

# Cambridge IGCSE™

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## CHEMISTRY

0620/23

Paper 2 Multiple Choice (Extended)

May/June 2021

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)

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## 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

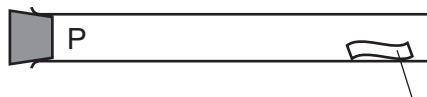
- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

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This document has **16** pages. Any blank pages are indicated.



- 1 A gas is released at point P in the apparatus shown.



damp universal indicator paper

Which gas turns the damp universal indicator paper red most quickly?

- A** ammonia,  $\text{NH}_3$
- B** chlorine,  $\text{Cl}_2$
- C** hydrogen chloride,  $\text{HCl}$
- D** sulfur dioxide,  $\text{SO}_2$
- 2 A  $1\text{ cm}^3$  sample of substance X is taken. This is sample 1.
- X is then converted to a different physical state and a  $1\text{ cm}^3$  sample is taken. This is sample 2.
- Sample 2 contains more particles in the  $1\text{ cm}^3$  than sample 1.
- Which process caused this increase in the number of particles in  $1\text{ cm}^3$ ?
- A** boiling of liquid X
- B** condensation of gaseous X
- C** evaporation of liquid X
- D** sublimation of solid X
- 3 Which statement about paper chromatography is correct?
- A** A solvent is needed to dissolve the paper.
- B** Paper chromatography separates mixtures of solvents.
- C** The solvent should cover the baseline.
- D** The baseline should be drawn in pencil.
- 4 Element X has 7 protons.
- Element Y has 8 more protons than X.
- Which statement about element Y is correct?
- A** Y has more electron shells than X.
- B** Y has more electrons in its outer shell than X.
- C** Y is in a different group of the Periodic Table from X.
- D** Y is in the same period of the Periodic Table as X.

- 5 A covalent molecule Q contains only six shared electrons.

What is Q?

- A** ammonia,  $\text{NH}_3$   
**B** chlorine,  $\text{Cl}_2$   
**C** methane,  $\text{CH}_4$   
**D** water,  $\text{H}_2\text{O}$
- 6 Which statement explains why metals are malleable?
- A** The atoms release electrons to become cations.  
**B** The electrons are free to move.  
**C** The electrons and the cations are attracted to each other.  
**D** The layers of ions can slide over each other.
- 7 Which statement about isotopes of the same element is correct?
- A** They have different numbers of electrons.  
**B** They have different numbers of neutrons.  
**C** They have different numbers of protons.  
**D** They have the same mass number.

- 8 The element silicon has the same structure as diamond.

Which statement about silicon is correct?

- A** Every silicon atom is bonded to three other atoms only.  
**B** Silicon has a high melting point.  
**C** Silicon is a good conductor of electricity.  
**D** Silicon is used as a lubricant.
- 9 Three ionic compounds of vanadium have the formulae  $\text{V}_2\text{O}$ ,  $\text{VCl}_2$  and  $\text{V}_2\text{O}_3$ .

What is the charge on the vanadium ion in each compound?

	$\text{V}_2\text{O}$	$\text{VCl}_2$	$\text{V}_2\text{O}_3$
<b>A</b>	+1	-2	+2
<b>B</b>	+1	+2	+3
<b>C</b>	+2	-2	+2
<b>D</b>	+2	+2	+3

- 10 In separate experiments, electricity was passed through concentrated aqueous sodium chloride and molten lead(II) bromide.

What would happen in **both** experiments?

- A A halogen would be formed at the anode.
  - B A metal would be formed at the cathode.
  - C Hydrogen would be formed at the anode.
  - D Hydrogen would be formed at the cathode.
- 11 The equation for the decomposition of calcium carbonate is shown.



What mass of calcium oxide is produced when 10 g of calcium carbonate is heated?

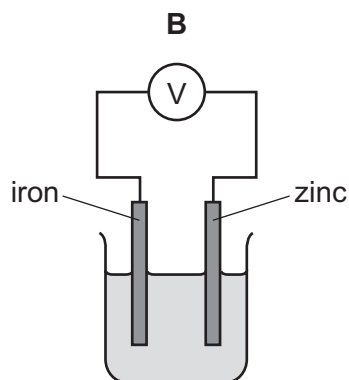
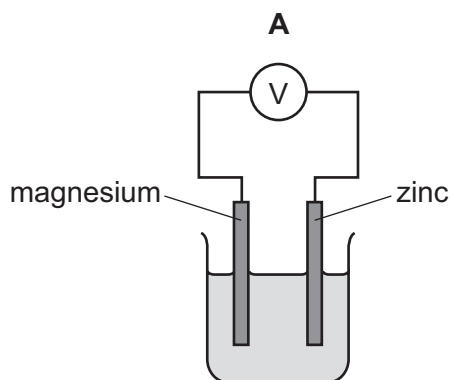
- A 4.4 g
  - B 5.0 g
  - C 5.6 g
  - D 10.0 g
- 12 Gas syringe X contains 100 cm<sup>3</sup> of hydrogen bromide gas, HBr.


Gas syringe Y contains 100 cm<sup>3</sup> of carbon dioxide gas. The volume of each gas is measured at room temperature and pressure.

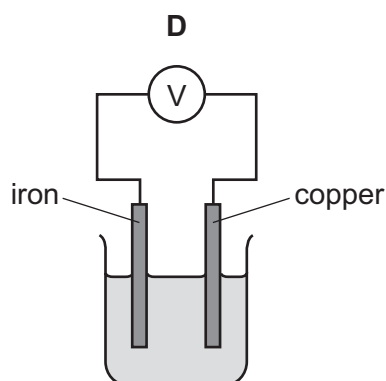
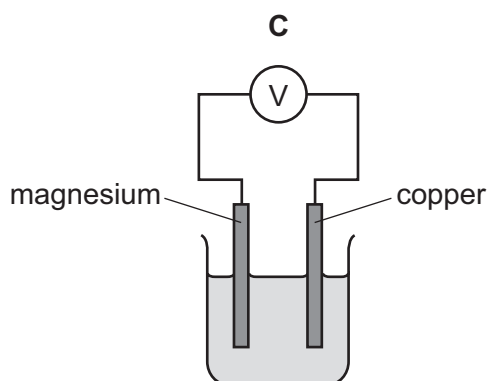
Which statement is correct?

- A The mass of HBr is less than the mass of CO<sub>2</sub>.
- B The number of molecules of HBr equals the number of molecules of CO<sub>2</sub>.
- C The gas in syringe X contains more atoms than the gas in syringe Y.
- D The number of moles of HBr is more than the number of moles of CO<sub>2</sub>.

13 Which simple cell produces the most electrical energy?



key  
 = voltmeter



14 When sulfur is heated it undergoes a .....1..... change as it melts.

Further heating causes the sulfur to undergo a .....2..... change and form sulfur dioxide.

Which words complete gaps 1 and 2?

	1	2
<b>A</b>	chemical	chemical
<b>B</b>	chemical	physical
<b>C</b>	physical	chemical
<b>D</b>	physical	physical

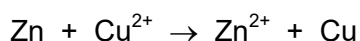
15 Four statements about the effect of increasing temperature on a reaction are shown.

- 1 The activation energy becomes lower.
- 2 The particles move faster.
- 3 There are more collisions between reacting particles per second.
- 4 There are more collisions which have energy greater than the activation energy.

Which statements are correct?

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

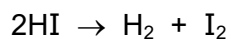
16 An example of a redox reaction is shown.



Which statement about the reaction is correct?

- A** Zn is the oxidising agent and it oxidises  $\text{Cu}^{2+}$ .
- B** Zn is the oxidising agent and it reduces  $\text{Cu}^{2+}$ .
- C** Zn is the reducing agent and it oxidises  $\text{Cu}^{2+}$ .
- D** Zn is the reducing agent and it reduces  $\text{Cu}^{2+}$ .

- 17 The equation for the decomposition of hydrogen iodide is shown.



Some bond energies are shown.

bond	bond energy in kJ/mol
H–H	440
I–I	150
H–I	300

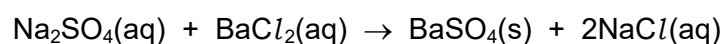
What is the energy change for the reaction?

- A** –290 kJ/mol    **B** –10 kJ/mol    **C** +10 kJ/mol    **D** +290 kJ/mol
- 18 Element X forms an oxide, XO, that neutralises sulfuric acid.

Which row describes X and XO?

	element X	nature of oxide, XO
<b>A</b>	metal	acidic
<b>B</b>	metal	basic
<b>C</b>	non-metal	acidic
<b>D</b>	non-metal	basic

- 19 Aqueous solutions of sodium sulfate and barium chloride are mixed.



Which process is used to separate a sample of barium sulfate from the reaction mixture?

- A** precipitation  
**B** filtration  
**C** evaporation  
**D** distillation

20 Information about element J is shown.

- Its atoms have four electrons in their outer shell.
- It is a non-metal.
- Its oxide has a macromolecular structure.
- It has a high melting point.

What is J?

- A beryllium
- B carbon
- C silicon
- D sulfur

21 Which property is shown by transition elements?

- A low density
- B low melting point
- C variable oxidation state
- D white compounds

22 Helium and neon exist as monoatomic gases at room temperature and pressure.

statement 1 Helium and neon have eight electrons in their outer shell.

statement 2 Helium and neon are unreactive.

Which option is correct?

- A Statement 1 and statement 2 are incorrect.
- B Statement 1 is correct and explains statement 2.
- C Statement 1 is correct, but does not explain statement 2.
- D Statement 1 is incorrect, but statement 2 is correct.



23 What are possible effects of an inadequate water supply during a drought?

- 1 crop failure
- 2 wastage of water
- 3 human disease
- 4 death of farm animals

A 1, 2 and 3      B 1 and 2 only      C 1, 3 and 4      D 3 and 4 only

24 Which statement explains why galvanising prevents iron from rusting?

- A Zinc is more reactive than iron and corrodes in preference to iron.  
B Zinc is more reactive than iron and loses electrons less easily than iron.  
C Zinc is less reactive than iron and corrodes in preference to iron.  
D Zinc is less reactive than iron and loses electrons more easily than iron.

25 Some metal nitrates and carbonates decompose when heated strongly.

Metal Q has a nitrate that decomposes to give a salt and a colourless gas only.

The carbonate of metal Q does not decompose when heated with a Bunsen burner.

What is metal Q?

- A calcium  
B copper  
C sodium  
D zinc

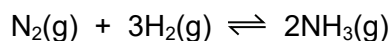
26 Which compounds are released by the extraction of zinc from zinc blende and by respiration?

	extraction of zinc	respiration
A	CO <sub>2</sub> and SO <sub>2</sub>	CO <sub>2</sub> only
B	CO <sub>2</sub> and SO <sub>2</sub>	CO <sub>2</sub> and H <sub>2</sub> O
C	CO <sub>2</sub> only	CO <sub>2</sub> only
D	CO <sub>2</sub> only	CO <sub>2</sub> and H <sub>2</sub> O

27 Which gas is an air pollutant that causes acid rain?

- A argon
- B carbon monoxide
- C methane
- D nitrogen dioxide

28 Ammonia is made from nitrogen and hydrogen. The equation for the reaction is shown.



The forward reaction is exothermic.

Which conditions give the greatest equilibrium yield of ammonia?

	temperature / °C	pressure / atm
A	200	15
B	200	150
C	500	15
D	500	150

29 Which reaction does **not** occur during the extraction of iron from hematite in a blast furnace?

- A  $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
- B  $\text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3$
- C  $\text{CO}_2 + \text{C} \rightarrow 2\text{CO}$
- D  $4\text{Fe} + 3\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3$

30 Which substance is used as a catalyst in the manufacture of sulfuric acid by the Contact process?

- A iron
- B nickel
- C phosphoric acid
- D vanadium(V) oxide

31 Metal X is a good conductor of electricity and is used for electrical wiring.

Metal Y is used to make an alloy which is resistant to corrosion and is used to make cutlery.

Metal Z is light and strong and is used in the manufacture of aircraft.

What are X, Y and Z?

	X	Y	Z
<b>A</b>	aluminium	iron	copper
<b>B</b>	copper	iron	aluminium
<b>C</b>	aluminium	copper	iron
<b>D</b>	copper	aluminium	iron

32 The formulae of two compounds of manganese are  $\text{MnO}_2$  and  $\text{KMnO}_4$ .

In these two compounds the oxidation state of potassium is +1 and the oxidation state of oxygen is -2.

What are the oxidation states of manganese in each of these two compounds?

	$\text{MnO}_2$	$\text{KMnO}_4$
<b>A</b>	+2	+3
<b>B</b>	+2	+7
<b>C</b>	+4	+3
<b>D</b>	+4	+7

33 Which statement about calcium carbonate is correct?

**A** It is made by the thermal decomposition of limestone.

**B** It is used to neutralise alkaline soils.

**C** It is a reactant in the test for carbon dioxide.

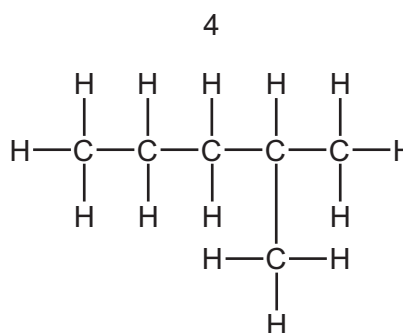
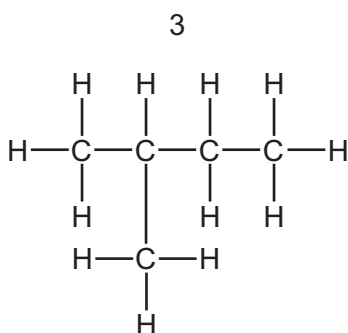
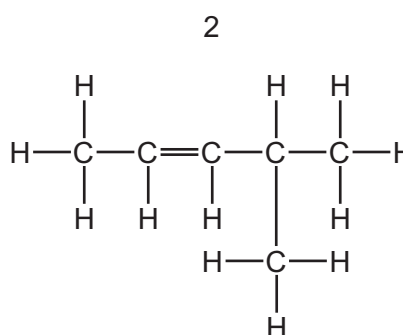
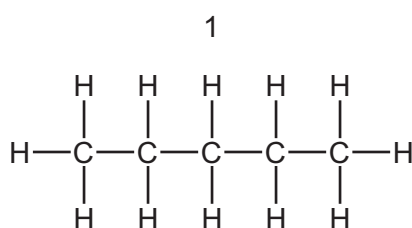
**D** It is used to remove impurities in iron extraction.

34 Ethanol is reacted with acidified potassium manganate(VII).

Which row describes the type of reaction and the type of organic compound formed?

	type of reaction	organic compound
<b>A</b>	oxidation	carboxylic acid
<b>B</b>	oxidation	alkene
<b>C</b>	dehydration	carboxylic acid
<b>D</b>	dehydration	alkene

35 The diagrams show the structural formulae of four compounds.



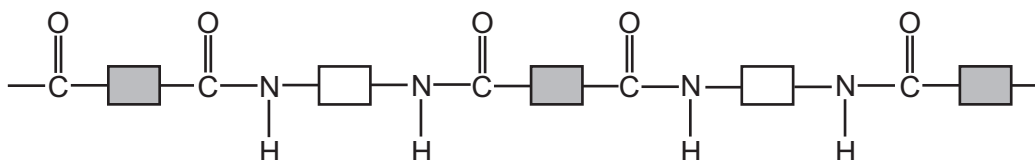
Which two compounds are structural isomers?

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

36 Which statement about alkanes is correct?

- A** They burn in oxygen.  
**B** They contain carbon, hydrogen and oxygen atoms.  
**C** They contain double bonds.  
**D** They contain ionic bonds.

- 37 How much hydrogen is needed to react completely with 0.02 moles of butene to make butane?  
**A** 0.24 dm<sup>3</sup>      **B** 0.48 dm<sup>3</sup>      **C** 0.96 dm<sup>3</sup>      **D** 1.20 dm<sup>3</sup>
- 38 What is an advantage of the fermentation process for producing ethanol compared with the catalytic addition of steam to ethene?  
**A** Fermentation requires less heat energy.  
**B** Ethanol from fermentation needs to be distilled.  
**C** Raw materials for fermentation are non-renewable.  
**D** The fermentation process is carried out in batches rather than continuously.
- 39 The structure of a synthetic polymer is shown.



The structure shows that it is a .....1..... . It is formed by .....2..... polymerisation.

Which words complete gaps 1 and 2?

	1	2
<b>A</b>	polyamide	addition
<b>B</b>	polyamide	condensation
<b>C</b>	polyester	addition
<b>D</b>	polyester	condensation

- 40 Which substance is a natural polymer?  
**A** ethene  
**B** *Terylene*  
**C** nylon  
**D** protein

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The Periodic Table of Elements

		Group																																																																																																																		
I	II	III	IV	V	VI	VII	VIII					VIII																																																																																																								
3 <b>Li</b> lithium 7	4 <b>Be</b> beryllium 9	1 <b>H</b> hydrogen 1	5 <b>B</b> boron 11	6 <b>C</b> carbon 12	7 <b>N</b> nitrogen 14	8 <b>O</b> oxygen 16	9 <b>F</b> fluorine 19	10 <b>Ne</b> neon 20					2 <b>He</b> helium 4																																																																																																							
11 <b>Na</b> sodium 23	12 <b>Mg</b> magnesium 24	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <b>Key</b>                      atomic number                      atomic symbol                      name                      relative atomic mass                 </div>																																																																																																																		
19 <b>K</b> potassium 39	20 <b>Ca</b> calcium 40	13 <b>Al</b> aluminium 27	14 <b>Si</b> silicon 28	15 <b>P</b> phosphorus 31	16 <b>S</b> sulfur 32	17 <b>Cl</b> chlorine 35.5	18 <b>Ar</b> argon 40					36 <b>Kr</b> krypton 84																																																																																																								
37 <b>Rb</b> rubidium 85	38 <b>Sr</b> strontium 88	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					54 <b>Xe</b> xenon 131																																																																																																							
55 <b>Cs</b> caesium 133	56 <b>Ba</b> barium 137	29 <b>Cu</b> copper 64	28 <b>Ni</b> nickel 59	27 <b>Co</b> cobalt 59	26 <b>Fe</b> iron 56	25 <b>Mn</b> manganese 55	24 <b>Cr</b> chromium 52	23 <b>V</b> vanadium 51	22 <b>Ti</b> titanium 48	21 <b>Sc</b> scandium 45	20 <b>Ca</b> calcium 40	19 <b>K</b> potassium 39	18 <b>Ar</b> argon 40	17 <b>Cl</b> chlorine 35.5	16 <b>S</b> sulfur 32	15 <b>P</b> phosphorus 31	14 <b>Si</b> silicon 28	13 <b>Al</b> aluminium 27	12 <b>Mg</b> magnesium 24	11 <b>Na</b> sodium 23	10 <b>Ne</b> neon 20	9 <b>F</b> fluorine 19	8 <b>O</b> oxygen 16	7 <b>N</b> nitrogen 14	6 <b>C</b> carbon 12	5 <b>B</b> boron 11	4 <b>Be</b> beryllium 9	3 <b>Li</b> lithium 7	2 <b>He</b> helium 4																																																																																							
87 <b>Fr</b> francium —	88 <b>Ra</b> radium —	81 <b>Tl</b> thallium 204	80 <b>Hg</b> mercury 201	79 <b>Au</b> gold 197	78 <b>Pt</b> platinum 195	77 <b>Ir</b> iridium 192	76 <b>Os</b> osmium 190	75 <b>Re</b> rhenium 186	74 <b>W</b> tungsten 184	73 <b>Ta</b> tantalum 181	72 <b>Hf</b> hafnium 178	71 <b>Ta</b> tantalum 181	70 <b>Hf</b> hafnium 178	69 <b>Tm</b> thulium 169	68 <b>Er</b> erbium 167	67 <b>Ho</b> holmium 165	66 <b>Dy</b> dysprosium 163	65 <b>Tb</b> terbium 159	64 <b>Gd</b> gadolinium 157	63 <b>Eu</b> europium 152	62 <b>Sm</b> samarium 150	61 <b>Pm</b> promethium —	60 <b>Nd</b> neodymium 144	59 <b>Pr</b> praseodymium 141	58 <b>Ce</b> cerium 140	57 <b>La</b> lanthanum 139	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	57–71 lanthanoids	112 <b>Cn</b> copernicium —	111 <b>Rg</b> roentgenium —	110 <b>Ds</b> darmstadtium —	109 <b>Mt</b> meitnerium —	108 <b>Hs</b> hassium —	107 <b>Bh</b> bohrium —	106 <b>Sg</b> seaborgium —	105 <b>Db</b> dubnium —	104 <b>Rf</b> rutherfordium —	103 <b>Lr</b> lawrencium —	102 <b>No</b> nobelium —	101 <b>Md</b> mendelevium —	100 <b>Fm</b> fermium —	99 <b>Es</b> einsteinium —	98 <b>Cf</b> californium —	97 <b>Bk</b> berkelium —	96 <b>Cm</b> curium —	95 <b>Am</b> americium —	94 <b>Pu</b> plutonium —	93 <b>Np</b> neptunium —	92 <b>U</b> uranium 238	91 <b>Pa</b> protactinium 231	90 <b>Th</b> thorium 232	89 <b>Ac</b> actinium —	116 <b>Lv</b> livermorium —	115 <b>Fl</b> flerovium —	114 <b>F1</b> —	113 <b>Nh</b> —	112 <b>Cn</b> copernicium —	111 <b>Rg</b> roentgenium —	110 <b>Ds</b> darmstadtium —	109 <b>Mt</b> meitnerium —	108 <b>Hs</b> hassium —	107 <b>Bh</b> bohrium —	106 <b>Sg</b> seaborgium —	105 <b>Db</b> dubnium —	104 <b>Rf</b> rutherfordium —	103 <b>Lr</b> lawrencium —	102 <b>No</b> nobelium —	101 <b>Md</b> mendelevium —	100 <b>Fm</b> fermium —	99 <b>Es</b> einsteinium —	98 <b>Cf</b> californium —	97 <b>Bk</b> berkelium —	96 <b>Cm</b> curium —	95 <b>Am</b> americium —	94 <b>Pu</b> plutonium —	93 <b>Np</b> neptunium —	92 <b>U</b> uranium 238	91 <b>Pa</b> protactinium 231	90 <b>Th</b> thorium 232	89 <b>Ac</b> actinium —	70 <b>Yb</b> ytterbium 173	69 <b>Tm</b> thulium 169	68 <b>Er</b> erbium 167	67 <b>Ho</b> holmium 165	66 <b>Dy</b> dysprosium 163	65 <b>Tb</b> terbium 159	64 <b>Gd</b> gadolinium 157	63 <b>Eu</b> europium 152	62 <b>Sm</b> samarium 150	61 <b>Pm</b> promethium —	60 <b>Nd</b> neodymium 144	59 <b>Pr</b> praseodymium 141	58 <b>Ce</b> cerium 140	57 <b>La</b> lanthanum 139	71 <b>Lu</b> lutetium 175	70 <b>Yb</b> ytterbium 173	69 <b>Tm</b> thulium 169	68 <b>Er</b> erbium 167	67 <b>Ho</b> holmium 165	66 <b>Dy</b> dysprosium 163	65 <b>Tb</b> terbium 159	64 <b>Gd</b> gadolinium 157	63 <b>Eu</b> europium 152	62 <b>Sm</b> samarium 150	61 <b>Pm</b> promethium —	60 <b>Nd</b> neodymium 144	59 <b>Pr</b> praseodymium 141	58 <b>Ce</b> cerium 140	57 <b>La</b> lanthanum 139

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.).