



Cambridge IGCSE™

COMBINED SCIENCE

Paper 2 Multiple Choice (Extended)

0653/21

May/June 2022

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.
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- 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.

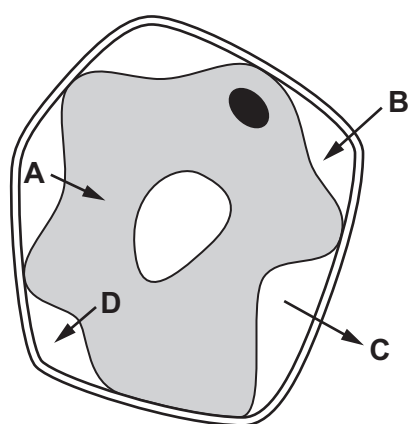


- 1 What is the outermost layer of an animal cell and a plant cell?

	animal cell	plant cell
A	cell membrane	cell membrane
B	cell membrane	cell wall
C	cell wall	cell membrane
D	cell wall	cell wall

- 2 The plant cell in the diagram is in a concentrated salt solution.

Which arrow represents osmosis?



- 3 The enzyme salivary amylase starts digesting starchy foods in the mouth.

This stops when the food reaches the stomach.

Why does this happen?

- A** The acid in the stomach slows down all reactions.
- B** The shape of the active site of the enzyme is altered by the low pH.
- C** The kinetic energy of molecules is reduced by acids.
- D** The shape of the substrate molecules is changed.

- 4 Which foods are rich in carbohydrate?

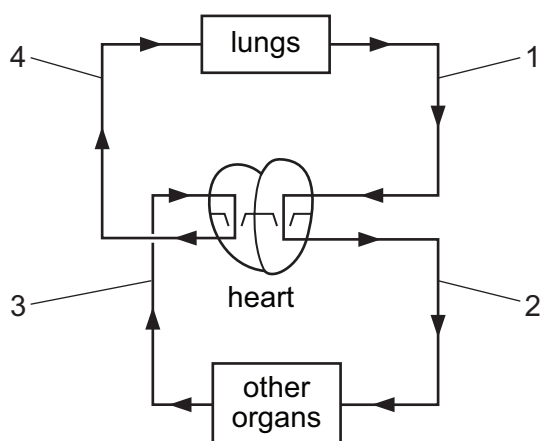
- 1 eggs
- 2 meat
- 3 potatoes
- 4 rice

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

5 Which row is correct for a protease enzyme?

	where secreted	molecule acted on	end product
A	stomach	protein	amino acids
B	pancreas	protein	fatty acid and glycerol
C	stomach	lipids	amino acids
D	pancreas	lipids	fatty acid and glycerol

6 The diagram shows the circulation of blood through the heart, lungs and other organs.



Which row gives a correct comparison of oxygen concentration in the blood in two of the numbered vessels?

	lower oxygen concentration	higher oxygen concentration
A	1	2
B	1	3
C	3	4
D	4	2

7 Which row shows the features of an efficient gas exchange surface in mammals?

	alveoli wall	blood supply	surface area
A	thick	low	large
B	thick	high	small
C	thin	high	large
D	thin	low	small

- 8 Physical activity affects our rate and depth of breathing.

What happens during **increased** physical activity?

	rate of breathing	depth of breathing
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

- 9 Which responses occur as a result of adrenaline secretion?

	increased breathing rate	decreased pupil diameter	increased pulse rate
A	✓	✗	✗
B	✓	✗	✓
C	✗	✓	✓
D	✗	✓	✗

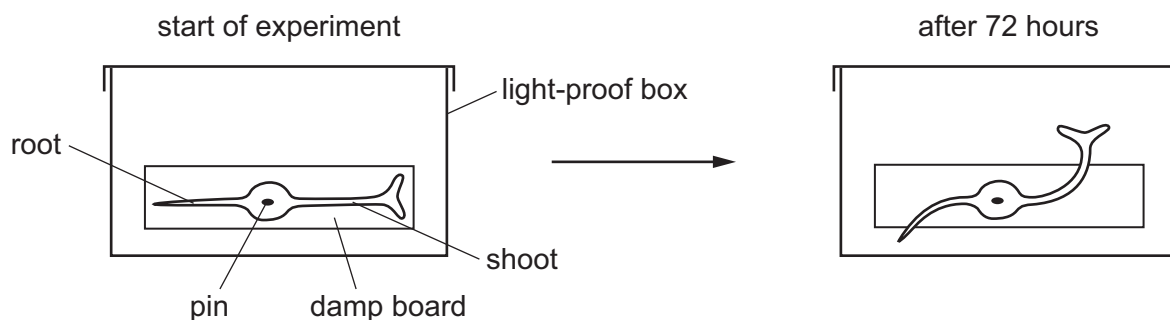
key

✓ = does occur

✗ = does not occur

- 10 A plant seedling is pinned horizontally onto a damp board inside a light-proof box.

The diagrams show the seedling at the start of the experiment and after 72 hours.



Which response is shown by the root and the shoot?

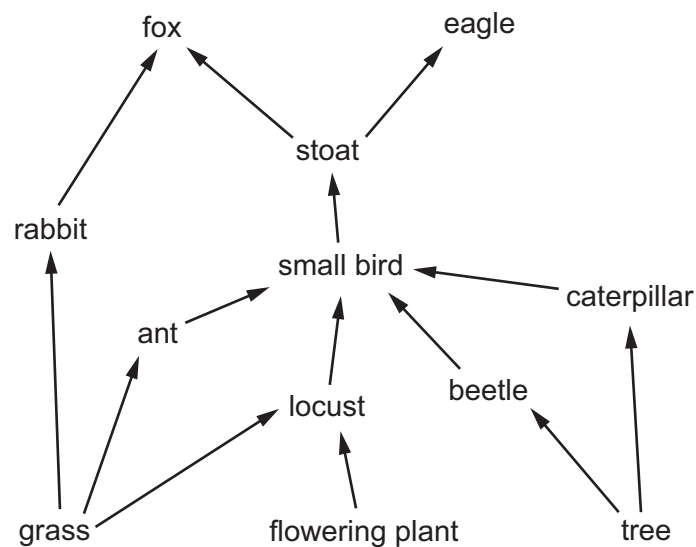
	root	shoot
A	gravitropism	gravitropism
B	gravitropism	phototropism
C	phototropism	gravitropism
D	phototropism	phototropism

11 During sexual intercourse the penis transfers sperm cells to the vagina.

What is the pathway for sperm cells from their site of production to the vagina?

- A sperm ducts → testes → urethra → vagina
- B testes → sperm ducts → urethra → vagina
- C testes → urethra → sperm ducts → vagina
- D urethra → testes → sperm ducts → vagina

12 The diagram shows part of a food web.



Which animal is a quaternary consumer **only**?

- A eagle
- B fox
- C locust
- D small bird

13 In the process of eutrophication, what causes the increased growth of producers?

- A increased carbon dioxide availability
- B increased decomposition
- C increased nitrate ion availability
- D increased oxygen availability

14 Which row describes a chemical change?

	test	result
A	one end of a piece of aluminium is heated	the other end gets hot
B	calcium carbonate is heated	carbon dioxide is made
C	a piece of iron is heated	it becomes more malleable
D	a beaker of water is heated	steam is made

15 What describes a solvent?

- A** a solid that dissolves in a liquid
- B** the amount of solid that dissolves in a liquid
- C** the liquid in which a solid dissolves
- D** the mixture formed when a solid dissolves in a liquid

16 The formula of sodium phosphate is Na_3PO_4 .

The formula of aluminium chloride is AlCl_3 .

What is the formula of aluminium phosphate?

- A** AlPO_4 **B** $\text{Al}(\text{PO}_4)_3$ **C** $\text{Al}_2(\text{PO}_4)_3$ **D** Al_3PO_4

17 Magnesium reacts with dilute hydrochloric acid.

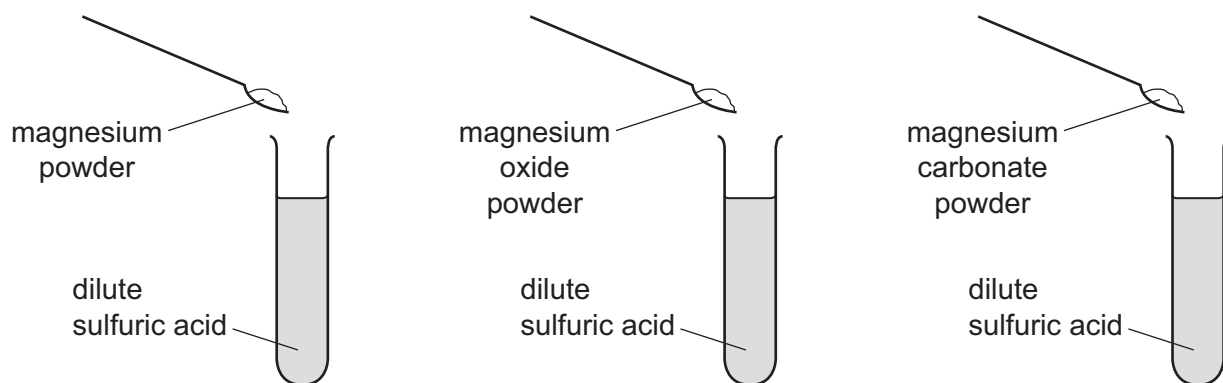
Which statement explains why the rate of this reaction increases when the concentration of the acid is increased?

- A** A greater proportion of the particles have the minimum energy to react.
- B** The particles are closer together and the particles collide more frequently.
- C** The particles collide more frequently and more of the particles have the minimum energy to react.
- D** The particles collide more frequently and the activation energy of the reaction is reduced.

18 In which equation is the underlined substance acting as an oxidising agent?

- A** $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$
- B** $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$
- C** $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$
- D** $\text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO}$

19 Three powders are added to dilute sulfuric acid, as shown.



Which powders react to produce water?

	magnesium	magnesium oxide	magnesium carbonate
A	✓	✓	✗
B	✓	✗	✗
C	✗	✓	✓
D	✗	✗	✓

key

✓ = does produce water

✗ = does not produce water

20 Elements X, Y and Z are in Group I of the Periodic Table.

Some information about these elements is shown.

	melting point /°C	<u>density</u> g/cm ³
X		1.53
Y	98	
Z	63	0.86

Which row correctly identifies elements X, Y and Z?

	X	Y	Z
A	potassium	sodium	rubidium
B	rubidium	potassium	sodium
C	rubidium	sodium	potassium
D	sodium	rubidium	potassium

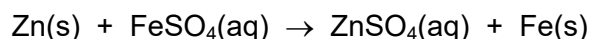
21 The results of two tests on substance Q are shown.

test	result
add dilute hydrochloric acid to solid Q	bubbles of colourless gas, R, which turns limewater milky
add aqueous sodium hydroxide to a solution of Q	green precipitate

Which cation is present in Q and what is gas R?

	cation present in Q	gas R
A	iron(II)	carbon dioxide
B	iron(II)	chlorine
C	iron(III)	carbon dioxide
D	iron(III)	chlorine

22 The equation for the reaction between zinc and aqueous iron(II) sulfate is shown.



Which statements about this reaction are correct?

- 1 Zinc atoms give electrons to iron ions.
- 2 Iron atoms have a greater tendency to form positive ions than zinc atoms.
- 3 Zinc displaces iron because it is more reactive than iron.

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

23 Iron is extracted from hematite in the blast furnace.

Coke and hematite are added at the top of the blast furnace, and hot air enters at the bottom.

Which statements are correct?

- 1 Coke burns to produce high temperatures.
- 2 Carbon monoxide is formed by the reaction of carbon with carbon dioxide.
- 3 Hematite contains iron(III) oxide which is oxidised by carbon monoxide.
- 4 The oxygen needed for the combustion of the coke comes from the hematite.

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

24 Which statement about a chemical test for water is correct?

- A Anhydrous cobalt(II) chloride turns blue.
- B Anhydrous cobalt(II) chloride turns white.
- C Anhydrous copper(II) sulfate turns blue.
- D Anhydrous copper(II) sulfate turns white.

25 Alkenes are hydrocarbons that belong to the same homologous series.

What are the general properties of a homologous series?

- 1 same general formula
- 2 same melting point
- 3 similar chemical properties

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

26 Methane, ethane and propane are all alkanes. Their formulae are shown.

methane, CH_4

ethane, C_2H_6

propane, C_3H_8

Which statement is **not** correct?

- A All three compounds are hydrocarbons.
- B All three compounds burn.
- C Methane is the main constituent of natural gas.
- D Propane burns completely to form carbon dioxide and hydrogen.

27 Which substance rapidly turns aqueous bromine from orange to colourless?

- A ethane
- B ethanol
- C ethene
- D methane

28 Which statement about forces is always correct?

- A A resultant force is needed to keep an object moving at constant speed in a straight line.
- B Air resistance acting on an object falling in still air causes its speed to increase.
- C Friction on an object sliding along rough ground acts in the opposite direction to its motion.
- D No forces act on any object that is at rest.

29 A table of mass 20 kg is supported on four legs. The area of contact between each leg and the ground is $1.0 \times 10^{-3} \text{ m}^2$.

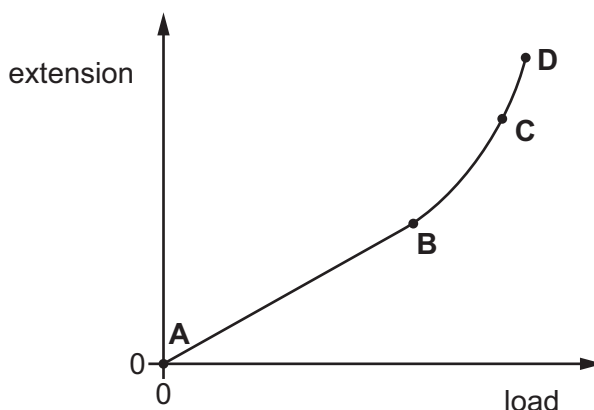
The value of the gravitational field strength g is 10 N/kg.

How much pressure is exerted on the ground by each leg?

- A 5000 Pa B 20 000 Pa C 50 000 Pa D 200 000 Pa

30 The diagram shows an extension–load graph for a spring.

Which labelled point is the limit of proportionality of the spring?

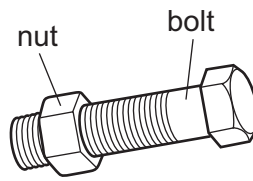


31 A boy of mass 80 kg is running at a speed of 4.0 m/s.

What is his kinetic energy?

- A 160 J B 320 J C 640 J D 1280 J

- 32** A mechanic cannot remove a large steel nut from a steel bolt because it is too tight.



What does the mechanic do to help remove the nut?

- A** cool the nut and heat the bolt
- B** heat the bolt only
- C** heat the nut and the bolt through the same temperature rise
- D** heat the nut only

- 33** A metal rod is heated at one end.

Thermal energy moves from the hotter end to the colder end.

How do molecules and free electrons transfer thermal energy along the rod?

	molecules	free electrons
A	move from the hotter end to the colder end	move from the hotter end to the colder end
B	move from the hotter end to the colder end	pass kinetic energy to neighbouring electrons
C	pass kinetic energy to neighbouring molecules	move from the hotter end to the colder end
D	pass kinetic energy to neighbouring molecules	pass kinetic energy to neighbouring electrons

- 34** Light travels at a speed of 3.0×10^8 m/s in a vacuum.

A radio station transmits radio waves at a frequency of 9.1×10^7 Hz.

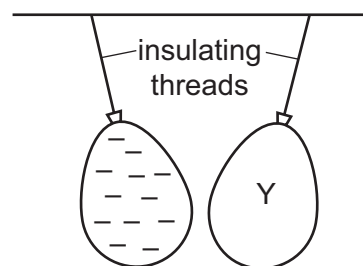
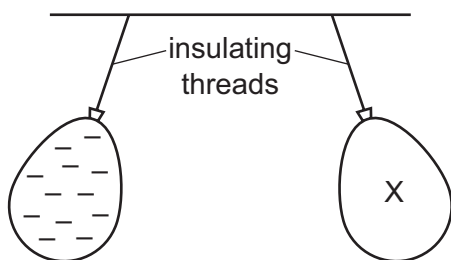
What is the wavelength of the radio waves?

- A** 0.30 m **B** 0.33 m **C** 3.0 m **D** 3.3 m
- 35** Which region of the electromagnetic spectrum is used in remote controllers to control a television?
- A** microwaves
 - B** infrared
 - C** ultraviolet
 - D** visible light

36 Where does sound travel at the greatest speed?

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

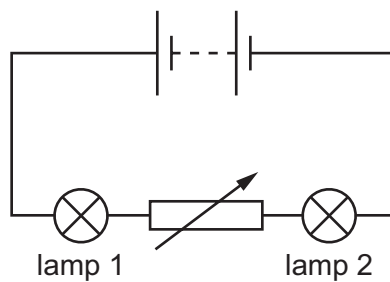
37 Two balloons X and Y are suspended by insulating threads. They are each held near a negatively charged balloon. The balloons hang as shown.



What is the charge on balloon X and what is the charge on balloon Y?

	balloon X	balloon Y
A	negative	negative
B	negative	positive
C	positive	negative
D	positive	positive

38 A circuit contains two lamps and a variable resistor.



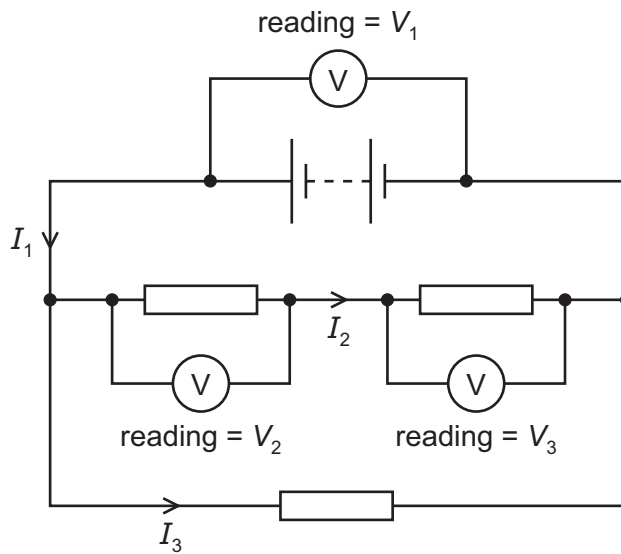
The resistance of the variable resistor is increased.

What happens to the brightness of lamp 1 and what happens to the brightness of lamp 2?

	brightness of lamp 1	brightness of lamp 2
A	decreases	decreases
B	decreases	increases
C	no change	decreases
D	no change	increases

39 The diagram shows a circuit that includes three resistors, a battery and three voltmeters.

Readings V_1 , V_2 and V_3 on the voltmeters, and currents I_1 , I_2 and I_3 , are labelled.



Which row gives the relationships between the currents and between the voltages?

	currents	voltages
A	$I_1 = I_2 + I_3$	$V_1 = V_2 + V_3$
B	$I_1 = I_2 + I_3$	$V_1 + V_2 = V_3$
C	$I_1 + I_2 = I_3$	$V_1 = V_2 + V_3$
D	$I_1 + I_2 = I_3$	$V_1 + V_2 = V_3$

40 There is a current I in a resistor when there is a potential difference (p.d.) V across it.

Which quantity is equal to the product IV ?

- A** the charge passing through the resistor
- B** the energy transferred in the resistor
- C** the power transferred in the resistor
- D** the resistance of the resistor

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The Periodic Table of Elements

Group																	
I	II	1 H hydrogen 1										III	IV	V	VI	VII	VIII
3 Li lithium 7	4 Be beryllium 9	Key atomic number atomic symbol name relative atomic mass										5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
	11 Na sodium 23																
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						
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	75 Re rhenium 186	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 —	107 Bh bohrium —	108 Hs hassium —	109 Mt meitnerium —	110 Ds darmstadtium —	111 Rg roentgenium —	112 Cn copernicium —	114 Fl flerovium —	116 Lv livermorium —				

lanthanoids

actinoids

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.).



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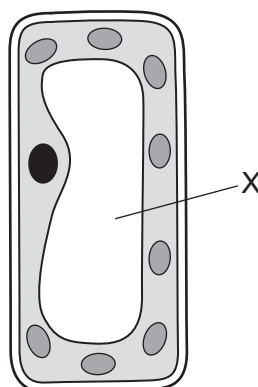
This document has **16** pages.



- 1 What is the outermost layer of an animal cell and a plant cell?

	animal cell	plant cell
A	cell membrane	cell membrane
B	cell membrane	cell wall
C	cell wall	cell membrane
D	cell wall	cell wall

- 2 The diagram shows a plant palisade mesophyll cell.



What will happen to structure X if this cell is immersed in distilled water or concentrated salty water?

	structure X in distilled water	structure X in concentrated salty water
A	shrink	shrink
B	shrink	swell
C	swell	swell
D	swell	shrink

- 3 The enzyme salivary amylase starts digesting starchy foods in the mouth.

This stops when the food reaches the stomach.

Why does this happen?

- A** The acid in the stomach slows down all reactions.
- B** The shape of the active site of the enzyme is altered by the low pH.
- C** The kinetic energy of molecules is reduced by acids.
- D** The shape of the substrate molecules is changed.

4 Which two nutrients does a pregnant woman need in greater amounts to help her baby develop bones and blood?

- A calcium and iron
- B calcium and vitamin D
- C carbohydrate and iron
- D carbohydrate and vitamin D

5 Which row is correct for mechanical digestion?

	substance being broken down	broken down using	product of breakdown
A	large food molecules	enzymes	small pieces of food
B	large food molecules	teeth	small food molecules
C	large pieces of food	enzymes	small food molecules
D	large pieces of food	teeth	small pieces of food

6 What is a role of root hair cells?

- A to decrease surface area, to decrease loss of water
- B to decrease surface area, to increase uptake of water
- C to increase surface area, to decrease loss of water
- D to increase surface area, to increase uptake of water

7 The table shows two components of tobacco smoke and their possible effects on the body.

	component in tobacco smoke	effects on the body	
		decreased oxygen absorption by blood	increased blood pressure
1	carbon monoxide	x	✓
2	carbon monoxide	✓	x
3	nicotine	x	✓
4	nicotine	✓	x

Which rows show the correct effects of each component?

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

8 Physical activity affects our rate and depth of breathing.

What happens during **increased** physical activity?

	rate of breathing	depth of breathing
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

9 Some examples of responses in the body are listed.

- 1 decreased pupil diameter
- 2 increased breathing rate
- 3 increased pulse rate

Which responses are caused by the secretion of adrenaline?

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

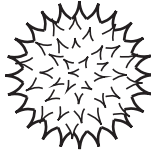
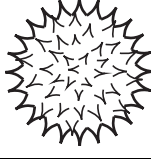
10 Some examples of how parts of a plant grow are listed.

- 1 grow away from gravity
- 2 grow away from the direction of light
- 3 grow towards gravity
- 4 grow towards the direction of light

Which growth responses are due to gravitropism?

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

11 Which row is correct for a wind-pollinated flower?

	pollen shape	position of stigma
A		outside of flower
B		inside of flower
C		inside of flower
D		outside of flower

12 During sexual intercourse the penis transfers sperm cells to the vagina.

What is the pathway for sperm cells from their site of production to the vagina?

- A** sperm ducts → testes → urethra → vagina
- B** testes → sperm ducts → urethra → vagina
- C** testes → urethra → sperm ducts → vagina
- D** urethra → testes → sperm ducts → vagina

13 What is an ecosystem?

- A** a habitat containing organisms interacting together, in a given area
- B** a unit containing all of the organisms and their environment, interacting together, in a given area
- C** an environment containing some organisms, interacting together
- D** the positions of organisms in a food web, interacting together, with the environment, in a given area

14 Three changes are listed.

- 1 Dilute hydrochloric acid is reacted with aqueous sodium hydroxide.
- 2 The mixture formed is then heated until all of the water is evaporated.
- 3 The solid that is formed is then heated until it melts.

Which row describes changes 1, 2 and 3?

	1	2	3
A	chemical	chemical	physical
B	chemical	physical	physical
C	physical	physical	chemical
D	physical	chemical	chemical

15 Substance Z exists as molecules that contain only one type of atom.

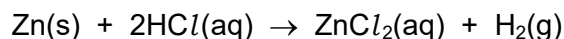
What is Z?

- A** a compound
- B** a mixture
- C** an element
- D** a noble gas

16 Which statement about the electrolysis of molten lead(II) bromide using carbon electrodes is correct?

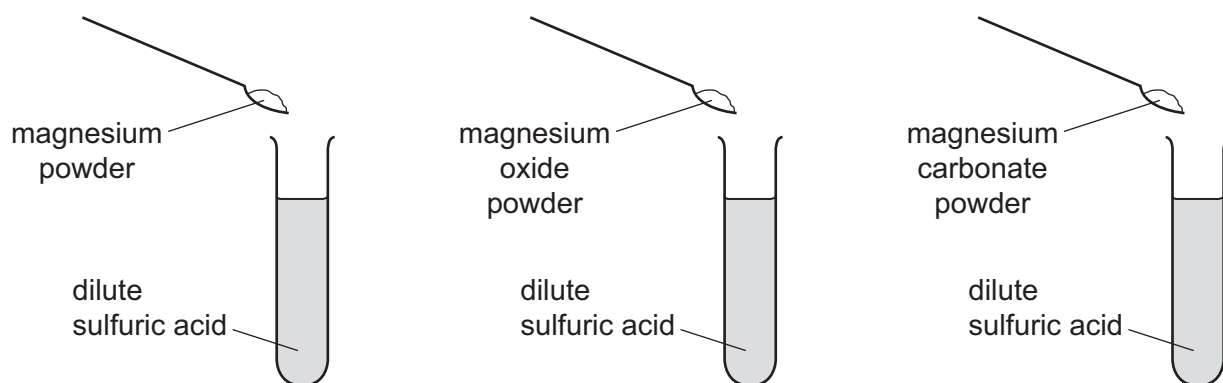
- A** Bromide ions gain electrons at the anode.
- B** Bromide ions lose electrons at the anode.
- C** Lead ions gain electrons at the anode.
- D** Lead ions lose electrons at the anode.

- 17 Zinc reacts with dilute hydrochloric acid to form hydrogen which is collected in a gas syringe.



Which statement is correct?

- A Larger pieces of zinc react faster than the same mass of smaller pieces because they have a larger total surface area.
 - B When a catalyst is added, the time taken to collect 20 cm³ of hydrogen is reduced because fewer particles have the activation energy.
 - C Hydrogen is produced faster when the acid is more concentrated because a larger proportion of the particles have the activation energy.
 - D Raising the temperature reduces the time taken to collect 20 cm³ of hydrogen because more particles have the activation energy.
- 18 Three powders are added to dilute sulfuric acid, as shown.



Which powders react to produce water?

	magnesium	magnesium oxide	magnesium carbonate
A	✓	✓	x
B	✓	x	x
C	x	✓	✓
D	x	x	✓

key

✓ = does produce water

x = does not produce water

19 Magnesium nitrate is produced by reacting magnesium oxide with dilute nitric acid.

Which process is used to produce a pure sample of magnesium nitrate crystals?

- A** Add excess dilute nitric acid to magnesium oxide, filter and boil the filtrate to dryness.
- B** Add excess dilute nitric acid to magnesium oxide, filter and evaporate the filtrate to the point of crystallisation.
- C** Add excess magnesium oxide to dilute nitric acid, filter and boil the filtrate to dryness.
- D** Add excess magnesium oxide to dilute nitric acid, filter and evaporate the filtrate to the point of crystallisation.

20 The results of two tests on substance Q are shown.

test	result
add dilute hydrochloric acid to solid Q	bubbles of colourless gas, R, which turns limewater milky
add aqueous sodium hydroxide to a solution of Q	green precipitate

Which cation is present in Q and what is gas R?

	cation present in Q	gas R
A	iron(II)	carbon dioxide
B	iron(II)	chlorine
C	iron(III)	carbon dioxide
D	iron(III)	chlorine

21 Indium is an element in the Periodic Table.

Which row describes the electronic structure and character of indium?

	number of outer shell electrons	character
A	3	metal
B	3	non-metal
C	5	metal
D	5	non-metal

22 Which statements about the reactivity series of metals are correct?

- 1 Iron is higher in the reactivity series than copper because it cannot be extracted from its oxide using carbon.
- 2 Sodium is higher in the reactivity series than copper because it has a greater tendency to form positive ions.
- 3 Magnesium is higher in the reactivity series than zinc because it can displace zinc ions from aqueous solution.

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

23 Which equations represent reactions that take place in the blast furnace?

- 1 $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
- 2 $2\text{CO}_2 \rightarrow 2\text{CO} + \text{O}_2$
- 3 $2\text{FeO} + \text{C} \rightarrow 2\text{Fe} + \text{CO}_2$
- 4 $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$

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

24 Which colour change is seen when water is added to anhydrous cobalt(II) chloride?

- A** blue to pink
B blue to white
C pink to blue
D white to blue

25 Which statement about homologous series is correct?

- A** Alkanes and alkenes have the same general formula.
B Alkenes contain only double bonds.
C Alkanes and alkenes have similar chemical properties.
D Ethene, C_2H_4 , and propene, C_3H_6 , are members of the same homologous series.

26 Methane, ethane and propane are all alkanes. Their formulae are shown.

methane, CH_4

ethane, C_2H_6

propane, C_3H_8

Which statement is **not** correct?

- A All three compounds are hydrocarbons.
- B All three compounds burn.
- C Methane is the main constituent of natural gas.
- D Propane burns completely to form carbon dioxide and hydrogen.

27 Which substance rapidly turns aqueous bromine from orange to colourless?

- A ethane
- B ethanol
- C ethene
- D methane

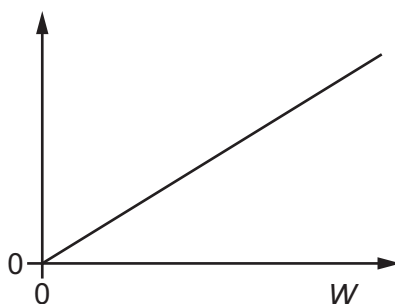
28 A student investigates a spring that obeys Hooke's law.

The student suspends loads with different weights from the spring and measures the length of the spring for each weight.

L_o is the length of the spring when there is no load on it.

L_w is the length of the spring when there is a load of weight W on it.

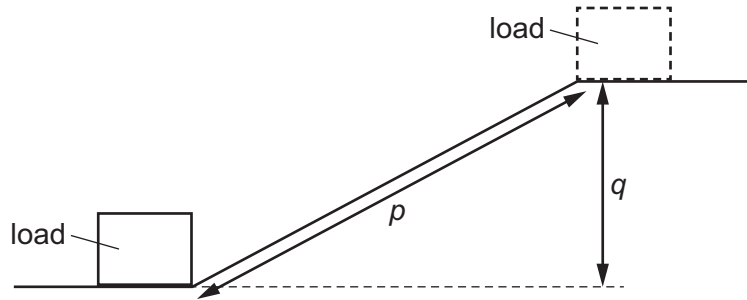
The graph shows the student's results.



Which quantity is plotted on the y-axis?

- A $L_w - L_o$
- B $L_w + L_o$
- C L_w
- D $\frac{L_w}{L_o}$

- 29 A load of mass m is moved to the top of a slope of length p and vertical height q .



Which expression gives the gravitational potential energy gained by the load?

- A** mgp **B** mgq **C** mp **D** mq

- 30 Motor X does 300 J of work in 10 s.

Motor Y is twice as powerful as motor X.

Which row gives possible values for the work done and the time taken for motor Y?

	work done / J	time taken / s
A	300	5
B	300	20
C	600	5
D	600	20

- 31 Which group of energy sources consists of only renewable sources?

- A** geothermal, nuclear, solar
B geothermal, solar, wind
C nuclear, solar, wind
D oil, geothermal, solar

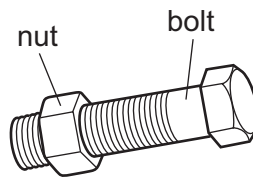
- 32 Air is trapped in a sealed glass bottle that has a fixed volume.

The temperature of the air in the bottle decreases.

Which statement describes what happens to the air in the bottle?

- A** The average separation of the molecules decreases and the pressure decreases.
B The average separation of the molecules decreases but the pressure remains the same.
C The average separation of the molecules remains the same but the pressure decreases.
D The average separation of the molecules remains the same and the pressure remains the same.

- 33** A mechanic cannot remove a large steel nut from a steel bolt because it is too tight.



What does the mechanic do to help remove the nut?

- A** cool the nut and heat the bolt
- B** heat the bolt only
- C** heat the nut and the bolt through the same temperature rise
- D** heat the nut only

- 34** Light travels at a speed of 3.0×10^8 m/s in a vacuum.

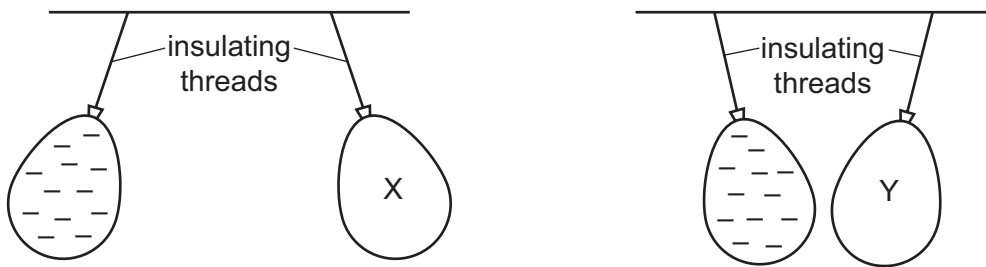
A radio station transmits radio waves at a frequency of 9.1×10^7 Hz.

What is the wavelength of the radio waves?

- A** 0.30 m **B** 0.33 m **C** 3.0 m **D** 3.3 m
- 35** Where does sound travel at the greatest speed?

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

- 36** Two balloons X and Y are suspended by insulating threads. They are each held near a negatively charged balloon. The balloons hang as shown.



What is the charge on balloon X and what is the charge on balloon Y?

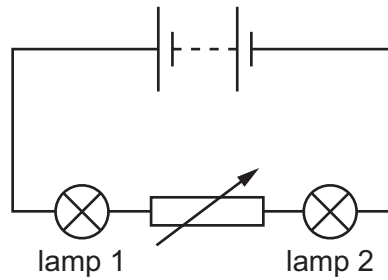
	balloon X	balloon Y
A	negative	negative
B	negative	positive
C	positive	negative
D	positive	positive

- 37** A 1.0 m length of resistance wire with a cross-sectional area of 0.032 mm^2 has a resistance of 15Ω .

Which other wire, made from the same material, also has a resistance of 15Ω ?

	length / m	cross-sectional area / mm^2
A	0.50	0.0080
B	0.50	0.064
C	2.0	0.0080
D	2.0	0.064

- 38 A circuit contains two lamps and a variable resistor.

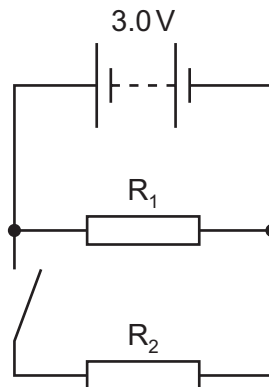


The resistance of the variable resistor is increased.

What happens to the brightness of lamp 1 and what happens to the brightness of lamp 2?

	brightness of lamp 1	brightness of lamp 2
A	decreases	decreases
B	decreases	increases
C	no change	decreases
D	no change	increases

- 39 Two identical resistors R_1 and R_2 are connected to a 3.0V battery as shown. The switch in the circuit is open.



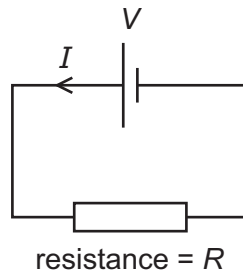
The switch is now closed.

What happens?

- A** The current in the battery halves.
- B** The current in the battery stays the same.
- C** The potential difference across R_1 stays the same.
- D** The potential difference across R_2 becomes 1.5V.

40 A cell produces a potential difference (p.d.) V across a resistor of resistance R .

There is a current I in the resistor.



Which expression gives the energy transferred in the resistor in a time t ?

A $\frac{IV}{t}$

B IVt

C $\frac{IR}{t}$

D IRt

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The Periodic Table of Elements

Group																	
I	II	1 H hydrogen 1										III	IV	V	VI	VII	VIII
3 Li lithium 7	4 Be beryllium 9	Key atomic number atomic symbol name relative atomic mass										5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
	11 Na sodium 23											12 Mg magnesium 24	13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	
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	75 Re rhenium 186	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 —	107 Bh bohrium —	108 Hs hassium —	109 Mt meitnerium —	110 Ds darmstadtium —	111 Rg roentgenium —	112 Cn copernicium —	114 Fl flerovium —	116 Lv livermorium —	117 Ts tennessine —	118 Og oganesson —	119 Nh nihonium —	120 Dl dubnium —

lanthanoids

actinoids

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.).



Cambridge IGCSE™

COMBINED SCIENCE

0653/23

Paper 2 Multiple Choice (Extended)

May/June 2022

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 What is the outermost layer of an animal cell and a plant cell?

	animal cell	plant cell
A	cell membrane	cell membrane
B	cell membrane	cell wall
C	cell wall	cell membrane
D	cell wall	cell wall

- 2 What is the definition of diffusion?

- A** the downward movement of particles in the atmosphere
- B** the movement of particles down a concentration gradient
- C** the movement of molecules against a concentration gradient
- D** the movement of particles from a hotter to a cooler region

- 3 The enzyme salivary amylase starts digesting starchy foods in the mouth.

This stops when the food reaches the stomach.

Why does this happen?

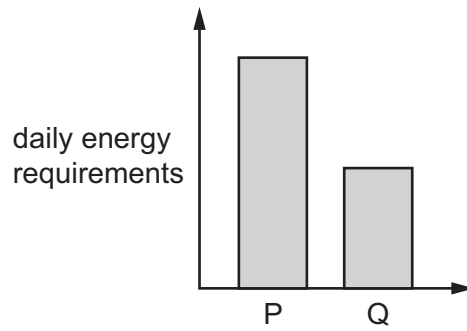
- A** The acid in the stomach slows down all reactions.
- B** The shape of the active site of the enzyme is altered by the low pH.
- C** The kinetic energy of molecules is reduced by acids.
- D** The shape of the substrate molecules is changed.

- 4 Stomata are found in the leaves of plants.

What is their main function?

- A** gas exchange
- B** structural support
- C** transport of food molecules
- D** transport of water

- 5 The graph shows the daily energy requirements for two people, P and Q.

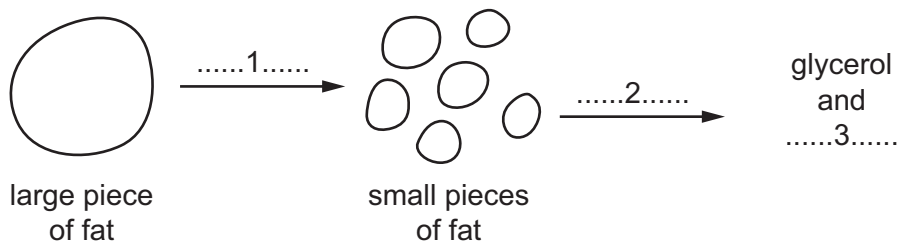


Which statements could describe P and Q?

- 1 P is a mother who is breast-feeding her baby and Q is a mother who is bottle-feeding her baby.
- 2 P is a 20-year-old adult male and Q is a 20-year-old adult female.
- 3 P is an office worker and Q is a professional cyclist.

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

- 6 The diagram shows the digestion of fat.



Which row completes gaps 1, 2 and 3 in the diagram?

	1	2	3
A	chemical digestion	chemical digestion	amino acids
B	chemical digestion	mechanical digestion	fatty acids
C	mechanical digestion	mechanical digestion	amino acids
D	mechanical digestion	chemical digestion	fatty acids

- 7 Which statement about root hair cells is correct?

- A** They are present in large numbers to increase the absorption of water.
- B** They are only present in young seedlings before major roots grow.
- C** They are branched to help prevent the wind dislodging a plant.
- D** They have a large surface area to allow carbon dioxide uptake.

8 Physical activity affects our rate and depth of breathing.

What happens during **increased** physical activity?

	rate of breathing	depth of breathing
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

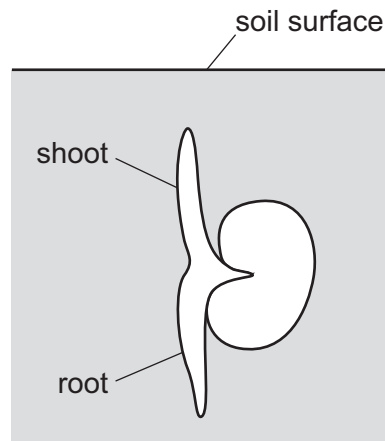
9 Some statements about adrenaline are listed.

- 1 It has one target organ.
- 2 It is a hormone.
- 3 It is produced by a gland.
- 4 It is transported in the blood.

Which statements are correct?

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

10 The diagram shows a seed germinating in soil.

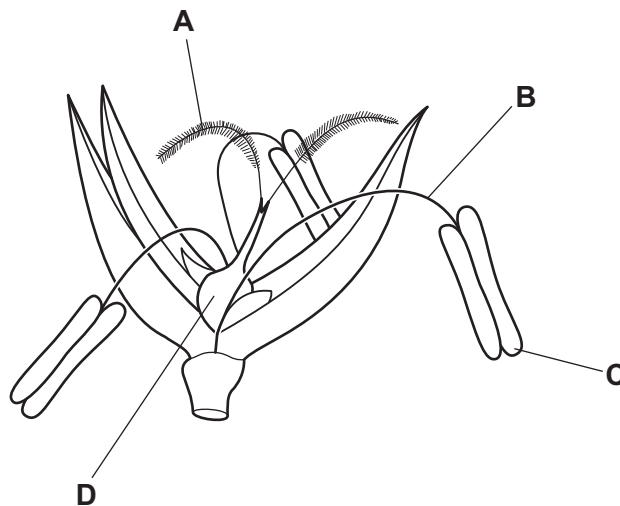


Which tropic responses are taking place in the shoot and root while they are still underground?

	shoot	root
A	gravitropism	gravitropism
B	gravitropism	phototropism
C	phototropism	gravitropism
D	phototropism	phototropism

11 The diagram shows a typical wind-pollinated flower.

Which structure is the stigma?



- 12** During sexual intercourse the penis transfers sperm cells to the vagina.

What is the pathway for sperm cells from their site of production to the vagina?

- A** sperm ducts → testes → urethra → vagina
- B** testes → sperm ducts → urethra → vagina
- C** testes → urethra → sperm ducts → vagina
- D** urethra → testes → sperm ducts → vagina

- 13** The diagram shows a food chain from an ocean ecosystem.

microscopic plants → krill → small fish → tuna → shark

What is the trophic level of the tuna?

- A** primary consumer
- B** quaternary consumer
- C** secondary consumer
- D** tertiary consumer

- 14** When solid sodium carbonate is added to dilute hydrochloric acid, it dissolves and carbon dioxide is given off.

Which statement is correct?

- A** This is a chemical change because sodium carbonate dissolves.
- B** This is a chemical change because the acid reacts with sodium carbonate.
- C** This is a physical change because sodium carbonate dissolves.
- D** This is a physical change because the acid reacts with sodium carbonate.

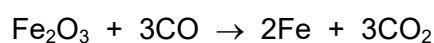
- 15** Which statement about non-metallic elements is correct?

- A** They are hard.
- B** They are malleable.
- C** They conduct electricity.
- D** They have low densities.

- 16 Which statement about the movement of particles during the electrolysis of dilute sulfuric acid is correct?
- A** Anions move to the negative electrode and lose electrons.
- B** Electrons travel through the electrolyte from the cathode to the anode.
- C** Electrons travel through the external circuit from the anode to the cathode.
- D** Positive ions move to the anode and gain electrons.
- 17 Which row describes what happens to the frequency of collisions between reacting particles and the energy of these collisions when the concentration of the reactants is decreased?

	frequency of collisions	energy of collisions
A	decreases	decreases
B	decreases	no change
C	increases	decreases
D	increases	no change

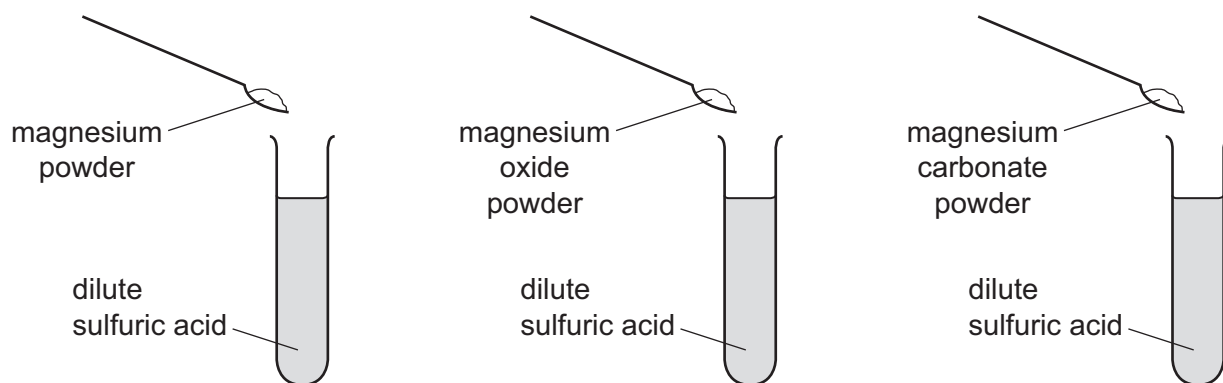
- 18 The equation for a reaction that occurs in the blast furnace is shown.



Which statement about the reaction is correct?

- A** Fe_2O_3 is the oxidising agent.
- B** CO_2 is the reducing agent.
- C** CO is reduced.
- D** Fe_2O_3 is oxidised.

19 Three powders are added to dilute sulfuric acid, as shown.



Which powders react to produce water?

	magnesium	magnesium oxide	magnesium carbonate
A	✓	✓	✗
B	✓	✗	✗
C	✗	✓	✓
D	✗	✗	✓

key

✓ = does produce water

✗ = does not produce water

20 Salt X is produced in the reaction between solid Y and acid Z.

The following method is used to prepare crystals of salt X.

- Solid Y is added to acid Z until no further reaction occurs.
- Any unreacted solid Y is removed by filtration.
- The filtrate is evaporated to the point of crystallisation and left to cool.
- Salt X crystallises.

Which row shows the substances that can be used to produce a salt by using this method?

	solid Y	acid Z	salt X
A	insoluble copper	dilute hydrochloric acid	soluble copper(II) chloride
B	insoluble lead carbonate	dilute sulfuric acid	insoluble lead sulfate
C	soluble sodium hydroxide	dilute hydrochloric acid	soluble sodium chloride
D	insoluble zinc oxide	dilute sulfuric acid	soluble zinc sulfate

21 The results of two tests on substance Q are shown.

test	result
add dilute hydrochloric acid to solid Q	bubbles of colourless gas, R, which turns limewater milky
add aqueous sodium hydroxide to a solution of Q	green precipitate

Which cation is present in Q and what is gas R?

	cation present in Q	gas R
A	iron(II)	carbon dioxide
B	iron(II)	chlorine
C	iron(III)	carbon dioxide
D	iron(III)	chlorine

22 In which mixture is the aqueous metal ion displaced by the metal?

A Cu^{2+} and Zn **B** Fe^{2+} and Cu **C** Mg^{2+} and Zn **D** Zn^{2+} and Fe

23 Iron is extracted from iron(III) oxide in the blast furnace.

Which reaction produces the heat to maintain a high temperature in the furnace?

- A** calcium carbonate $\rightarrow$ calcium oxide + carbon dioxide
B carbon + oxygen $\rightarrow$ carbon dioxide
C iron(III) oxide + carbon monoxide $\rightarrow$ iron + carbon dioxide
D silicon dioxide + calcium oxide $\rightarrow$ calcium silicate

24 Which statement about the treatment of the water supply is correct?

- A** After filtration and chlorination, the water contains no impurities.
B Chlorine is added to remove dissolved impurities.
C Water is filtered and chlorinated to remove solids and kill bacteria.
D Water is filtered to remove dissolved impurities.

- 25 Which statement best describes the members of a homologous series?
- A They have different general formulae and different chemical properties.
 - B They have different general formulae and similar chemical properties.
 - C They have the same general formula and different chemical properties.
 - D They have the same general formula and similar chemical properties.

- 26 Methane, ethane and propane are all alkanes. Their formulae are shown.

methane, CH_4

ethane, C_2H_6

propane, C_3H_8

Which statement is **not** correct?

- A All three compounds are hydrocarbons.
 - B All three compounds burn.
 - C Methane is the main constituent of natural gas.
 - D Propane burns completely to form carbon dioxide and hydrogen.
- 27 Which substance rapidly turns aqueous bromine from orange to colourless?
- A ethane
 - B ethanol
 - C ethene
 - D methane

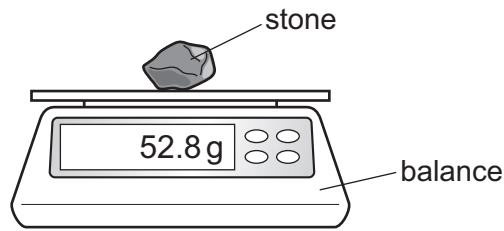
- 28 A climber climbs a mountain.

The gravitational field strength at the top of the mountain is less than it is at the bottom.

How do the mass and the weight of the climber at the top compare with the mass and the weight at the bottom?

	mass at top compared with mass at bottom	weight at top compared with weight at bottom
A	less	less
B	less	the same
C	the same	less
D	the same	the same

- 29 A stone is placed on a balance. The reading on the balance is shown.



The stone is lowered carefully into a measuring cylinder that contains 50 cm^3 of water. The level of the water in the measuring cylinder rises to the 72 cm^3 mark.

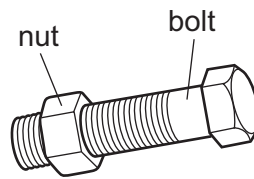
What is the density of the stone?

- A** 0.42 g/cm^3 **B** 0.73 g/cm^3 **C** 1.36 g/cm^3 **D** 2.40 g/cm^3
- 30 A man lifts four heavy boxes from the ground onto a high shelf, one at a time.
- When does he develop the greatest power?
- A** lifting a box of mass 20 kg in 3.0 s
B lifting a box of mass 20 kg in 4.0 s
C lifting a box of mass 30 kg in 3.0 s
D lifting a box of mass 30 kg in 4.0 s
- 31 The volume of a gas decreases and the temperature of the gas increases.

Which row describes the changes to the separation and to the speed of the gas molecules?

	separation	speed
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

- 32 A mechanic cannot remove a large steel nut from a steel bolt because it is too tight.



What does the mechanic do to help remove the nut?

- A cool the nut and heat the bolt
- B heat the bolt only
- C heat the nut and the bolt through the same temperature rise
- D heat the nut only

- 33 What is the main method of thermal energy transfer in liquids?

- A conduction
- B convection
- C absorption
- D radiation

- 34 Light travels at a speed of 3.0×10^8 m/s in a vacuum.

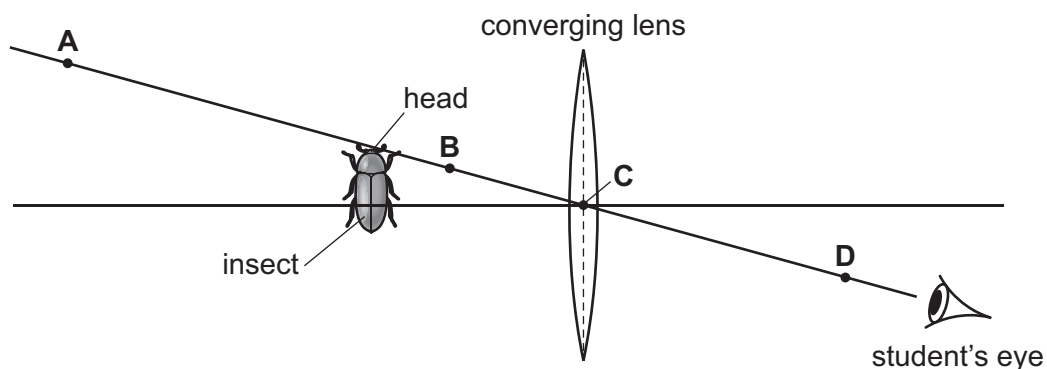
A radio station transmits radio waves at a frequency of 9.1×10^7 Hz.

What is the wavelength of the radio waves?

- A 0.30 m B 0.33 m C 3.0 m D 3.3 m

- 35 A student uses a converging lens as a magnifying glass to view an insect.

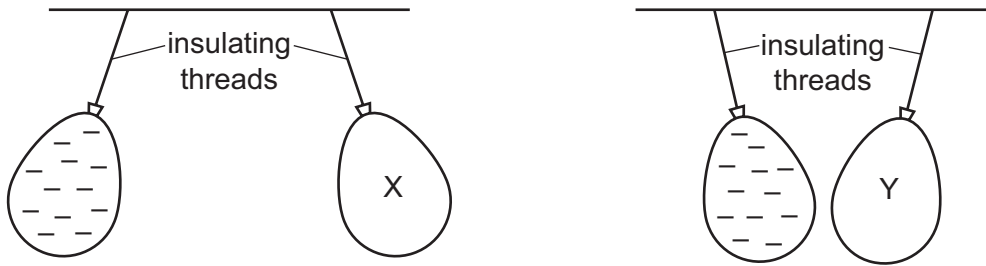
Which labelled point is a possible position for the image of the head of the insect?



36 Where does sound travel at the greatest speed?

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

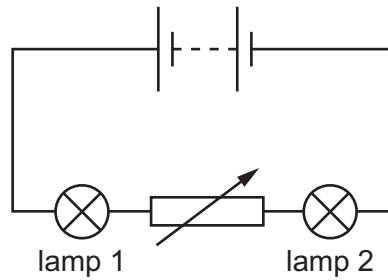
37 Two balloons X and Y are suspended by insulating threads. They are each held near a negatively charged balloon. The balloons hang as shown.



What is the charge on balloon X and what is the charge on balloon Y?

	balloon X	balloon Y
A	negative	negative
B	negative	positive
C	positive	negative
D	positive	positive

- 38 A circuit contains two lamps and a variable resistor.



The resistance of the variable resistor is increased.

What happens to the brightness of lamp 1 and what happens to the brightness of lamp 2?

	brightness of lamp 1	brightness of lamp 2
A	decreases	decreases
B	decreases	increases
C	no change	decreases
D	no change	increases

- 39 A torch (flashlight) contains a 3.0 V battery. When the torch is switched on the current in the battery is 0.50 A.

How much energy is transferred by the battery in 1.0 minute?

- A** 1.5 J **B** 6.0 J **C** 90 J **D** 360 J

- 40 What is the purpose of a fuse in an electric circuit?

- A** to disconnect the circuit if the current becomes too large
- B** to increase the voltage if the current becomes too small
- C** to prevent someone cutting the insulation of the wiring
- D** to stop water getting into the circuit

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The Periodic Table of Elements

Group																			
I	II											III	IV	V	VI	VII	VIII		
3 Li lithium 7	4 Be beryllium 9	Key atomic number atomic symbol name relative atomic mass										1 H hydrogen 1							2 He helium 4
11 Na sodium 23	12 Mg magnesium 24	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	75 Re rhenium 186	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 —	107 Bh bohrium —	108 Hs hassium —	109 Mt meitnerium —	110 Ds darmstadtium —	111 Rg roentgenium —	112 Cn copernicium —		114 Fl flerovium —		116 Lv livermorium —				

lanthanoids

actinoids

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.).