



**Cambridge International Examinations**  
Cambridge International General Certificate of Secondary Education (9–1)

\* 0 1 2 3 4 5 6 7 8 9 \*

**CHEMISTRY**

**0971/01**

Paper 1 Multiple Choice (Core)

**For Examination from 2018**

SPECIMEN PAPER

**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.

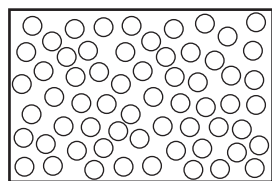
Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 18.

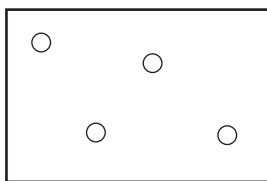
Electronic calculators may be used.

This document consists of **18** printed pages.

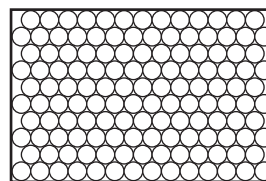
- 1 The diagrams show the arrangement of particles in three different physical states of substance X.



state 1



state 2



state 3

Which statement about the physical states of substance X is correct?

- A Particles in state 1 vibrate about fixed positions.
- B State 1 changes to state 2 by diffusion.
- C State 2 changes directly to state 3 by condensation.
- D The substance in state 3 has a fixed volume.

- 2 What is always true for a pure substance?

- A It always boils at 100 °C.
- B It contains only one type of atom.
- C It has a sharp melting point.
- D It is solid at room temperature.

- 3 Element Y has a nucleon number of 19 and a proton number of 9.

Which group in the Periodic Table does it belong to?

- A I
- B III
- C VII
- D VIII

- 4 The nucleon number and proton number of the lithium atom are shown by the symbol  ${}^7_3\text{Li}$ .

What is the correct symbol for the lithium ion in lithium chloride?

- A  ${}^6_2\text{Li}^-$
- B  ${}^6_3\text{Li}^+$
- C  ${}^7_3\text{Li}^+$
- D  ${}^7_3\text{Li}^-$

- 5 What is the relative molecular mass,  $M_r$ , of  $\text{HNO}_3$ ?

- A 5
- B 31
- C 32
- D 63

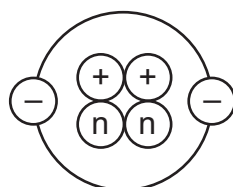
6 The table shows the structure of different atoms and ions.

particle	proton number	nucleon number	number of protons	number of neutrons	number of electrons
Mg	12	24	12	W	12
Mg <sup>2+</sup>	X	24	12	12	10
F	9	19	9	Y	9
F <sup>-</sup>	9	19	9	10	Z

What are the values of W, X, Y and Z?

	W	X	Y	Z
<b>A</b>	10	10	9	9
<b>B</b>	10	12	10	9
<b>C</b>	12	10	9	10
<b>D</b>	12	12	10	10

7 The diagram shows the structure of an atom.



key

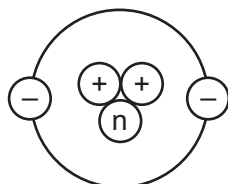
⊕ = proton

⊙ = neutron

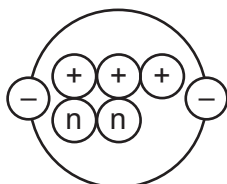
⊖ = electron

Which diagram shows the structure of an isotope of this atom?

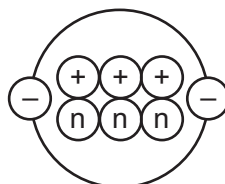
**A**



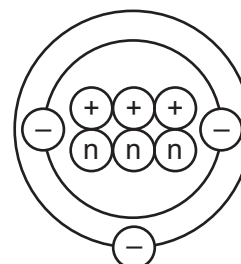
**B**



**C**



**D**



8 Which two elements react together to form an ionic compound?

element	electronic structure
R	2,4
T	2,8
X	2,8,1
Z	2,8,7

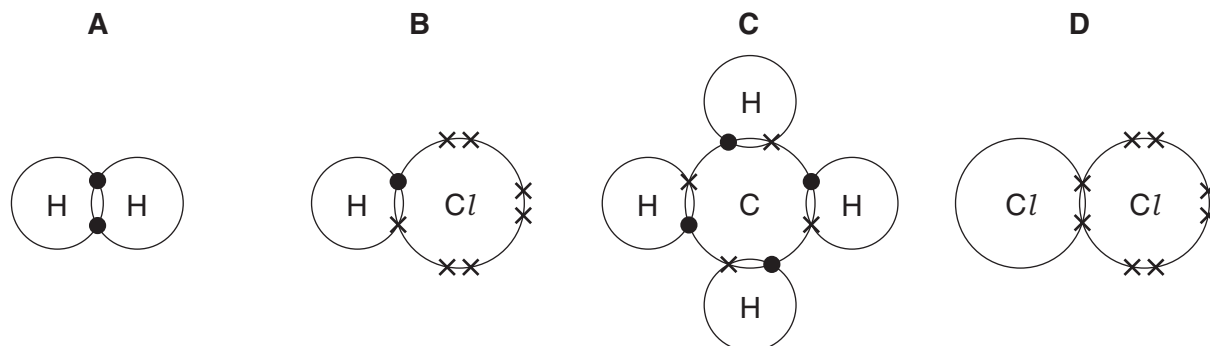
- A** R and T      **B** T and X      **C** X and Z      **D** Z and R

9 Element X forms an acidic, covalent oxide.

Which row shows how many electrons there could be in the outer shell of an atom of X?

	1	2	6	7
<b>A</b>	✓	✓	✗	✗
<b>B</b>	✓	✗	✓	✗
<b>C</b>	✗	✗	✓	✓
<b>D</b>	✗	✓	✗	✓

10 Which diagram does **not** show the outer shell electrons in the molecule correctly?



11 The chemical formulae of two substances, W and X, are given.

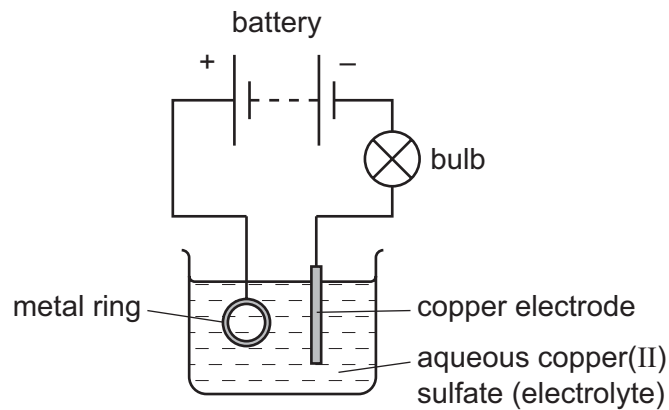


Which statements are correct?

- 1 W and X contain the same amount of oxygen.
- 2 W contains three times as much silicon as X.
- 3 X contains twice as much aluminium as W.

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

12 The diagram shows apparatus used in an attempt to electroplate a metal ring with copper.



The experiment did not work.

Which change is needed in the experiment to make it work?

- A Add solid copper(II) sulfate to the electrolyte.
- B Increase the temperature of the electrolyte.
- C Replace the copper electrode with a carbon electrode.
- D Reverse the connections to the battery.

13 Three electrolysis cells are set up. Each cell has inert electrodes.

The electrolytes are listed below.

cell 1     aqueous sodium chloride

cell 2     dilute sulfuric acid

cell 3     molten lead(II) bromide

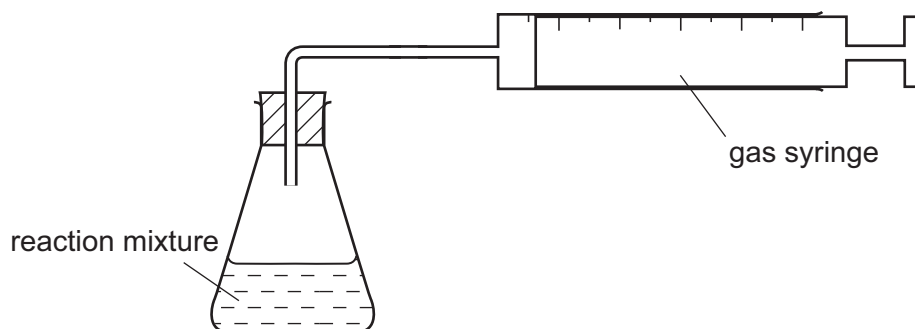
In which of these cells is a gas formed at **both** electrodes?

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

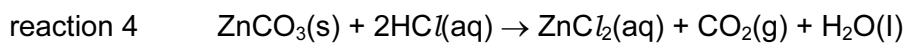
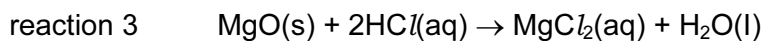
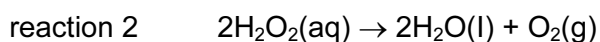
14 Which process is **not** exothermic?

- A burning a fossil fuel
- B obtaining lime from limestone
- C radioactive decay of  $^{235}\text{U}$
- D reacting hydrogen with oxygen

15 The apparatus shown can be used to measure the rate of some chemical reactions.



For which two reactions would this apparatus be suitable?

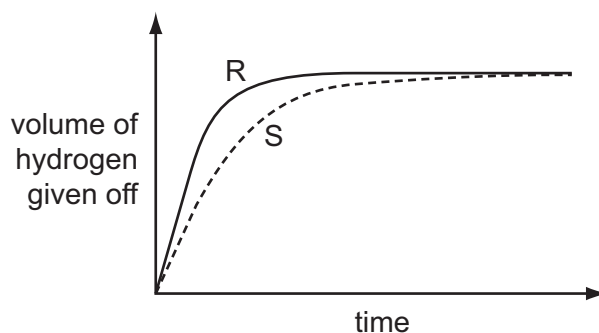


- A** 1 and 2      **B** 1 and 3      **C** 2 and 4      **D** 3 and 4

16 A student investigates the rate of reaction between magnesium and excess sulfuric acid.

The volume of hydrogen given off in the reaction is measured over time.

The graph shows the results of two experiments, R and S.



Which change in conditions would cause the difference between R and S?

- A A catalyst is added in S.
- B The acid is more concentrated in R than in S.
- C The magnesium is less finely powdered in R than in S.
- D The temperature in R is lower than in S.

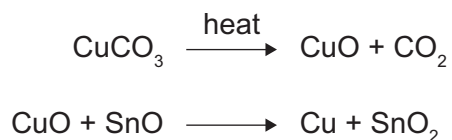
17 When pink cobalt(II) chloride crystals are heated they form steam and a blue solid.

When water is added to the blue solid, it turns pink and becomes hot.

Which terms describe the pink cobalt(II) chloride crystals and the reactions?

	pink cobalt(II) chloride	reactions
<b>A</b>	aqueous	irreversible
<b>B</b>	anhydrous	reversible
<b>C</b>	hydrated	irreversible
<b>D</b>	hydrated	reversible

- 18 The red colour in some pottery glazes may be formed as a result of the reactions shown.



These equations show that .....1..... is oxidised and .....2..... is reduced.

Which substances correctly complete gaps 1 and 2 in the above sentence?

	1	2
<b>A</b>	CO <sub>2</sub>	SnO <sub>2</sub>
<b>B</b>	CuCO <sub>3</sub>	CuO
<b>C</b>	CuO	SnO
<b>D</b>	SnO	CuO

- 19 Carbon dioxide gas reacts with aqueous sodium hydroxide.

Which type of reaction takes place?

- A** decomposition
- B** fermentation
- C** neutralisation
- D** oxidation

- 20 An aqueous solution of the organic compound methylamine has a pH greater than 7.

Which statement about methylamine is correct?

- A** It neutralises an aqueous solution of sodium hydroxide.
- B** It reacts with copper(II) carbonate to give carbon dioxide.
- C** It reacts with hydrochloric acid to form a salt.
- D** It turns blue litmus red.

- 21 A solution contains barium ions and silver ions and one type of anion.

What could the anion be?

- A** chloride only
- B** nitrate only
- C** sulfate only
- D** chloride or nitrate or sulfate



22 A mixture containing two anions was tested and the results are shown below.

test	result
dilute nitric acid added	effervescence of a gas which turned limewater milky
dilute nitric acid added, followed by aqueous silver nitrate	yellow precipitate formed

Which anions were present?

- A carbonate and chloride
- B carbonate and iodide
- C sulfate and chloride
- D sulfate and iodide

23 Astatine is an element in Group VII of the Periodic Table. It has only ever been produced in very small amounts.

What are the likely properties of astatine?

	colour	state	reaction with aqueous potassium iodide
<b>A</b>	black	solid	no reaction
<b>B</b>	dark brown	gas	brown colour
<b>C</b>	green	solid	no reaction
<b>D</b>	yellow	liquid	brown colour



27 Aluminium is an important metal with many uses.

Some of its properties are listed.

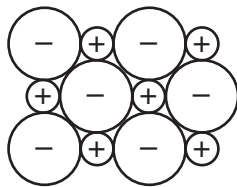
- 1 It is a good conductor of heat.
- 2 It has a low density.
- 3 It has an oxide layer that prevents corrosion.

Which set of properties help to explain the use of aluminium for cooking and storing food?

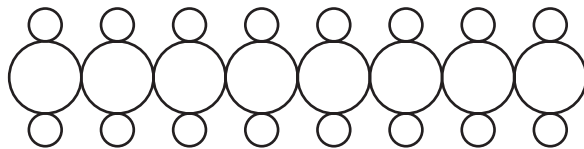
- A** 1 only      **B** 1 and 2 only      **C** 2 and 3 only      **D** 1, 2 and 3

28 Which diagram could represent the structure of an alloy?

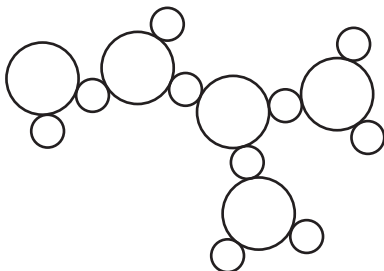
**A**



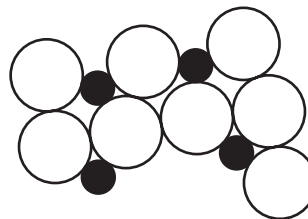
**B**



**C**



**D**



- 29 The table shows the results of adding three metals, P, Q and R, to dilute hydrochloric acid and to water.

metal	dilute hydrochloric acid	water
P	hydrogen produced	hydrogen produced
Q	no reaction	no reaction
R	hydrogen produced	no reaction

What is the order of reactivity of the metals?

	most reactive	→	least reactive
<b>A</b>	P		Q
<b>B</b>	P		R
<b>C</b>	R		P
<b>D</b>	R		Q

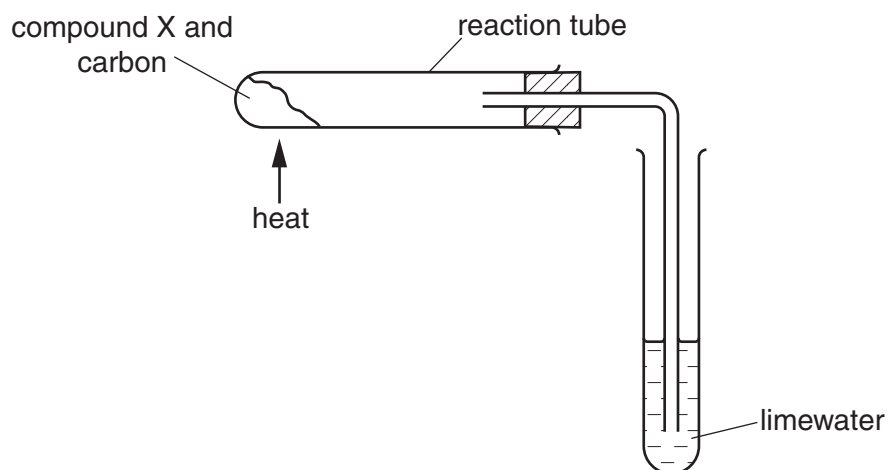
- 30 The table gives the composition of the atmosphere of four newly discovered planets.

planet	composition of atmosphere
W	argon, carbon dioxide and oxygen
X	argon, nitrogen and oxygen
Y	argon, carbon dioxide and methane
Z	methane, nitrogen and oxygen

On which planets is the greenhouse effect likely to occur?

- A** W only
- B** W, X and Z
- C** W and Y only
- D** W, Y and Z

31 Compound X is heated with carbon using the apparatus shown.

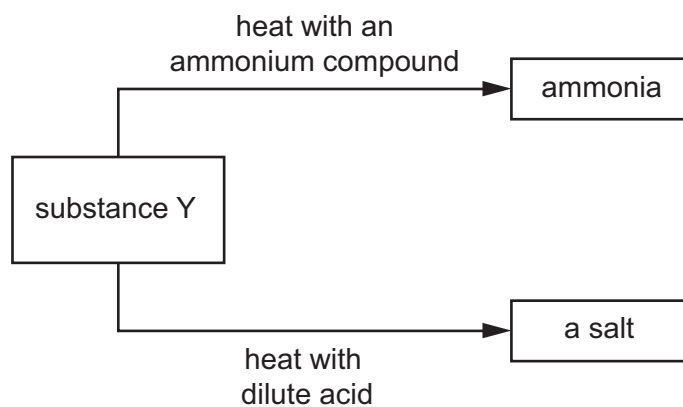


A brown solid is formed in the reaction tube and the limewater turns cloudy.

What is compound X?

- A calcium oxide
- B copper(II) oxide
- C magnesium oxide
- D sodium oxide

32 The diagram shows some reactions of substance Y.

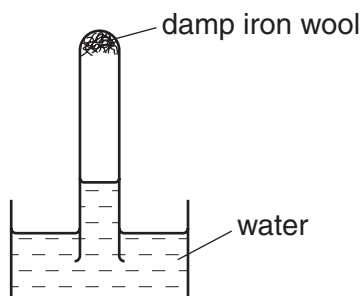


Which type of substance is Y?

- A an alcohol
- B a base
- C a catalyst
- D a metal

33 A test-tube containing damp iron wool is inverted in water.

After three days, the water level inside the test-tube has risen.



Which statement explains this rise?

- A Iron oxide has been formed.
- B Iron wool has been reduced.
- C Oxygen has been formed.
- D The temperature of the water has risen.

34 Greenhouse gases may contribute to climate change.

Two of these gases are emitted into the atmosphere as a result of processes within animals.

Gas .....1..... is produced by process .....3..... .

Gas .....2..... is produced by process .....4..... .

Which row correctly complete gaps 1, 2, 3 and 4?

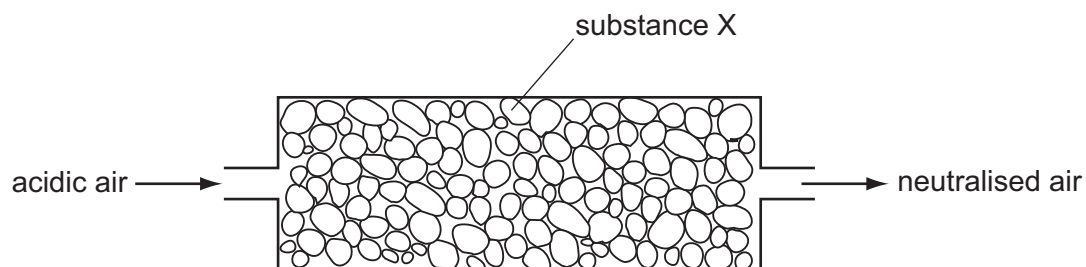
	1	2	3	4
<b>A</b>	CO	C <sub>2</sub> H <sub>6</sub>	digestion	respiration
<b>B</b>	CO	C <sub>2</sub> H <sub>6</sub>	respiration	digestion
<b>C</b>	CO <sub>2</sub>	CH <sub>4</sub>	digestion	respiration
<b>D</b>	CO <sub>2</sub>	CH <sub>4</sub>	respiration	digestion

- 35 To grow rose plants, a fertiliser containing nitrogen, phosphorus and potassium is often used. For the best rose flowers, the fertiliser should contain a high proportion of potassium.

Which fertiliser is best for producing rose flowers?

fertiliser	proportion by mass		
	N	P	K
<b>A</b>	9	0	25
<b>B</b>	13	13	20
<b>C</b>	29	5	0
<b>D</b>	29	15	5

- 36 Air containing an acidic impurity was neutralised by passing it through a column containing substance X.

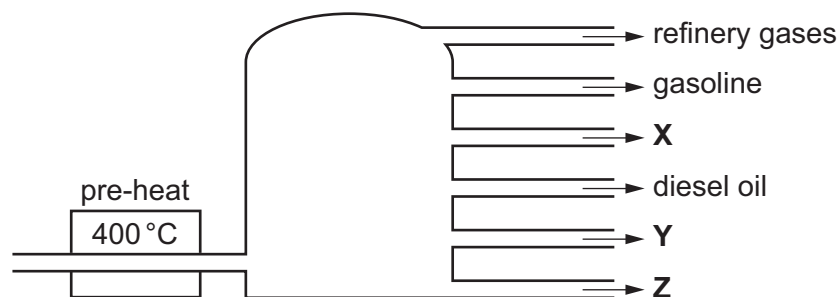


What is substance X?

- A** calcium oxide
- B** sand
- C** sodium chloride
- D** concentrated sulfuric acid

37 In an oil refinery, petroleum is separated into useful fractions.

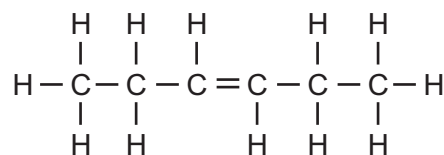
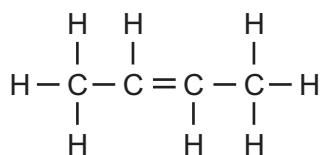
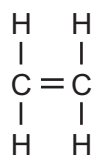
The diagram shows some of these fractions.



What are fractions X, Y and Z?

	X	Y	Z
<b>A</b>	fuel oil	bitumen	paraffin (kerosene)
<b>B</b>	fuel oil	paraffin (kerosene)	bitumen
<b>C</b>	paraffin (kerosene)	bitumen	fuel oil
<b>D</b>	paraffin (kerosene)	fuel oil	bitumen

38 The structures of three compounds are shown.



Why do these substances all belong to the same homologous series?

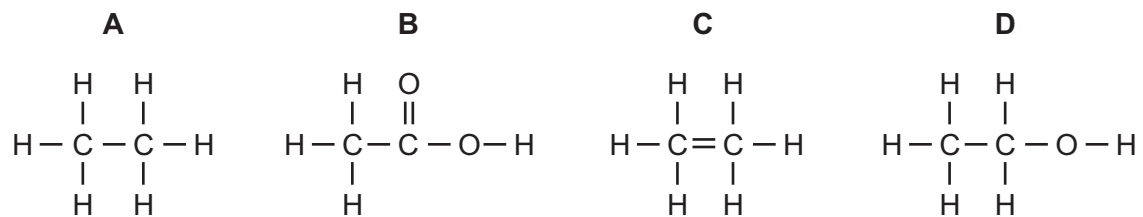
- A** They all contain an even number of carbon atoms.
- B** They all contain the same functional group.
- C** They are all hydrocarbons.
- D** They are all saturated.

39 Which bond is **not** in a molecule of ethanoic acid?

- A** C–O
- B** C=O
- C** C=C
- D** O–H



40 Which structure is **incorrect**?



Group																																																																																	
I	II	III	IV	V	VI	VII	VIII																																																																										
3 <b>Li</b> lithium 7	4 <b>Be</b> beryllium 9	11 <b>Na</b> sodium 23	12 <b>Mg</b> magnesium 24	13 <b>Al</b> aluminium 27	14 <b>Si</b> silicon 28	15 <b>P</b> phosphorus 31	16 <b>S</b> sulphur 32	17 <b>Cl</b> chlorine 35.5	18 <b>Ar</b> argon 40	19 <b>K</b> potassium 39	20 <b>Ca</b> calcium 40	21 <b>Sc</b> scandium 45	22 <b>Ti</b> titanium 48	23 <b>V</b> vanadium 51	24 <b>Cr</b> chromium 52	25 <b>Mn</b> manganese 55	26 <b>Fe</b> iron 56	27 <b>Co</b> cobalt 59	28 <b>Ni</b> nickel 59	29 <b>Cu</b> copper 64	30 <b>Zn</b> zinc 65	31 <b>Ga</b> gallium 70	32 <b>Ge</b> germanium 73	33 <b>As</b> arsenic 75	34 <b>Se</b> selenium 79	35 <b>Br</b> bromine 80	36 <b>Kr</b> krypton 84	37 <b>Rb</b> rubidium 85	38 <b>Sr</b> strontium 88	39 <b>Y</b> yttrium 89	40 <b>Zr</b> zirconium 91	41 <b>Nb</b> niobium 93	42 <b>Mo</b> molybdenum 96	43 <b>Tc</b> technetium -	44 <b>Ru</b> ruthenium 101	45 <b>Rh</b> rhodium 103	46 <b>Pd</b> palladium 106	47 <b>Ag</b> silver 108	48 <b>Cd</b> cadmium 112	49 <b>In</b> indium 115	50 <b>Sn</b> tin 119	51 <b>Sb</b> antimony 122	52 <b>Te</b> tellurium 128	53 <b>I</b> iodine 127	54 <b>Xe</b> xenon 131	55 <b>Cs</b> caesium 133	56 <b>Ba</b> barium 137	57-71 lanthanoids	72 <b>Hf</b> hafnium 178	73 <b>Ta</b> tantalum 181	74 <b>W</b> tungsten 184	75 <b>Re</b> rhenium 186	76 <b>Os</b> osmium 190	77 <b>Ir</b> iridium 192	78 <b>Pt</b> platinum 195	79 <b>Au</b> gold 197	80 <b>Hg</b> mercury 201	81 <b>Tl</b> thallium 204	82 <b>Pb</b> lead 207	83 <b>Bi</b> bismuth 209	84 <b>Po</b> polonium -	85 <b>At</b> astatine -	86 <b>Rn</b> radon -	87 <b>Fr</b> francium -	88 <b>Ra</b> radium -	89-103 actinoids	104 <b>Rf</b> rutherfordium -	105 <b>Db</b> dubnium -	106 <b>Sg</b> seaborgium -	107 <b>Bh</b> bohrium -	108 <b>Hs</b> hassium -	109 <b>Mt</b> meitnerium -	110 <b>Ds</b> darmstadtium -	111 <b>Rg</b> roentgenium -	112 <b>Cn</b> copernicium -	113 <b>Nh</b> nihonium -	114 <b>Fl</b> flerovium -	115 <b>Mc</b> moscovium -	116 <b>Lv</b> livermorium -	117 <b>Ts</b> tennessine -	118 <b>Og</b> oganesson -
		<b>Key</b> atomic number atomic symbol name relative atomic mass		1 <b>H</b> hydrogen 1																																																																													
lanthanoids		57 <b>La</b> lanthanum 139	58 <b>Ce</b> cerium 140	59 <b>Pr</b> praseodymium 141	60 <b>Nd</b> neodymium 144	61 <b>Pm</b> promethium -	62 <b>Sm</b> samarium 150	63 <b>Eu</b> europium 152	64 <b>Gd</b> gadolinium 157	65 <b>Tb</b> terbium 159	66 <b>Dy</b> dysprosium 163	67 <b>Ho</b> holmium 165	68 <b>Er</b> erbium 167	69 <b>Tm</b> thulium 169	70 <b>Yb</b> ytterbium 173	71 <b>Lu</b> lutetium 175																																																																	
actinoids		89 <b>Ac</b> actinium -	90 <b>Th</b> thorium 232	91 <b>Pa</b> protactinium 231	92 <b>U</b> uranium 238	93 <b>Np</b> neptunium -	94 <b>Pu</b> plutonium -	95 <b>Am</b> americium -	96 <b>Cm</b> curium -	97 <b>Bk</b> berkelium -	98 <b>Cf</b> californium -	99 <b>Es</b> einsteinium -	100 <b>Fm</b> fermium -	101 <b>Md</b> mendelevium -	102 <b>No</b> nobelium -	103 <b>Lr</b> lawrencium -																																																																	

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.)

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

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