Cambridge Assessment International Education

Cambridge IGCSE™

CHEMISTRY **0620/23**

Paper 2 Multiple Choice (Extended) **May/June 2024**

45 minutes

You must answer on the multiple choice answer sheet.

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

INSTRUCTIONS

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

INFORMATION

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

This document has **20** pages. Any blank pages are indicated.

[Turn over

1 Sodium chloride is a liquid at 900 °C.

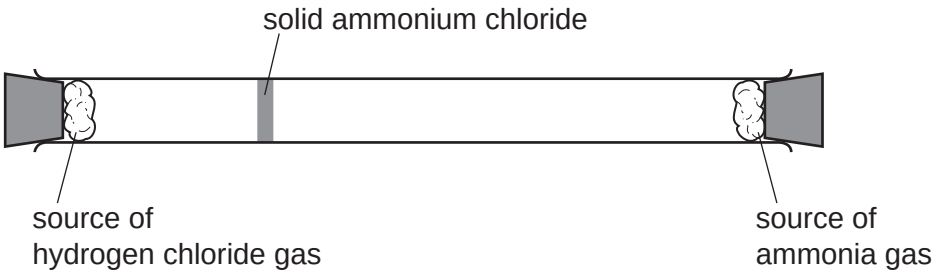
Which row describes the arrangement and the motion of the particles in sodium chloride at 900 °C?

	arrangement of particles	motion of particles
A	regular	vibrate about a fixed point
B	regular	move randomly
C	random	vibrate about a fixed point
D	random	move randomly

2 Hydrogen chloride gas, HC*l*, reacts with ammonia gas, NH_3, to form solid ammonium chloride.

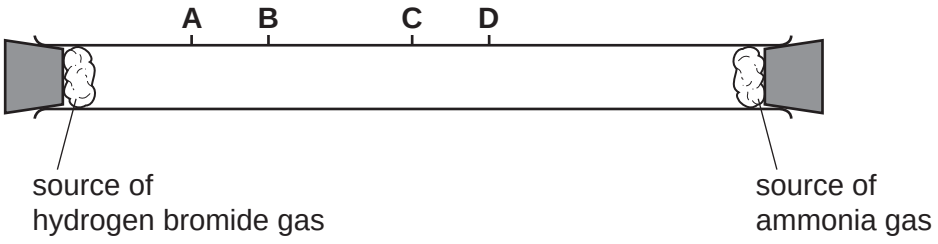
The apparatus is set up as shown.

After a few minutes, a white cloud of solid ammonium chloride forms where the two gases meet.



The experiment is repeated using hydrogen bromide gas, HBr, in place of hydrogen chloride.

How far along the tube does the white cloud of solid ammonium bromide form?



3 Substances P and Q both conduct electricity.

P is a mixture of two different types of atom.

Q is made of only one type of atom.

Which row describes P and Q?

	P	Q
A	alloy	element
B	alloy	compound
C	compound	alloy
D	compound	element

4 An atom of element R contains 15 protons, 16 neutrons and 15 electrons.

What is R?

A gallium

B phosphorus

C sulfur

D zinc

5 Which molecule contains a double covalent bond between two atoms of the same element?

A carbon dioxide

B ethanol

C ethene

D nitrogen

6 Silicon(IV) oxide is a covalently bonded compound.

Which statements are correct?

1 Silicon atoms form four single bonds in silicon(IV) oxide.

2 Oxygen atoms form two double bonds in silicon(IV) oxide.

3 Silicon(IV) oxide has a high melting point.

4 Silicon(IV) oxide contains one silicon atom and four oxygen atoms.

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

7 The equation for the reaction of iron(III) oxide with carbon monoxide is shown.

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

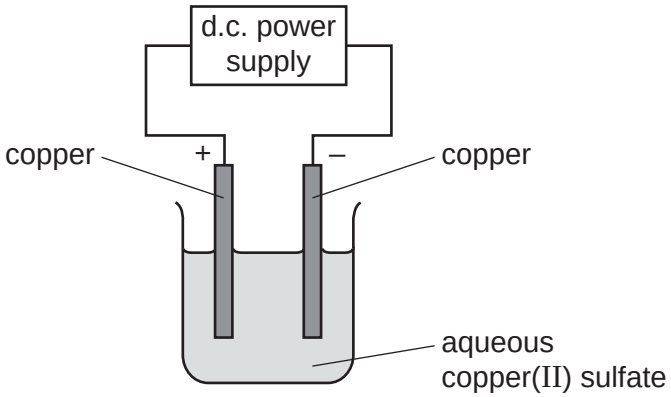
What is the percentage yield of iron when 16.8 g of carbon monoxide reacts completely with iron(III) oxide to form 8.96 g of iron?

A 26.7% **B** 40.0% **C** 53.3% **D** 80.0%

8 What is the volume of 14.5 g of gaseous butane, C_4H_{10}, at room temperature and pressure?

A 96.0 cm^3 **B** 6.0 cm^3 **C** 96.0 dm^3 **D** 6.0 dm^3

9 Aqueous copper(II) sulfate is electrolysed using copper electrodes.



Which statement describes what happens during the electrolysis?

A Copper atoms gain electrons at the cathode and copper(II) ions lose electrons at the anode.

B Electrons move in the external circuit from the positive electrode to the negative electrode.

C Copper(II) ions move through the electrolyte from the cathode to the anode.

D Copper is formed at the cathode and oxygen is formed at the anode.

10 Electrolysis is carried out on concentrated aqueous potassium bromide using inert electrodes.

Which products are formed at the anode and the cathode?

	anode	cathode
A	bromine	hydrogen
B	bromine	potassium
C	hydrogen	bromine
D	hydrogen	potassium

11 Hydrogen–oxygen fuel cells and gasoline are each used to power cars.

Which statement describes an advantage of using hydrogen–oxygen fuel cells in cars in comparison with gasoline engines?

A Hydrogen is a non-renewable resource.

B Hydrogen is produced during the fractional distillation of petroleum.

C Hydrogen–oxygen fuel cells do **not** release carbon dioxide.

D Hydrogen–oxygen fuel cells need electricity to work.

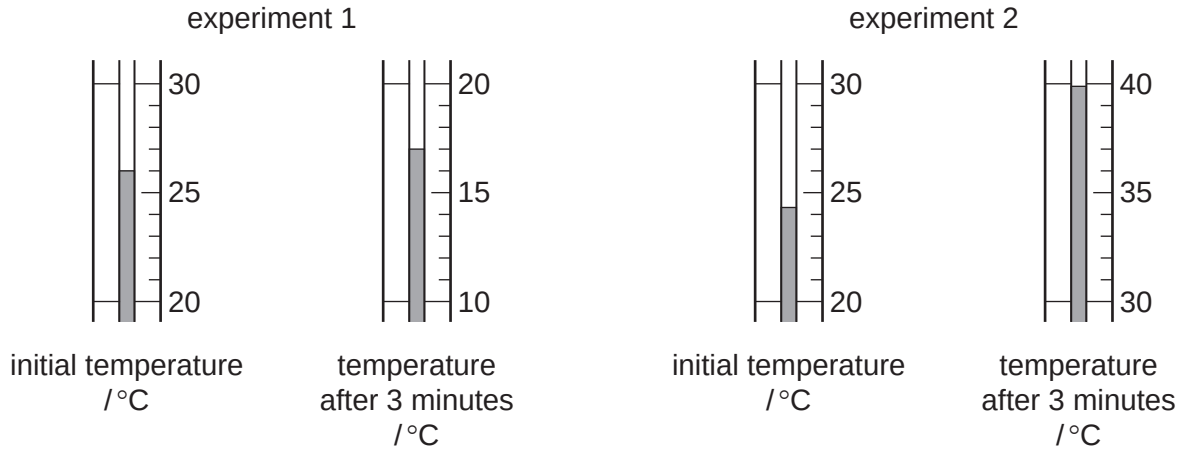
12 Plant cells use energy from sunlight for photosynthesis.

Which row describes and explains the energy change that occurs?

	type of energy change	explanation of energy change
A	endothermic	less energy is released making bonds than is absorbed to break bonds
B	endothermic	more energy is released making bonds than is absorbed to break bonds
C	exothermic	less energy is released making bonds than is absorbed to break bonds
D	exothermic	more energy is released making bonds than is absorbed to break bonds

13 Two different experiments are done to find the enthalpy change, ΔH, of each reaction.

The temperature of each reaction mixture is measured at the beginning of the reaction and after 3 minutes.

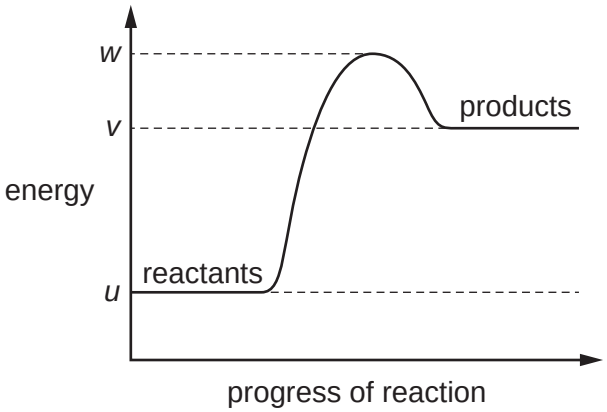


Which row gives the correct sign for the value of ΔH for each experiment and identifies if the reaction is endothermic or exothermic?

	experiment 1	experiment 2
A	negative and endothermic	positive and exothermic
B	negative and exothermic	positive and endothermic
C	positive and endothermic	negative and exothermic
D	positive and exothermic	negative and endothermic

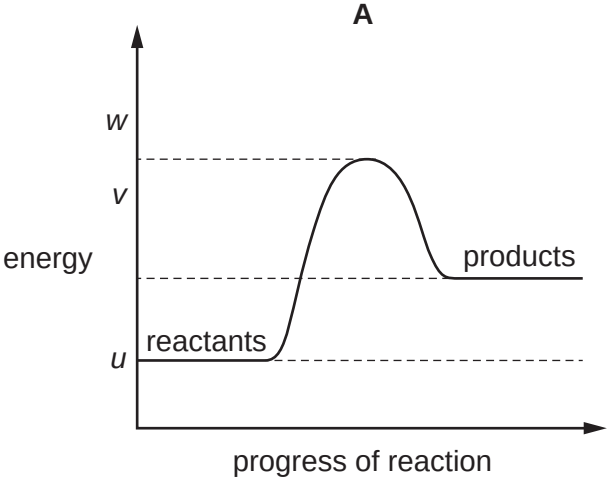
14 The reaction pathway diagram for an endothermic reaction is shown.

u, *v* and *w* are known energy values.



Which diagram shows the reaction pathway diagram when a catalyst is used in the reaction?

A



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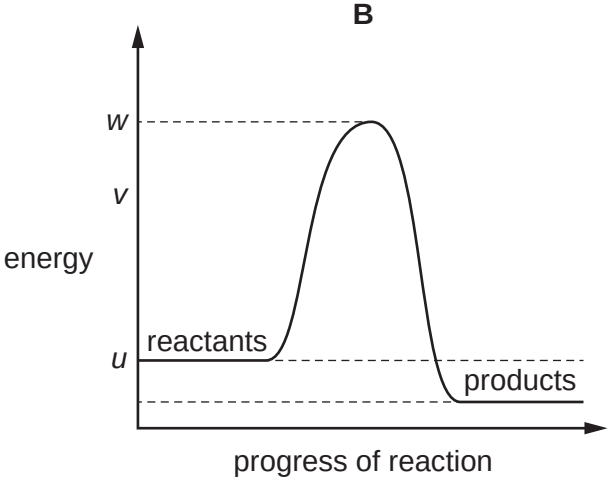

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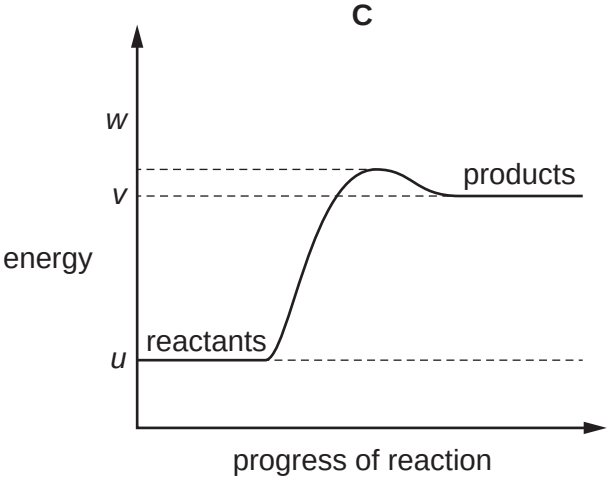

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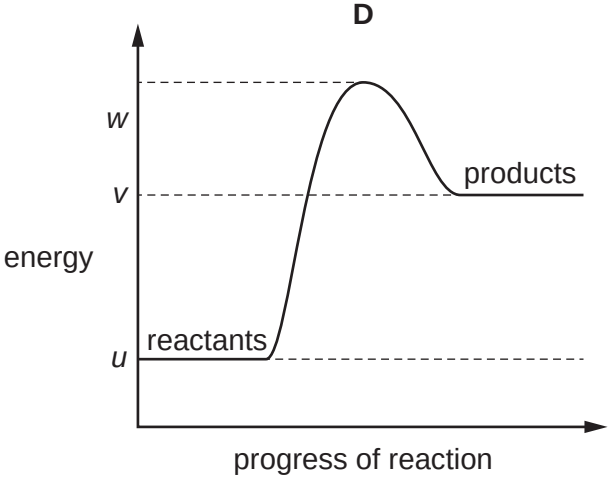


15 Which process is a physical change?

A burning a piece of magnesium

B reacting calcium carbonate with hydrochloric acid

C melting an ice cube

D the rusting of an iron nail

16 The Contact process is used to convert sulfur dioxide to sulfur trioxide. Vanadium(V) oxide is the catalyst in this process.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

The forward reaction in this equilibrium is exothermic.

Which statements about this process are correct?

1 The catalyst increases the rate of both the forward and backward reactions.

2 A low pressure increases the yield of sulfur trioxide.

3 A low pressure is used to keep the costs low.

4 A high temperature increases the yield of sulfur trioxide.

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

17 The equation for the decomposition of hydrogen peroxide, H_2O_2, is shown.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

In an experiment, the total volume of oxygen produced is 100 cm^3.

The experiment is repeated using 1.00 g of a solid catalyst. All other conditions remain the same.

Which row describes the total volume of oxygen and the mass of the catalyst at the end of the second experiment?

	total volume of oxygen / cm^3	mass of catalyst / g
A	more than 100	less than 1.00
B	100	less than 1.00
C	100	1.00
D	more than 100	1.00

18 Nitrogen reacts with hydrogen to form ammonia in the presence of an iron catalyst. The reaction is reversible.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Which statement about this reaction is correct?

A The iron catalyst decreases the activation energy of only the forward reaction.

B When equilibrium is reached, the forward reaction has stopped.

C When the pressure changes, the concentration of ammonia at equilibrium remains constant.

D Nitrogen and hydrogen never completely convert to ammonia.

19 The equation for a redox reaction is shown.

$$H_2O_2 + 2KI + H_2SO_4 \rightarrow I_2 + K_2SO_4 + 2H_2O$$

Potassium iodide is ..... 1 ..... agent in this reaction because iodide ions ..... 2 ..... electrons.

Which words complete gaps 1 and 2?

	1	2
A	an oxidising	lose
B	an oxidising	gain
C	a reducing	lose
D	a reducing	gain

20 Element E is in Group II of the Periodic Table.

Which row describes element E and its oxide?

	element E	oxide of E
A	metal	acidic
B	metal	basic
C	non-metal	acidic
D	non-metal	basic

21 Lead(II) iodide is formed as a precipitate in the reaction shown.

$$Pb(NO_3)_2(aq) + 2NaI(aq) \rightarrow PbI_2(s) + 2NaNO_3(aq)$$

Which method is used to separate the lead(II) iodide from the mixture?

A crystallisation

B distillation

C evaporation

D filtration

22 Which statement explains why sulfur, S, has similar chemical properties to selenium, Se?

A They both have the same number of electrons in their outer electron shell.

B They are both solids at room temperature and pressure.

C They are both non-metals.

D They both form negative ions.

23 Atoms of sodium, rubidium and element Q each have one outer shell electron.

Some properties of these elements are shown.

element	melting point in °C	boiling point in °C	density in g/cm^3
sodium	98	883	0.97
rubidium	39	688	1.53
Q	28	672	1.87

What is Q?

A hydrogen

B lithium

C potassium

D caesium

24 Which statement about elements in Group VIII of the Periodic Table is correct?

A They all have a full outer shell of electrons.

B They all react with Group I elements to form ionic compounds.

C They are all diatomic molecules.

D They are all liquids at room temperature and pressure.

25 The electrical conductivity of magnesium is tested.

Magnesium is then added to dilute sulfuric acid. A gas, W, is produced.

Which row describes the electrical conductivity of magnesium and identifies W?

	electrical conductivity of magnesium	gas W
A	good	hydrogen
B	good	oxygen
C	poor	hydrogen
D	poor	oxygen

26 Aluminium metal is extracted from its purified ore by electrolysis.

Which statement about the electrolyte in this process is correct?

A The electrolyte is purified molten bauxite only.

B The electrolyte is purified bauxite dissolved in molten cryolite.

C The electrolyte is purified molten cryolite only.

D The electrolyte is purified cryolite dissolved in molten bauxite.

27 Part of the reactivity series is shown.

potassium
X
calcium
Y
aluminium

Which metals are represented by X and Y?

	X	Y
A	copper	magnesium
B	sodium	magnesium
C	sodium	silver
D	copper	silver

28 Some substances found in water extracted from a river are listed.

1 plastics
2 nitrates
3 oxygen

Which substances are harmful to aquatic life?

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

29 Car engines which use gasoline as a fuel produce oxides of nitrogen.

Oxides of nitrogen are removed from the exhaust gases.

Which statements about the formation or removal of oxides of nitrogen are correct?

1 Gasoline reacts with nitrogen in the air to produce oxides of nitrogen.
2 Gasoline contains nitrogen.
3 Nitrogen and oxygen react at high temperatures to produce oxides of nitrogen.
4 Nitrogen monoxide, NO, reacts with carbon monoxide, CO, in a catalytic converter.

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

30 Which structures represent a pair of structural isomers?

1 $CH_3CH_2CH_2CH_2CH_2CH_3$

2 $CH_3CH_2CH_2CH_2CH(CH_3)_2$

3 $CH_3CH(CH_3)CH_2CH_2CH_3$

4 $CH_3CH(CH_3)CH_2CH_2CH_2CH_3$

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

31 Alkanes are a homologous series of hydrocarbons.

The table shows the names and boiling points of the first four members of this series.

name	boiling point / °C
methane	–162
ethane	–89
propane	–42
butane	0

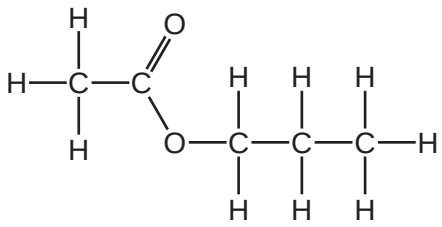
Pentane is the next member of the series.

Which row gives the molecular formula and the boiling point of pentane?

	molecular formula	boiling point / °C
A	C_5H_{10}	36
B	C_5H_{12}	–51
C	C_5H_{10}	–51
D	C_5H_{12}	36

32 Which displayed formula represents the ester formed by the reaction of propan-1-ol with ethanoic acid?

A



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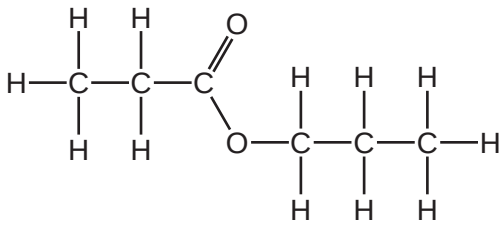

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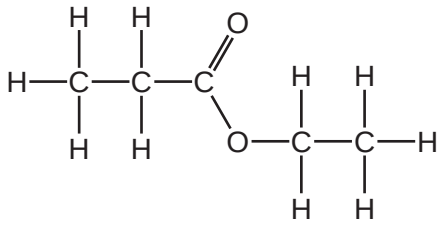

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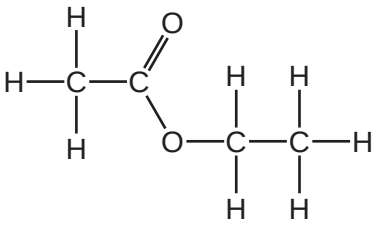


33 Ethanol can be manufactured by fermentation and by the catalytic addition of steam to ethene.

Which statement identifies an advantage of using **one** of these methods?

A Catalytic addition requires a high temperature and pressure.

B Ethanol produced by fermentation is extracted by distillation.

C Fermentation is a batch process.

D The raw material in fermentation is a renewable resource.

34 Which statement about carboxylic acids is correct?

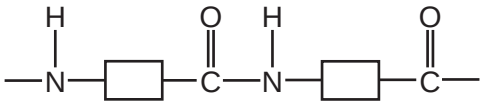
A They react with alkalis to form a salt and water.

B They react with metals to form a salt and water.

C They react with metal carbonates to form a salt, water and hydrogen.

D The general formula for carboxylic acids is $C_nH_{2n+1}OH$.

35 The structure of a polymer is shown.



Which statement about this polymer is correct?

A Alkenes are polymerised to make the polymer.

B It is a polyester.

C It is an addition polymer.

D Water is produced when the polymer is made.

36 Methane undergoes substitution reactions with chlorine and complete combustion with excess oxygen.

Which row about the two reactions is correct?

	condition for reaction with chlorine	equation for the complete combustion
A	an acid catalyst	methane + oxygen → carbon dioxide + hydrogen
B	an acid catalyst	methane + oxygen → carbon dioxide + water
C	ultraviolet light	methane + oxygen → carbon dioxide + hydrogen
D	ultraviolet light	methane + oxygen → carbon dioxide + water

37 What is used to identify the end-point of an acid–base titration?

A balance

B measuring cylinder

C indicator

D volumetric pipette

38 Four pure substances, P, Q, R and S, are tested using chromatography. The same solvent is used each time.

The table shows the distance moved by each substance and by the solvent from the baseline.

substance	distance moved by substance / cm	distance moved by solvent / cm
P	4.5	10.0
Q	3.0	20.0
R	4.5	20.0
S	13.5	30.0

Which two substances are identical?

A P and R **B** P and S **C** Q and R **D** Q and S

39 A substance is tested with three different reagents.

Which row shows the results obtained with aqueous iron(II) nitrate?

	aqueous sodium hydroxide	acidified aqueous silver nitrate	acidified aqueous barium nitrate
A	green precipitate, insoluble in excess	no reaction	no reaction
B	green precipitate, insoluble in excess	white precipitate	white precipitate
C	white precipitate, insoluble in excess	cream precipitate	no reaction
D	white precipitate that dissolves in excess	no reaction	white precipitate

40 A student carries out a flame test on a sample.

The flame colour observed is light green.

Which ion is present in the sample?

A Ba^{2+} **B** Ca^{2+} **C** Li^{+} **D** K^{+}

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The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
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 –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

Key

atomic number
atomic symbol
name
relative atomic mass

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

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