



Cambridge IGCSE™

COMBINED SCIENCE

Paper 2 Multiple Choice (Extended)

0653/21

May/June 2024

45 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

INSTRUCTIONS

- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

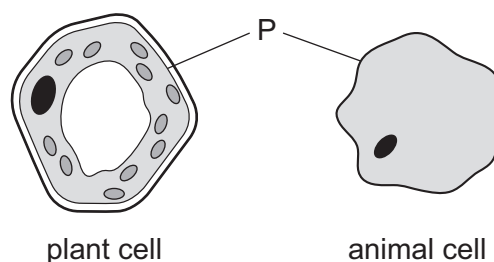
INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

This document has **16** pages. Any blank pages are indicated.



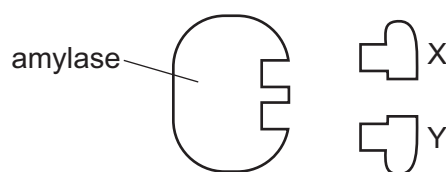
- 1 The diagram shows a plant cell and an animal cell as seen under a light microscope.



What is structure P and what is one of its functions?

	structure P	function
A	cell membrane	controls the entry of substances into the cell
B	cell membrane	supports the cell
C	cell wall	controls the entry of substances into the cell
D	cell wall	supports the cell

- 2 The diagram represents the enzyme amylase and the products of digestion by amylase.



What are products X and Y?

	X	Y
A	amino acid	amino acid
B	fatty acid	glycerol
C	glycerol	fatty acid
D	simple sugar	simple sugar

- 3 Which type of cell needs a supply of magnesium ions to carry out its main function?

- A** a ciliated cell
- B** palisade mesophyll cell
- C** a red blood cell
- D** a root hair cell

4 Which process produces food molecules that are small enough to be absorbed?

- A chemical digestion
- B egestion
- C ingestion
- D mechanical digestion

5 Which statement about the structure and function of blood vessels is correct?

- A Arteries have valves and always carry oxygenated blood.
- B Arteries have a thick muscular wall to maintain a high blood pressure.
- C Veins have a narrow lumen to allow the blood to flow quickly.
- D Veins have a thin wall so that they can exchange molecules with tissue cells.

6 Which processes use the energy released by respiration?

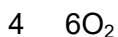
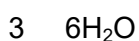
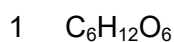
	diffusion	growth	osmosis	protein synthesis
A	✓	✓	x	x
B	✓	x	x	✓
C	x	✓	x	✓
D	x	x	✓	x

key

✓ = yes

x = no

7 Molecules from the balanced chemical equation for aerobic respiration are listed.



What represents the correct equation for aerobic respiration using these molecules?

- A $1 + 2 \rightarrow 3 + 4$
- B $2 + 3 \rightarrow 1 + 4$
- C $1 + 4 \rightarrow 2 + 3$
- D $3 + 4 \rightarrow 1 + 2$

8 Which statement about adrenaline is correct?

- A It is produced by a gland.
- B It is transported in the red blood cells.
- C It only has one target organ.
- D It reduces the size of the pupils.

9 Auxin stimulates cell elongation.

If a light shines onto a shoot, why does it grow towards the direction of the light?

- A Auxin spreads evenly through the shoot.
- B Auxin stays in the shoot tip.
- C More auxin collects on the side of the shoot furthest from the light.
- D More auxin collects on the side of the shoot nearest the light.

10 Which statement about sexual reproduction is **always** correct?

- A It involves only one parent.
- B It involves the fusion of nuclei.
- C It produces genetically identical offspring.
- D It takes place only in animals.

11 Which row describes adaptations of a wind-pollinated flower?

	anthers inside flower	large petals	stigma outside flower
A	✓	✓	x
B	x	✓	✓
C	✓	x	x
D	x	x	✓

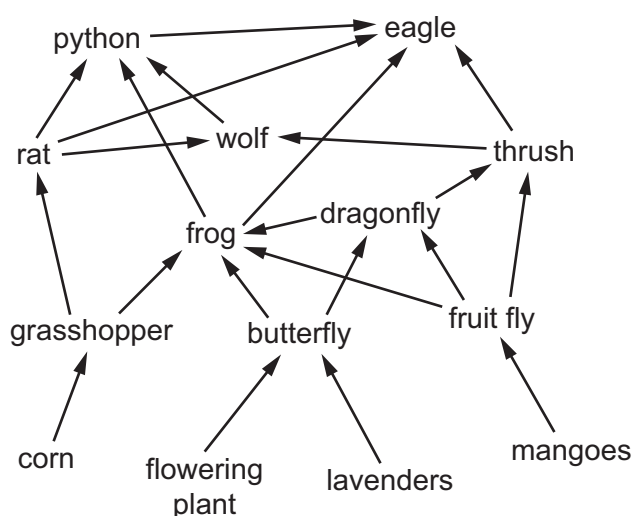
12 The list shows the adaptive features of some gametes.

- 1 a flagellum
- 2 a jelly coat
- 3 a sac of enzymes at one end
- 4 a store of energy

Which features are present in a human male gamete?

- A** 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

13 The diagram shows a food web.



How many of the food chains in this food web support the wolf?

- A** 2 **B** 3 **C** 4 **D** 5

14 50g of a liquid alkane at 20 °C is left in an open, insulated beaker for 30 minutes.

After this time, the mass of the liquid is 42g and its temperature is 18 °C.

Which statement is correct?

- A** Some of the liquid evaporates in an exothermic process.
- B** The evaporation is an endothermic process because covalent bonds in the alkane molecules are broken.
- C** The temperature decreases because energy is used to overcome attractive forces between the liquid molecules.
- D** There are fewer molecules in the remaining liquid so they move further apart.

15 What is an example of a physical change?

- A carbon dioxide turning limewater milky
- B the crystallisation of copper(II) sulfate from solution
- C the electrolysis of molten lead(II) bromide
- D the thermal decomposition of calcium carbonate

16 Which statement defines the nucleon number of an atom?

- A It is the total number of neutrons and protons in the atom.
- B It is the total number of neutrons and electrons in the atom.
- C It is the total number of neutrons, protons and electrons in the atom.
- D It is the total number of neutrons in the atom.

17 The formula of magnesium nitrate is $\text{Mg}(\text{NO}_3)_2$.

Which symbols represent the ions in magnesium nitrate?

	magnesium	nitrate
A	Mg^+	NO_3^-
B	Mg^+	NO_3^{2-}
C	Mg^{2+}	NO_3^{2-}
D	Mg^{2+}	NO_3^-

18 Which rows identify the electrode products for the named electrolyte?

	electrolyte	product at anode	product at cathode
1	dilute sulfuric acid	oxygen	hydrogen
2	dilute sulfuric acid	sulfur dioxide	hydrogen
3	concentrated aqueous sodium chloride	chlorine	hydrogen
4	molten lead(II) bromide	lead	bromine

- A 1 and 3
- B 1 and 4
- C 2 and 3
- D 2 and 4

- 19 Hydrogen reacts with oxygen to produce water as shown.



The reaction causes the surroundings to heat up.

Which row identifies the type of reaction and explains why it is endothermic or exothermic?

	type of reaction	explanation
A	endothermic	the bonds formed are stronger than the bonds broken
B	endothermic	the bonds formed are weaker than the bonds broken
C	exothermic	the bonds formed are stronger than the bonds broken
D	exothermic	the bonds formed are weaker than the bonds broken

- 20 An experiment is set up to investigate the rate of reaction between calcium carbonate and dilute hydrochloric acid.

A fixed mass of solid calcium carbonate is placed in a conical flask, and an excess of the acid is added using a measuring cylinder. Carbon dioxide is produced in the reaction.

Which other pieces of apparatus are used to find the rate of reaction?

- 1 a balance
- 2 a thermometer
- 3 a stop-watch

- A** 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

- 21 Which aqueous substances form a white precipitate when they are mixed?

- A** barium chloride and hydrochloric acid
- B** barium chloride and nitric acid
- C** silver nitrate and nitric acid
- D** silver nitrate and hydrochloric acid

- 22** All sodium compounds are soluble. Magnesium hydroxide is insoluble.

An excess of a solid is added to dilute nitric acid, mixed, filtered and then the filtrate is left to crystallise.

Which solids react with dilute nitric acid and can be used separately to prepare crystals of magnesium nitrate?

- A** magnesium hydroxide and sodium carbonate only
- B** magnesium and magnesium hydroxide only
- C** magnesium and sodium carbonate only
- D** magnesium, magnesium hydroxide and sodium carbonate

- 23** Astatine is an element near the bottom of Group VII in the Periodic Table.

Which row shows properties of astatine?

	physical state at room temperature	reacts with iodide ions
A	gas	no
B	solid	no
C	gas	yes
D	solid	yes

- 24** Which statement about the properties of the elements in Period 3 of the Periodic Table is correct?

- A** The elements on the left lose electrons more readily.
- B** The elements on the left are less malleable.
- C** The elements on the right are metallic.
- D** The elements on the right form cations.

- 25** Iron is extracted from its ore in a blast furnace.

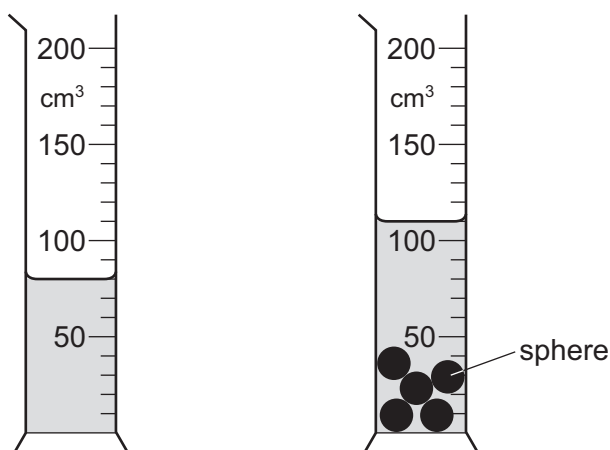
Which statement about this process is correct?

- A** Carbon dioxide reduces iron(III) oxide.
- B** Iron(III) oxide reduces carbon monoxide.
- C** Carbon oxidises iron(III) oxide.
- D** Carbon dioxide oxidises carbon.

- 26** A water supply contains small insoluble impurities. It also contains bacteria.

Which statement describes how the insoluble impurities are removed and how the bacteria are killed?

- A** The water supply is filtered.
 - B** The water supply is filtered and treated with chloride ions.
 - C** The water supply is filtered and treated with chlorine.
 - D** The water supply is treated with chlorine and chloride ions.
- 27** Which products are obtained by the cracking of larger alkane molecules?
- A** smaller alkane molecules, smaller alkene molecules and hydrogen
 - B** smaller alkane molecules only
 - C** smaller alkene molecules and hydrogen only
 - D** smaller alkene molecules only
- 28** Five identical solid spheres are placed in a measuring cylinder containing a liquid. The diagrams show the measuring cylinder before and after the spheres are placed inside.



The mass of one sphere is 12 g.

What is the density of the material used to make the spheres?

- A** 0.40 g/cm^3
- B** 0.50 g/cm^3
- C** 2.0 g/cm^3
- D** 2.5 g/cm^3

- 29 A book rests on a table.

Which two quantities are needed to calculate the pressure exerted by the book on the table?

- A the density of the book and the volume of the book
- B the density of the book and the area of contact between the book and the table
- C the weight of the book and the volume of the book
- D the weight of the book and the area of contact between the book and the table

- 30 Which row shows the expressions for the gravitational potential energy (GPE) and the kinetic energy (KE) of an object?

	GPE	KE
A	$\frac{mg}{h}$	$\frac{1}{2}mv^2$
B	$\frac{mg}{h}$	$\frac{1}{2}(mv)^2$
C	mgh	$\frac{1}{2}mv^2$
D	mgh	$\frac{1}{2}(mv)^2$

- 31 Which row compares the distances between the molecules and the forces between the molecules in a solid and in a gas?

	distances between the molecules	forces between the molecules
A	larger in a gas	larger in a gas
B	larger in a gas	larger in a solid
C	larger in a solid	larger in a gas
D	larger in a solid	larger in a solid

- 32 Which statement is correct for evaporation?

- A Evaporation occurs only at the boiling point of the liquid.
- B Evaporation occurs only at the surface of a liquid.
- C Evaporation involves a vapour changing into a liquid.
- D Evaporation increases the temperature of the remaining liquid.

- 33** A sea wave reaches the shore at a rate of three wavelengths every 60 s.

What is the frequency of the wave?

- A** 0.050 Hz **B** 1.0 Hz **C** 3.0 Hz **D** 20 Hz

- 34** A sound wave moves from a solid into a liquid.

The frequency of the sound does not change.

What happens to the speed and what happens to the wavelength of the sound wave?

	speed	wavelength
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

- 35** A thin converging lens has a focal length of 5.0 cm.

The lens is placed at different distances from the object.

At which distance does the lens act as a magnifying glass?

- A** 15 cm **B** 10 cm **C** 6.0 cm **D** 3.0 cm

- 36** A plastic rod becomes negatively charged when rubbed with a cloth.

The cloth becomes positively charged.

Which statement describes the charging process?

- A** The rod and the cloth both gain electrons.
B The rod and the cloth both lose electrons.
C The rod gains electrons and the cloth loses electrons.
D The rod loses electrons and the cloth gains electrons.

- 37** Which list contains a material that prevents electrical charge from flowing through it?

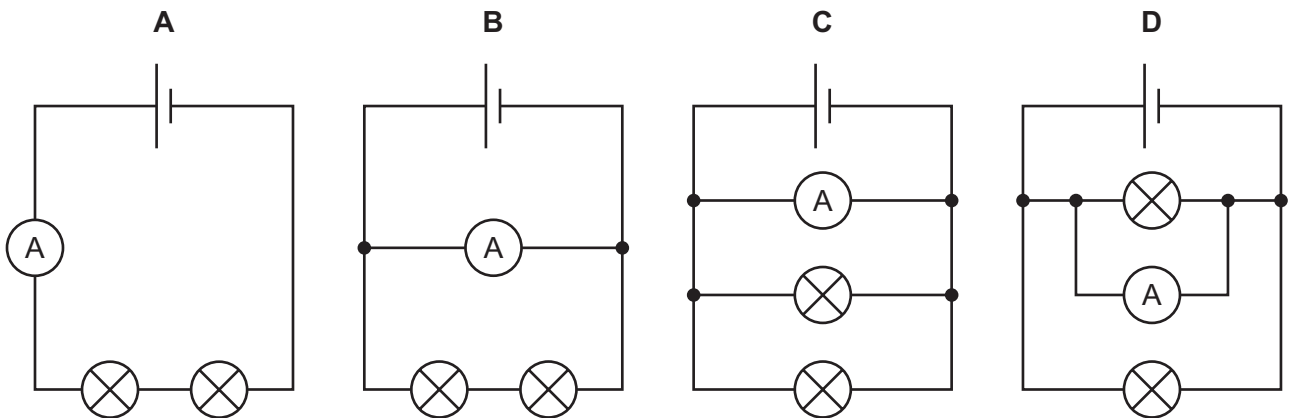
- A** aluminium, copper, mercury
B brass, nickel, steel
C glass, gold, zinc
D silver, iron, lead

38 Which expression is equal to current?

- A charge $\times$ time
- B $\frac{\text{charge}}{\text{time}}$
- C resistance $\times$ potential difference (p.d.)
- D $\frac{\text{resistance}}{\text{potential difference (p.d.)}}$

39 The diagrams show four circuits, each containing an ammeter and two lamps of different resistances.

Which circuit shows an ammeter with a reading equal to the current in each lamp?



40 There is a current of 20 mA in an electrical component when there is a potential difference (p.d.) of 10 V across it.

How much energy is transferred by the component in 30 minutes?

- A 6.0 J B 360 J C 6000 J D 360 000 J

BLANK PAGE

BLANK PAGE

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.

The Periodic Table of Elements

Group																				
I	II											III	IV	V	VI	VII	VIII			
		1 H hydrogen 1																		
		Key atomic number atomic symbol name relative atomic mass																		
3 Li lithium 7	4 Be beryllium 9													5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19		
11 Na sodium 23	12 Mg magnesium 24													13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40	
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84			
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium —	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131			
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids		72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium —	85 At astatine —	86 Rn radon —			
87 Fr francium —	88 Ra radium —	89–103 actinoids		104 Rf rutherfordium —	105 Db dubnium —	106 Sg seaborgium —	108 Hs hassium —	109 Mt meitnerium —	110 Ds darmstadtium —	111 Rg roentgenium —	112 Cn copernicium —	113 Nh nihonium —	114 Fl flerovium —	115 Mc moscovium —	116 Lv livermorium —	117 Ts tennessine —	118 Og oganeson —			

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium —	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium —	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium —	94 Pu plutonium —	95 Am americium —	96 Cm curium —	97 Bk berkelium —	98 Cf californium —	99 Es einsteinium —	100 Fm fermium —	101 Md mendelevium —	102 No nobelium —	103 Lr lawrencium —

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).



Cambridge IGCSE™

COMBINED SCIENCE

Paper 2 Multiple Choice (Extended)

0653/22

May/June 2024

45 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

INSTRUCTIONS

- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

INFORMATION

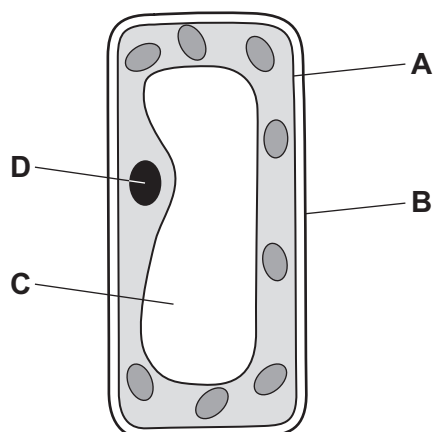
- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

This document has **16** pages. Any blank pages are indicated.



- 1 The diagram shows a typical plant cell.

Which part of the cell controls the movement of materials into and out of the cell?



- 2 Molecules can move from one area to another by diffusion.

Which statement applies to diffusion?

- A** A partially permeable membrane is needed for diffusion to happen.
- B** Diffusion can only happen when a substance is in solution in water.
- C** Molecules can only enter or leave living cells by diffusion.
- D** Molecules move by diffusion down a concentration gradient.

- 3 Biological catalysts speed up reactions.

What is another name for biological catalysts?

- A** antibodies
- B** enzymes
- C** fatty acids
- D** hormones

- 4 Which row is correct for photosynthesis in a leaf?

	substrates	products	cells where photosynthesis occurs
A	$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$	$6\text{H}_2\text{O} + 6\text{CO}_2$	palisade mesophyll
B	$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$	$6\text{H}_2\text{O} + 6\text{CO}_2$	upper epidermis
C	$6\text{H}_2\text{O} + 6\text{CO}_2$	$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$	palisade mesophyll
D	$6\text{H}_2\text{O} + 6\text{CO}_2$	$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$	upper epidermis

5 Which type of molecule is starch?

- A carbohydrate
- B fat
- C protein
- D vitamin

6 Chemical digestion starts in the mouth and continues throughout the length of the alimentary canal.

What is a sequence of three organs in the alimentary canal where chemical digestion occurs?

- A oesophagus → gall bladder → liver
- B oesophagus → stomach → small intestine
- C small intestine → gall bladder → large intestine
- D small intestine → stomach → oesophagus

7 How are mineral ions transported around the human body?

- A attached to antibodies
- B attached to haemoglobin
- C dissolved in blood plasma
- D inside blood platelets

8 Which row correctly lists the features of a gas exchange surface in animals?

	large surface area	thin surface	good blood supply	good ventilation with air
A	✓	✓	x	x
B	✓	x	✓	x
C	x	✓	✓	x
D	✓	✓	✓	✓

key

✓ = present

x = absent

- 9 When the hormone adrenaline is released in humans it causes changes in breathing rate and pupil size.

What are the correct changes?

	breathing rate	pupil size
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

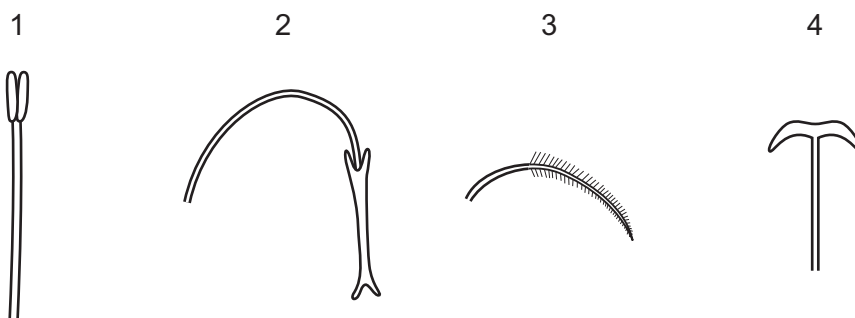
- 10 The table shows some possible tropic responses in a plant.

	part of plant	direction of growth response to	
		gravity	light (from one direction)
1	root	away	towards
2	root	towards	away
3	shoot	away	towards
4	shoot	towards	away

What are the correct tropic responses for gravitropism and phototropism?

- A** 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

- 11 Which row shows the anther and stigma of an insect-pollinated flower?

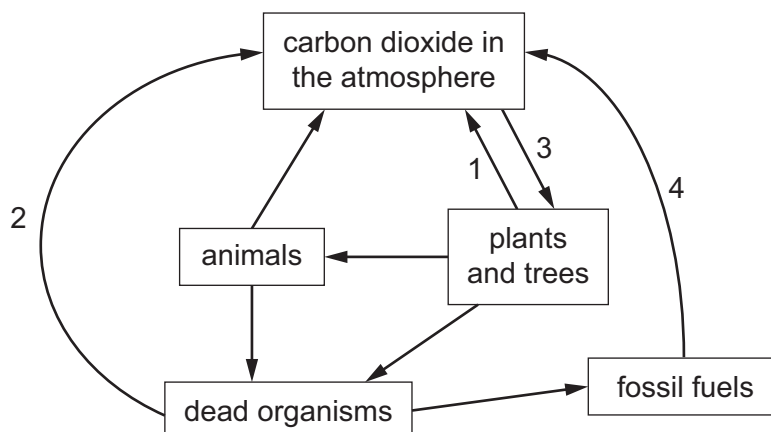


	insect-pollinated anther	insect-pollinated stigma
A	1	2
B	1	4
C	4	1
D	4	3

12 What gives the human embryo protection from mechanical shock?

- A amniotic fluid
- B cervix
- C placenta
- D umbilical cord

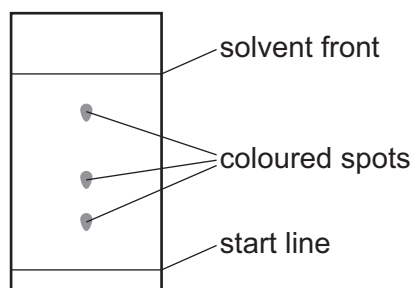
13 The diagram shows part of the carbon cycle.



Which arrows represent decomposition and combustion?

- A 1 and 2
- B 1 and 4
- C 2 and 3
- D 2 and 4

14 The diagram shows a chromatogram of an ink sample after separation by paper chromatography.



Which calculation is used to determine the R_f value of a coloured spot on the chromatogram?

- A $\frac{\text{distance travelled by the solvent from the start line}}{\text{distance travelled by the spot from the start line}}$
- B $\frac{\text{distance travelled by the spot from the start line}}{\text{distance travelled by the solvent from the start line}}$
- C $\frac{\text{distance from the bottom of the chromatography paper to the spot}}{\text{distance from the bottom to the top of the chromatography paper}}$
- D $\frac{\text{distance from the bottom to the top of the chromatography paper}}{\text{distance from the bottom of the chromatography paper to the spot}}$

15 White solid X is formed when magnesium reacts with oxygen.

What is X?

- A a compound
- B a mixture
- C an alloy
- D an element

16 Which statement describes the formation of ions when two different atoms combine?

- A The two atoms share a pair of electrons.
- B Both atoms lose electrons.
- C Both atoms gain electrons.
- D One atom gains electrons and one loses electrons.

17 A solution of barium chloride reacts with dilute sulfuric acid to form a precipitate.

What is the ionic equation for this reaction?

- A $\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{aq})$
- B $\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})$
- C $\text{BaCl}_2(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{BaSO}_4(\text{aq}) + 2\text{HCl}(\text{aq})$
- D $\text{Ba}^{2+}(\text{aq}) + 2\text{Cl}^{-}(\text{aq}) + 2\text{H}^{+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{HCl}(\text{aq})$

18 Dilute sulfuric acid is electrolysed using platinum electrodes.

Which statements about this electrolysis are correct?

- 1 Water is broken down to give hydrogen and oxygen.
- 2 Water is covalent but the solution conducts electricity because it contains equal concentrations of H^{+} ions and OH^{-} ions.
- 3 The equation for the reaction at the anode is $4\text{OH}^{-} \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^{-}$.
- 4 The equation for the reaction at the cathode is $2\text{H}^{+} \rightarrow \text{H}_2 + 2\text{e}^{-}$.

- A 1 and 3 B 1 and 4 C 2 and 3 D 2 and 4

19 Which row about an endothermic reaction is correct?

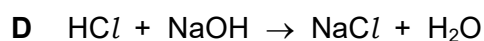
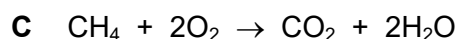
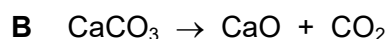
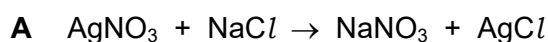
	energy	temperature change in the reaction mixture
A	given out	decreases
B	taken in	increases
C	given out	increases
D	taken in	decreases

20 Hydrogen peroxide decomposes to form water and oxygen.

Which changes in temperature and in concentration **both** reduce the rate of this reaction?

	temperature of hydrogen peroxide	concentration of hydrogen peroxide
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

21 Which equation represents a redox reaction?



22 Copper sulfate is a soluble salt which is prepared by reacting insoluble copper oxide with dilute sulfuric acid.

Which statement about the preparation of copper sulfate crystals is **not** correct?

A After the reaction, the mixture is filtered and copper sulfate solution is collected.

B Excess copper oxide is used to ensure that all the acid is used up.

C The final solution is heated so that all the water boils off.

D The mixture of copper oxide and dilute sulfuric acid is heated to speed up the reaction.

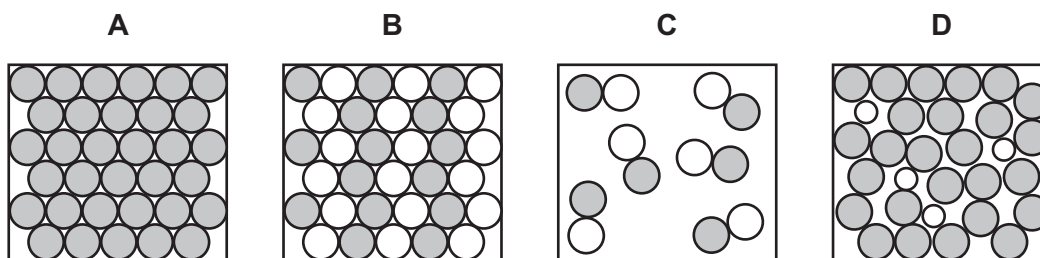
- 23** Magnesium carbonate reacts with dilute sulfuric acid.

A gas is produced.

What is the test for this gas?

- A** It bleaches damp litmus paper.
- B** It 'pops' with a lighted splint.
- C** It relights a glowing splint.
- D** It turns limewater milky.

- 24** Which diagram represents the particles in an alloy?



- 25** What causes an enhanced greenhouse effect?

- A** decreased concentration of methane in the atmosphere
- B** decreased concentration of nitrogen in the atmosphere
- C** increased concentration of carbon dioxide in the atmosphere
- D** increased concentration of oxygen in the atmosphere

- 26** Which statement about alkenes is correct?

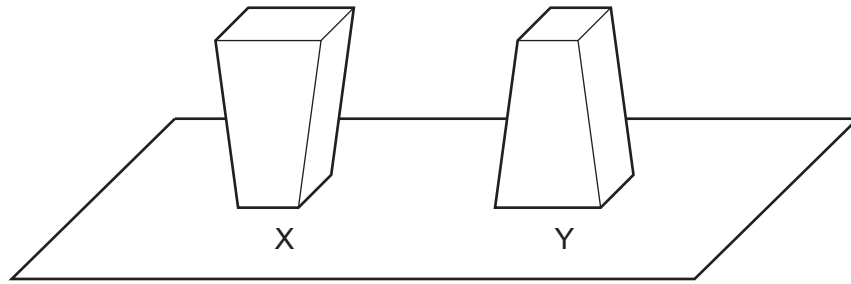
- A** They are saturated hydrocarbons.
- B** They have the general formula C_nH_{2n+2} .
- C** They have similar chemical properties.
- D** They are all gases at room temperature.

- 27** A hydrocarbon with the formula C_9H_{20} is cracked to form one molecule of ethene and two other hydrocarbon molecules.

What are the two other molecules?

- A** C_4H_{10} and C_3H_8
- B** C_4H_8 and C_3H_8
- C** C_4H_8 and C_3H_6
- D** C_7H_{14} and H_2

- 28 Two identical solid objects X and Y are placed on a bench.



How do the forces and the pressures on the bench due to X and Y compare?

	forces	pressures
A	different	different
B	different	equal
C	equal	different
D	equal	equal

- 29 An object has mass and is in a gravitational field.

Which property does the object possess because it is in a gravitational field?

- A** density
- B** resistance
- C** volume
- D** weight

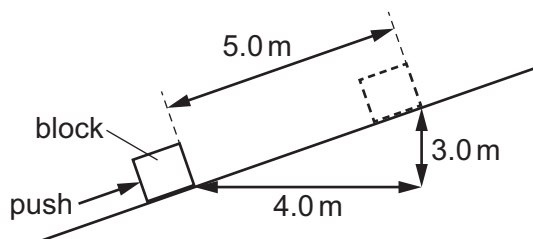
- 30 A spring obeys Hooke's law.

In which unit is its spring constant measured?

- A** m/N
- B** N
- C** N/m
- D** Nm

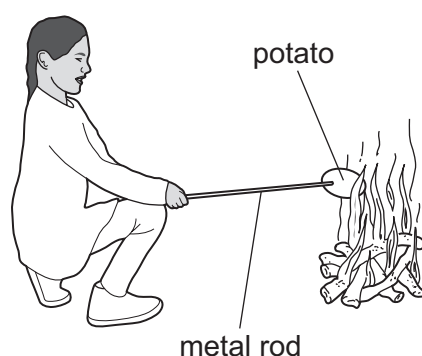
- 31 A block has a mass of 5.0 kg.

A student pushes the block 5.0 m up a slope. The gravitational field strength is 10 N/kg.



How much gravitational potential energy does the block gain?

- A** 25 J **B** 150 J **C** 200 J **D** 250 J
- 32 An automatic coffee maker has a power rating of 900 W and takes 3.0 minutes to make a cup of coffee.
- How much energy is transferred by the coffee maker when it makes a cup of coffee?
- A** 5.0 J **B** 300 J **C** 2700 J **D** 162 000 J
- 33 In which list are all the energy resources renewable?
- A** geothermal, hydroelectric, nuclear
- B** geothermal, tides, hydroelectric
- C** tides, nuclear, coal
- D** solar, wind, coal
- 34 A student cooks a potato over a fire. The student holds the potato using a metal rod.



Which transfer of thermal energy is caused mainly by radiation?

- A** from the fire to the air above the fire
- B** from the fire to the student's face
- C** from the inside of the potato to the student's hand
- D** from the outside of the potato to the inside of the potato

- 35 A student uses a thin converging lens of focal length 5.0 cm as a magnifying glass.

What is a possible position of the object?

- A 4.0 cm from the lens, on the same side of the lens as the student
- B 4.0 cm from the lens, on the side of the lens away from the student
- C 6.0 cm from the lens, on the same side of the lens as the student
- D 6.0 cm from the lens, on the side of the lens away from the student

- 36 What is **not** able to transmit sound waves?

- A a gas
- B a liquid
- C a solid
- D a vacuum

- 37 There is a potential difference (p.d.) of 6.0 V across a resistor of resistance 1.5 k Ω .

How much charge passes through the resistor in 5.0 minutes?

- A 1.2 C B 20 C C 30 C D 1200 C

- 38 Wire X and wire Y are made from the same material. Each wire has a circular cross-section.

The resistance of wire X is R , its length is l and its diameter is d .

The length of wire Y is $2l$ and its diameter is $2d$.

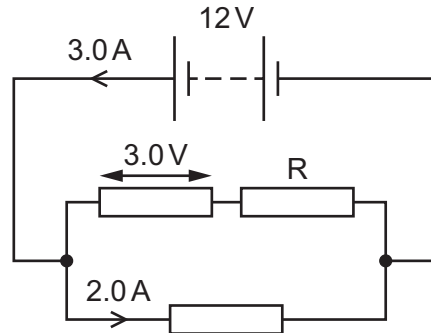
What is the resistance of wire Y?

- A $\frac{R}{2}$ B R C $4R$ D $8R$

- 39** The diagram shows three resistors connected to a 12 V battery.

The current at two points in the circuit and the potential difference (p.d.) across one resistor are shown.

Another resistor is labelled R.



What is the current in resistor R and what is the p.d. across resistor R?

	current in resistor R /A	p.d. across resistor R /V
A	1.0	3.0
B	1.0	9.0
C	2.0	3.0
D	2.0	9.0

- 40** A fault develops in an electric circuit and the current in the circuit becomes too large.

A component in the circuit protects the wires from overheating.

Which component protects the wires?

- A** ammeter
- B** fuse
- C** lamp
- D** voltmeter

BLANK PAGE

BLANK PAGE

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.

The Periodic Table of Elements

Group																				
I	II											III	IV	V	VI	VII	VIII			
		1 H hydrogen 1																		
		Key atomic number atomic symbol name relative atomic mass																		
3 Li lithium 7	4 Be beryllium 9													5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19		
11 Na sodium 23	12 Mg magnesium 24													13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40	
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84			
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium —	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131			
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids		72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium —	85 At astatine —	86 Rn radon —			
87 Fr francium —	88 Ra radium —	89–103 actinoids		104 Rf rutherfordium —	105 Db dubnium —	106 Sg seaborgium —	108 Hs hassium —	109 Mt meitnerium —	110 Ds darmstadtium —	111 Rg roentgenium —	112 Cn copernicium —	113 Nh nihonium —	114 Fl flerovium —	115 Mc moscovium —	116 Lv livermorium —	117 Ts tennessine —	118 Og oganeson —			

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium —	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium —	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium —	94 Pu plutonium —	95 Am americium —	96 Cm curium —	97 Bk berkelium —	98 Cf californium —	99 Es einsteinium —	100 Fm fermium —	101 Md mendelevium —	102 No nobelium —	103 Lr lawrencium —

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).



Cambridge IGCSE™

COMBINED SCIENCE

Paper 2 Multiple Choice (Extended)

0653/23

May/June 2024

45 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

INSTRUCTIONS

- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

This document has **16** pages. Any blank pages are indicated.

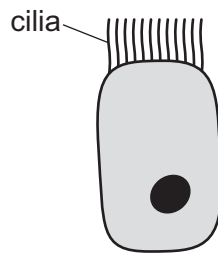


- 1 1..... is the ability to detect and respond to changes in the environment.

Which word completes gap 1?

- A Excretion
- B Movement
- C Sensitivity
- D Reproduction

- 2 The diagram shows a ciliated cell.

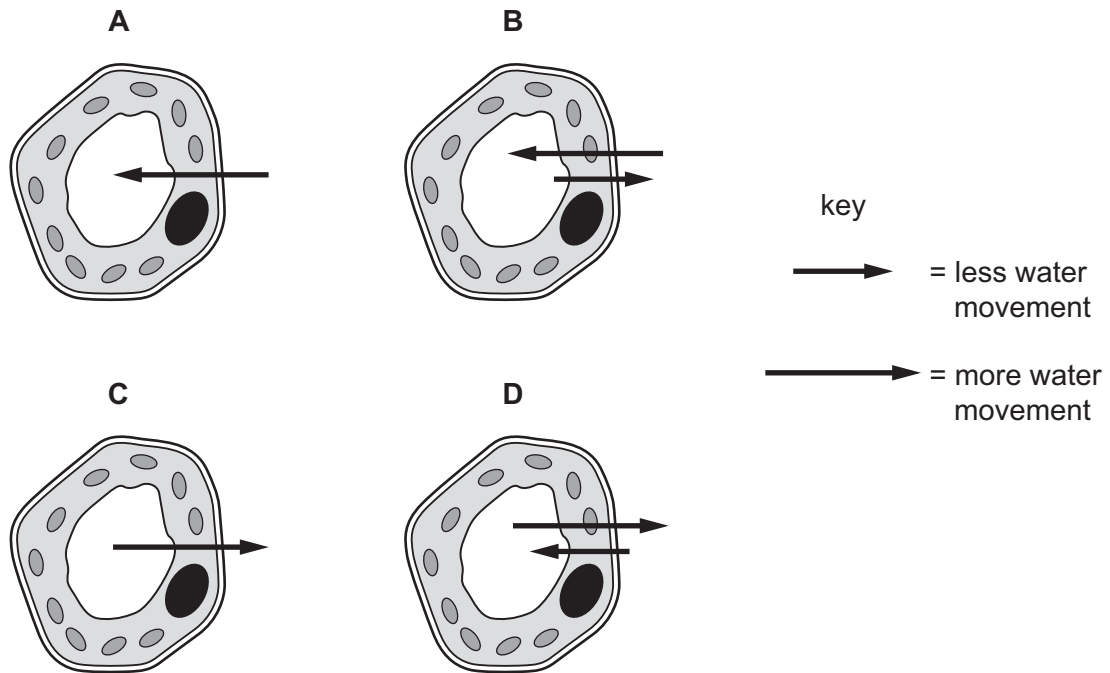


Which row shows where ciliated cells are found in the human gas exchange system and their correct function?

	location of ciliated cells		function of ciliated cells	
	bronchi	trachea	move mucus away from lungs	move mucus towards lungs
A	✓	✓	✓	✗
B	✓	✓	✗	✓
C	✓	✗	✓	✗
D	✗	✓	✗	✓

- 3 A plant cell was placed in a solution with a lower water potential than the cell.

Which diagram represents the movement of water during the process of osmosis?



- 4 Which small molecules are used to make proteins?

- A amino acids
- B fatty acids
- C glucose
- D glycerol

- 5 Which substances are used and produced during photosynthesis?

	substances used	substances produced
A	carbon dioxide and glucose	oxygen and water
B	carbon dioxide and water	glucose and oxygen
C	glucose and oxygen	carbon dioxide and water
D	oxygen and water	carbon dioxide and glucose

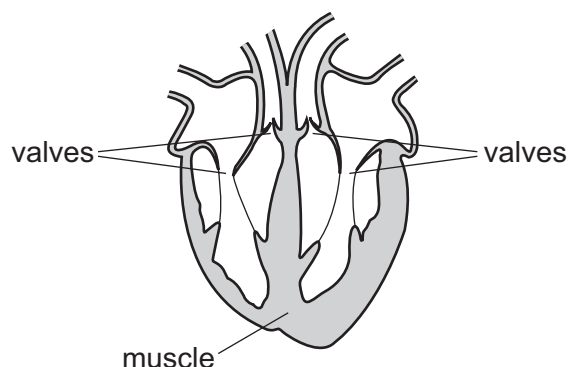
6 Which process is defined as the taking of substances, for example food and drink, into the body through the mouth?

- A absorption
- B digestion
- C egestion
- D ingestion

7 Which changes will increase transpiration rate?

	humidity	temperature
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

8 A diagram of the human heart is shown.



Which row describes the function of the valves and the action of the muscles when blood is pumped out of the heart?

	valves	muscles
A	allow blood to flow in both directions	contract
B	allow blood to flow in both directions	relax
C	allow blood to flow in one direction only	contract
D	allow blood to flow in one direction only	relax

9 Why do cells respire?

- A to produce oxygen
- B to produce water
- C to release energy
- D to use glucose

10 A light shines onto a shoot from one side.

Which row explains why the shoot bends towards the light?

	more auxin on the side of the shoot	more cell elongation on the side of the shoot
A	furthest from the light	furthest from the light
B	furthest from the light	nearest to the light
C	nearest to the light	furthest from the light
D	nearest to the light	nearest to the light

11 Which combination of features describes pollen grains from a wind-pollinated flower?

- A large and spiky
- B small and light
- C spiky and sticky
- D sticky and smooth

12 Which type of blood cell is affected by the human immunodeficiency virus (HIV) and which effect does the virus have on those cells?

	type of blood cell	effect on the blood cell
A	red	prevents them carrying oxygen
B	red	reduces antibody production
C	white	prevents them carrying oxygen
D	white	reduces antibody production

13 Some effects that may happen in an ecosystem are listed.

- 1 decrease in atmospheric carbon dioxide
- 2 increase in atmospheric carbon dioxide
- 3 build up of soil
- 4 loss of soil

Which effects can be caused by deforestation?

- A** 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

14 Which term describes ammonia, NH_3 ?

- A** atom
- B** molecule
- C** element
- D** ion

15 A mixture of salt water and sand is filtered.

Which statement is correct?

- A** The salt and the sand are trapped by the filter paper.
- B** The salt is dissolved in the water and passes through the filter paper.
- C** The sand is insoluble in water and passes through the filter paper.
- D** The sand is trapped by the filter paper and pure water is obtained.

16 Copper sulfate crystals dissolve in water.

Which word describes the role of the water?

- A** filtrate
- B** solute
- C** solution
- D** solvent

17 Which statement about covalent compounds is correct?

- A** They are formed between a metal and a non-metal.
- B** They are formed when atoms gain or lose electrons.
- C** They are formed when atoms share pairs of electrons.
- D** They conduct electricity when they are molten.

- 18 Magnesium reacts with dilute hydrochloric acid forming magnesium chloride and hydrogen.

Which equation is correct for this reaction?

- A $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl} + \text{H}_2$
B $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$
C $\text{Mg} + \text{HCl} \rightarrow \text{MgCl} + \text{H}$
D $2\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$

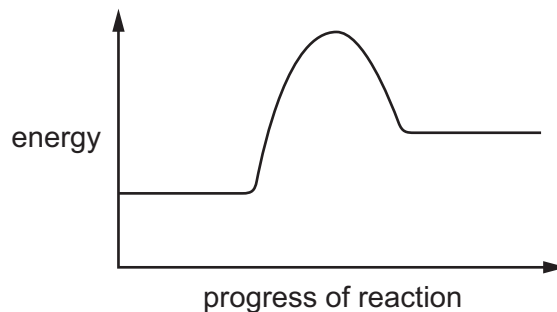
- 19 Concentrated aqueous sodium chloride is electrolysed using platinum electrodes.

Which statements are correct?

- 1 The equation for the reaction at the cathode is $\text{Na}^+(\text{aq}) + \text{e}^- \rightarrow \text{Na}(\text{s})$.
- 2 The equation for the reaction at the anode is $2\text{Cl}^-(\text{aq}) \rightarrow \text{Cl}_2(\text{g}) + 2\text{e}^-$.
- 3 At the positive electrode, hydroxide ions from water form oxygen.
- 4 At the negative electrode, hydrogen ions from water form hydrogen.

- A 1 and 2 B 1 and 3 C 2 and 4 D 3 and 4

- 20 The energy level diagram for an endothermic reaction is shown.



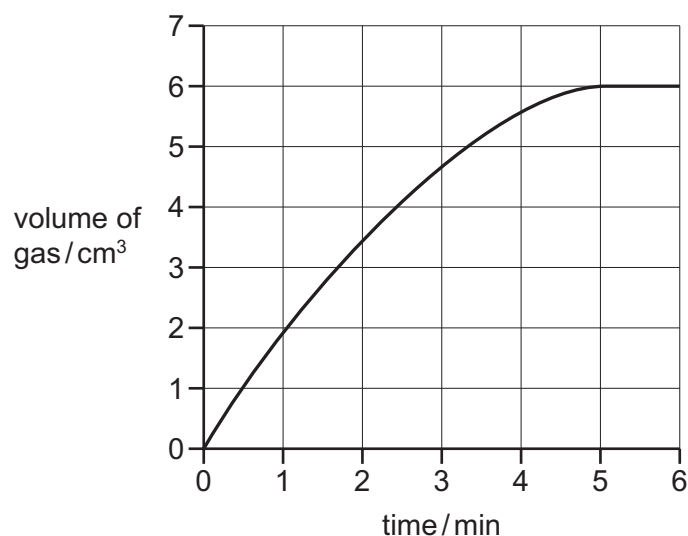
Which statement about this reaction is correct?

- A The activation energy is the minimum energy to react.
B The energy required to break bonds is less than the energy released on making new bonds.
C The activation energy is less than the energy change for the reaction.
D The final products have less energy than the reactants.

21 Magnesium is reacted with dilute hydrochloric acid.

The volume of gas produced is measured for 6 minutes.

The graph obtained from the results is shown.



Which part of the graph shows the greatest rate of reaction?

- A** between 0 and 1 minute
- B** between 2 and 4 minutes
- C** between 4 and 5 minutes
- D** between 5 and 6 minutes

22 Magnesium sulfate is a soluble salt which is prepared by reacting magnesium with dilute sulfuric acid.

Which row shows the first two steps in the preparation of pure magnesium sulfate?

	step 1	step 2
A	react excess dilute sulfuric acid with magnesium	heat to evaporate unreacted acid
B	react excess dilute sulfuric acid with magnesium	filter to remove the excess acid
C	react dilute sulfuric acid with excess magnesium	filter to remove the unreacted magnesium
D	react dilute sulfuric acid with excess magnesium	heat to evaporate some of the water

23 What is the test for nitrate ions?

- A add aqueous sodium hydroxide, then aluminum foil, and warm, test any gas formed with damp red litmus paper
- B acidify, then add aqueous barium chloride
- C acidify, then add aqueous silver nitrate
- D add dilute hydrochloric acid, test any gas produced with limewater

24 Which equation represents a displacement reaction of the elements in Group VII of the Periodic Table?

- A $\text{Br}_2 + 2\text{NaCl} \rightarrow 2\text{NaBr} + \text{Cl}_2$
- B $\text{Cl}_2 + 2\text{NaI} \rightarrow 2\text{NaCl} + \text{I}_2$
- C $\text{I}_2 + 2\text{NaCl} \rightarrow 2\text{NaI} + \text{Cl}_2$
- D $\text{I}_2 + 2\text{NaBr} \rightarrow 2\text{NaI} + \text{Br}_2$

25 Which statement about the reactivity of metals is correct?

- A Sodium is very reactive because its atoms attract electrons very strongly.
- B Aluminium is more reactive than magnesium because aluminium forms 3+ ions but magnesium forms 2+ ions.
- C Calcium is a reactive metal because it forms very strong covalent bonds with other elements.
- D Copper is less reactive than magnesium because magnesium has a greater tendency to form positive ions.

26 Which substance reduces iron(III) oxide in the blast furnace?

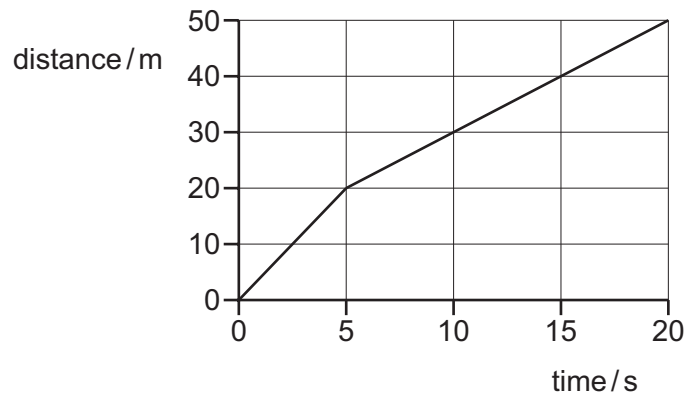
- A carbon dioxide
- B carbon monoxide
- C limestone (calcium carbonate)
- D oxygen

27 Which statements describe the molecules within a single fraction obtained from petroleum?

- 1 They are unsaturated hydrocarbons.
- 2 They have very different numbers of carbon atoms.
- 3 They have similar boiling points.
- 4 They react with other chemicals in a similar way.

- A 1 and 2
- B 1 and 3
- C 2 and 4
- D 3 and 4

- 28 The distance–time graph is for a student walking across a park.



What is the student's average speed walking across the park?

- A** 2.0 m/s **B** 2.5 m/s **C** 3.0 m/s **D** 4.0 m/s
- 29 The gravitational field strength is 10 N/kg.

What is the mass of an object that has a weight of 5.0 N?

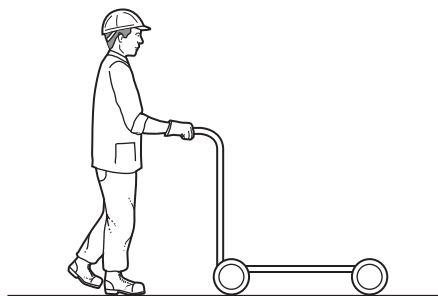
- A** 0.50 kg **B** 2.0 kg **C** 5.0 kg **D** 50 kg
- 30 A wire is stretched by a force. A force–extension graph is produced.

What is the significance of the extension at the limit of proportionality on the graph?

- A** It is the maximum extension before the wire breaks.
B It is the maximum extension for which Hooke's law is obeyed.
C It is the minimum extension before the wire breaks.
D It is the minimum extension for which Hooke's law is obeyed.

- 31** A worker exerts a horizontal force on a trolley.

The trolley moves in a straight line along a horizontal surface.



The worker pushes the trolley forwards for 5.0 m and then pulls it backwards for 2.0 m.

The worker exerts a force of 200 N when pushing and when pulling.

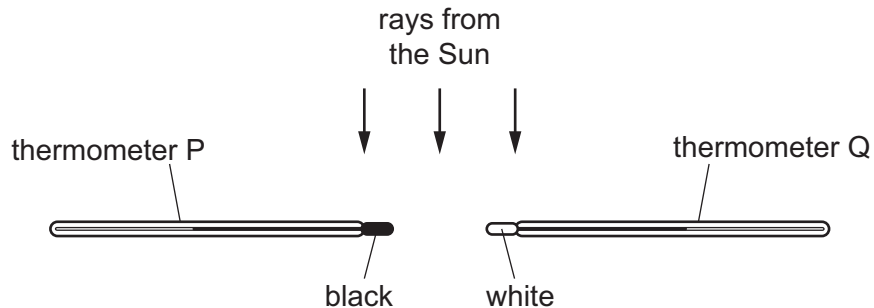
How much work does the worker do on the trolley?

- A** 400 J **B** 600 J **C** 1000 J **D** 1400 J
- 32** A stone of mass 0.30 kg is thrown upwards with an initial speed of 12 m/s.
- The speed of the stone decreases as the stone rises.
- By how much does the kinetic energy decrease when the stone reaches 4.0 m/s?
- A** 2.4 J **B** 9.6 J **C** 19 J **D** 38 J
- 33** Which statement describes one way in which solids conduct thermal energy?
- A** Electrons are tightly packed so that vibrations pass from one electron to the next.
- B** Molecules are tightly packed so that vibrations pass from one molecule to the next.
- C** Solids contain free molecules that are able to move through the solid.
- D** Solids contain molecules that are arranged in a regular structure so that thermal energy can pass through the spaces between them.

- 34** The diagram shows two identical thermometers, initially at the same temperature, placed in bright sunshine.

The bulb of thermometer P is painted black.

The bulb of thermometer Q is painted white.



The readings on the thermometers increase by different amounts.

How are the thermometer readings different and why?

- A** The reading on P is greater than on Q because black surfaces are good absorbers of radiation.
 - B** The reading on P is greater than on Q because black surfaces are poor emitters of radiation.
 - C** The reading on P is smaller than on Q because black surfaces are good emitters of radiation.
 - D** The reading on P is smaller than on Q because black surfaces are poor absorbers of radiation.
- 35** A converging lens is used as a magnifying glass.

Where is the image formed and what is the nature of the image?

	position of image	nature
A	on the opposite side of the lens from the object	real
B	on the opposite side of the lens from the object	virtual
C	on the same side of the lens as the object	real
D	on the same side of the lens as the object	virtual

- 36** A telescope in the vacuum of space has an infrared detector, an ultraviolet detector and a visible light detector.

An explosion on the surface of the Sun emits infrared, ultraviolet and visible light at the same time.

Which detector is the first to detect radiation from the explosion?

- A** the infrared detector
- B** the ultraviolet detector
- C** the visible light detector
- D** all three detect radiation at the same time

- 37** Two sounds with equal frequencies are produced by a loudspeaker.

The first sound has a large amplitude.

The second sound has a smaller amplitude.

How do the two sounds compare?

- A** The second sound is higher pitched.
- B** The second sound is lower pitched.
- C** The second sound is louder.
- D** The second sound is quieter.

- 38** A series circuit consists of a variable resistor and a power supply that supplies a variable electromotive force (e.m.f.).

Both the resistance of the variable resistor and the e.m.f. of the power supply are changed.

Which two changes together **must** cause the current in the circuit to decrease?

	resistance of variable resistor	e.m.f. of power supply
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

- 39** A car has two lamps connected in parallel to a 12 V battery. Each lamp has a resistance of 2.5Ω .

What is the total current in the circuit when the lamps are switched on?

- A** 2.4 A
- B** 4.8 A
- C** 9.6 A
- D** 15 A

- 40 What is the relationship between energy E transferred in a component, current I through it, potential difference (p.d.) V across it, and time t ?

A $E = \frac{It}{V}$

B $E = IVt$

C $E = \frac{VI}{t}$

D $E = \frac{Vt}{I}$

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.

The Periodic Table of Elements

Group																		
I	II											III	IV	V	VI	VII	VIII	
1Hhydrogen1 Key atomic number atomic symbol name relative atomic mass																		
3Li lithium 7	4Be beryllium 9																	
11Na sodium 23	12Mg magnesium 24	13Al aluminium 27	14Si silicon 28	15P phosphorus 31	16S sulfur 32	17Cl chlorine 35.5	18Ar argon 40											
19K potassium 39	20Ca calcium 40	21Sc scandium 45	22Ti titanium 48	23V vanadium 51	24Cr chromium 52	25Mn manganese 55	26Fe iron 56	27Co cobalt 59	28Ni nickel 59	29Cu copper 64	30Zn zinc 65	31Ga gallium 70	32Ge germanium 73	33As arsenic 75	34Se selenium 79	35Br bromine 80	36Kr krypton 84	
37Rb rubidium 85	38Sr strontium 88	39Y yttrium 89	40Zr zirconium 91	41Nb niobium 93	42Mo molybdenum 96	43Tc technetium —	44Ru ruthenium 101	45Rh rhodium 103	46Pd palladium 106	47Ag silver 108	48Cd cadmium 112	49In indium 115	50Sn tin 119	51Sb antimony 122	52Te tellurium 128	53I iodine 127	54Xe xenon 131	
55Cs caesium 133	56Ba barium 137	57–71 lanthanoids		72Hf hafnium 178	73Ta tantalum 181	74W tungsten 184	75Re rhenium 186	76Os osmium 190	77Ir iridium 192	78Pt platinum 195	79Au gold 197	80Hg mercury 201	81Tl thallium 204	82Pb lead 207	83Bi bismuth 209	84Po polonium —	85At astatine —	86Rn radon —
87Fr francium —	88Ra radium —	89–103 actinoids		104Rf rutherfordium —	105Db dubnium —	106Sg seaborgium —	107Bh bohrium —	108Hs hassium —	109Mt meitnerium —	110Ds darmstadtium —	111Rg roentgenium —	112Cn copernicium —	113Nh nihonium —	114Fl flerovium —	115Mc moscovium —	116Lv livermorium —	117Ts tennessine —	118Og oganeson —

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium —	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
	89 Ac actinium —	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium —	94 Pu plutonium —	95 Am americium —	96 Cm curium —	97 Bk berkelium —	98 Cf californium —	99 Es einsteinium —	100 Fm fermium —	101 Md mendelevium —	102 No nobelium —	103 Lr lawrencium —

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).