information in the question. By comparing this data some candidates stated that 2000°C is above the melting point (so not solid) and below the boiling point (so not vapour).
- (b) Most candidates stated a use for copper (e.g. wiring) and a property (e.g. electrical conductor) that makes it useful for that use.

Question 12

- (a) Only the strongest candidates used ideas about convection to explain the movement of the smoke. The smoke falls into the box because it is denser than air. It rises out of the box when it is heated by the candle making it less dense than air.
- (b) A few candidates recalled the equation relating speed to frequency and wavelength. This equation required rearrangement and substitution of the data. Although many candidates made errors in powers-of-ten, most recorded their answer in standard form.

Question 13

Most candidates correctly selected numbers from the diagram of the human body to identify the locations of organs by their functions. The liver and the pancreas were the least well known.

Question 14

- (a) Candidates generally knew that zinc reacts with nitric acid to produce zinc nitrate. Common errors include zinc nitride and zinc hydroxide.
- (b) Most candidates knew that the hydrogen produced in the reaction can be confirmed by a popping sound made by a lighted splint.
- (c) Some candidates knew that the reaction rate can be increased by reducing the particle size/increasing the surface area. Very few candidates recalled that increased acid concentration also has this effect.

Question 15

- (a) Stronger candidates correctly recalled the equation relating charge, current and time.
- (b)(i) Very few candidates deduced that the wooden rod has resistance as a constant electrical property. Many candidates stated that wood does not conduct even though the question states that there is a current in the wood.
- (ii) Very few candidates gained this mark. Candidates should know that equations can be used qualitatively as well as quantitatively. Here, using $V = IR$, the resistor does not change so when the potential difference V decreases, the current I decreases.

Question 16

In this question, most candidates correctly connected plant structures with their functions.

COMBINED SCIENCE

Paper 5129/22 Theory

Key messages

Candidates who performed well:

- demonstrated knowledge and understanding in all three science disciplines with good recall of scientific terms and phrases
- used the command words e.g. state, describe, explain, calculate, to guide their answers
- recalled equations and showed the steps taken when making calculations
- interpreted diagrams and data by providing explanations as well as descriptions
- used data provided in the rubric to explain or justify conclusions.

General comments

This paper assesses a wide range of content from the separate science disciplines. The style of the questions was unchanged from previous series and therefore familiar to candidates who prepared for the exam using past papers and mark schemes. The paper is designed to give candidates access to the full range of grades and therefore some questions were highly accessible and others quite demanding. The questions required candidates to demonstrate skills of information handling and problem solving (AO2), alongside the greater focus on knowledge with understanding (AO1).

Comments on specific questions

Question 1

Most candidates selected at least one true statement about genes, chromosomes, gametes and cell division.

Question 2

- (a) Only the strongest candidates consistently recalled that air contains 21% oxygen.
- (b)(i) Only the strongest candidates correctly completed the calculation of the mass of oxygen that reacts with potassium. Here, 2 atoms of oxygen ($A_r = 16$) react with 4 atoms of potassium ($A_r = 39$). The 7.8 g of potassium represents 0.2 mole of potassium, meaning that 0.1 mole of oxygen is used to react with it. The molar mass of oxygen is 16, so the amount of oxygen used is 0.1×16 or 1.6 g
- (ii) Only the strongest candidates stated clearly that oxygen does not conduct electricity. Only a very small number knew that potassium oxide only conducts when it is molten.
- (iii) Candidates generally deduced that at the given temperature, potassium will be a vapour (gaseous state) but many did not refer to the information given about melting temperature and boiling temperature in their explanation. A simple description is that the given temperature is above the boiling point.

Question 3

- (a) Most candidates correctly used the given value $g = 10 \text{ N / kg}$ to calculate the weight in newtons of the 0.12 kg rocket.
- (b)(i) Only the strongest candidates recalled that g is also the acceleration of free fall with units 10 m / s^2 . A common error was to make a calculation using the height of 100 m given in the question.

Candidates should know how to apply the common command words such as state, describe, explain and calculate to avoid such errors.

- (ii) Most candidates recalled that gravitational force acts on an object in freefall, but very few candidates recalled that friction or air resistance also acts on a moving object.
- (iii) Only the strongest candidates recalled and used the relationship between speed, acceleration and time. In free fall at 10 m/s^2 the rocket will travel at 10 m/s after one second and 20 m/s after 2 s. A very common error was to divide the total height of 100 m by 2 s. There were two common misconceptions. Firstly, this would be the average speed, not the speed change. Secondly it assumes that the rocket takes 2 s to fall 100 m .

Question 4

- (a) Most candidates gained at least one mark for interpreting the graph to identify the oesophagus as the structure between the mouth and the stomach and the small intestine as the structure between the stomach and the colon.
- (b)(i)–(iii) Many candidates correctly interpreted the graph to state that proteins begin to be digested when they enter the stomach and that carbohydrates are mostly digested in the small intestine. Only the strongest candidates recalled that the acidity of the stomach reduces carbohydrate digestion. A common misconception was that the acid breaks down the carbohydrate.
- (c) This question refers to the ‘small nutrient molecules’. A very common misconception was that they form a stool and are egested. Candidates should know that the small molecules are absorbed through the wall of the small intestine and carried to the rest of the body in the blood stream.

Question 5

- (a)(i)–(iii) This question was about the cracking of icosane. Very few candidates made a correct sum of the number of carbon and hydrogen atoms in the products to balance the reaction. Only the strongest candidates recalled any of the conditions necessary for cracking and very few could state a use for hydrogen gas. Candidates should know that hydrogen is used in fuel cells.
- (b) In this question, ethane is compared with ethene. Few candidates recalled that they both contain bonds between hydrogen and carbon. Some candidates recalled that ethene has a double bond between carbon atoms.

Question 6

- (a) Many candidates correctly recalled the equation for density. Candidates demonstrated a secure understanding of significant figures.
- (b) Only the strongest candidates gained a mark for this question. Few could recall the equation $\text{work} = \text{force} \times \text{distance}$ in the direction of the force in order to describe the stone falling through water in a qualitative way. In this case, the weight of the stone moves in the direction of gravity. Candidates could also state that work is done against water resistance, which acts upwards.

Question 7

- (a) Only the strongest candidates correctly recalled the formulas for either the reactants or the products to complete the balanced chemical equation for photosynthesis.
- (b) Many candidates knew that chlorophyll absorbs light energy. However, very few gained the second mark for explaining that the light energy is stored as chemical energy.
- (c) This question was about the conversion of glucose to other forms of carbohydrate for different functions. Candidates should know that cellulose is used to build cell walls, that starch is how the plant stores energy and that sucrose is the form of carbohydrate that can be transported around the plant. A common misconception was that starch produces energy.

Question 8

- (a)–(e) Most candidates gained at least two marks for selecting letters of chemical equations showing different processes. Candidates were least likely to identify the equation showing physical change but most likely to identify the equation showing polymerisation.

Question 9

- (a) Only the strongest candidates recalled any of the processes to obtain useful energy from geothermal sources. Candidates should know that geothermal means heat energy from the Earth. This energy is used to heat water to produce steam that can then spin a turbine connected to a generator.
- (b) Many candidates knew that geothermal sources are renewable.

Question 10

Most candidates gained at least two marks for drawing lines between boxes in this question about the function of different components of blood. Candidates generally knew the function of platelets, but the difference between lymphocytes and phagocytes was less well known.

Question 11

- (a) (i) Many candidates drew a regular arrangement of the atoms in solid aluminium. A common error was to leave gaps between the atoms. Candidates should know that there are no gaps between particles in solids.
- (ii) Many candidates recalled that particles in solids only vibrate. A common error was to state that they do not move.
- (b) (i)–(ii) Most candidates recalled a use for aluminium and stated at least one other property of metals. The question refers to the electrical conductivity of aluminium. Many candidates repeated this property rather than stating one other property.

Question 12

- (a) (i) Candidates who recalled the equation $P = VI$ gained this mark. Most candidates divided the voltage by the current.
- (ii)–(iii) Many candidates used either Ohm's law or the sum of voltages in series to show how the voltage across the resistor is determined. Many candidates applied both strategies to show how the total resistance is determined.
- (b) Only the strongest candidates recalled that a fuse or trip switch can switch off a current when it becomes too large for a circuit.

Question 13

- (a) Many candidates identified a valve on the diagram of the heart. Stronger candidates identified the atrium or the ventricle. Very few candidates identified the septum.
- (b) Only the strongest candidates stated clearly that the valve (or labelled structure) opens or closes. Very few candidates recalled that the other structures contract during one heartbeat.

Question 14

- (a) Most candidates gained a mark for drawing a horizontal and vertical intercept with the curve. Many also correctly halved the counter reading, 100 counts/minute, at time = 0 to find the time when the reading is 50 counts/minute.

- (b) Candidates should know that radioactive sources have many uses in sterilisation, cancer treatment, tracers and carbon dating. There was a misconception that they are used to produce energy (that is the role of nuclear fuel). Any references to weaponry were ignored.
- (c) Only the strongest candidates recalled the safety precautions for handling radioactive sources. Any references to shielding that is not substantial, e.g. goggles, PPE and lab coats (that are not lead-lined) were ignored, as it is penetrated by gamma radiation. Candidates generally gained marks for knowing that sources must be handled using tongs. Very few candidates referred to reducing exposure time.

Question 15

- (a) (i) Many candidates recalled that the acid that produces a sulfate is sulfuric acid. Stronger candidates generally gained the second mark for recognising that the displaced carbonate forms carbon dioxide.
- (ii) Only the strongest candidates recalled that when a reactant is used in excess, the excess can be removed by filtering. Many candidates used the word equation in (a)(i) and the reference to 'dry sample' to refer to the water that is produced. However, most candidates did not clearly express how the water is removed. Candidates should know that the water evaporates when it is heated.
- (b) A few candidates recalled the conditions for rates of reaction (surface area, temperature and concentration) to suggest a suitable change to one of these variables that would result in a lower rate.

COMBINED SCIENCE

Paper 5129/31 Experimental Skills and Investigations

Key messages

'The language of measurement' on page 39 of the syllabus covers many of the key words whose understanding is tested in the alternative to practical paper. Centres are advised to ensure that candidates understand the different terms and definitions. They are not required to be able to recall the specific definitions but they may be required to use their knowledge in response to a specific question.

General comments

Marks for each part of a question are indicated. Candidates need to make sure that they have enough relevant points in their answer to gain all of the marks.

Comments on specific questions

Question 1

- (a) (i) This question required candidates to use values provided to complete the table to a suitable number of significant figures. The majority of candidates were able to complete the table and calculate the change in temperature. Some candidates did not use the correct figures. However, the majority were able to gain the mark for the change in temperature.
- (ii) Most candidates knew that a thermometer is used to measure the temperature. A few candidates wrote boiling tube.
- (iii) This question proved difficult for the majority of the candidates with only the more able candidates knowing that the starting mass of the food would be needed to determine the change of the water per gram of food. There were a range of incorrect answers; some candidates quoted the units that the temperature would be measured in while others described the size of the particles in the food.
- (iv) This question asked candidates why the procedure was repeated at least two more times for each food. Many of the candidates knew that repeating the experiment would enable anomalies to be identified and would therefore show whether the investigation was repeatable.
- (b) (i) Candidates found this question challenging. They needed to look at the arrangement of the apparatus in Figure 1.1 and to think about how this arrangement led to recorded temperatures being lower than expected. More able candidates understood that not all of the energy from the food was transferred to the boiling tube. Only a few candidates appreciated that the combustion of the food was incomplete.
- (ii) Candidates were told in the question to suggest an improvement other than repeating the investigation. However, some candidates still suggested repeating the investigation and calculating a mean. Some candidates suggested using a more accurate or a different thermometer. This question also required candidates to consider the arrangement of the apparatus and more able candidates were able to suggest a reasonable method of reducing heat loss.
- (c) Many candidates knew that Biuret reagent is the test for protein. Candidates who did not score the first mark usually wrote Benedict's reagent.

Question 2

- (a) Many candidates were able to identify the filter paper from the diagram. Some candidates thought that the label was pointing to the filter funnel itself and did not gain this mark.
- (b) Only the most able candidates appreciated that the white solid was soluble and therefore was not present in the residue. Many candidates did not appreciate what residue meant and therefore wrote about the white solid being present in the filter paper.
- (c) Candidates were tested on their ability to match the colour of the universal indicator with the pH given. Some candidates simply wrote that the universal indicator paper would change colour, however, a more detailed response was required as the question had been specific in telling the candidates that the pH was 2.
- (d) At the end of this paper there are two pages of notes for use in qualitative analysis. Candidates could use these notes to work out which ions were present in the solution.
- (e) (i) Most candidates found this question demanding. Only a few of them knew that there would be bubbles produced in a solution where a gas was being released.
- (ii) Candidates were told that the residue was copper carbonate and then given another test from the notes for use in qualitative analysis. It is important that candidates know how to use these notes.
- (f) This question proved demanding for many candidates. Those candidates who knew the test for carbon dioxide usually scored both marks.

Question 3

- (a) (i) This question was very poorly answered by candidates who appeared not to understand the question. Centres are advised to look at page 37 of the current syllabus which states take readings with appropriate precision, reading to the nearest half-scale division where required.
- (ii) The instructions given to the candidates was to draw a straight line from the centre of the ball and to measure its height. Many of the candidates drew a line at an angle and did not gain the marks.
- (iii) Many candidates were able to suggest a way to improve the apparatus to obtain a more accurate result.
- (b) (i) Candidates were instructed to calculate an average time from the two stopwatches given. Many candidates were able to read the two stopwatches and calculate an average.
- (ii) Candidates who gained this mark appreciated that the result from **3 (b) (i)** was needed to calculate this value.
- (c) (i) When drawing graphs, candidates should:
- label the axes fully with both a quantity and the specific unit
 - use a sensible scale correct to $\pm$ half a small square
 - plot neat points to cover at least half of the grid
 - draw a single line of best fit.
- Most candidates attempted to draw the graph. In this example, the axes were labelled for the candidates. Many candidates used a sensible scale and were able to plot the points correctly. However, many of the best-fit curves did not gain the final mark.
- (ii) Most candidates were able to describe the relationship shown by the results.

Question 4

The planning question always includes a set of bullet points which candidates need to address as part of their answer. Candidates needed to address at least one point from each section and then any three others in order to gain full credit. Stronger responses came from candidates who addressed the bullet points individually. Many candidates gained at least one mark from the apparatus and the method section of the

plan. Also, many candidates knew that five different temperatures were needed to test the statement and that each temperature needed to be tested three times. Only a few candidates were able to gain all of the marks as many of the candidates did not fully understand how to use the results to draw a conclusion.

COMBINED SCIENCE

Paper 5129/32 Experimental Skills and Investigations

Key messages

'The language of measurement' on page 39 of the syllabus covers many of the key words whose understanding is tested in the alternative to practical paper. Centres are advised to ensure that candidates understand the different terms and definitions. They are not required to be able to recall the specific definitions but they may be required to use their knowledge in response to a specific question.

General comments

Marks for each part of a question are indicated. Candidates need to make sure that they have enough relevant points in their answer to gain all the marks.

Comments on specific questions

Question 1

- (a) (i) Most candidates knew that a measuring cylinder was needed to measure the volume.
- (ii) In this question candidates were asked to name two variables that needed to be kept constant in the investigation. Many candidates were able to name one variable that needed to be kept constant such as the volume of the lipase. A common incorrect answer was repeating the procedure.
- (b) (i) Candidates were asked to use the results to complete the table of the results. There was one mark for correct temperatures and times recorded in any order and one mark for the correct units. Many candidates gained the mark for completing the table but many wrote secs for the unit of time and did not gain the second mark.
- (ii) Many were able to use the results given to predict the temperature at which the lipase worked best.
- (iii) Many candidates did not appreciate that an accurate measurement could be achieved by using smaller intervals of temperature with temperatures either side of the predicted value in **1 (b) (ii)**.
- (c) Many candidates knew that Biuret reagent is the test for protein. Candidates who did not score the first mark usually wrote Benedict's reagent.

Question 2

- (a) Most candidates knew that the apparatus was a condenser.
- (b) Candidates were asked to identify the error in the apparatus. The more able candidates were able to place a ring around the top of the flask. They knew that without a bung that gas could escape.
- (c) (i) Most candidates were able to measure both the initial and final temperatures.
- (ii) This was another very well-answered question.
- (iii) Many candidates did not appreciate that the boiling point was the final temperature reached in the apparatus. Many candidates wrote 100°C.

- (d)(i) At the end of this paper there are two pages of notes for use in qualitative analysis. Candidates could use these notes to work out which ions were present in the solution.
- (ii) This question proved demanding to the candidates who had not appreciated that the universal indicator paper turned purple/violet indicating a pH value of 14.
- (iii) Candidates found this question very demanding. Candidates had not linked the pH value of 14 to the OH^- ion.
- (iv) This question also required candidates to use the qualitative analysis notes. It is important that candidates know how to use these notes.

Question 3

- (a) Many candidates knew that the apparatus was a clamp and it is used to hold the stand in place.
- (b) Candidates were asked to determine the extension from their calculated values. Few candidates knew how to answer this question from their results.
- (c) When drawing graphs, candidates should:
- label the axes fully with both a quantity and the specific unit
 - use a sensible scale correct to $\pm$ half a small square
 - plot neat points to cover at least half of the grid
 - draw a single line of best fit.

Most candidates attempted to draw the graph. In this example, the axes were labelled for the candidates. Many of the candidates used a sensible scale and were able to plot the points correctly. However, many of the best-fit curves did not gain the final mark.

- (d)(i) This question proved demanding for candidates who did not appreciate that the arrangement minimised parallax error.
- (ii) Most candidates were not able to name another possible source of error. Only the most able knew that errors could include difficulty in releasing the load and starting the stopwatch at the same time or difficulty in observing stopwatch and scale reading simultaneously.
- (iii) The usual correct response was repeat and calculate an average. Many candidates did not include calculating an average and did not gain this mark.

Question 4

The prompt information presented is to give candidates the general idea as to what points the candidates need to address 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. There were four different pieces of apparatus that candidates could use in their method. Many candidates suggested the use of a thermometer and balance, gaining at least one mark. Some candidates knew that the volume of water needed to be kept constant. More able candidates knew that five different masses of ammonium nitrate should be used to give a range of values and that repeats for each mass would enable a reliable mean to be calculated. Only the most able candidates suggested calculating a change in temperature for each mass and using that to test the prediction.