



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

COMBINED SCIENCE

Paper 2 Multiple Choice (Extended)

0653/21

May/June 2018

45 minutes

Additional Materials: Multiple Choice Answer Sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)



READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.

DO NOT WRITE IN ANY BARCODES.

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 separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 16.

Electronic calculators may be used.

This document consists of **16** printed pages.



- 1** Most cars burn fossil fuels to release energy for their movement.

Which characteristic of living organisms is similar to this?

- A** excretion
- B** growth
- C** nutrition
- D** respiration

- 2** Which structure controls the passage of substances into and out of a cell?

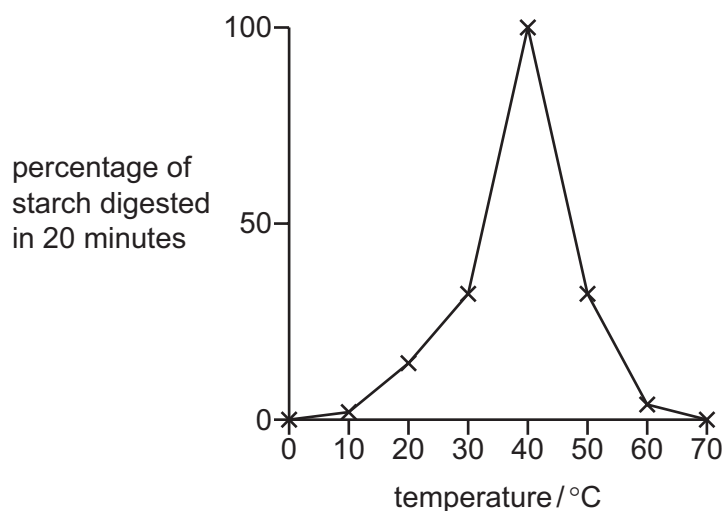
- A** cell membrane
- B** cell wall
- C** nucleus
- D** vacuole

3 Amylase is an enzyme that digests starch.

Identical mixtures of starch and amylase are kept at different temperatures.

The percentage of starch digested in 20 minutes is recorded.

The results are shown in the graph.



The mixtures that were kept at 0 °C and 70 °C are then kept at a temperature of 40 °C for one hour.

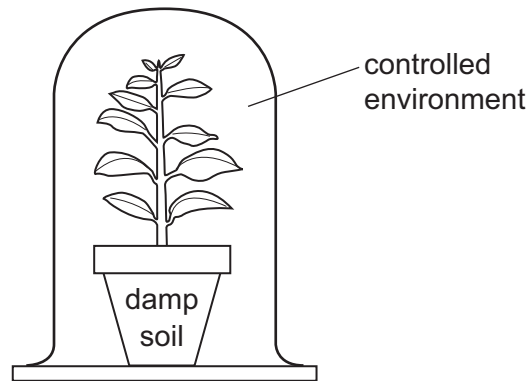
What are the results after this hour?

	percentage of starch digested	
	sample originally kept at 0 °C	sample originally kept at 70 °C
A	0	0
B	0	100
C	100	0
D	100	100

4 Which two chemical substances are required for photosynthesis?

- A** carbon dioxide and glucose
- B** glucose and oxygen
- C** oxygen and water
- D** water and carbon dioxide

- 5 The diagram shows a plant in a controlled environment.



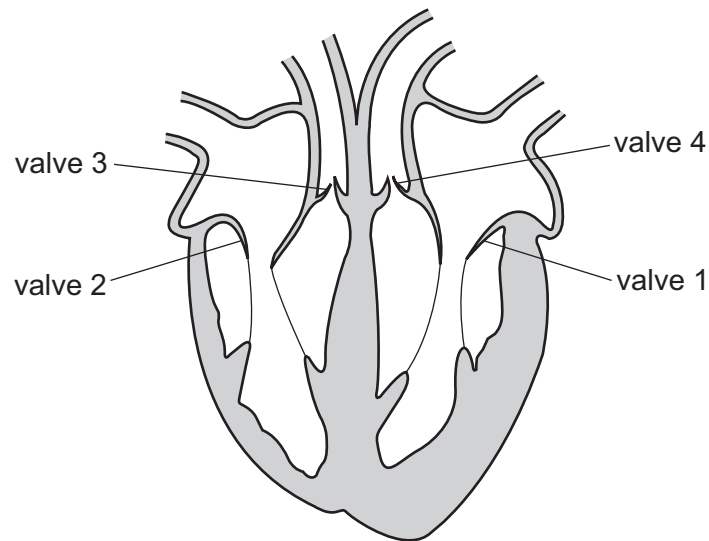
The list gives three ways in which the environment can be altered.

- 1 humidity increased
- 2 light intensity increased
- 3 temperature increased

Which changes will cause an increase in the rate of transpiration of the plant?

	1	2	3
A	✓	✓	x
B	✓	x	x
C	x	x	✓
D	x	✓	✓

- 6 The diagram shows a section through the human heart.



What happens to the valves as blood is being pumped to the lungs?

	valve 1	valve 2	valve 3	valve 4
A	closed	closed	open	closed
B	closed	closed	open	open
C	open	open	closed	closed
D	open	open	closed	open

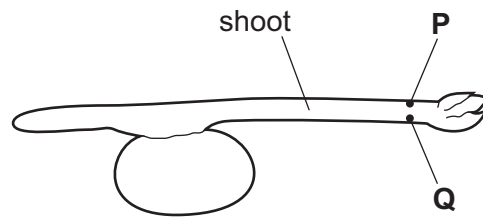
- 7 What is the maximum number of carbon dioxide molecules produced when four glucose molecules are used in aerobic respiration?

A 6 **B** 12 **C** 24 **D** 48

- 8 Why is tar in cigarette smoke a harmful chemical?

A It causes addiction.
B It causes cancer.
C It makes platelets stick together.
D It sticks to blood vessel walls.

- 9 The diagram shows a seedling with its shoot horizontal.



Gravity is the stimulus acting on the seedling.

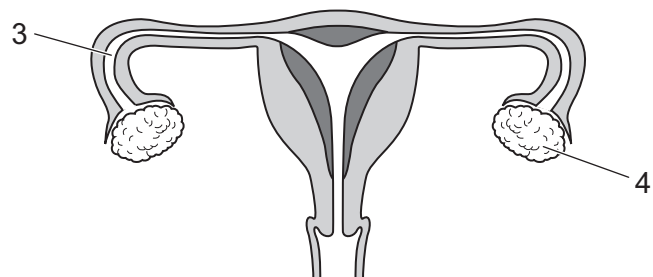
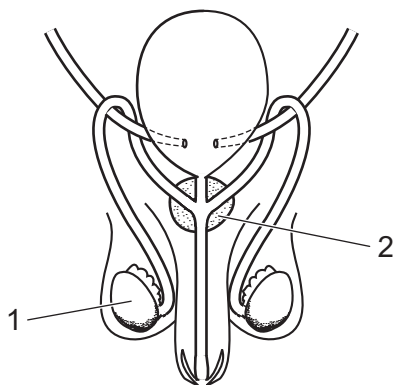
Where will the greatest concentrations of auxin be found in the shoot and what effect will this have on the rate of cell elongation?

	greatest concentration of auxin	effect of auxin on rate of cell elongation
A	P	increases
B	P	decreases
C	Q	increases
D	Q	decreases

- 10 Why are many flowers brightly coloured?

- A** to attract insects to pollinate the flower
- B** to encourage birds to eat insects on the flower
- C** to frighten animals away from the flower
- D** to help with wind-pollination of the flower

- 11 The diagrams show the human male and female reproductive systems.



Which numbered parts produce gametes?

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

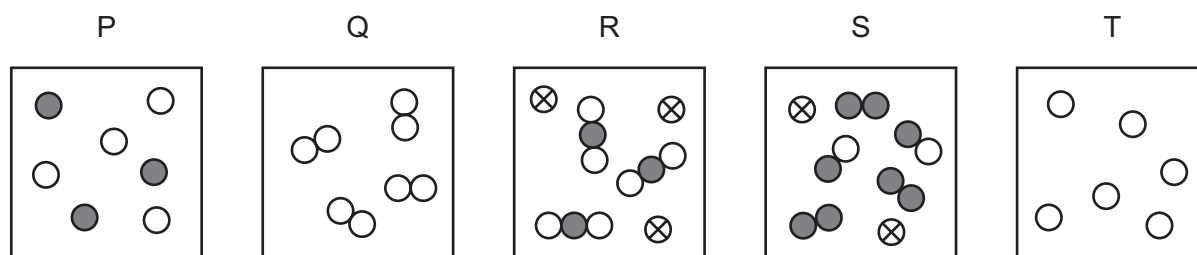
12 At which trophic level in a food chain does transpiration occur?

- A trophic level 1
- B trophic level 2
- C trophic level 3
- D trophic level 4

13 Which statement about greenhouse gases is correct?

- A They are caused by acid rain.
- B They are produced by photosynthesis.
- C They generate heat when they react with sunlight.
- D They reduce the loss of heat from the Earth.

14 The diagrams represent different substances.



Which row describes the substances?

	only separate atoms	only molecules	mixture of atoms and molecules
A	P	Q	S
B	Q	T	R
C	T	P	R
D	T	Q	P

15 Which row describes the method used to obtain salt from salt water and petrol from petroleum?

	salt from salt water	petrol from petroleum
A	crystallisation	distillation
B	crystallisation	fractional distillation
C	filtration	distillation
D	filtration	fractional distillation

16 Some changes are listed.

- 1 boiling
- 2 decomposing
- 3 evaporating
- 4 oxidising

Which changes are physical changes?

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

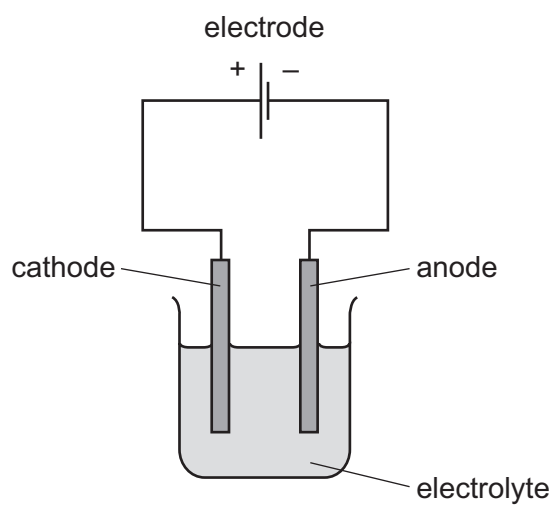
17 The formula of a sodium ion is Na^+ . The formula of an oxide ion is O^{2-} .

What is the formula of sodium oxide?

- A** NaO **B** NaO_2 **C** Na_2O **D** Na_2O_3

18 The diagram shows apparatus for electrolysis.

Only one label is correct.



Which label on the diagram is correct?

- A** anode
B cathode
C electrode
D electrolyte

19 Molten sodium chloride is electrolysed.

Which row shows the product and the equation for the reaction at the stated electrode?

	electrode	product	equation for reaction at the electrode
A	negative	chlorine	$2Cl^- \rightarrow Cl_2 + 2e^-$
B	negative	sodium	$Na^+ + e^- \rightarrow Na$
C	positive	chlorine	$2Cl^{2-} \rightarrow Cl_2 + 4e^-$
D	positive	sodium	$Na^+ + 2e^- \rightarrow Na$

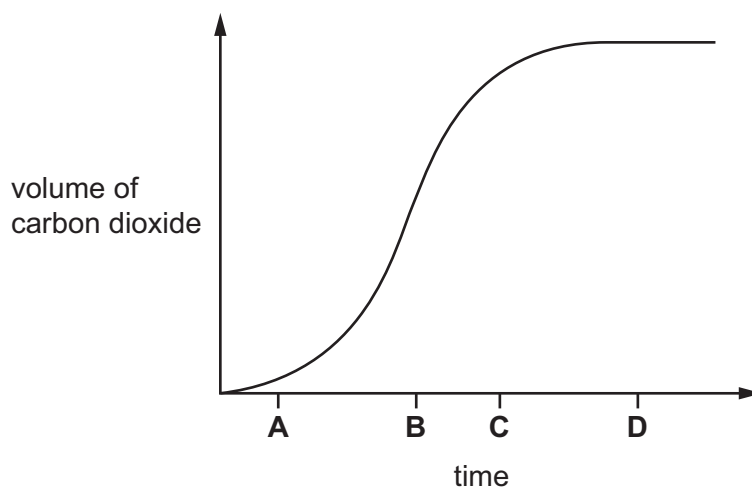
20 Which change **must** take place in an endothermic reaction?

- A** Bubbles of gas are released.
- B** The mass decreases.
- C** The temperature decreases.
- D** The temperature increases.

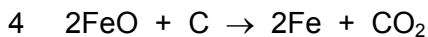
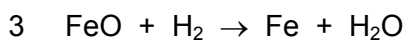
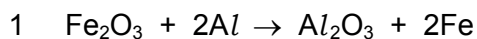
21 The volume of carbon dioxide produced in a reaction is measured.

The results are plotted on a graph.

At which time is the rate of reaction greatest?



22 Four reaction equations involving oxides of iron are listed.



Which statement is correct?

- A In reaction 1, Al is being oxidised by Fe_2O_3 .
- B In reaction 2, FeO is being reduced by O_2 .
- C In reaction 3, H_2 is being reduced by FeO.
- D In reaction 4, FeO is being oxidised by carbon.

23 Excess solid copper oxide is added to warm dilute sulfuric acid and stirred.

How are pure copper sulfate crystals obtained from the mixture?

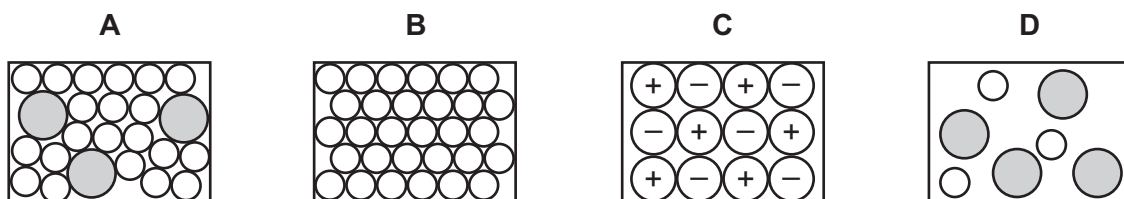
- A distil the mixture → wash the solid → dry the solid
- B filter the mixture → distil the filtrate
- C filter the mixture → heat the filtrate to saturation → cool and filter → dry the solid
- D heat the mixture to saturation → cool and filter → dry the solid

24 Which statement describes the metallic character of elements in Period 2 of the Periodic Table?

- A The first and last elements in this period are metals.
- B The metallic elements are in the centre of this period.
- C The metallic elements are on the left of this period.
- D The metallic elements are on the right of this period.

25 The arrangement of particles in four substances is shown.

Which diagram represents an alloy?



26 Which process produces a gas that contributes to climate change?

- A the electrolysis of molten lead(II) bromide
- B the reaction of calcium with water
- C the reaction of copper oxide with dilute sulfuric acid
- D the thermal decomposition of calcium carbonate

27 Butane, C_4H_{10} , and decane, $C_{10}H_{22}$, are alkanes.

Molecules of decane are larger than molecules of butane.

Which row describes the properties of decane compared to those of butane?

	boiling point	intermolecular attractive forces
A	higher	stronger
B	higher	weaker
C	lower	stronger
D	lower	weaker

28 Diagrams 1, 2 and 3 show two distance-time graphs and one speed-time graph.

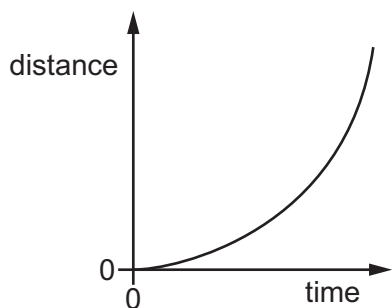


diagram 1

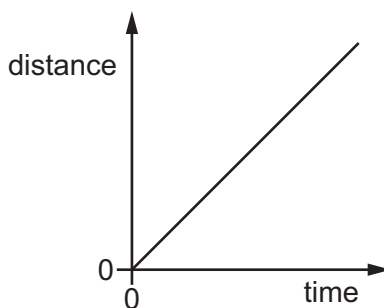


diagram 2

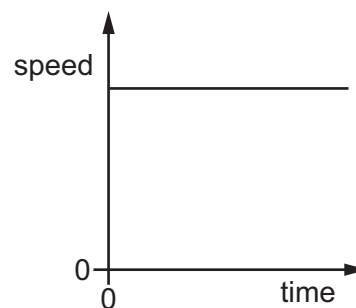


diagram 3

Which of the diagrams represent the motion of an object that is accelerating?

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

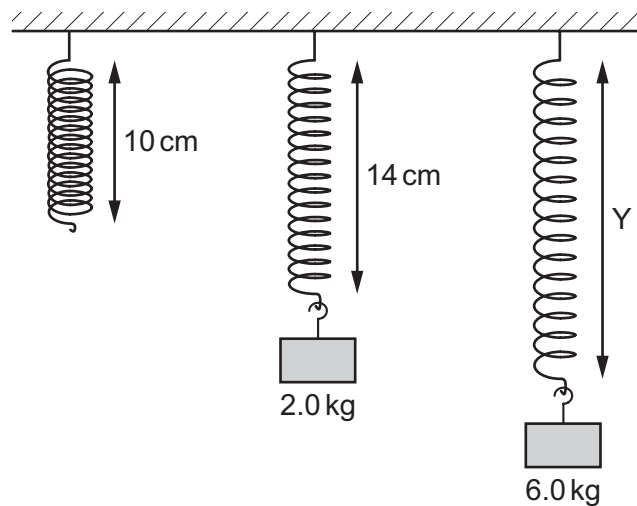
- 29** A student takes an object from one place on Earth to another place where the gravitational field is weaker.

Which property of the object has a smaller value at the second location?

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

- 30** An unstretched spring obeys Hooke's law and has a length of 10 cm. A load with a mass of 2.0 kg is hung from it, and its length becomes 14 cm.

The load is now increased to 6.0 kg, and the new length of the spring is Y. The limit of proportionality is not reached.



What is Y?

- A** 22 cm
- B** 26 cm
- C** 30 cm
- D** 42 cm

- 31** Electricity can be obtained from the energy in water behind a hydroelectric dam.

Is this energy resource renewable, and in which form is its energy stored?

	renewable	form of energy
A	no	chemical
B	no	gravitational potential
C	yes	chemical
D	yes	gravitational potential

- 32 A machine does 6.0 kJ of useful work in 20 minutes.

How much useful power does it produce?

- A 0.30 W B 5.0 W C 120 W D 300 W

- 33 On a summer's day, hot air rises above hot roofs.

What is the name of this process?

- A concentration
B condensation
C conduction
D convection

- 34 A radio station transmits signals at a frequency of 9.1×10^7 Hz.

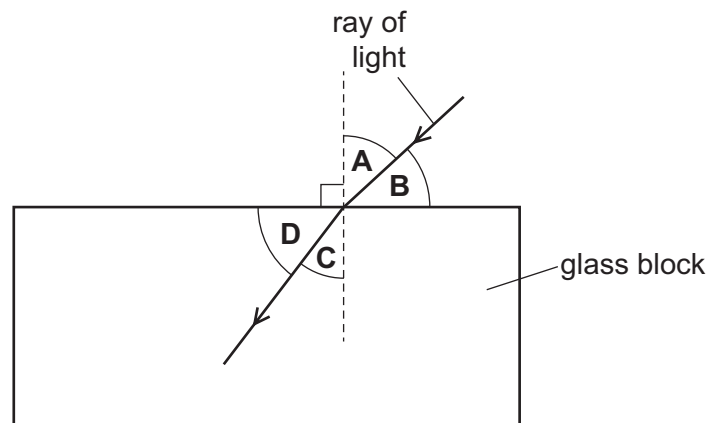
What is the wavelength of the radio waves?

Light travels at a speed of 3.0×10^8 m/s.

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

- 35 The diagram shows a ray of light as it enters a glass block.

Which labelled angle is the angle of refraction?



- 36** Optical fibres are used to transmit telephone conversations.

What is transmitted by the optical fibres?

- A** electromagnetic waves with constant amplitude
- B** pulses of electromagnetic waves
- C** pulses of sound waves
- D** sound waves with constant amplitude

- 37** A student writes two sentences about sound waves.

‘A sound wave travels through the air as compressions and X.....’

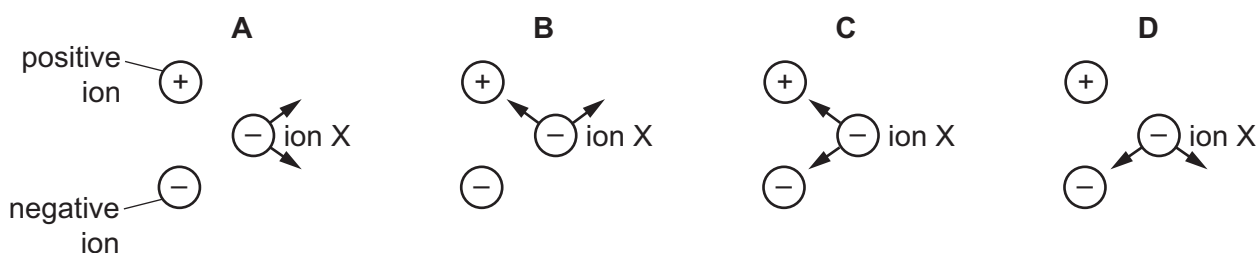
‘The air at the compressions has a different Y..... from the air at X.....’

What are the missing words, X and Y?

	X	Y
A	rarefactions	density
B	rarefactions	state
C	refractions	density
D	refractions	state

- 38** A negative ion X is close to a positive ion and another negative ion. Electrical forces act on ion X because of the charges in the other two ions.

Which diagram shows the directions of the two forces acting on ion X?



- 39** A 240 V mains supply causes a current of 4.00 A in a heater.

How much energy is transferred in the heater in 5.00 minutes?

- A** 192 J
- B** 4800 J
- C** 18 000 J
- D** 288 000 J

40 An electric kettle has the following label attached to its base.

current:	7.5 A
frequency:	50 Hz
power:	1800 W
voltage:	240 V

How is an appropriate fuse for the kettle labelled?

- A** 10 A **B** 60 Hz **C** 2000 W **D** 300 V

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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				
																			5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19
																			13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5
11 Na sodium 23	12 Mg magnesium 24											31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84						
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	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131						
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	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium —	85 At astatine —	86 Rn radon —						
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids		72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	114 Fl flerovium —	116 Lv livermorium —										
87 Fr francium —	88 Ra radium —	89–103 actinoids		104 Rf rutherfordium —	105 Db dubnium —	106 Sg seaborgium —	108 Hs hassium —	109 Mt meitnerium —	110 Ds darmstadtium —	111 Rg roentgenium —	112 Cn copernicium —												

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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A copy of the Periodic Table is printed on page 20.

Electronic calculators may be used.

This document consists of **17** printed pages and **3** blank pages.



1 Which pair of structures is found in a typical plant cell but **not** in a typical animal cell?

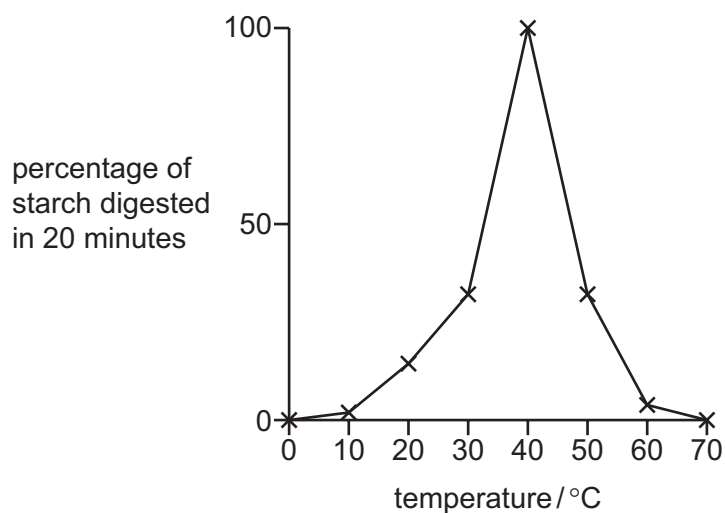
- A cell membrane and chloroplasts
- B cell membrane and cytoplasm
- C cell wall and chloroplasts
- D cell wall and cytoplasm

2 Amylase is an enzyme that digests starch.

Identical mixtures of starch and amylase are kept at different temperatures.

The percentage of starch digested in 20 minutes is recorded.

The results are shown in the graph.



The mixtures that were kept at 0 °C and 70 °C are then kept at a temperature of 40 °C for one hour.

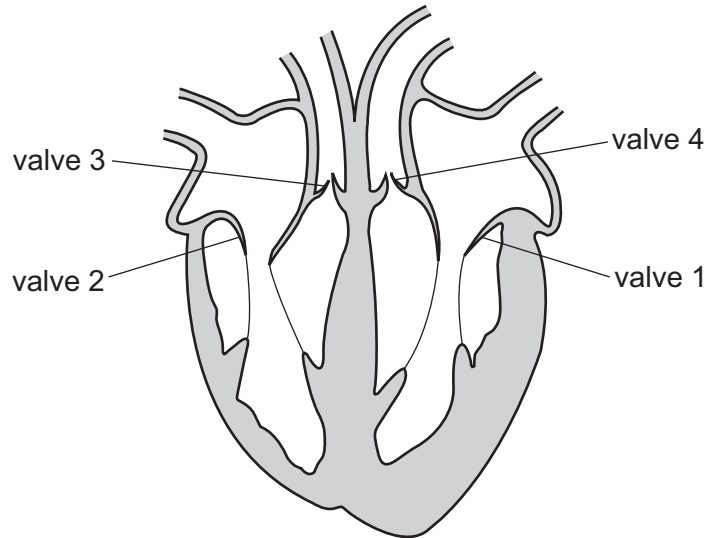
What are the results after this hour?

	percentage of starch digested	
	sample originally kept at 0 °C	sample originally kept at 70 °C
A	0	0
B	0	100
C	100	0
D	100	100

3 Which two chemical substances are required for photosynthesis?

- A carbon dioxide and glucose
- B glucose and oxygen
- C oxygen and water
- D water and carbon dioxide

4 The diagram shows a section through the human heart.



What happens to the valves as blood is being pumped to the lungs?

	valve 1	valve 2	valve 3	valve 4
A	closed	closed	open	closed
B	closed	closed	open	open
C	open	open	closed	closed
D	open	open	closed	open

5 Two students exercised for five minutes. Immediately afterwards, each student measured her own pulse rate.

The pulse rate for one student was lower than the pulse rate for the other student.

Why might her pulse rate be lower?

- A Her exercise was harder.
- B Her heart rate was higher.
- C She had secreted more adrenaline.
- D She takes regular exercise.

6 What is **not** a feature of a gas exchange surface in animals?

- A moist
- B permeable
- C small surface area
- D thin

7 What is the maximum number of carbon dioxide molecules produced when four glucose molecules are used in aerobic respiration?

- A 6 B 12 C 24 D 48

8 Adrenaline is sometimes called the 'fight or flight' hormone.

Which is an effect of adrenaline that helps prepare the body to fight or to take flight when frightened?

- A It increases blood glucose concentration.
- B It increases the rate of digestion.
- C It maintains a constant body temperature.
- D It slows down the heart rate.

9 Which row describes sexual reproduction?

	number of parents	offspring genetically identical to parents	involves zygote production
A	1	✓	✓
B	1	x	x
C	2	✓	x
D	2	x	✓

10 Which features are correct for a wind-pollinated flower?

	nectar	petals
A	absent	small
B	absent	large
C	present	small
D	present	large

- 11 In a food chain, the energy transferred from the first trophic level to the second trophic level is greater than the energy transferred from the second trophic level to the third trophic level.

Which process is **not** a reason for this difference?

- A egestion
- B excretion
- C movement
- D photosynthesis

- 12 Fertilisers help crop plants grow.

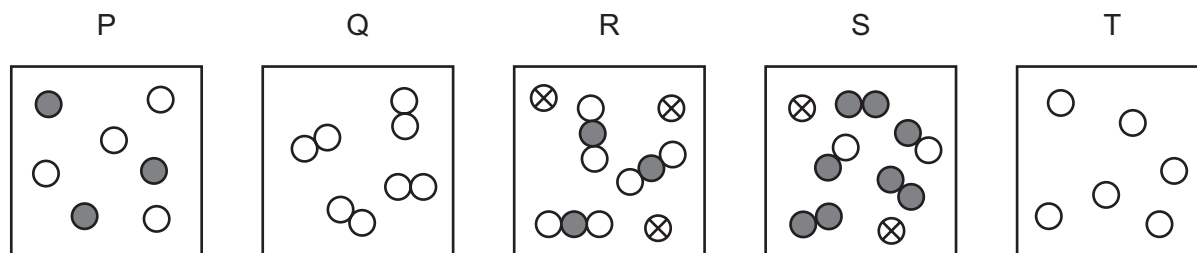
How might the overuse of fertilisers damage the ecosystem?

- A Animals feeding on the crop plants will die.
- B It will lead to flooding
- C Nutrients will not be available to plants.
- D Waterways will be polluted.

- 13 What are the effects of acid rain?

	damage to limestone buildings	damage to trees
A	✓	x
B	✓	✓
C	x	x
D	x	✓

14 The diagrams represent different substances.



Which row describes the substances?

	only separate atoms	only molecules	mixture of atoms and molecules
A	P	Q	S
B	Q	T	R
C	T	P	R
D	T	Q	P

15 Which method is used to separate a mixture of two liquids?

- A** chromatography
- B** crystallisation
- C** filtration
- D** fractional distillation

16 Which process involves a physical change?

- A** adding magnesium to nitric acid
- B** burning methane
- C** evaporating petroleum
- D** rusting iron

17 An ion of element X has 8 protons, 8 neutrons and 10 electrons.

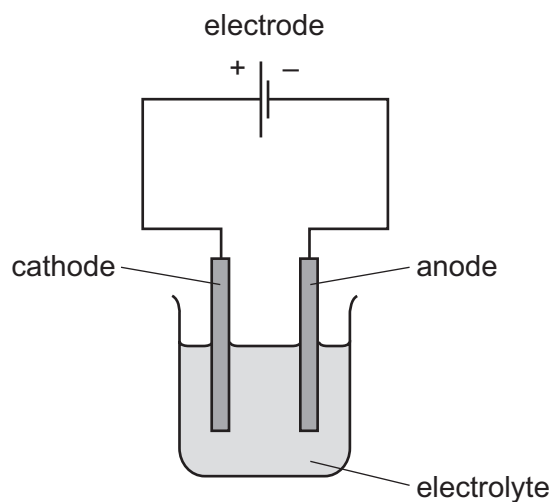
An ion of element Y has 11 protons, 12 neutrons and 10 electrons.

What is the formula of the ionic compound formed between X and Y?

- A** XY
- B** XY₂
- C** X₂Y
- D** X₂Y₂

- 18 The diagram shows apparatus for electrolysis.

Only one label is correct.



Which label on the diagram is correct?

- A anode
 - B cathode
 - C electrode
 - D electrolyte
- 19 When aqueous copper chloride is electrolysed, ions move to the electrodes.
- Which ions move to the positive electrode?
- A chloride
 - B copper
 - C hydrogen
 - D oxide
- 20 Which change **must** take place in an endothermic reaction?
- A Bubbles of gas are released.
 - B The mass decreases.
 - C The temperature decreases.
 - D The temperature increases.

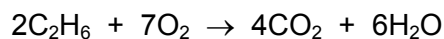
21 Magnesium reacts with dilute hydrochloric acid in four experiments.

The same mass of magnesium and the same volume and concentration of the acid are used.

Which conditions produce the greatest rate of reaction?

	magnesium	temperature / °C
A	powder	10
B	powder	20
C	ribbon	10
D	ribbon	20

22 The equation for the combustion of ethane is shown.



Which statement about this reaction is correct?

- A** Ethane is oxidised because it gains oxygen.
- B** Ethane is reduced because carbon to hydrogen bonds are broken.
- C** It is endothermic because chemical energy is transformed to heat.
- D** It is exothermic because heat is transformed to chemical energy.

23 Zinc sulfate is a soluble salt.

It is made by reacting excess zinc with dilute sulfuric acid.

Which row describes how zinc sulfate is obtained from the mixture after the reaction has finished?

	step 1	step 2	step 3
A	evaporate all of the water	wash the solid that is left	dry the solid
B	filter the mixture	collect the residue from the filter paper	wash and dry the residue
C	filter the mixture	saturate the solution and crystallise	filter, wash and dry the crystals
D	saturate the solution	allow the solution to crystallise	filter, wash and dry the crystals

24 Part of the Periodic Table is shown.

I II																		III IV V VI VII VIII	
V																		W X	

Which element forms an anion and which element forms a cation?

	forms an anion	forms a cation
A	V	W
B	V	X
C	W	V
D	X	W

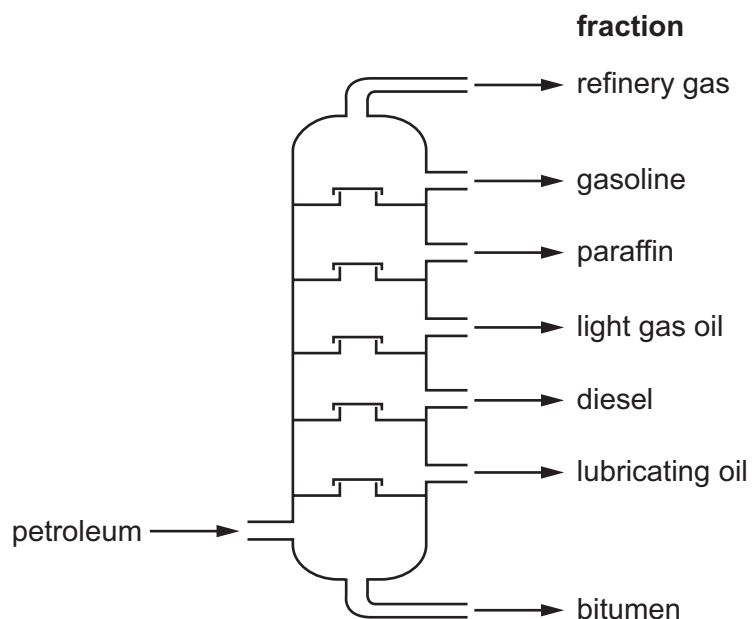
25 Which statement about metals is **not** correct?

- A** Calcium is extracted from its ore by electrolysis.
- B** Compounds containing metals are ionic and the metal is always the positive ion.
- C** Magnesium is more reactive than iron because it forms positive ions less easily than iron.
- D** Some metals react with dilute hydrochloric acid to give hydrogen.

26 Which process produces a gas that contributes to climate change?

- A** the electrolysis of molten lead(II) bromide
- B** the reaction of calcium with water
- C** the reaction of copper oxide with dilute sulfuric acid
- D** the thermal decomposition of calcium carbonate

27 The fractional distillation of petroleum is shown.

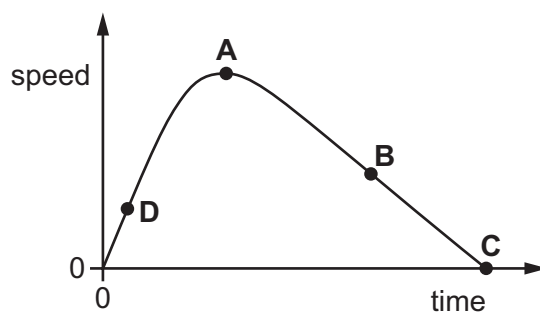


Which fraction contains molecules with the largest intermolecular attractive forces?

- A bitumen
- B diesel
- C gasoline
- D refinery gas

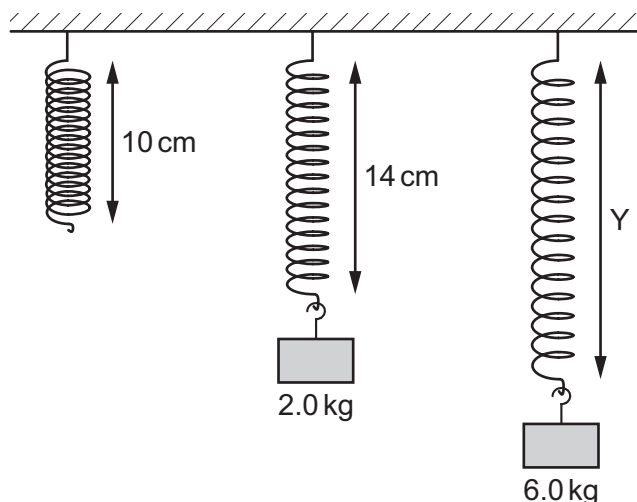
28 The graph shows how the speed of a bicycle varies with time.

At which labelled point is the acceleration of the bicycle the greatest?



- 29** An unstretched spring obeys Hooke's law and has a length of 10 cm. A load with a mass of 2.0 kg is hung from it, and its length becomes 14 cm.

The load is now increased to 6.0 kg, and the new length of the spring is Y. The limit of proportionality is not reached.



What is Y?

- A** 22 cm **B** 26 cm **C** 30 cm **D** 42 cm
- 30** A train is travelling along a straight, horizontal track at constant speed.
- The work done by the train is recorded as it travels through a measured distance.
- Which quantity can be calculated using only these two pieces of information?
- A** force exerted by the train
B speed of the train
C time taken to travel this distance
D weight of the train
- 31** The molecules of a substance are close together. They are vibrating and constantly changing places within the substance.
- The substance now loses energy and this causes it to change state.
- Which change of state has occurred?
- A** gas to liquid
B liquid to gas
C liquid to solid
D solid to liquid

32 On a summer's day, hot air rises above hot roofs.

What is the name of this process?

- A** concentration
- B** condensation
- C** conduction
- D** convection

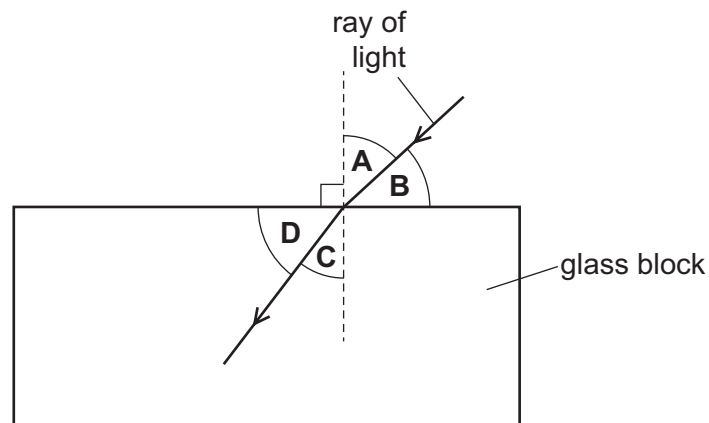
33 A wave has a frequency of 120 Hz and a wavelength of 50 cm.

What is the speed of the wave?

- A** 2.4 m/s **B** 60 m/s **C** 240 m/s **D** 6000 m/s

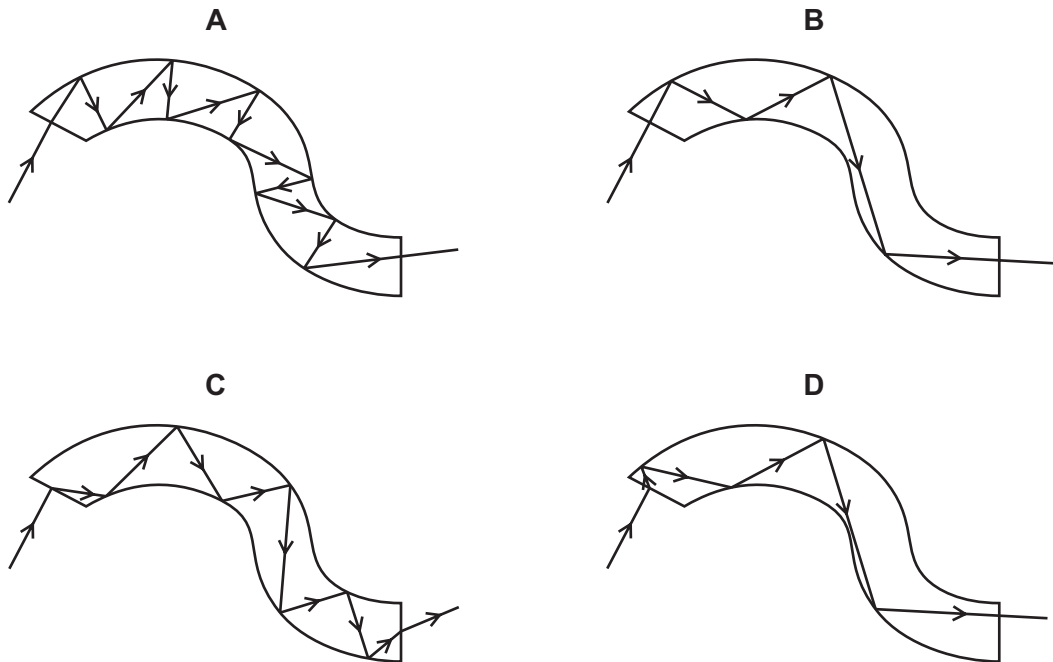
34 The diagram shows a ray of light as it enters a glass block.

Which labelled angle is the angle of refraction?



- 35** Light travels along a glass optical fibre by total internal reflection. The light enters the fibre at right angles to the end.

Which diagram shows the path of the light in the fibre?



- 36** Gamma rays, radio waves and visible light all travel in a vacuum.

How do the speeds of these waves compare?

- A** Gamma rays have the highest speed.
- B** Radio waves have the highest speed.
- C** The waves all have the same speed.
- D** Visible light waves have the highest speed.

37 A student writes two sentences about sound waves.

'A sound wave travels through the air as compressions and X......'

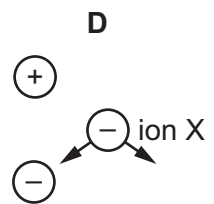
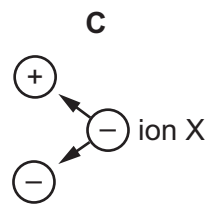
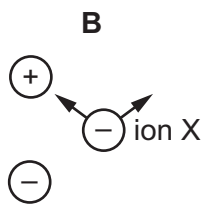
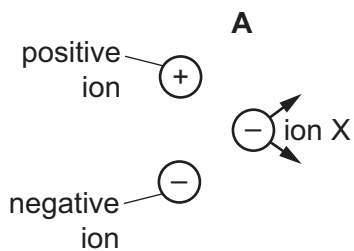
'The air at the compressions has a different Y..... from the air at X......'

What are the missing words, X and Y?

	X	Y
A	rarefactions	density
B	rarefactions	state
C	refractions	density
D	refractions	state

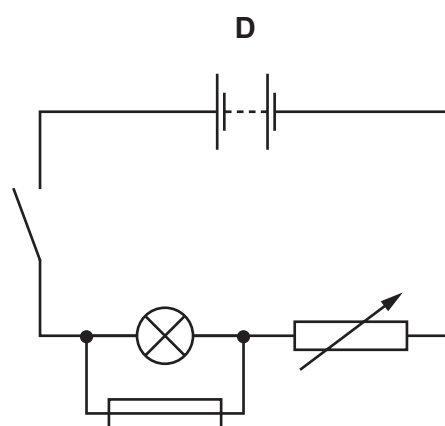
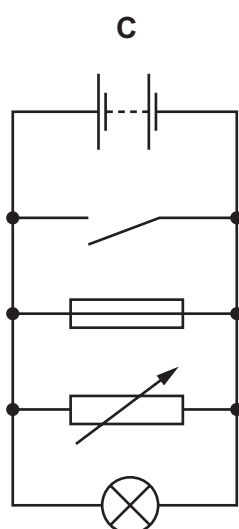
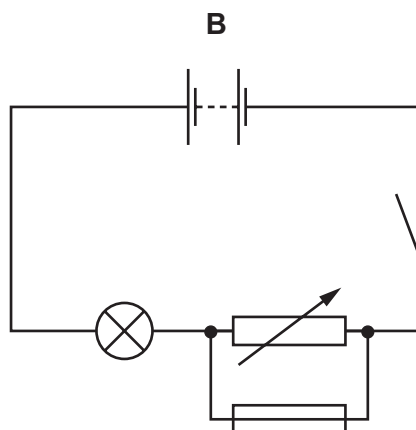
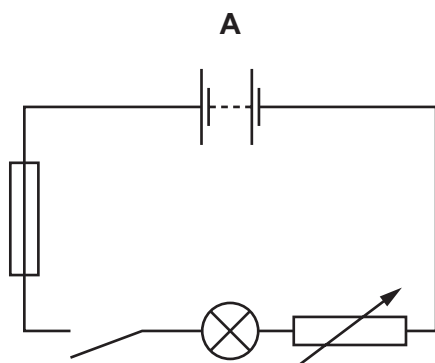
38 A negative ion X is close to a positive ion and another negative ion. Electrical forces act on ion X because of the charges in the other two ions.

Which diagram shows the directions of the two forces acting on ion X?



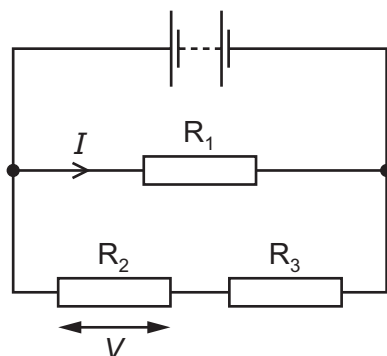
39 A lamp can be dimmed or switched off. Its circuit is protected by a fuse.

Which diagram shows this circuit?



40 The diagram shows three identical resistors R_1 , R_2 and R_3 connected to a battery.

The current in R_1 is I . The potential difference (p.d.) across R_2 is V .



Which row gives the current in R_3 and the p.d. across R_3 ?

	current in R_3	p.d. across R_3
A	$\frac{I}{2}$	$\frac{V}{2}$
B	$\frac{I}{2}$	V
C	I	$\frac{V}{2}$
D	I	V

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Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

COMBINED SCIENCE

Paper 2 Multiple Choice (Extended)

0653/23

May/June 2018

45 minutes

Additional Materials: Multiple Choice Answer Sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)



READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.

DO NOT WRITE IN ANY BARCODES.

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 separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 16.

Electronic calculators may be used.

This document consists of **16** printed pages.



1 Which structure found in plant cells traps light energy for photosynthesis?

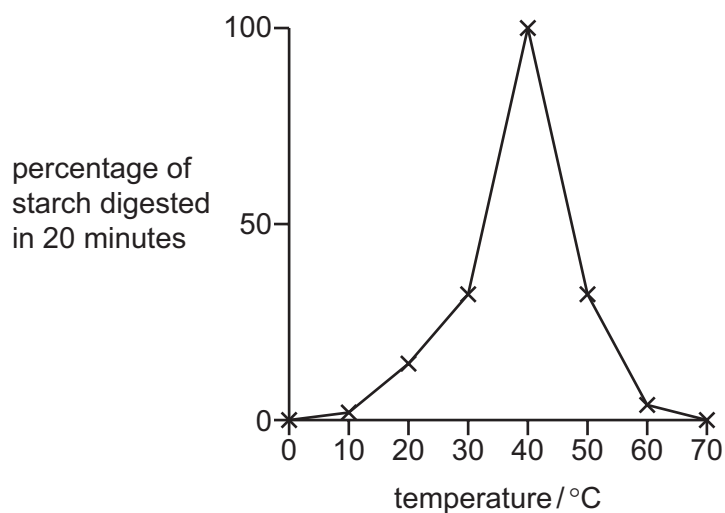
- A cell wall
- B chloroplast
- C nucleus
- D vacuole

2 Amylase is an enzyme that digests starch.

Identical mixtures of starch and amylase are kept at different temperatures.

The percentage of starch digested in 20 minutes is recorded.

The results are shown in the graph.



The mixtures that were kept at 0 °C and 70 °C are then kept at a temperature of 40 °C for one hour.

What are the results after this hour?

	percentage of starch digested	
	sample originally kept at 0 °C	sample originally kept at 70 °C
A	0	0
B	0	100
C	100	0
D	100	100

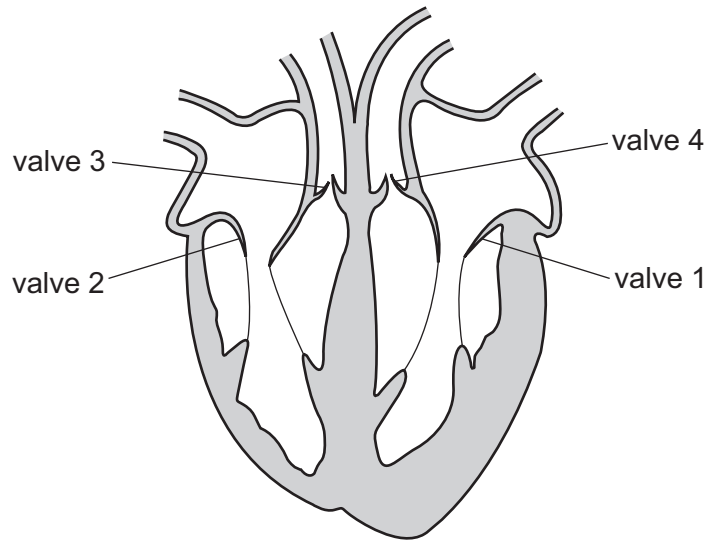
- 3 Which substance is broken down to produce lactic acid during the manufacture of yoghurt?
- A glucose
 - B lactose
 - C protein
 - D starch
- 4 Which two chemical substances are required for photosynthesis?
- A carbon dioxide and glucose
 - B glucose and oxygen
 - C oxygen and water
 - D water and carbon dioxide

- 5 A person eats a diet high in carbohydrate and fat and low in fibre.

What might be the long-term consequences of this diet?

	constipation	obesity	starvation
A	x	✓	✓
B	✓	x	✓
C	x	x	x
D	✓	✓	x

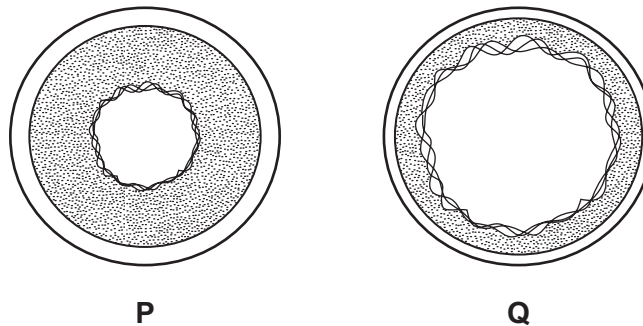
- 6 The diagram shows a section through the human heart.



What happens to the valves as blood is being pumped to the lungs?

	valve 1	valve 2	valve 3	valve 4
A	closed	closed	open	closed
B	closed	closed	open	open
C	open	open	closed	closed
D	open	open	closed	open

- 7 The diagram shows cross-sections of two different blood vessels.



What type of blood vessel is **Q** and what is the relative blood pressure in **Q** compared with **P**?

	blood vessel Q	relative blood pressure in Q
A	artery	higher
B	artery	lower
C	vein	higher
D	vein	lower

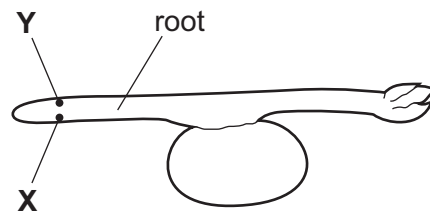
8 What is the maximum number of carbon dioxide molecules produced when four glucose molecules are used in aerobic respiration?

- A 6 B 12 C 24 D 48

9 What are the functions of the cilia and mucus in the gas exchange system?

	cilia	mucus
A	make mucus	trap pathogens
B	make mucus	move cilia
C	move mucus	trap pathogens
D	move mucus	move cilia

10 The diagram shows a seedling with its root horizontal.



Gravity is the stimulus acting on the seedling.

Where will the greatest concentration of auxin be found in the root and what effect will this have on the rate of cell elongation?

	greatest concentration of auxin	effect of auxin on rate of cell elongation
A	X	decreases
B	X	increases
C	Y	decreases
D	Y	increases

11 The table shows some features of flowers.

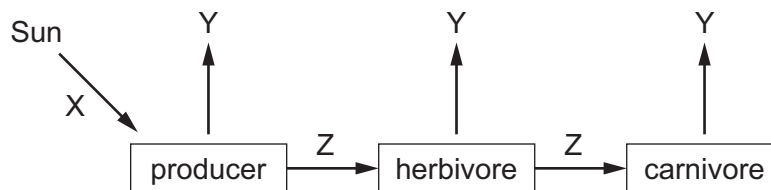
Which features are typical of wind-pollinated flowers?

	petals	position of anther	nectaries
A	large	inside flower	absent
B	large	outside flower	present
C	small	inside flower	present
D	small	outside flower	absent

12 What is a **disadvantage** of breast-feeding compared with bottle-feeding using formula milk?

- A** difficult to measure the amount of milk given
- B** milk contains antibodies
- C** milk is always immediately available
- D** milk is at the optimum temperature

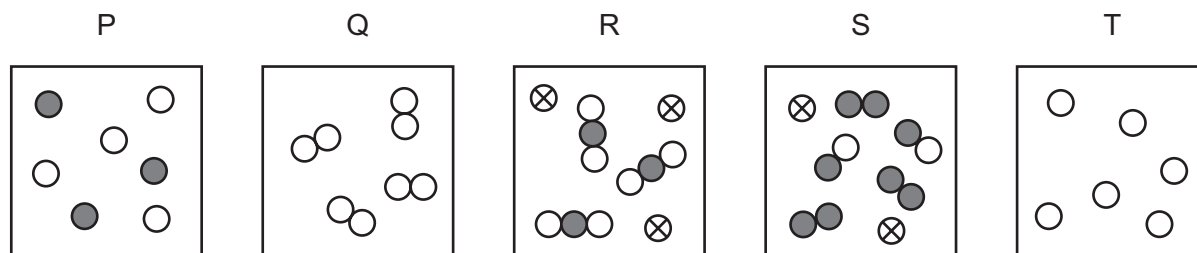
13 The diagram shows how energy flows through a food chain.



What are the main energy transfers shown by arrows X, Y and Z?

	X	Y	Z
A	chemical → chemical	chemical → heat	chemical → light
B	chemical → chemical	chemical → light	chemical → light
C	light → chemical	chemical → heat	chemical → chemical
D	light → chemical	chemical → light	chemical → chemical

14 The diagrams represent different substances.



Which row describes the substances?

	only separate atoms	only molecules	mixture of atoms and molecules
A	P	Q	S
B	Q	T	R
C	T	P	R
D	T	Q	P

15 A mixture of salt water and sand is filtered.

Which statement is correct?

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

16 Which process is **not** a chemical change?

- A** the electrolysis of molten lead bromide
- B** the fractional distillation of petroleum
- C** the oxidation of copper
- D** the rusting of iron

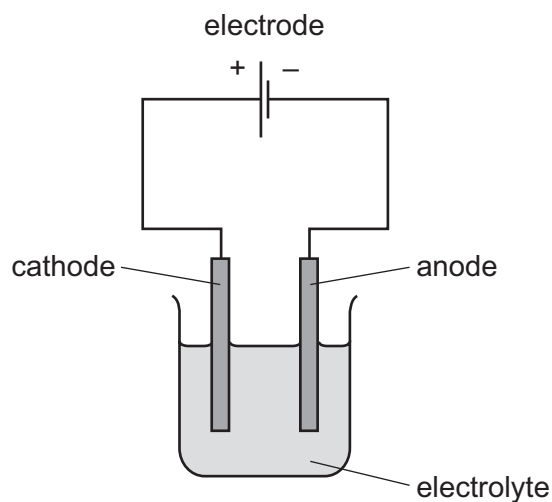
17 Chromium oxide contains chromium ions, Cr^{3+} , and oxide ions, O^{2-} .

What is the formula of chromium oxide?

- A** CrO
- B** CrO_2
- C** Cr_2O_3
- D** Cr_3O_2

18 The diagram shows apparatus for electrolysis.

Only one label is correct.



Which label on the diagram is correct?

- A anode
- B cathode
- C electrode
- D electrolyte

19 Molten calcium chloride is electrolysed.

What happens at the negative electrode?

- A Calcium atoms lose electrons to form calcium ions.
- B Calcium ions gain electrons to form calcium atoms.
- C Chloride ions lose electrons to form chlorine molecules.
- D Chlorine molecules gain electrons to form chloride ions.

20 Which change **must** take place in an endothermic reaction?

- A Bubbles of gas are released.
- B The mass decreases.
- C The temperature decreases.
- D The temperature increases.

21 Dilute hydrochloric acid is reacted with calcium carbonate at 20 °C.

The reaction is repeated at 30 °C.

Which statement about the second reaction is correct?

- A It is faster because there are fewer collisions per second between reacting particles.
- B It is faster because there are more collisions per second between reacting particles.
- C It is slower because there are fewer collisions per second between reacting particles.
- D It is slower because there are more collisions per second between reacting particles.

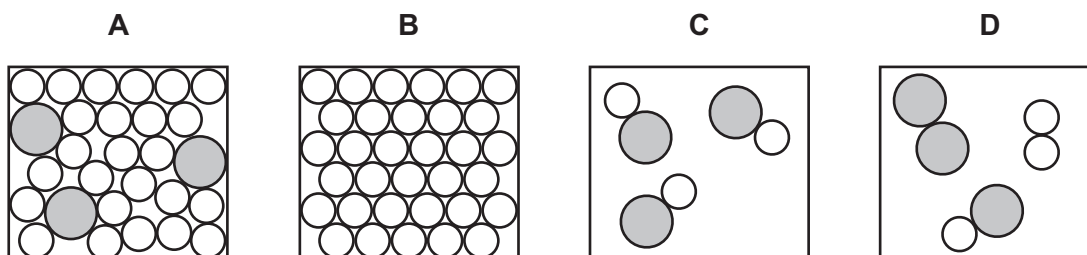
22 Which reaction is a redox reaction?

- A $2\text{HCl} + \text{CaCO}_3 \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$
- B $\text{AgNO}_3 + \text{KCl} \rightarrow \text{AgCl} + \text{KNO}_3$
- C $\text{Ca}(\text{OH})_2 + \text{CO}_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O}$
- D $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$

23 What is the trend shown by the elements across a period in the Periodic Table, from left to right?

- A metals $\rightarrow$ non-metals
- B metals $\rightarrow$ non-metals $\rightarrow$ metals
- C non-metals $\rightarrow$ metals
- D non-metals $\rightarrow$ metals $\rightarrow$ non-metals

24 Which diagram represents the arrangement of atoms in an alloy?



25 Which reaction does **not** take place in the blast furnace?

- A calcium carbonate $\rightarrow$ calcium oxide + carbon dioxide
- B calcium oxide + silicon dioxide $\rightarrow$ calcium silicate
- C iron oxide + carbon monoxide $\rightarrow$ iron + carbon dioxide
- D iron oxide + carbon dioxide $\rightarrow$ iron + carbon monoxide

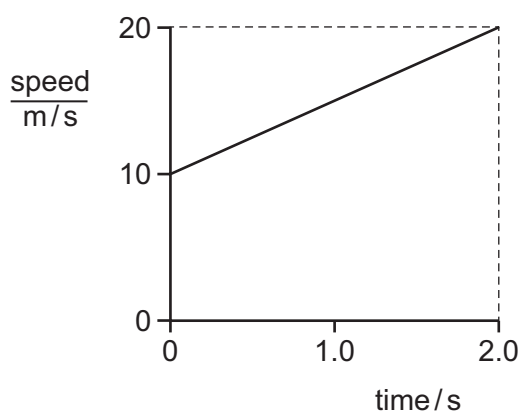
26 Which process produces a gas that contributes to climate change?

- A the electrolysis of molten lead(II) bromide
- B the reaction of calcium with water
- C the reaction of copper oxide with dilute sulfuric acid
- D the thermal decomposition of calcium carbonate

27 Which statement about hydrocarbons is **not** correct?

- A Alkenes are made by cracking alkanes.
- B Butene decolourises bromine.
- C C_2H_4 is an alkene.
- D Ethanol is an alkane.

28 The diagram shows a speed-time graph for a falling object.

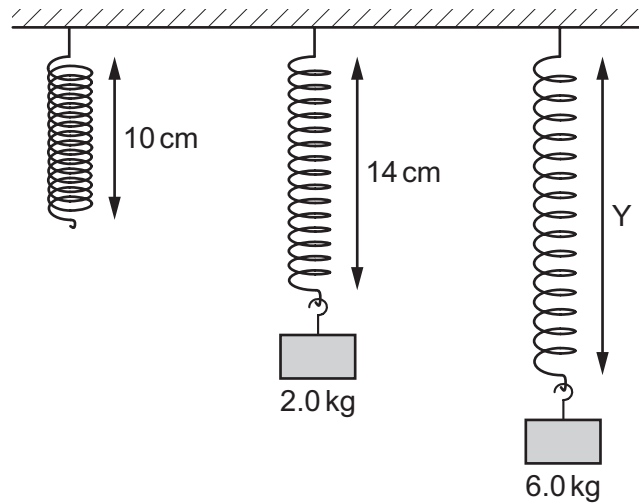


How far does the object fall in 2.0 seconds?

- A 5.0 m
- B 20 m
- C 30 m
- D 40 m

- 29** An unstretched spring obeys Hooke's law and has a length of 10 cm. A load with a mass of 2.0 kg is hung from it, and its length becomes 14 cm.

The load is now increased to 6.0 kg, and the new length of the spring is Y. The limit of proportionality is not reached.



What is Y?

- A** 22 cm **B** 26 cm **C** 30 cm **D** 42 cm
- 30** A copper block is pulled down a rough slope at a constant speed.
- Which form of energy of the block increases?
- A** chemical
B gravitational
C kinetic
D thermal

- 31** A weightlifter lifts 150 kg through a distance of 2.0 m in a time of 1.5 s.

The acceleration of free fall g is 10 m/s^2 .

How much power does she produce?

- A** 200 W **B** 450 W **C** 2000 W **D** 4500 W

- 32 On a summer's day, hot air rises above hot roofs.

What is the name of this process?

- A concentration
- B condensation
- C conduction
- D convection

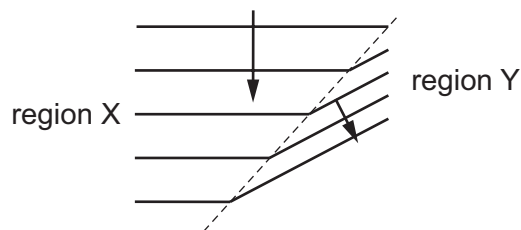
- 33 The diagram shows part of the electromagnetic spectrum. Two regions are labelled P and Q.

infra-red waves	P	ultraviolet waves	Q	gamma rays
-----------------	---	-------------------	---	------------

What type of radiation is P, and which radiation has the lower frequency, P or Q?

	radiation P	lower frequency
A	visible light	P
B	visible light	Q
C	X-rays	P
D	X-rays	Q

- 34 The diagram represents a water wave moving into a region where the depth of water is different.

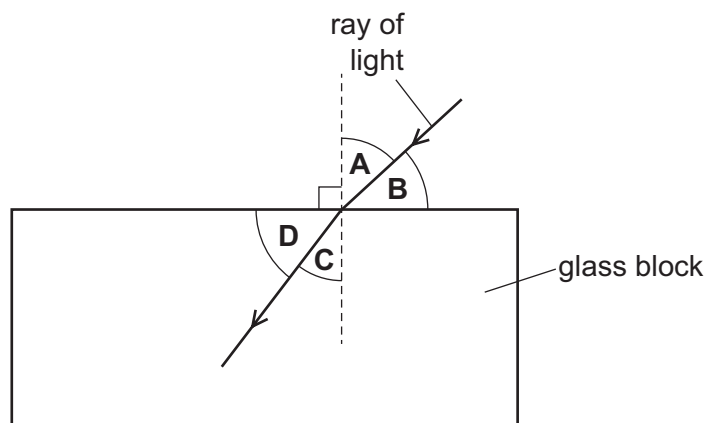


How do the speed and wavelength of the waves in region Y compare with their values in region X?

	speed in Y	wavelength in Y
A	greater	smaller
B	greater	the same
C	smaller	smaller
D	smaller	the same

35 The diagram shows a ray of light as it enters a glass block.

Which labelled angle is the angle of refraction?



36 A student writes two sentences about sound waves.

'A sound wave travels through the air as compressions and X.....'

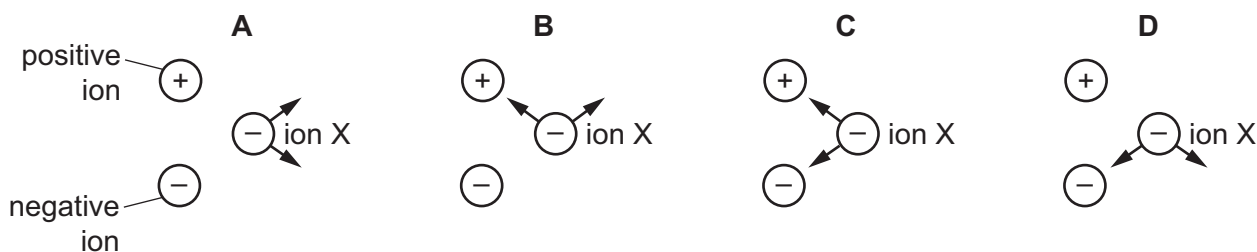
'The air at the compressions has a different Y..... from the air at X.....'

What are the missing words, X and Y?

	X	Y
A	rarefactions	density
B	rarefactions	state
C	refractions	density
D	refractions	state

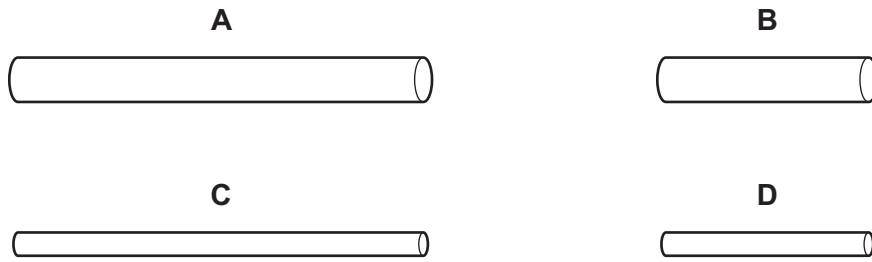
37 A negative ion X is close to a positive ion and another negative ion. Electrical forces act on ion X because of the charges in the other two ions.

Which diagram shows the directions of the two forces acting on ion X?

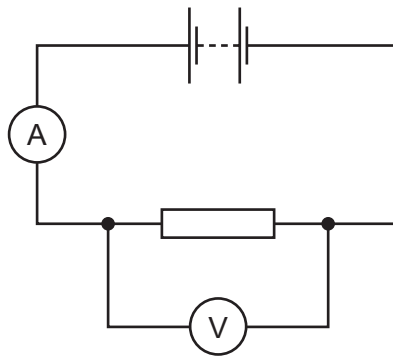


- 38** The diagram shows four wires at the same temperature, made from the same metal. The diagram is drawn to scale.

Which wire has the least electrical resistance between its ends?



- 39** A resistor is connected in a circuit as shown.

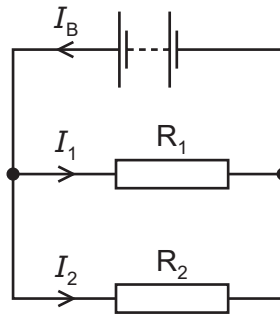


The reading on the ammeter is 2.0 A and the reading on the voltmeter is 4.0 V .

What is the power produced in the resistor?

- A** 0.50 W **B** 2.0 W **C** 6.0 W **D** 8.0 W

40 A circuit consists of two identical resistors, R_1 and R_2 , and a battery.



The current in the battery is I_B . The current in R_1 is I_1 and the current in R_2 is I_2 .

How are I_B , I_1 and I_2 related?

- A $I_B = I_1 = I_2$
- B $I_B > I_1$ and $I_1 = I_2$
- C $I_B < I_2$ and $I_1 = I_2$
- D $I_B > I_1 > I_2$

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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
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 —				—

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.).