COMBINED SCIENCE

Paper 5129/11
Multiple Choice

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

General comments

Candidates performed very well on **Questions 2**, **3**, **6**, **18**, **29**.

Questions 7, **8**, **11**, **17**, **20**, **31**, **33**, **37**, **39** and **40** proved the most challenging.

Comments on specific questions

Question 1

Many candidates knew that the liver is involved in the breakdown of excess amino acids and glycogen storage. Many candidates thought that the liver is involved in the excretion of urea rather than its production.

Question 2

This was a straightforward question with most candidates selecting the correct response, absorption.

Question 3

This was another straightforward question with most candidates selecting the correct response, which was photosynthesis as the process which produces oxygen.

Question 4

Many candidates knew that carbon dioxide and water are needed for a plant to make carbohydrates.

Candidates who did not score this mark tended to select glucose and carbon dioxide as they had confused respiration with photosynthesis.

Question 5

Many candidates knew that bacteria are used in biotechnology because they produce complex molecules and there are no ethical concerns in using them.

Question 6

This question was accessible to most of the candidates who knew which statements were true for the process of osmosis.

Question 7

This question proved challenging to the candidates, with all options being chosen. Many candidates incorrectly thought that gas exchange occurs across the cuticle of the leaf. The candidates who appreciated that gas transport into and out of the leaf occurs through the stomata and involves the air spaces gained this mark.

Question 8

This question proved challenging to the candidates with all options being chosen. Many candidates knew that the veins contain valves, however an understanding of the thickness of the walls proved difficult for many.

Question 9

Candidates were asked to decide which cell had the highest rate of diffusion. Many appreciated the difference in the concentration of oxygen molecules inside and outside of the cell and were able to deduce the cell with the highest rate of diffusion.

Question 10

Almost all candidates were able to identify the stage of the carbon cycle where bacteria are directly involved.

Question 11

This question proved challenging for many of the candidates. Few candidates knew that the blood from the lungs moved directly into the left atrium.

Question 12

Some candidates knew that anaerobic respiration produced lactic acid and a small amount of energy.

Question 13

Many of the candidates knew that the palisade mesophyll cell would contain chloroplasts and that these would not be found in cheek cells.

Question 14

Most candidates recognised that the particles gain kinetic energy, but a large proportion of these candidates thought that the particles fill all the available space and chose option **B**.

Question 15

Ideas about solutions were well understood by the candidates.

Question 16

Most candidates knew that the atomic number of an element represents the number of protons in the nucleus. However, there was some confusion between neutrons and nucleons.

Question 17

There was evidence of guesswork amongst the candidates. A significant number of candidates thought that covalent bonding involved the transfer of electrons from one atom to another.

Question 18

This proved to be an easy question for the stronger candidates.

Question 19

Ideas about exothermic and endothermic reactions were not well understood by many of the candidates.

Question 20

There was evidence of guesswork amongst the strongest candidates. Candidates are expected to recognise that the apparatus could be used to study a reaction that involves the loss of a gas.

Question 21

The properties of an alkali were well known by the stronger candidates.

Question 22

The trends shown by the elements from left to right across the Periodic Table were well understood by a majority of the candidates.

Question 23

The tests for cations were not well known by a large proportion of the candidates.

Question 24

The vast majority of the candidates were able to deduce the order of reactivity.

Question 25

The composition of a sample of clean air was not well understood. A large proportion of candidates thought that the volume of other gases in the sample was either 8% or 6% and chose options **C** and **D**.

Question 26

A large proportion of candidates thought that chlorine is used to remove impurities from drinking water.

Question 27

The trends in the properties of the fractions obtained from the fractional distillation of petroleum were well known by the stronger candidates.

Question 28

Most candidates selected either option **A** or the correct answer, option **B**. More candidates selected option **A**. Option **A** states, ‘doubling the force **and** halving the mass of the object’. Candidates may have interpreted this as ‘doubling the force **or** halving the mass of the object’.

Question 29

The uses of electromagnetic radiation were well known.

Question 30

Many candidates knew that charge is the quantity which is measured in coulombs. Option **D**, potential difference, was the incorrect response most commonly selected.

Question 31

There was evidence of guesswork in this question. All options were popular choices.

Question 32

The ability to recall and use the equation for density was well demonstrated.

Question 33

This item proved to be demanding. The question assessed an understanding of the term 'angle of incidence'. Many candidates believed that the angle of incidence is the angle between the incident ray and the mirror surface selecting the incorrect option **D**.

Question 34

Most candidates were aware that the two spheres were carrying the same sign of charge but there was some uncertainty of the reason behind the effect of introducing the positively charged strip. Consequently, some candidates selected option **A** rather than the correct answer, option **D**.

Question 35

Most candidates appreciated that the calculation for resistance involved a ratio and rejected options **B** and **C.** The incorrect ratio in option **A** was selected by a significant number of candidates.

Question 36

Most candidates knew that the length would increase but a significant number thought that the diameter would also increase and selected the incorrect option **D**.

Question 37

This question highlighted the need for candidates to read questions carefully. The question asked for the angle between the ray of light in glass and the surface of the glass. The correct response is option **C,** but more candidates selected option **B**. This range would be more appropriate for the angle of refraction.

Question 38

The level of impact of these energy resources on the environment was well known. The most commonly selected incorrect response was option **C.**

Question 39

Although most candidates rejected option **C**, there was evidence of guesswork in this question.

Question 40

Most candidates were aware that elements can have more than one isotope.

COMBINED SCIENCE

Paper 5129/12
Multiple Choice

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

General comments

Candidates performed very well on **Question 4**, **5**, **28** and **38**. **Question 2**, **6**, **8**, **10**, **18**, **19**, **24**, **25**, **30**, **31**, **32**, **36** and **37** proved the most challenging for candidates.

Comments on specific questions

Question 1

Many of the candidates knew that the palisade mesophyll cells would have chloroplasts and that these would be absent in root hair cells.

Question 2

This question proved challenging to many of the candidates. Many candidates knew that the water would move from a higher water potential to a lower water potential. Fewer candidates knew that the cell would become flaccid rather than turgid.

Question 3

This question required knowledge of both photosynthesis and respiration. Only the strongest candidates knew that carbon dioxide diffuses out of the leaves during the night and oxygen diffuses out during the day.

Question 4

Many candidates knew that water is delivered to the leaves by the xylem for the process of photosynthesis.

Question 5

Many of the candidates knew that the two processes occurring in the mouth were physical digestion and chemical digestion by amylase.

Question 6

This question proved challenging to the candidates, with all four options being chosen. The strongest candidates knew that amino acids are broken down in the liver.

Question 7

Many candidates knew the difference in the concentration of both oxygen and carbon dioxide in both inspired and expired air.

Question 8

This question proved challenging. Some candidates thought that anaerobic respiration produced both lactic acid and carbon dioxide. The strongest candidates knew that anaerobic respiration produced lactic acid only.

Question 9

Most candidates knew that increasing salt in the diet increases the risk of coronary heart disease.

Question 10

This question required candidates to know that a simple reflex action does not involve the brain. Only the strongest correctly identified the components of the simple reflex.

Question 11

Many candidates did not appreciate that sperm has to move to the egg and therefore did not score this mark.

Question 12

This question required candidates to know that meiosis halves the chromosome number and therefore the number of chromosomes in the cell would decrease by the end of the process.

Question 13

Most candidates knew the effects of deforestation.

Question 14

The arrangement of the particles in a gas was well known by most candidates.

Question 15

The relative masses and relative charges of electrons, neutrons and protons was well known although there was evidence of guesswork amongst the weaker candidates.

Question 16

The properties of ionic compounds are well known by a majority of the candidates.

Question 17

Most candidates were able to translate the structural formula into a dot-and-cross diagram of the compound.

Question 18

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

Question 19

There was evidence of guesswork particularly amongst the weaker candidates. Candidates are expected to be able to use the stoichiometry of an equation to calculate the amounts of reactants or products.

Question 20

The concept of catalysis was not well understood by most candidates.

Question 21

Many candidates understand that when a substance loses oxygen in a chemical reaction it is reduced.

Question 22

The colour of universal indicator in an alkaline solution was well known by most candidates.

Question 23

The arrangement of the elements in the Periodic Table was understood by many of the candidates.

Question 24

There was evidence of guesswork particularly amongst the weaker candidates.

Question 25

There was evidence of guesswork even amongst the strongest candidates.

Question 26

A majority of the candidates were able to recognise the structural formula of methane as the main component in natural gas.

Question 27

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

Question 28

The units for speed and acceleration were well known.

Question 29

Many candidates were able to calculate the mass of the astronaut on the Moon. There was some evidence of confusion between mass and weight as a significant number of candidates calculated the weight of the astronaut and selected the incorrect option, **C**.

Question 30

The majority of candidates did not appreciate that the total mass being pulled across the surface was 4.0 kg and selected option **C** or option **D** rather than the correct option, **B**.

Question 31

Most candidates appreciated that the weight of the two objects, P and Q, must be the same for the beam to be balanced. More candidates selected option **B** rather than the correct option, **C**, giving further evidence of a confusion between the two quantities mass and weight.

Question 32

There was evidence of guesswork in this question. Most candidates selected option **C** rather than the correct option, **D**.

Question 33

The fact that waves transfer energy was well known and most candidates selected the correct option, **B**. A significant number of candidates thought that waves also transfer matter and selected option **A**.

Question 34

There was evidence of guesswork in this question. All options were popular choices.

Question 35

Most candidates were able to determine the angle of reflection from the second mirror.

Question 36

Many candidates were unable to recall the speed of electromagnetic waves in a vacuum or focused on the unit of the value given rather than considering the unit and the value given. The most popular option selected was **B** instead of the correct option, **D**.

Question 37

The fact that there was evidence of guesswork in this question suggests that the property of a thermistor or its circuit symbol was not well known.

Question 38

Most candidates were able to determine the reading on a voltmeter that is connected across four cells in series.

Question 39

Most candidates were able to calculate the quantity of energy transferred in kilojoules and in kilowatt-hours. All three incorrect options were equally popular.

Question 40

The majority of candidates knew that the radioactive source needed to have a long half-life and most selected the correct option, **A**.

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

(a) Candidates selected words from a list to complete sentences about transpiration. There was some confusion between evaporation and diffusion.

(b) Candidates interpreted a graph to compare rates of transpiration in two plant species at different temperatures. Candidates usually gained the marks for selecting data from the graph. Some candidates did not use the phrases ‘more than’ or ‘less than’ when making their comparisons.

Question 2

(a) Almost all candidates correctly interpreted the trend in the melting points of Group I elements to predict the melting point of potassium.

(b) Many candidates find stoichiometric calculations demanding. Here, the mass of potassium is 1/10th of the molar mass. The equation shows a 1 : 1 reaction between water and potassium so 1/0th of the molar mass of water is required, or 1.8 g.

(c) Many candidates attempted to name the salt formed in the reaction rather than the gas produced. Candidates should learn that in the reaction between Group I metals and water, hydrogen gas is released.

(d) Only a few candidates recalled that aluminium has a strong oxide surface layer making it unreactive with water.

Question 3

(a) (i) Some candidates did not refer to either distance or time when trying to define speed. Candidates who performed well clearly recalled the equation and described it qualitatively as the distance travelled per unit time.

(ii) Most candidates recalled the correct equation for speed. Some candidates did not convert minutes into seconds correctly and others did not record their calculation to two significant figures.

(b) Candidates were required to interpret different stages of a speed-time graph. Candidates who performed well referred to the *y*-axis label 'speed' in their answers. Candidates usually gained the mark for recognising acceleration in the middle part of the graph.

Question 4

Candidates drew lines between boxes to make correct sentences about enzymes in the human body. A common misconception was that enzymes are denatured at 37 °C. However, this is the optimum temperature for enzyme action in the body.

Question 5

(a) Candidates needed to understand the chemical equation and recognise from the state symbols that a solid compound is shown in the products. A few candidates gained this mark, but some referred to one product being solid and the other being liquid. This is a correct reading of the state symbols but it does not explain which product is the precipitate.

(b) (i) Many candidates did not recall that a solid can be separated from a reaction mixture by filtering. Some candidates suggested separation by evaporation but this only removes water and leaves the silver bromide mixed with the sodium nitrate.

(ii) Candidates needed to refer back to the chemical equation and recognise that aqueous sodium nitrate may be on the surface of the crystals of silver bromide so, to purify them, they must be washed in distilled water and then dried, e.g. slowly in air or by patting them between pieces of filter paper.

(c) Some candidates correctly converted between units to determine the concentration of silver nitrate in distilled water. In this question, they first needed to determine that 200 cm^3 is one-fifth of 1 dm^3. So, 5 times more solute is needed for the same concentration at 1 dm^3.

(d) Most candidates correctly predicted the chemical formula of silver chloride.

Question 6

(a) Most candidates gained this mark by finding the difference between the horizontal forces and deducing the direction of movement.

(b) (i) Candidates needed to recall the equation relating force, mass and acceleration. Rearrangement was also necessary to calculate the acceleration using the mass and force values given. Most candidates gained these two marks.

(ii) Most candidates recognised from the term 'elastic' in the stem of the question, that the rubber block would stretch when it is pulled by the force and that this would also change its shape. Some candidates also referred to the increase in heat due to friction between the block and the surface it moves on.

Question 7

In this question, candidates drew lines between boxes to match the names of specialised cells with their functions. This type of question often reveals misconceptions. In this question: phagocytes engulf pathogens, not lymphocytes; motor neurones pass nerve impulses to muscles, not relay neurones.

Question 8

In this question, candidates completed sentences about petroleum. Candidates referred to its separation into fractions by distillation, although a common misconception was cracking. Most candidates knew that refinery gas is used for cooking. Some candidates knew or could deduce that the combustion of this hydrocarbon produces carbon dioxide. Many candidates were uncertain about how to compare the flammability of refinery gas with kerosene.

Question 9

(a) Only the strongest candidates could explain that the steel rod, used as a lever, reduces the force needed to lift the heavy block.

(b) Most candidates gained a mark for recalling the equation for work done and substituted values for force and distance into this equation. However, the value for distance was in standard notation and needed to be converted to 0.02 metres.

Question 10

(a) A common error was to mark the position of sperm deposition in the uterus rather than near the entrance to the cervix.

(b) Many candidates indicated that the labelled structure was the uterus. This was not sufficient. The label line was on the uterus lining – the structure that breaks down and discharges in menstruation.

(c) Most candidates gained a mark on this question, usually for naming the oviduct. A common error was to name the ovary as an ovum. Most candidates were not clear about the function of the uterus wall. Some candidates knew that the muscles contract during birth. Similarly, there were few correct answers about the function of the cervix, although some knew that it dilates during birth.

Question 11

(a) (i) Most candidates correctly determined the group and period of the atom shown in the diagram.

(ii) Most candidates knew that electrons are lost when a positive ion is formed. Some candidates also recognised that an ion with a +2 charge has lost 2 electrons.

(b) Only the strongest candidates recalled that a positive ion is also called a cation.

Question 12

(a) Some candidates recalled that natural gas is a store of chemical energy. A common error was to give another name for natural gas, methane, or some other petroleum fraction. A commonly seen wrong answer was that the energy store is kinetic.

(b) (i) Candidates who performed well on this question understood that the diameter of the hot tube will have expanded when heated allowing the cold shaft to go inside. The diameter of the hot tube will then contract as the hot tube cools. This scenario is an application of thermal expansion.

(ii) Some of the strongest candidates referred to the black surface of the tube as a good absorber. However, in this situation, the tube needs to lose heat quickly to bond with the shaft. The relevant property is that the black surface is a good radiator of heat. Candidates needed to mention this. property.

Question 13

(a) Most candidates knew that decomposers are involved in break down or decay. However, only stronger candidates referred to organic matter or dead organisms to obtain the mark. Weaker candidates often referred vaguely to waste. Candidates should also be aware that improved soil fertility is a consequence of decomposition rather than a central function (or role).

(b) Candidates needed to identify and explain two consequences of deforestation. Weaker candidates often gained one mark for identifying habitat loss or soil erosion but were unlikely to explain why these were consequences of deforestation.

(c) Most candidates identified one other human activity that harms ecosystems.

Question 14

(a) In this question, candidates needed to work backwards from the products of a chemical reaction to deduce the reactants. Candidates generally recognised that a metal nitrate is produced in a reaction with nitric acid. The production of water requires the presence of oxygen in the reactants, but few candidates deduced lithium oxide from this information.

(b) Candidates generally understood that an exothermic reaction involves a transfer of energy, but many candidates did not refer either to heat or thermal energy.

(c) Only a few candidates explained that the products of the reaction could not return to their original form as these products were new substances and hence not a physical change.

Question 15

(a) Almost all candidates were awarded both marks for connecting the wave terms to their definitions.

(b) (i) Very few candidates could recall the general properties of waves used to compare radio waves and microwaves. Some candidates knew that they are both transverse and they have the same speed in a vacuum.

(ii) A few candidates were able to suggest a difference based on applications e.g. microwaves are used in cooking, but radio waves are not. Some candidates recalled the order of the electromagnetic spectrum to suggest that radio waves have longer wavelengths. A common error was that radio waves are for communication and microwave are not (mobile phones use microwaves).

(c) Candidates needed to convert 90 km to 90 000 m then recall and rearrange the equation speed = distance / time. Only a few candidates understood the time unit of μs.

Question 16

(a) (i) In this question, candidates interpreted a chromatogram of five substances. Most candidates recognised that impure substances have more than one spot.

(ii) Most candidates identified the insoluble substance that remained on the baseline.

(b) (i) Most candidates knew that nitrogen makes up 78% of clean, dry air.

(ii) Candidates found it difficult to explain why carbon dioxide is a gas at room temperature and pressure. Room temperature is much higher than the boiling point of carbon dioxide and the forces between the carbon dioxide molecules are weak.

(iii) This was also a demanding question for candidates, although some stated correctly that higher pressure would force the carbon dioxide molecules closer together, i.e. condense.

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) (i) Many candidates could place an 'X' on a diagram of the human digestive system to locate structures (the mouth and the stomach) where physical digestion takes place.

(ii) Most candidates correctly named the three parts of the digestive system on the diagram.

(b) In this question, candidates selected words from a list to complete sentences about the chemical break down of food molecules by different enzymes. Most candidates deduced correctly that fats are broken down into fatty acids but only stronger candidates were secure in their knowledge of enzymes.

Question 2

(a) Candidates interpreted a table of data showing a trend in the density of Group VII elements. Many weaker candidates were not able to suggest a value for fluorine that was more than zero but less than $0.003\,g/cm^3$.

(b) Some candidates recognised that bromine displaces iodide in this reaction, with the element iodine as a product. There were many errors in the products due to the introduction of elements that were not present in the reactants, for example sodium chloride, hydrogen and water.

(c) Candidates needed to use the Periodic Table provided in the exam paper and recognise that chlorine is above bromine in Group VII and so there will be no reaction. Only a few candidates could explain this.

Question 3

(a) Almost all candidates identified the swimmer with the lowest time as swimming fastest.

(b) (i) Most candidates calculated the distance correctly. Some candidates misunderstood the question and tried to find the distance using the speed equation.

(ii) Candidates needed to refer to the table to determine the total time taken by the team and many did this successfully. There were some simple arithmetic errors, and many answers were not converted to two significant figures.

Question 4

(a) (i) Most candidates knew that tar in cigarette smoke increases the risk of lung cancer. A common error was carbon monoxide. Some candidates also stated tobacco and these candidates possibly had a misconception about the phrase 'component of cigarette smoke'

(ii) Other harmful conditions are listed in the syllabus. Damaged or yellowing teeth – stated by many candidates is not listed. A common error was to state heart attack rather than heart disease.

(b) Most candidates correctly determined the percentage risk from the line graph.

(c) Most candidates gained at least one mark for selecting a correct conclusion about the graph.

Question 5

(a) (i) State symbols are (s), (l), (g) and (aq). By convention, the symbol includes the brackets.

(ii) Only the strongest candidates knew the names of two chemicals used to test for sulfate ions.

(b) Most candidates correctly added the relative atomic masses of sodium, sulfur and oxygen in the required proportions to find the relative formula mass of Na_2SO_4.

(c) Some candidates knew that sulfuric acid contains sulfate ions but there was a lot of confusion, such as sodium, sodium acid and sodium sulfate. These candidates seemed to be referencing the previous question.

Question 6

(a) Most candidates calculated the weight of the Mars Rover. A common error was to recall the equation incorrectly and divide the mass by the gravitation field strength rather than multiply.

(b) (i) Candidates needed to use the same equation applied in **6(a)** in a rearranged form to determine the gravitational field strength on Mars. Many candidates tried to use Earth's gravitational field strength in their calculations resulting in power-of-ten errors.

(ii) Only a few candidates were able to define gravitational field strength. The unit for gravitational field strength is given in the stem of **3(a),** and the unit can be used to help recall an acceptable definition. Here, N is the unit of force, / means 'per' and kg is a unit of mass. Hence, force per unit mass.

Question 7

In this question, candidates drew three lines between boxes to make correct sentences about aerobic respiration. These types of question often reveal misconceptions. In this question, the incorrect alternatives all related to anaerobic respiration.

Question 8

In this question, candidates needed to insert words or phrases in sentences about petroleum. Most candidates knew that the bitumen fraction is used in making roads. However, few candidates could describe petroleum as a mixture of hydrocarbons or that the incomplete combustion of a hydrocarbon releases

particulate matter which increases the risk of cancer. Some candidates occasionally gained a mark for knowing that kerosene is less viscous than bitumen.

Question 9

(a) Most candidate know that the drill bit gets hot due to friction with the block of wood.

(b) (i) Very few candidates could recall the names of relevant energy stores. Here, the drill is powered by a battery which stores chemical energy. Additionally, the drill moves downwards as it goes deeper into the hole, decreasing its gravitational energy. A common misconception was that kinetic energy decreases. However, there is no information about the speed of the drill.

(ii) Very few candidates could recall that in almost all situations where energy is transferred, one of the stores that increases is the thermal store since heat is often lost to the surroundings.

(iii) This was a demanding question. Candidates needed to recall the equation that links power, voltage and current ($P = VI$), but very few could do this. Candidates also needed to rearrange the equation in terms of current and also convert the power from 1.2 kJ to 1200 J. Some candidates gained a mark for recalling the equation, some for converting the power.

Question 10

(a) Some candidates knew that plants obtain carbon dioxide from the atmosphere and that the carbon dioxide enters through the stomata. Only stronger candidates gained both marks.

(b) Very few candidates gave transpiration as the process that moves water up the stem of a plant.

(c) Some candidates could recall that chlorophyll absorbs light energy in photosynthesis. A few candidates also recalled that glucose is a product of this reaction.

Question 11

(a) In this question, candidates needed to describe the electronic configuration of an atom. A common error was to identify the name of the element (aluminium) only. Another common error was to identify the element gallium, forgetting that hydrogen is in Period 1.

(b) Some candidates recognised that the electronic configuration of nitrogen changes from 2,5 to 2,8 and gained a mark. Only stronger candidates gained both marks for understanding that nitrogen gains three electrons when it forms this ion.

(c) Very few candidates could recall the name for a negative ion (anion).

Question 12

(a) Candidates needed to complete the diagram to show a reasonable angle of reflection from the surface and then use the information in the stem of the question ‘back towards the car’ to determine the refraction angle which produces a parallel ray to the incident ray. A common error was to draw the ray refracting through the reflecting surface indicating that many candidates confuse the terms reflection and refraction.

(b) Only a few candidates recalled that waves are oscillations that transfer energy to complete the sentence about transverse waves such as light.

(c) Some candidates gave clear examples from the syllabus of what visible light is used for.

Question 13

In this question, candidates needed to draw lines between boxes to link structures involved in human reproduction with their function. There were two common misconceptions: that sperm are deposited in the uterus rather than the vagina and that the vagina, rather than the uterus, contracts to push the baby out during birth.

Question 14

(a) (i) Most candidates could identify the solute in the solution formed by ammonium nitrate and water. Common errors were ammonia and nitrate as well as water (the solvent).

(ii) Most candidates knew that endothermic reactions cause a decrease in the temperature during the reaction.

(iii) Concentration calculations often involve a change in unit from cm^3 to dm^3 and then either a scaling up or a scaling down of the mass of the solid that is dissolved in the solution. In this question, 100 cm^3 of water is one-tenth of 1 dm^3. So, ten times the mass of solid (1.5 g → 15 g) will dissolve in the larger volume. Few candidates used this method.

(iv) Most candidates knew that yellow indicates the solution is acidic and most knew that this type of question requires a numerical value to be suggested.

(b) (i) Candidates needed to recall the molecular formula of ammonia, NH_3. The responses of many candidates indicated that the term 'molecular formula' was not understood. A common misconception was to give the general formula of alkanes or alkenes.

(ii) Only a few candidates could explain that ammonia has a low boiling point because the attraction forces between the molecules are weak.

Question 15

A few candidates knew that a body of water behind a dam stores gravitational potential energy or stated that it is hydroelectric. Very few candidates recalled the name of the rotating machine (turbine) or the connected machine that produces the electricity (generator).

Question 16

(a) Most candidates could identify the technique shown in the diagram as chromatography.

(b) Most candidates interpreted the chromatogram to deduce the two pure substances.

(c) Only a few candidates could explain why substance **E** did not move away from the baseline. Chromatography works when the solid 'spot' dissolves in the solvent and different parts of the solid mixture are carried at different speeds with the solvent. Substance **E** does not move because it is not soluble.

Question 17

(a) Only a few candidates recalled the name of the instrument used to detect and measure nuclear radiation (Geiger counter).

(b) Most candidates observed that the count-rate decreased each day but few gained more than one mark in this describe and explain question. Candidates were prompted to describe changes in the nucleus in their answer but only a few candidates attempted to do this. Candidates needed to explain radioactivity in terms of unstable nuclei emitting radiation (alpha, beta or gamma) as they break down into more stable forms.

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 practical paper. Centres would be advised to ensure that the candidates understand the different terms and definitions. Candidates are not required to recall the specific definitions of the terms, however, they may be required to use their knowledge in response to a specific question.

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.

Comments on specific questions

Question 1

(a) (i) Most candidates were able to identify the measuring cylinder from the diagram of the apparatus.

(ii) In this question, candidates had to convert and record timings on stopwatches into values to the nearest second. Candidates needed to record 25 and 39 s. Candidates who did not score this mark tended to record the values exactly as shown in Fig. 1.3 without recording to the nearest second.

(iii) Stronger candidates knew that results are more accurate if repeated, as this enables anomalous data to be recognised and excluded before calculating a reliable mean.

(b) (i) When drawing this line graph, candidates should:

- label the axes fully with both a quantity **and** a unit
- use a sensible scale so that plotted points cover at least half of the grid
- plot neat data points
- draw a curved line of best fit.

Many candidates were able to label the axes. However, many did not include the units. 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) Many candidates were able to describe the relationship shown by the results.

(c) (i) Many candidates knew that Benedict's reagent was the test for glucose. Candidates who did not score this mark usually wrote biuret's reagent.

(ii) This question required candidates to know the colour change. This was attempted correctly by most of the candidates, although some gave the colour change for iodine solution with starch.

Question 2

(a) (i) Many candidates were able to identify **C** as a test-tube. Apparatus **B**, the delivery tube, proved demanding and was often identified as a filter funnel.

(ii) This question proved demanding for many of the candidates who had not appreciated that the delivery tube on left-hand side of the conical flask needed to be extended so that it was below the level of the limewater.

(iii) Most candidates knew that limewater could be used to test for carbon dioxide.

(b) (i) Many candidates did not appreciate that they needed to write both the name and the appearance in order to gain the mark.

(ii) Candidates were asked to explain why the ice was needed. Many candidates wrote that the ice would cool down the gas which was insufficient to gain this mark. Candidates needed to appreciate that the gas needed to be condensed.

(c) (i) Candidates were given a table to complete by recording the results in the correct order. Many were able to record at least one of the values correctly, however, many recorded the second and third results the wrong way round.

(ii) Many candidates scored one mark for the idea of a gas being produced.

Question 3

(a) (i) Many candidates gained the two marks for the three different diameters of the paper cylinder. Some candidates drew three different circumferences rather than diameters and whilst they missed these marks, they were able to access the marks for **3(a)(ii)** due to error carried forward.

(ii) In this question, candidates were asked to calculate the average diameter of the diameters they had produced in **3(a)(i)**. The question gave an instruction to candidates to show their working, therefore marks were available for evidence of the calculations. Many candidates wrote a final answer without evidence and could not gain all the marks available.

(b) Many candidates knew that apparatus **Y** was a clamp.

(c) (i) Many candidates were able to measure both values of *h* and record values for both.

(ii) Many candidates correctly calculated the percentage difference from their results in **3(c)(i)**.

(iii) In this question, candidates had to identify an error and suggest an improvement to the apparatus linked to the error. Some of the stronger candidates identified that the distance from the top of the cylinder to the pivot was not the same. Only a few candidates were able to suggest a suitable improvement.

(iv) This proved to be a demanding question. Centres can refer to page 37 of the syllabus where candidates are expected to be able to comment on and explain whether results are equal within the limits of experimental accuracy (assumed to be ± 10% at this level of study).

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 bullet point and then any three others in order to gain full credit. Stronger responses came from candidates that addressed the bullet points individually.

Many candidates gained at least one mark from the apparatus and the method sections of the plan, however, only a few candidates were able to explain how the results would be used to draw a conclusion. Stronger candidates did appreciate that plotting a graph of *R* against *d* and finding the trend would gain them the mark for their use of results.

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 practical paper. Centres would be advised to ensure that the candidates understand the different terms and definitions. Candidates are not required to recall the specific definitions of the terms. However, they may be required to use their knowledge and understanding in response to a specific question.

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.

Comments on specific questions

Question 1

(a) (i) This question proved to be demanding for some candidates. Candidates who did score the mark usually wrote 'balance' or 'weighing scale'. The word 'Scales', without additional clarification, was not credited.

(ii) Candidates were asked to calculate two different values from data. Most candidates scored at least one mark, usually for the calculation of the final mass for 0.6 mol / dm^3. Many candidates could not gain the second mark as they had not included a minus sign before the value of 18 in the 'percentage change in mass' column.

(iii) In this graph question, candidates were given axes and were asked to label them. Many candidates found this demanding.

(b) Many candidates knew that an experiment's accuracy could be improved by repeating and averaging the results.

(c) (i) Many candidates knew the test for glucose and the observation for a positive test. Candidates who did not gain these marks tended to state that iodine was used to test for glucose.

(ii) Many candidates knew that iodine is used to test for starch. However, many did not read the question fully and wrote that the solution would turn blue-black in the presence of starch when the question asked for the negative result.

Question 2

(a) Most candidates were able to identify at least one piece of the apparatus. Many were able to identify **A** as a conical flask.

(b) (i) The candidates were given a table to complete. Many were able to record at least one of the values correctly, however, many recorded the second and third results the wrong way round.

(ii) Candidates were asked to suggest why there was an increase in the mass of the contents of the glass tube containing the copper. Many knew that something had been added to the copper but only the stronger candidates knew that the copper had reacted with oxygen.

(c) (i) This question proved demanding for many of the candidates who had not appreciated that the delivery tube on left-hand side in the conical flask needed to be extended so that it was below level of limewater.

(ii) Most candidates knew that limewater would turn milky when carbon dioxide passes through it.

(d) (i) Most candidates were able to determine the volume of nitrogen in apparatus **B**.

(ii) Candidates had to use their value from **2(d)(i)** to calculate the percentage of nitrogen and inert gases in the air. Many of the candidates gained this mark.

Question 3

(a) (i) This question required candidates to draw the circuit diagram of the arrangement of the solar cell, the switch and the voltmeter. Candidates were given the symbol for the solar cell which they needed to be included in their circuits. However, many candidates did not include the solar cell in their diagram, and did not score the mark.

(ii) This question required candidates to record the voltage. Most candidates did not record their value to the required degree of precision to gain this mark.

(iii) Many candidates knew that the parallax error was an example of measurement error.

(iv) The possible source of inaccuracy proved demanding for many candidates. They needed to consider points such as the needle does not point to zero when there is no voltage or that the needle may not move freely

(b) (i) Many candidates were able to predict the relationship between the two variables. Stronger candidates stated that the smaller the distance, the larger the reading/voltage. However, some of the candidates did not consider the instruction and tried to explain why the voltage changed.

(ii) Candidates needed to produce a table in which to record results. The question gave the candidates clear instructions as to what should be included in the table. An example of such a table is given below:

distance between solar cell and light source / cm	voltage / V	
	1st	2nd
5		
10		
15		
20		
25		

The candidates were expected to include at least 5 different distances and at least 2 sets of repeats.

(c) Many candidates knew how to use a graphical method to identify anomalous results. Many were able to describe that the results needed to be plotted as voltage against distance and that the anomalous result would be the point that is furthest from the best-fit line.

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 bullet point and then any three others in order to gain full credit. Stronger responses came from candidates that addressed the bullet points individually.

Most candidates were able to identify at least one piece of relevant apparatus and were able to suggest an outline method. Stronger candidates were able to access higher marks by suggesting using five different concentrations of acid and repeating the investigation with each concentration of acid.