



Cambridge IGCSE™

COMBINED SCIENCE

0653/21

Paper 2 Multiple Choice (Extended)

October/November 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.
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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 are characteristics of all living organisms?

- A breathing, excretion, nutrition
- B excretion, growth, nutrition
- C reproduction, respiration, germination
- D secretion, growth, sensitivity

2 Which row describes a correct structural adaptation for red blood cells and for cells lining the trachea?

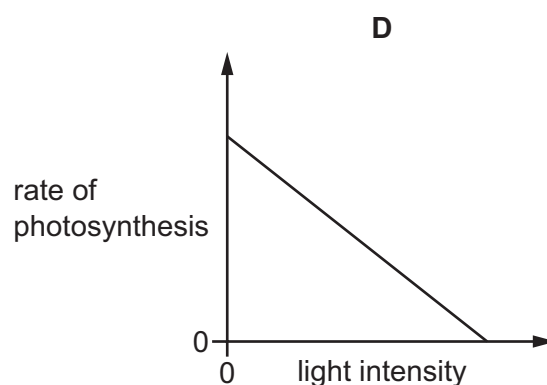
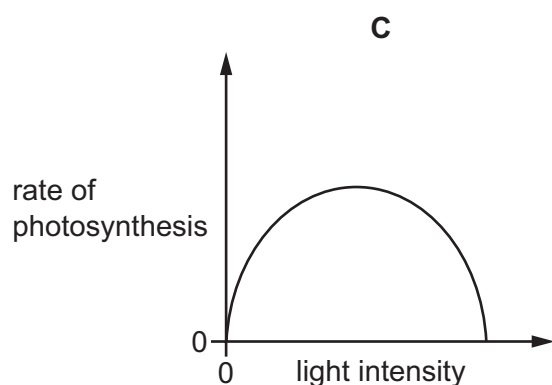
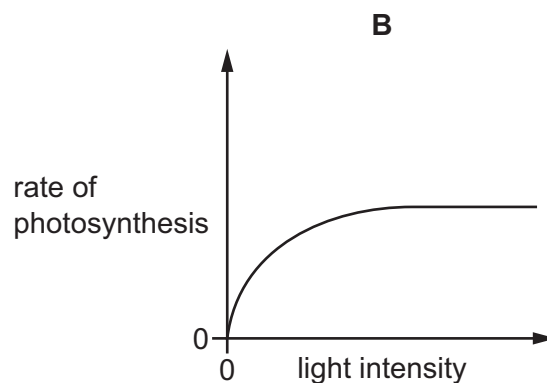
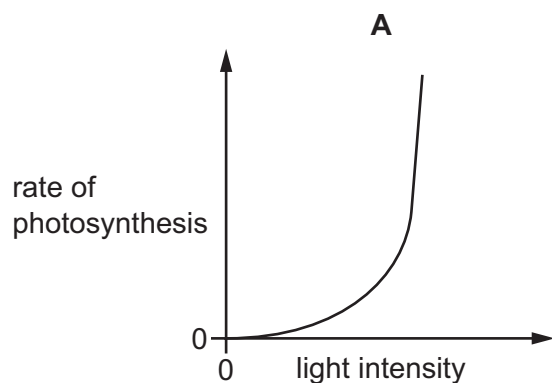
	red blood cells	cells lining the trachea
A	nucleus absent	cilia present
B	nucleus present	cilia present
C	nucleus absent	small surface area
D	nucleus present	small surface area

3 A student tests samples of four different foods.

Which row is the correct result for a sample containing only fat and starch?

	Benedict's solution	biuret test	ethanol emulsion	iodine solution
A	blue	purple	clear	blue-black
B	blue	blue	cloudy	blue-black
C	red	purple	clear	brown
D	red	blue	cloudy	brown

- 4 Which graph correctly shows the effect of varying light intensity on the rate of photosynthesis?



- 5 Which row correctly matches the type of digestion to its effect on the food particles?

	type of digestion	makes smaller	makes soluble
A	chemical	no	yes
B	chemical	yes	yes
C	mechanical	no	no
D	mechanical	yes	yes

- 6 A student investigates factors affecting the rate of transpiration in a plant.

Which row shows the correct effects on the rates of transpiration?

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

- 7 Which structures in the circulatory system ensure the one-way flow of blood?

- A** arteries
- B** atria
- C** valves
- D** ventricles

- 8 When at rest, a student measures his rate of breathing and the volume of air inspired.

number of breaths per minute	volume of air inspired per minute /dm ³
12	6.0

He then runs 400 m and immediately measures his breathing again.

Which set of results does he obtain?

	number of breaths per minute	volume of air inspired per minute /dm ³
A	12	6.0
B	12	12.5
C	30	6.0
D	30	12.5

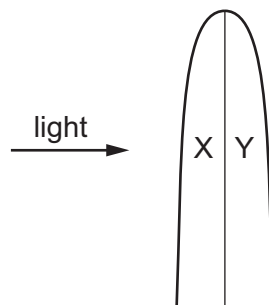
9 What is the word equation for aerobic respiration?

- A carbon dioxide + chlorophyll $\rightarrow$ glucose + oxygen
- B carbon dioxide + glucose $\rightarrow$ oxygen + water
- C glucose + oxygen $\rightarrow$ carbon dioxide + water
- D oxygen + light energy $\rightarrow$ carbon dioxide + water

10 Which row shows the correct changes when the hormone adrenaline is secreted?

	blood glucose	breathing rate	pulse rate
A	decreases	decreases	decreases
B	increases	decreases	increases
C	decreases	increases	decreases
D	increases	increases	increases

11 Light shines on a shoot tip from the direction shown.



After three days, the shoot tip has bent towards the light.

What is the reason for this change?

- A Auxin moves away from the light causing cell elongation in area Y.
- B Auxin moves away from the light preventing cell elongation in area Y.
- C Auxin moves towards the light causing cell elongation in area X.
- D Auxin moves towards the light preventing cell elongation in area X.

12 Which environmental conditions are necessary for seeds to germinate?

	oxygen	suitable temperature	sunlight	water
A	yes	yes	yes	no
B	yes	yes	no	yes
C	no	no	yes	yes
D	no	yes	no	yes

13 What is the function of amniotic fluid?

- A** to cushion the fetus
- B** to remove carbon dioxide
- C** to supply nutrients
- D** to supply oxygen

14 Which particles are present in the nuclei of hydrogen atoms, ${}^1_1\text{H}$?

- A** electrons and neutrons
- B** electrons only
- C** protons and neutrons
- D** protons only

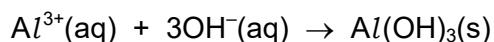
15 Which statement explains the difference in boiling point between ionic and covalent compounds?

- A** The boiling point of covalent compounds is higher because covalent bonds are stronger than ionic bonds.
- B** The boiling point of covalent compounds is higher because the attractive forces between covalent molecules are stronger than the attractive forces between ions.
- C** The boiling point of ionic compounds is higher because the attractive forces between ions are stronger than covalent bonds.
- D** The boiling point of ionic compounds is higher because the attractive forces between ions are stronger than the attractive forces between covalent molecules.

- 16** Aqueous sodium hydroxide is added to aqueous aluminium sulfate.

A white precipitate of aluminium hydroxide is formed.

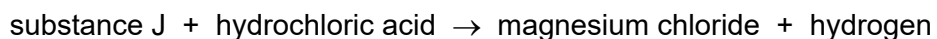
The ionic equation for this reaction is shown.



What is the full symbol equation for this reaction?

- A** $\text{AlSO}_4(\text{aq}) + 3\text{NaOH}(\text{aq}) \rightarrow \text{Al}(\text{OH})_3(\text{s}) + \text{Na}_3\text{SO}_4(\text{aq})$
- B** $\text{Al}_2(\text{SO}_4)_3(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow \text{Al}(\text{OH})_3(\text{s}) + \text{Na}_2\text{SO}_4(\text{aq})$
- C** $\text{Al}_2(\text{SO}_4)_3(\text{aq}) + 6\text{NaOH}(\text{aq}) \rightarrow 2\text{Al}(\text{OH})_3(\text{s}) + 3\text{Na}_2\text{SO}_4(\text{aq})$
- D** $\text{Al}_3(\text{SO}_4)_2(\text{aq}) + 9\text{NaOH}(\text{aq}) \rightarrow 3\text{Al}(\text{OH})_3(\text{s}) + 2\text{Na}_2\text{SO}_4(\text{aq})$
- 17** Concentrated aqueous sodium chloride is electrolysed using inert electrodes.
- Which statement is correct?
- A** Chloride ions lose electrons at the cathode.
- B** Hydrogen ions gain electrons at the cathode.
- C** Oxide ions gain electrons at the anode.
- D** Sodium ions gain electrons at the cathode.
- 18** Which statements explain why the rate of a reaction increases when the temperature is increased?
- 1 More of the colliding molecules have enough energy to react.
 - 2 The molecules are closer together, so they collide more frequently.
 - 3 The molecules are further apart, so they collide less frequently.
 - 4 The molecules are moving faster, so they collide more frequently.
- A** 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

- 19 The word equation represents the reaction between substance J and hydrochloric acid.



What is substance J?

- A magnesium
 - B magnesium carbonate
 - C magnesium hydroxide
 - D magnesium oxide
- 20 Which pair of gases can be identified using damp litmus paper and limewater?
- A carbon dioxide and hydrogen
 - B chlorine and carbon dioxide
 - C chlorine and oxygen
 - D hydrogen and chlorine

- 21 Aqueous potassium halides are mixed with aqueous halogens as listed.

- 1 potassium bromide + iodine
- 2 potassium chloride + bromine
- 3 potassium iodide + chlorine
- 4 potassium iodide + bromine

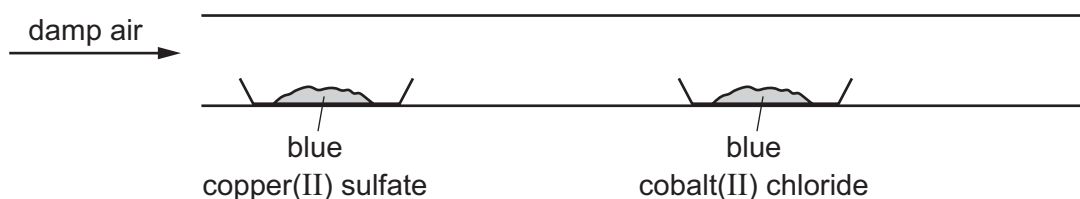
Which mixtures produce a chemical reaction?

- A 1 and 2 B 1 and 4 C 2 and 3 D 3 and 4
- 22 Which properties are shown by transition elements?
- 1 They form coloured compounds.
 - 2 They have low melting points.
 - 3 They have low densities.
 - 4 They can act as catalysts.
- A 1 and 2 B 1 and 4 C 2 and 3 D 3 and 4

23 Which statement about reactions in the blast furnace is **not** correct?

- A Carbon is oxidised by oxygen.
- B Carbon is oxidised by carbon dioxide.
- C Carbon dioxide is reduced by iron oxide.
- D Iron oxide is reduced by carbon monoxide.

24 Damp air is passed through a tube containing blue copper(II) sulfate and blue cobalt(II) chloride.



What is observed?

	copper(II) sulfate	cobalt(II) chloride
A	turns white	turns pink
B	turns white	no change
C	no change	turns pink
D	no change	no change

25 Naphtha and diesel oil are two fractions obtained from the fractional distillation of petroleum.

Which statement about naphtha and diesel oil is correct?

- A Molecules in naphtha are smaller than molecules in diesel oil.
- B Naphtha has a higher boiling point range than diesel oil.
- C Naphtha is less volatile than diesel oil.
- D Naphtha is removed from the fractionating column at a lower level than diesel oil.

26 The formula of the hydrocarbon octane is C_8H_{18} .

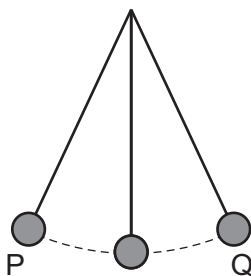
What are the products of the complete combustion of octane?

- A carbon and hydrogen
- B carbon and water
- C carbon dioxide and water
- D carbon monoxide and water

27 Which process is an example of thermal decomposition?

- A cracking an alkane
- B electrolysis of molten lead(II) bromide
- C extraction of iron in the blast furnace
- D fractional distillation of petroleum

28 A pendulum swings repeatedly from P to Q and back to P.



A stop-watch is used to find the period of the pendulum.

Which method gives the most accurate value for the period?

- A timing how long it takes to go from P to Q
- B timing how long it takes to go from P to Q to P
- C timing how long it takes to go from P to Q to P 10 times, and dividing this time by 10
- D timing how long it takes to go from P to Q to P 10 times, and multiplying this time by 10

29 When a spring is stretched by a force of 20 N, its length increases from 3.2 cm to 5.4 cm.

What is the spring constant of the spring?

- A 0.11 N/cm B 0.27 N/cm C 3.7 N/cm D 9.1 N/cm

- 30 The diagram shows a tank containing a liquid.



The base of the tank is rectangular and has dimensions 0.20 m by 0.50 m.

The mass of the liquid is 60 kg and its depth is 0.10 m.

Gravitational field strength $g = 10 \text{ N/kg}$.

What is the pressure exerted on the base of the tank by the liquid?

- A** 60 Pa **B** 600 Pa **C** 6000 Pa **D** 60 000 Pa

- 31 A piece of scientific equipment is taken from the Earth to a distant planet.

Which row describes the properties of the equipment on the distant planet?

	mass	weight
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

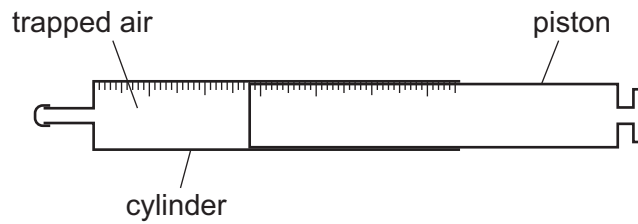
✓ = the same as on Earth

✗ = different on each planet

- 32 For which energy resource is energy stored as gravitational potential energy?

- A** geothermal energy
B hydroelectric energy
C nuclear fission
D wind energy

- 33** Air is trapped in a cylinder by a piston. The piston is moved so that the volume of the trapped air decreases. The pressure of the trapped air increases but the temperature of the trapped air does not change.



What happens to the average speed of the air particles and what happens to the average distance between them?

	average speed of particles	average distance between particles
A	does not change	decreases
B	does not change	increases
C	increases	decreases
D	increases	increases

- 34** In which states of matter is thermal energy transferred because of changes in the density of the medium?

- A** solids and liquids only
- B** liquids and gases only
- C** gases and solids only
- D** solids, liquids and gases

- 35** Light takes 500 s to travel from the Sun to the Earth.

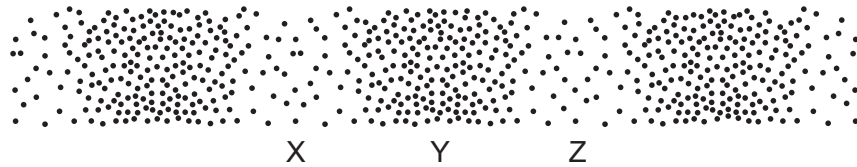
What is the distance from the Sun to the Earth?

- A** $1.7 \times 10^5 \text{ m}$
- B** $6.0 \times 10^5 \text{ m}$
- C** $3.0 \times 10^8 \text{ m}$
- D** $1.5 \times 10^{11} \text{ m}$

- 36 A sound wave passes through air.

The diagram shows the arrangement of the air particles at one moment.

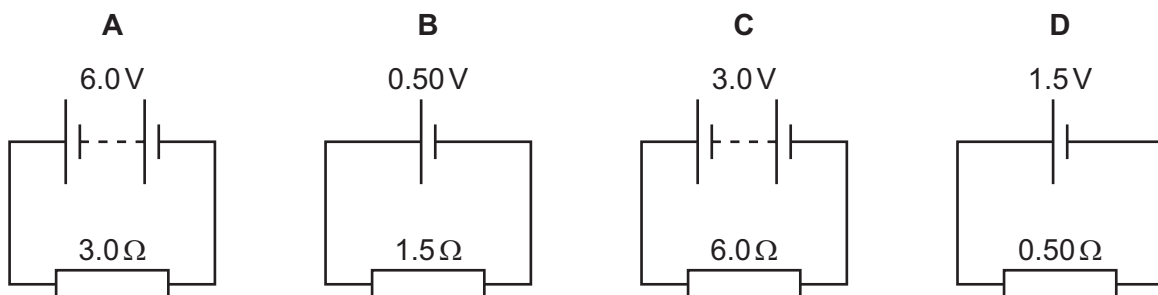
Three regions are labelled X, Y and Z.



In which region is there a rarefaction and which distance is equal to the wavelength of the sound wave?

	rarefaction	wavelength
A	X	XY
B	X	XZ
C	Y	XY
D	Y	XZ

- 37 In which circuit is there a current of 2.0 A?



- 38 The resistance of a wire depends on its length and on its diameter.

Which row shows two changes that **both** increase the resistance of the wire?

	change to length	change to diameter
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

- 39** A 20 V power supply provides a current of 5.0 A for 1.0 minute.

How much energy does the power supply transfer?

- A** 4.0 J **B** 100 J **C** 240 J **D** 6000 J

- 40** Why is the electricity supply to a mains circuit fitted with a fuse?

- A** to increase the current in the circuit
- B** to increase the resistance of the circuit
- C** to maintain a constant current in the circuit
- D** to prevent overheating of the cables in the circuit

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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	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	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	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 —	118 Og oganeson —	119 Uue unbinilium —	120 Uuh untrium —	121 Uut ununilium —

lanthanoids

actinoids

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



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1 What are characteristics of all living organisms?

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- B excretion, growth, nutrition
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- D secretion, growth, sensitivity

2 Which row describes a correct structural adaptation for red blood cells and for cells lining the trachea?

	red blood cells	cells lining the trachea
A	nucleus absent	cilia present
B	nucleus present	cilia present
C	nucleus absent	small surface area
D	nucleus present	small surface area

3 Food tests are carried out on a biscuit.

The results of the food tests are shown.

test for	colour observed
fat	white emulsion
protein	blue
reducing sugar	orange
starch	blue-black

Which biological molecules are present in the biscuit?

	fat	protein	reducing sugar	starch
A	✓	x	x	x
B	✓	x	✓	✓
C	x	✓	✓	✓
D	x	✓	x	x

4 Which substance in leaves traps light energy for use in photosynthesis?

- A carbohydrate
- B carbon
- C carbon dioxide
- D chlorophyll

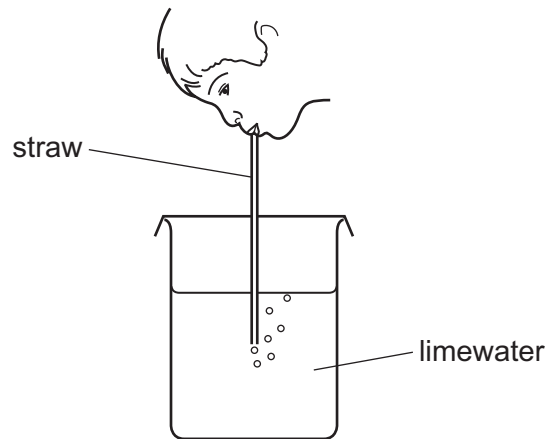
5 Which types of malnutrition could lead to constipation and scurvy?

	constipation	scurvy
A	excess of fibre	lack of vitamin C
B	excess of fibre	lack of vitamin D
C	lack of fibre	lack of vitamin C
D	lack of fibre	lack of vitamin D

6 Where is amylase active in the alimentary canal?

	stomach	small intestine
A	✓	✓
B	✓	x
C	x	✓
D	x	x

- 7 A student tests her exhaled breath by blowing through a straw into some limewater.



Which statements are correct about this test?

	colour of limewater at start of test	colour of limewater at end of test	what the test shows
A	colourless	milky white	carbon dioxide is present in the exhaled breath
B	colourless	milky white	water vapour is present in the exhaled breath
C	milky white	colourless	carbon dioxide is present in the exhaled breath
D	milky white	colourless	water vapour is present in the exhaled breath

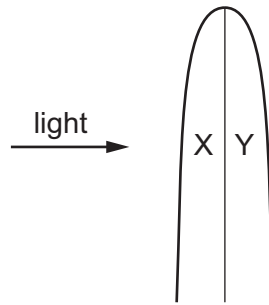
- 8 What is the word equation for aerobic respiration?

- A** carbon dioxide + chlorophyll → glucose + oxygen
- B** carbon dioxide + glucose → oxygen + water
- C** glucose + oxygen → carbon dioxide + water
- D** oxygen + light energy → carbon dioxide + water

- 9 What are two effects of the secretion of adrenaline on the human body?

- A** decreased blood glucose concentration and decreased pulse rate
- B** decreased blood glucose concentration and increased pulse rate
- C** increased blood glucose concentration and decreased pulse rate
- D** increased blood glucose concentration and increased pulse rate

10 Light shines on a shoot tip from the direction shown.



After three days, the shoot tip has bent towards the light.

What is the reason for this change?

- A** Auxin moves away from the light causing cell elongation in area Y.
- B** Auxin moves away from the light preventing cell elongation in area Y.
- C** Auxin moves towards the light causing cell elongation in area X.
- D** Auxin moves towards the light preventing cell elongation in area X.

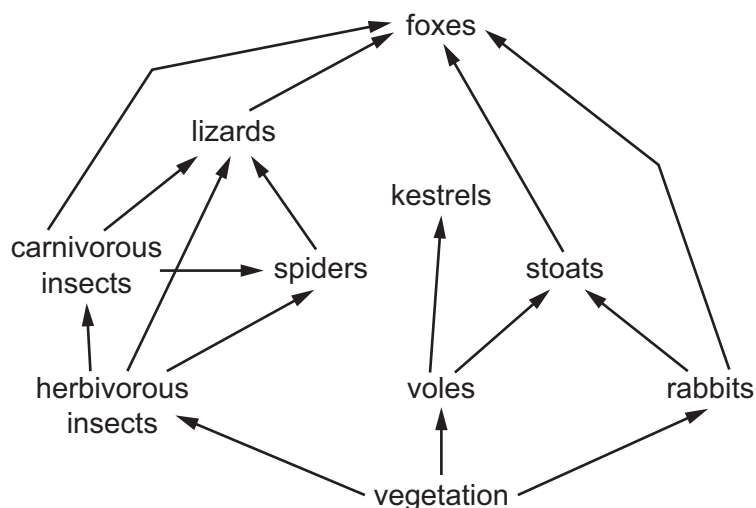
11 What are two features of sexual reproduction?

	feature 1	feature 2
A	fusion of two identical nuclei	requires two different parents
B	fusion of two zygotes	offspring are genetically identical
C	offspring are genetically different	fusion of two different nuclei
D	only requires a single parent	development from a single zygote

12 Which row is correct for the female gamete?

	released in large numbers	can move by itself
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

13 The diagram shows a food web.



Which organisms in this web are quaternary consumers?

- A carnivorous insects and foxes
- B foxes and lizards
- C kestrels and stoats
- D lizards and stoats

14 An atom of aluminium and an atom of fluorine are represented as shown.



Which statement is **not** correct?

- A The aluminium atom contains four more electrons than the fluorine atom.
- B The aluminium atom contains four more protons than the fluorine atom.
- C The aluminium atom contains eight more neutrons than the fluorine atom.
- D The aluminium atom contains eight more nucleons than the fluorine atom.

- 15 Which row describes and explains the difference in melting points between ionic and covalent compounds?

	melting point	reason
A	ionic compounds have higher melting points	ionic bonds are stronger than covalent bonds
B	ionic compounds have higher melting points	attractive forces between ions are stronger than attractive forces between molecules
C	ionic compounds have lower melting points	ionic bonds are weaker than covalent bonds
D	ionic compounds have lower melting points	attractive forces between ions are weaker than attractive forces between molecules

- 16 Potassium phosphate is an ionic compound used in fertilisers.

Phosphate ions have the symbol PO_4^{3-} .

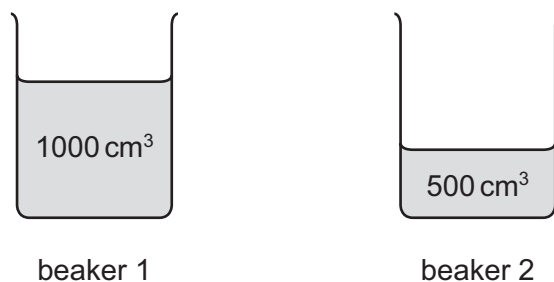
What is the formula for potassium phosphate?

- A** KPO_4 **B** $\text{K}(\text{PO}_4)_3$ **C** K_2PO_4 **D** K_3PO_4

- 17 Which equation represents the process that occurs at the cathode during the electrolysis of concentrated aqueous sodium chloride?

- A** $2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}^-$
B $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$
C $\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$
D $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$

- 18 The reaction between two aqueous reactants, P and Q, is carried out in two different beakers.



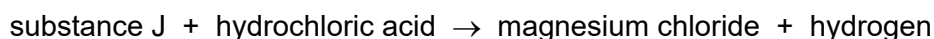
The temperature and the number of particles of P and Q are the **same** in both beakers.

Which statements about the collisions between the reacting particles in the two beakers must be correct?

- 1 The average energy of the collisions is greater in beaker 2.
- 2 The frequency of the collisions is greater in beaker 2.
- 3 The proportion of the collisions that result in a reaction is greater in beaker 2.

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

- 19 The word equation represents the reaction between substance J and hydrochloric acid.



What is substance J?

- A** magnesium
B magnesium carbonate
C magnesium hydroxide
D magnesium oxide

- 20 Which pair of gases can be identified using damp litmus paper and limewater?

- A** carbon dioxide and hydrogen
B chlorine and carbon dioxide
C chlorine and oxygen
D hydrogen and chlorine

21 Which statement about the elements in Group VII is correct?

- A Bromine reacts with potassium chloride to make chlorine.
- B Chlorine is the least reactive element in Group VII.
- C Chlorine reacts with potassium iodide to make iodine.
- D Potassium bromide reacts with all of the elements in Group VII.

22 Element X has a high density and conducts electricity when solid and when molten.

Where in the Periodic Table is element X placed?

- A Group 0
- B Group I
- C halogens
- D transition elements

23 Which metal **cannot** be extracted from its ore by heating with carbon?

- A Al B Cu C Fe D Zn

24 A few drops of liquid X are added to a white solid.

The white solid turns blue.

Which statements are correct?

- 1 The white solid is copper(II) sulfate.
- 2 Liquid X is water.
- 3 Liquid X turns blue cobalt(II) chloride paper pink.

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

25 Bitumen and gasoline are fractions obtained from petroleum by fractional distillation.

Which statement explains why the boiling range of the bitumen fraction is higher than the boiling range of the gasoline fraction?

- A It contains smaller molecules.
- B It leaves the fractional distillation column at the bottom.
- C Its molecules have greater forces of attraction.
- D Its molecules have stronger covalent bonds.

26 The formula of the hydrocarbon octane is C_8H_{18} .

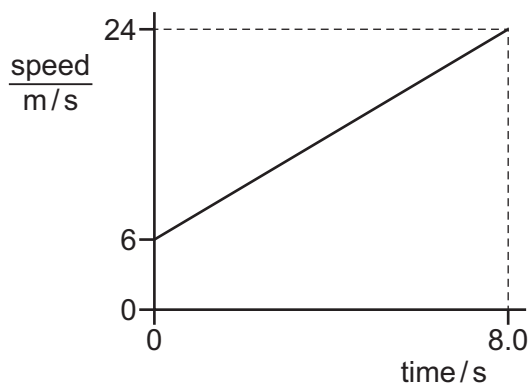
What are the products of the complete combustion of octane?

- A carbon and hydrogen
- B carbon and water
- C carbon dioxide and water
- D carbon monoxide and water

27 Which process is an example of thermal decomposition?

- A cracking an alkane
- B electrolysis of molten lead(II) bromide
- C extraction of iron in the blast furnace
- D fractional distillation of petroleum

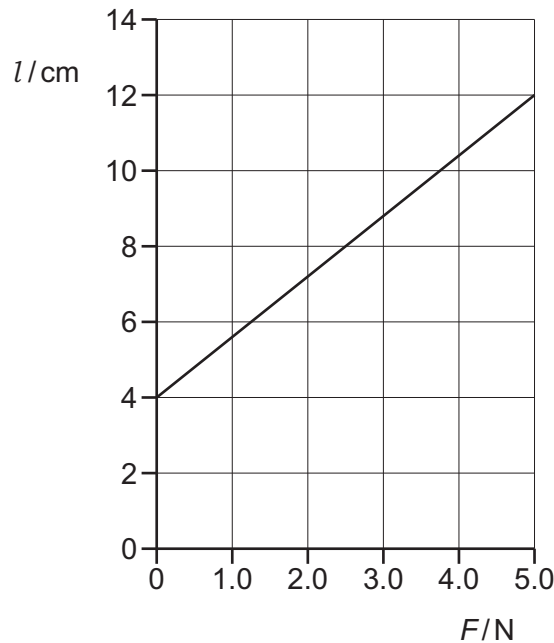
28 The diagram shows a speed–time graph for a car.



What is the distance travelled by the car between time = 0 and time = 8.0 s?

- A 96 m
- B 120 m
- C 144 m
- D 192 m

- 29 A spring is stretched by a force F . The graph shows how the length l of the spring changes with F .



What is the spring constant of the spring?

- A** 0.42 N/cm **B** 0.63 N/cm **C** 1.6 N/cm **D** 2.4 N/cm

- 30 A piece of scientific equipment is taken from the Earth to a distant planet.

Which row describes the properties of the equipment on the distant planet?

	mass	weight
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ = the same as on Earth

✗ = different on each planet

- 31 Which statement about water is correct?

- A** It boils at 0 °C and melts at 100 °C.
B It boils at 0 °C and melts at –100 °C.
C It boils at 100 °C and melts at –100 °C.
D It boils at 100 °C and melts at 0 °C.

- 32 The volume of a gas is increased but its temperature remains the same.

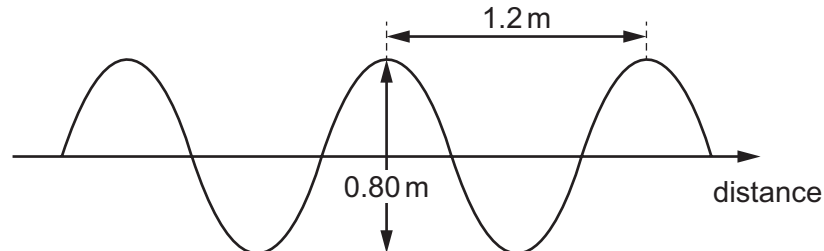
What happens to the molecules of the gas?

- A They move closer together.
- B They move further apart.
- C They move more quickly.
- D They move more slowly.

- 33 Which row compares how well a dull, black surface and a shiny, white surface emit and absorb thermal radiation?

	emitting thermal radiation	absorbing thermal radiation
A	dull, black is better	dull, black is better
B	dull, black is better	shiny, white is better
C	shiny, white is better	dull, black is better
D	shiny, white is better	shiny, white is better

- 34 The diagram represents a water wave that is moving at a speed of 6.0 m/s.



What is the frequency of the wave?

- A 3.0 Hz
- B 4.8 Hz
- C 5.0 Hz
- D 7.5 Hz

- 35 Which statement about sound is **not** correct?

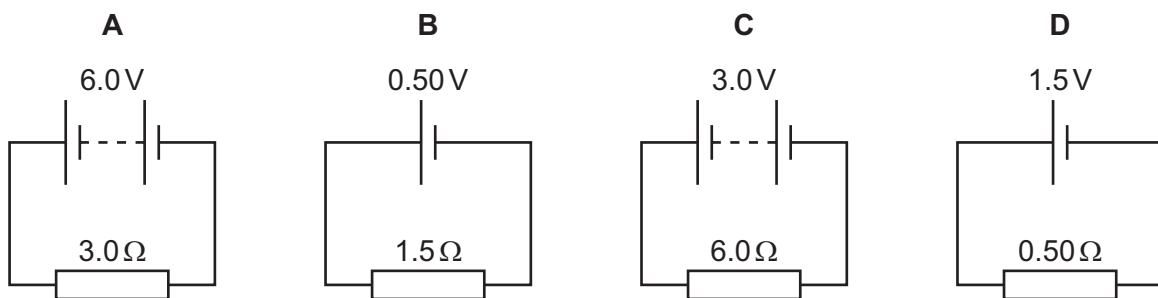
- A A sound wave of frequency 2000 Hz can be heard by a healthy human ear.
- B Sound waves can travel through a vacuum.
- C The loudness of a sound depends on the amplitude of the sound wave.
- D The pitch of a sound depends on the frequency of the sound wave.

- 36 A circuit consists of a resistor, a switch and a battery. The switch is closed.

Which expression is used to calculate the charge that passes through the resistor?

- A charge = current $\times$ voltage across the resistor
- B charge = $\frac{\text{current}}{\text{voltage across the resistor}}$
- C charge = current $\times$ time for which the switch is closed
- D charge = $\frac{\text{current}}{\text{time for which the switch is closed}}$

- 37 In which circuit is there a current of 2.0 A?



- 38 The resistance of a wire depends on its length and on its diameter.

Which row shows two changes that **both** increase the resistance of the wire?

	change to length	change to diameter
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

- 39 A 20 V power supply provides a current of 5.0 A for 1.0 minute.

How much energy does the power supply transfer?

- A 4.0 J B 100 J C 240 J D 6000 J

40 Why is the electricity supply to a mains circuit fitted with a fuse?

- A** to increase the current in the circuit
- B** to increase the resistance of the circuit
- C** to maintain a constant current in the circuit
- D** to prevent overheating of the cables in 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												
												5 B boron 11								6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
												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						
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 —			86 Rn radon —						

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)

October/November 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 are characteristics of all living organisms?

- A breathing, excretion, nutrition
- B excretion, growth, nutrition
- C reproduction, respiration, germination
- D secretion, growth, sensitivity

2 Which row describes a correct structural adaptation for red blood cells and for cells lining the trachea?

	red blood cells	cells lining the trachea
A	nucleus absent	cilia present
B	nucleus present	cilia present
C	nucleus absent	small surface area
D	nucleus present	small surface area

3 From which kind of molecule are enzymes made?

- A glucose
- B glycogen
- C fat
- D protein

4 A student investigates the effect of changing the light intensity on the rate of photosynthesis.

Which environmental conditions need to be kept constant in this investigation?

- A carbon dioxide concentration, light intensity and temperature
- B carbon dioxide concentration and temperature only
- C carbon dioxide concentration and light intensity only
- D light intensity and temperature only

5 Which condition is caused by a lack of vitamin D?

- A anaemia
- B constipation
- C rickets
- D scurvy

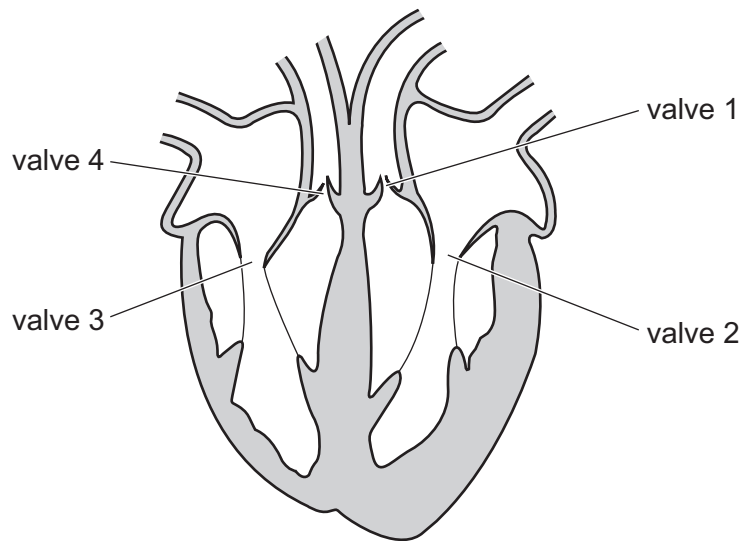
6 Which statement about digestion is correct?

- A Chemical digestion occurs in the liver.
- B Chemical digestion only occurs in the mouth.
- C Mechanical digestion occurs in the large intestine.
- D Mechanical digestion occurs in the mouth and stomach.

7 Which row shows the conditions that lead to the **slowest** rate of transpiration of a plant?

	humidity of air / %	temperature of air / °C
A	30	10
B	70	20
C	30	20
D	70	10

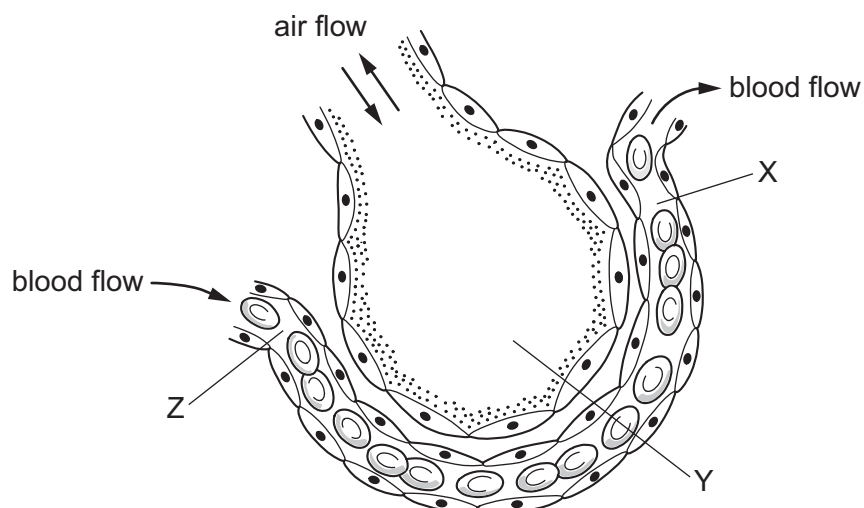
8 The diagram shows a section through the heart.



When valve 1 is open, which other valves are open and which are closed?

	valve 2	valve 3	valve 4
A	closed	closed	open
B	closed	open	closed
C	open	closed	open
D	open	open	closed

- 9 The diagram shows the cross-section of an alveolus in the lung.

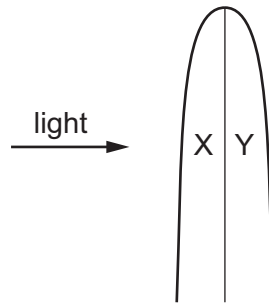


Which statement is correct?

- A** Carbon dioxide levels are higher at Z than at X.
- B** Carbon dioxide levels are higher at X than at Y.
- C** Carbon dioxide moves by diffusion from Y into the blood.
- D** Carbon dioxide moves by osmosis from the blood into Y.
- 10 What is the word equation for aerobic respiration?
- A** carbon dioxide + chlorophyll → glucose + oxygen
- B** carbon dioxide + glucose → oxygen + water
- C** glucose + oxygen → carbon dioxide + water
- D** oxygen + light energy → carbon dioxide + water
- 11 How does the body respond to being frightened?

	decreased blood glucose concentration	increased breathing rate	increased pulse rate	widened pupils
A	✓	✓	✓	✓
B	x	✓	✓	✓
C	x	x	✓	✓
D	✓	x	x	x

12 Light shines on a shoot tip from the direction shown.



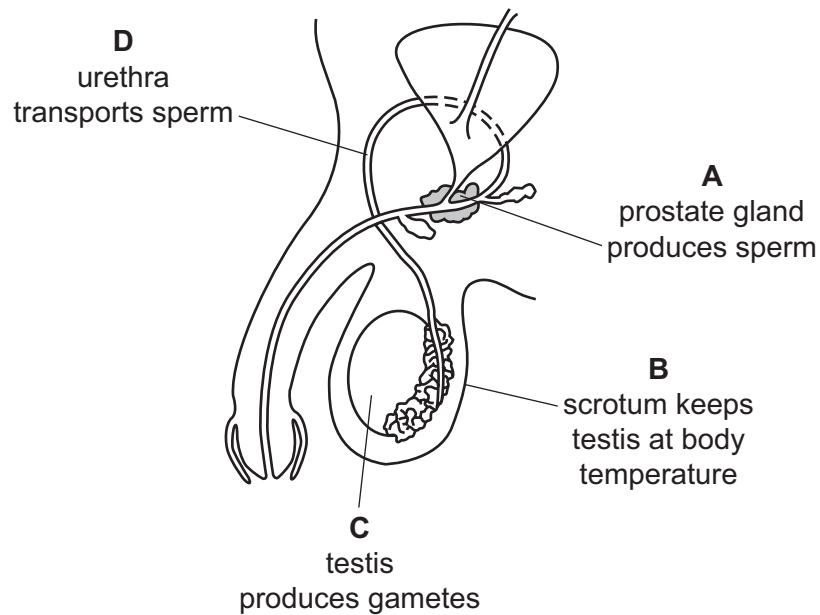
After three days, the shoot tip has bent towards the light.

What is the reason for this change?

- A** Auxin moves away from the light causing cell elongation in area Y.
- B** Auxin moves away from the light preventing cell elongation in area Y.
- C** Auxin moves towards the light causing cell elongation in area X.
- D** Auxin moves towards the light preventing cell elongation in area X.

13 The diagram shows the human male reproductive system.

Which label is correct?

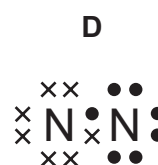
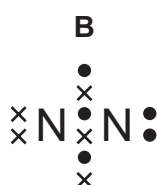


14 A sodium atom is represented by ${}^{23}_{11}\text{Na}$.

Which row shows the number of electrons, protons and neutrons in this atom?

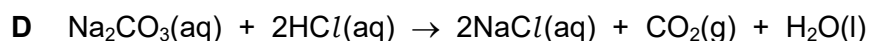
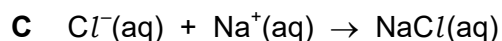
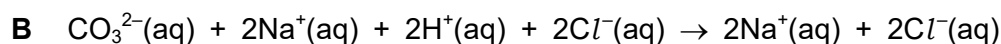
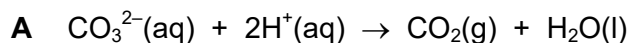
	electrons	protons	neutrons
A	10	11	12
B	11	11	12
C	11	12	11
D	12	12	23

15 Which dot-and-cross diagram represents the bonding in a molecule of nitrogen?



16 Dilute hydrochloric acid reacts with aqueous sodium carbonate to form sodium chloride, carbon dioxide and water.

What is the ionic equation for this reaction?



17 Concentrated aqueous sodium chloride is electrolysed using inert electrodes.

Which statement about this process is correct?

A Chloride ions lose electrons at the cathode.

B Hydrogen ions gain electrons at the cathode.

C Oxide ions lose electrons at the anode.

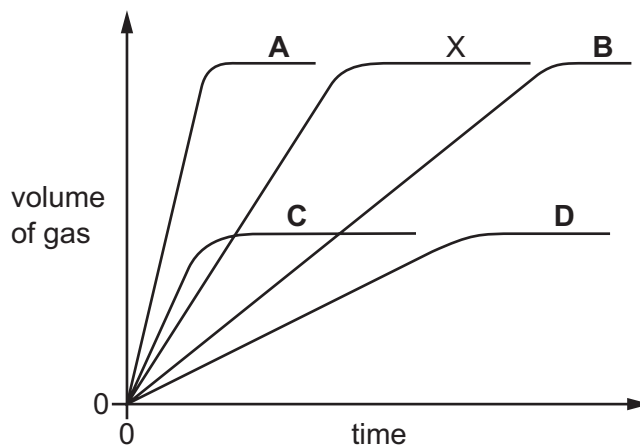
D Sodium ions gain electrons at the anode.

- 18 Excess limestone is added to 50 cm³ 1 mol/dm³ hydrochloric acid.

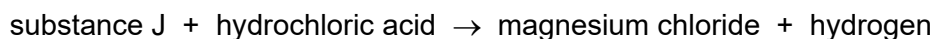
The volume of gas produced is measured over time.

The results produce line X on the graph.

Which line is produced when excess limestone is added to 50 cm³ 0.5 mol/dm³ hydrochloric acid at the same temperature?



- 19 The word equation represents the reaction between substance J and hydrochloric acid.



What is substance J?

- A magnesium
 - B magnesium carbonate
 - C magnesium hydroxide
 - D magnesium oxide
- 20 Which pair of gases can be identified using damp litmus paper and limewater?
- A carbon dioxide and hydrogen
 - B chlorine and carbon dioxide
 - C chlorine and oxygen
 - D hydrogen and chlorine

21 Fluorine is at the top of Group VII in the Periodic Table.

Which statements about fluorine are correct?

- 1 It is a solid at room temperature.
- 2 It has a dark colour.
- 3 It is a very reactive element.
- 4 It exists as diatomic molecules.

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

22 What are properties of transition elements?

- 1 They can act as catalysts.
- 2 They form coloured compounds.
- 3 They have high densities.

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 iron ore in a blast furnace.

Which substance is **not** one of the reactants added to the blast furnace?

- A** carbon
- B** carbon dioxide
- C** hematite
- D** oxygen

24 Which statements about clean air are correct?

- 1 It consists of 78% nitrogen.
- 2 It contains a small amount of argon.
- 3 It contains a small amount of carbon monoxide.
- 4 It is mostly a compound of nitrogen and oxygen.

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

25 Petroleum is separated into fractions by fractional distillation.

Which row describes the properties of the molecules in a single fraction?

	boiling points of the molecules	number of carbon atoms in the molecules
A	same	same
B	same	similar
C	similar	same
D	similar	similar

26 The formula of the hydrocarbon octane is C_8H_{18} .

What are the products of the complete combustion of octane?

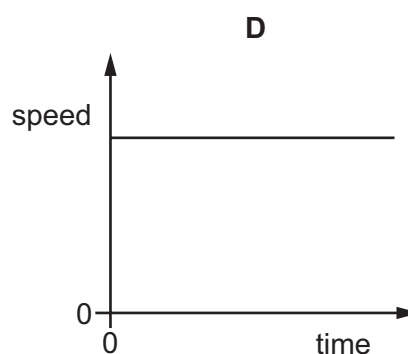
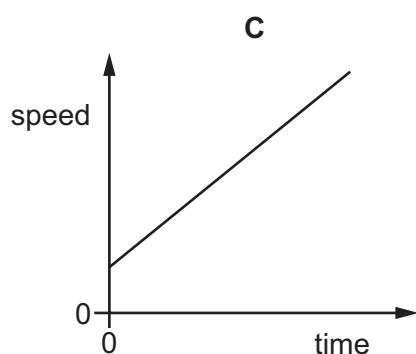
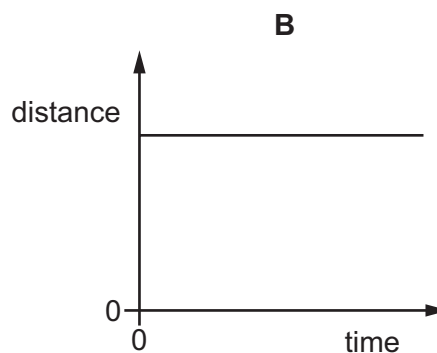
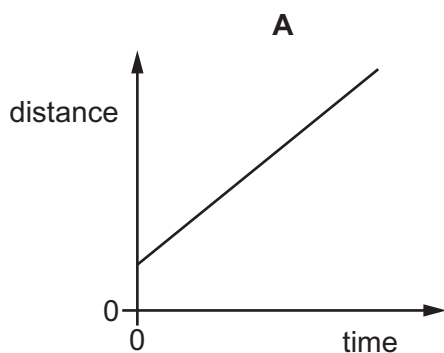
- A** carbon and hydrogen
- B** carbon and water
- C** carbon dioxide and water
- D** carbon monoxide and water

27 Which process is an example of thermal decomposition?

- A** cracking an alkane
- B** electrolysis of molten lead(II) bromide
- C** extraction of iron in the blast furnace
- D** fractional distillation of petroleum

- 28** The diagrams show two distance–time graphs and two speed–time graphs.

Which graph represents the motion of an object that is moving with a constant acceleration that is greater than zero?



- 29** A man has a mass of 76 kg and an average density of 950 kg/m^3 .

The man steps into a bath that is completely full of water. Water spills over the edge of the bath as the man lies down slowly and becomes completely submerged.

What is the volume of water that spills over the edge of the bath?

- A** 0.072 m^3 **B** 0.080 m^3 **C** 12.5 m^3 **D** 72.2 m^3

- 30** An aircraft is flying forwards at a steady speed in a straight line.

Which statement about the resultant force on the aircraft is correct?

- A** The resultant force is a backwards force caused by air resistance.
B The resultant force is a forwards force caused by the engines.
C The resultant force is a downwards force caused by the weight of the aircraft.
D The resultant force is zero because all the forces on the aircraft cancel.

- 31 A piece of scientific equipment is taken from the Earth to a distant planet.

Which row describes the properties of the equipment on the distant planet?

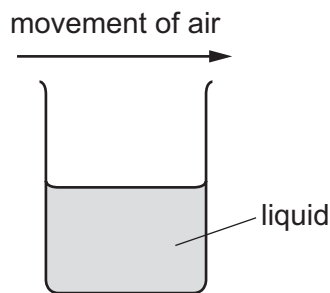
	mass	weight
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ = the same as on Earth

✗ = different on each planet

- 32 A liquid in a beaker evaporates as air moves over it.



Which change increases the rate of evaporation?

- A** decreasing the speed of the air over the beaker
 - B** decreasing the temperature of the liquid in the beaker
 - C** increasing the quantity of liquid in the beaker
 - D** increasing the width of the beaker
- 33 A hot object is placed in a vacuum. It loses thermal energy by radiation.
- What is this radiation?
- A** infrared waves
 - B** microwaves
 - C** ultraviolet waves
 - D** X-rays
- 34 The crests of a wave on the sea reach the beach at a rate of 6.0 crests every 60 seconds. The distance between one crest and the next is 20 m.

What is the speed of the wave?

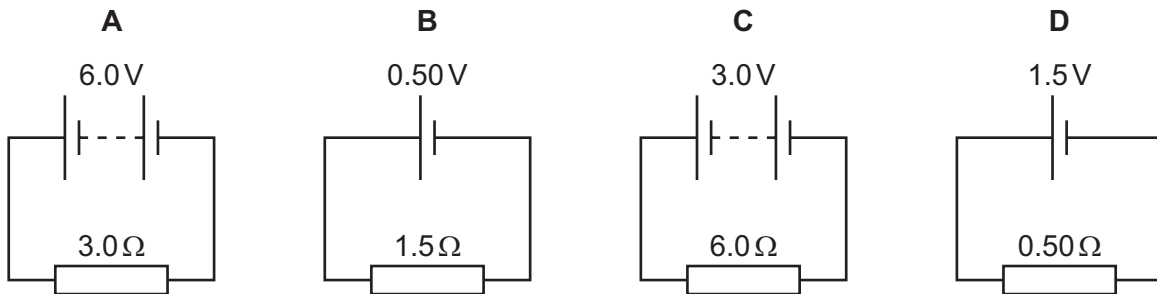
- A** 0.30 m/s
- B** 2.0 m/s
- C** 120 m/s
- D** 200 m/s

35 Sound travels at different speeds in different substances.

What are possible values for the speed of sound in air, in water and in steel?

	<u>speed in air</u> m/s	<u>speed in water</u> m/s	<u>speed in steel</u> m/s
A	330	6000	1500
B	330	1500	6000
C	6000	1500	330
D	6000	330	1500

36 In which circuit is there a current of 2.0 A?



37 The resistance of a wire depends on its length and on its diameter.

Which row shows two changes that **both** increase the resistance of the wire?

	change to length	change to diameter
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

38 A resistor of resistance 30 Ω and a resistor of resistance 60 Ω are connected in parallel.

What is their combined resistance?

- A** 0.050 Ω **B** 20 Ω **C** 45 Ω **D** 90 Ω

39 A 20 V power supply provides a current of 5.0 A for 1.0 minute.

How much energy does the power supply transfer?

- A** 4.0 J **B** 100 J **C** 240 J **D** 6000 J

40 Why is the electricity supply to a mains circuit fitted with a fuse?

- A** to increase the current in the circuit
- B** to increase the resistance of the circuit
- C** to maintain a constant current in the circuit
- D** to prevent overheating of the cables in the circuit

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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
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 —		

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.).