



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.

1 Sodium chloride is a liquid at 900 °C.

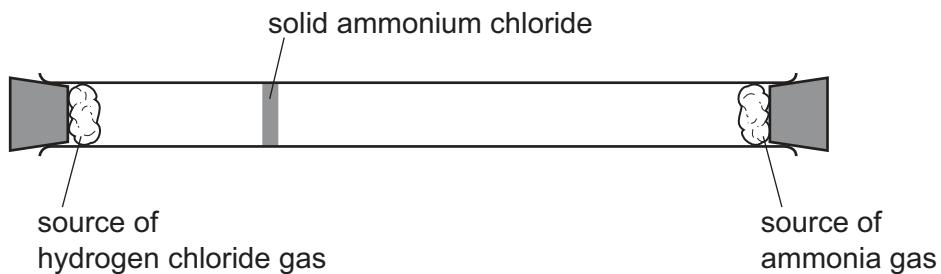
Which row describes the arrangement and the motion of the particles in sodium chloride at 900 °C?

	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, HCl , reacts with ammonia gas, NH_3 , to form solid ammonium chloride.

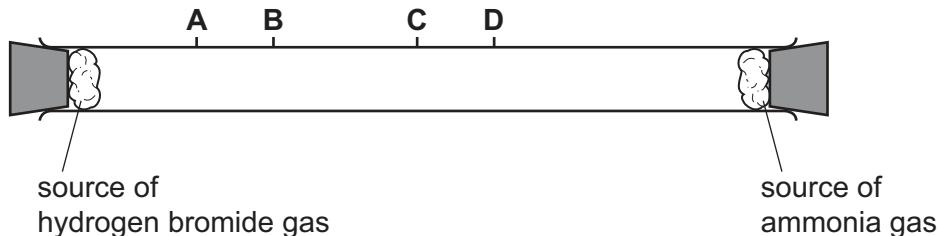
The apparatus is set up as shown.

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

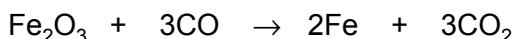
6 Silicon(IV) oxide is a covalently bonded compound.

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.



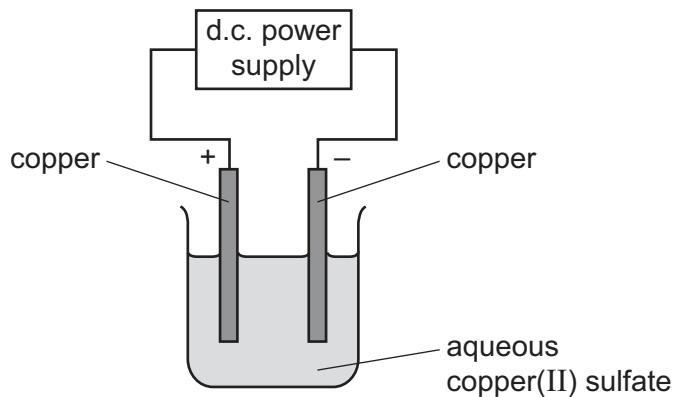
What is the percentage yield of iron when 16.8 g of carbon monoxide reacts completely with iron(III) oxide to form 8.96 g of iron?

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.

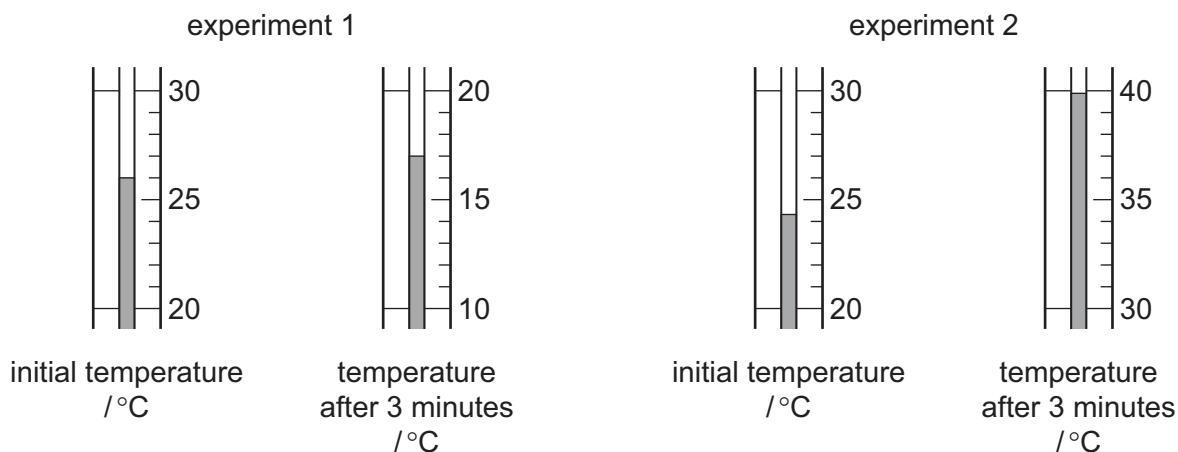
12 Plant cells use energy from sunlight for photosynthesis.

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.

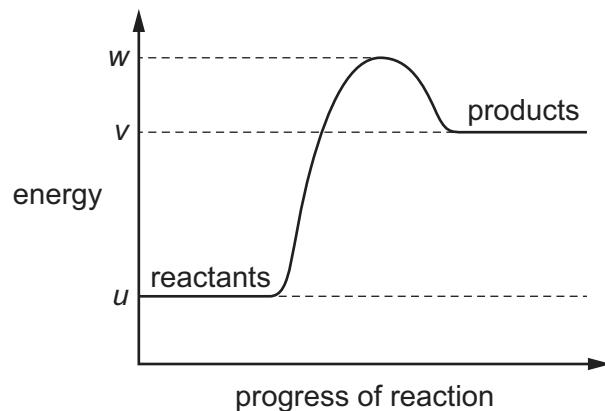


Which row gives the correct sign for the value of ΔH for each experiment and identifies if the reaction is endothermic or exothermic?

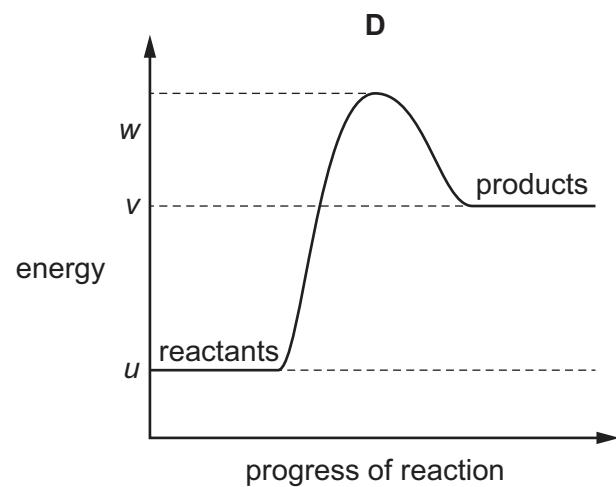
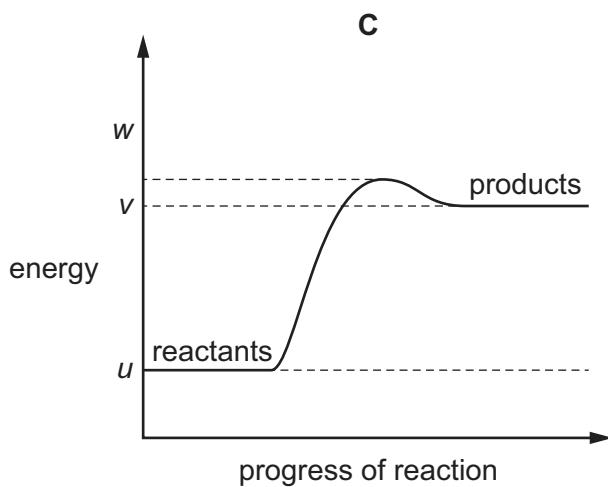
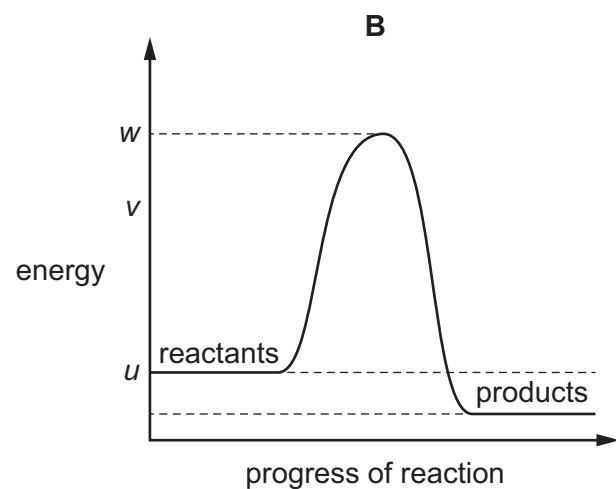
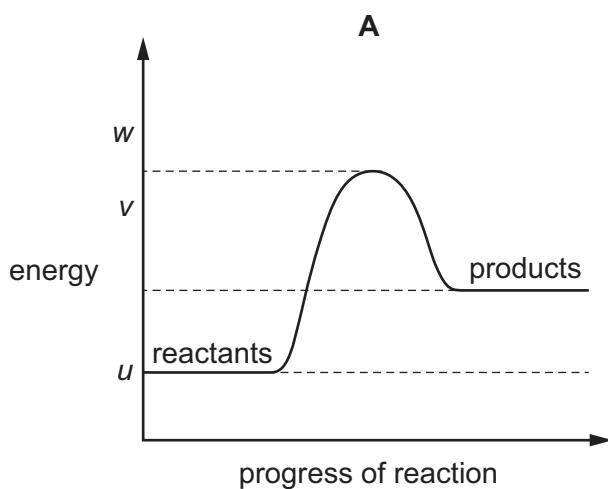
	experiment 1	experiment 2
A	negative and endothermic	positive and exothermic
B	negative and exothermic	positive and endothermic
C	positive and endothermic	negative and exothermic
D	positive and exothermic	negative and endothermic

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

u , v and w are known energy values.



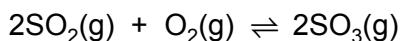
Which diagram shows the reaction pathway diagram when a catalyst is used in the reaction?



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.



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.



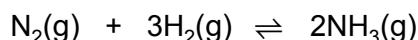
In an experiment, the total volume of oxygen produced is 100 cm^3 .

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

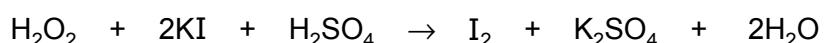
18 Nitrogen reacts with hydrogen to form ammonia in the presence of an iron catalyst. The reaction is reversible.



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.



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

Which words complete gaps 1 and 2?

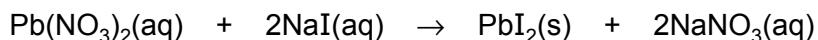
	1	2
A	an oxidising	lose
B	an oxidising	gain
C	a reducing	lose
D	a reducing	gain

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.



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 $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
- 2 $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}(\text{CH}_3)_2$
- 3 $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_2\text{CH}_3$
- 4 $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$

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.

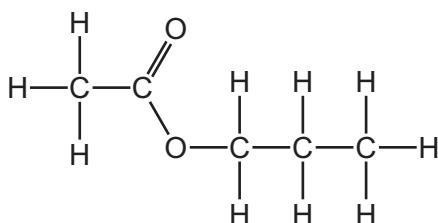
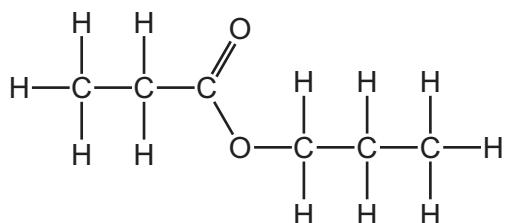
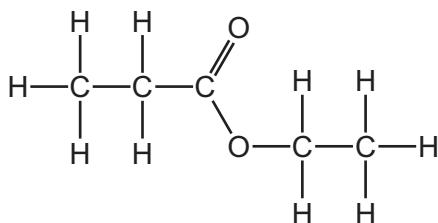
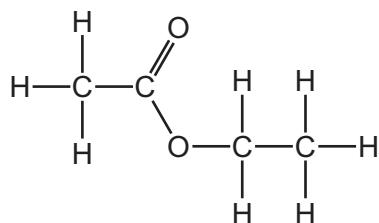
name	boiling point/°C
methane	–162
ethane	–89
propane	–42
butane	0

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**B****C****D**

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

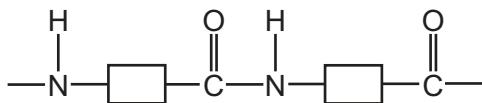
Which statement identifies an advantage of using **one** of these methods?

- 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 $\text{C}_n\text{H}_{2n+1}\text{OH}$.

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 \rightarrow carbon dioxide + hydrogen
B	an acid catalyst	methane + oxygen \rightarrow carbon dioxide + water
C	ultraviolet light	methane + oxygen \rightarrow carbon dioxide + hydrogen
D	ultraviolet light	methane + oxygen \rightarrow 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

I		II		Group																
				I						II			IV		V		VI		VII	
				Key																
				atomic number		atomic symbol														
				name		relative atomic mass														
3	Li	4	Be	beryllium	9			1	H	hydrogen	1									
11	Na	12	Mg	magnesium	24															
19	K	20	Ca	calcium	40	21	Sc	scandium	Ti	titanium	48	22	V	vanadium	51	23	Cr	chromium	52	
39	potassium	39	Ca	calcium	40	45	Sc	scandium	Ti	titanium	48	55	V	vanadium	51	24	Cr	chromium	52	
37	Rb	38	Sr	strontium	88	39	Y	yttrium	Zr	zirconium	89	40	41	Nb	niobium	93	42	Tc	technetium	—
85	rubidium	85	Sr	strontium	88	89	Y	yttrium	Zr	zirconium	91	96	Mo	molybdenum	96	43	Ru	ruthenium	101	
55	Cs	56	Ba	barium	137	57-71	Hf	hafnium	Ta	tantalum	178	72	73	W	tungsten	184	74	Re	rhenium	186
133	caesium	133	Ba	barium	137	178	Hf	hafnium	Ta	tantalum	181	75	76	Os	osmium	190	77	Ir	iridium	192
87	Fr	88	Ra	radium	—	89-103	Rf	actinoids	Db	dubnium	—	104	105	Sg	seaborgium	—	106	Bh	bohrium	—
—	francium	—	Ra	radium	—	actinoids	Rf	actinoids	Db	dubnium	—	107	108	Hs	meitnerium	—	109	Mt	meitnerium	—

20

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

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