



**Cambridge International Examinations**  
Cambridge International General Certificate of Secondary Education

CANDIDATE  
NAME

CENTRE  
NUMBER

--	--	--	--	--

CANDIDATE  
NUMBER

--	--	--	--

\* 2 1 3 9 4 1 7 1 8 9 \*



**CHEMISTRY**

**0620/32**

Paper 3 Theory (Core)

**October/November 2018**

**1 hour 15 minutes**

Candidates answer on the Question Paper.

No Additional Materials are required.

**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

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

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.

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

You may lose marks if you do not show your working or if you do not use appropriate units.

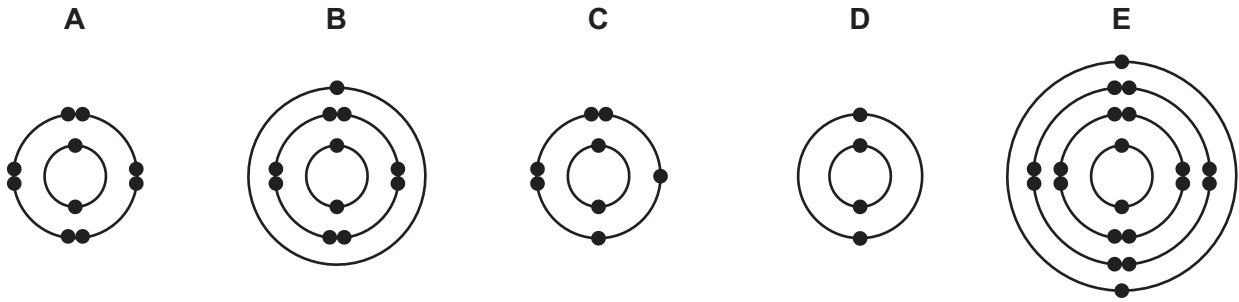
At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

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

1 (a) The electronic structures of five atoms, **A**, **B**, **C**, **D** and **E**, are shown.



Answer the following questions about these structures.

Each structure may be used once, more than once or not at all.

State which structure, **A**, **B**, **C**, **D** or **E**, represents:

- (i) an atom in Group VIII of the Periodic Table ..... [1]
- (ii) an atom of a reactive non-metal ..... [1]
- (iii) an atom with a proton number of 11 ..... [1]
- (iv) an atom with only **three** shells of electrons ..... [1]
- (v) an atom which forms a stable ion with a single positive charge. .... [1]

(b) Complete the table to show the number of electrons, neutrons and protons in the nitrogen atom and chromium ion shown.

	number of electrons	number of neutrons	number of protons
$^{15}_7\text{N}$	7		
$^{52}_{24}\text{Cr}^{2+}$		28	

[3]

[Total: 8]

- 2 (a) The table shows the concentrations of the ions present in a solution obtained from cells in the body.

ion present	formula of ion	concentration in mg/1000 cm <sup>3</sup>
sodium	Na <sup>+</sup>	273
potassium	K <sup>+</sup>	540
calcium	Ca <sup>2+</sup>	3
magnesium	Mg <sup>2+</sup>	20
chloride	Cl <sup>-</sup>	140
hydrogencarbonate	HCO <sub>3</sub> <sup>-</sup>	730
phosphate	PO <sub>4</sub> <sup>3-</sup>	1

Answer these questions using only information from the table.

- (i) Which negative ion is present in the highest concentration?

..... [1]

- (ii) Calculate the mass of potassium ions present in 250 cm<sup>3</sup> of this solution.

mass of potassium ions = ..... mg [1]

- (iii) Calculate the **total** mass of positive ions present in 1000 cm<sup>3</sup> of this solution.

total mass of positive ions = ..... mg [1]

- (iv) Give the name of the compound formed from Na<sup>+</sup> and HCO<sub>3</sub><sup>-</sup> ions.

..... [1]

- (b) Describe what is observed in these **two** reactions.

- An excess of aqueous sodium hydroxide is added to a solution containing Ca<sup>2+</sup> ions.

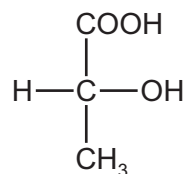
.....

- An excess of aqueous ammonia is added to a solution containing Ca<sup>2+</sup> ions.

.....

[2]

- (c) Lactic acid can build up in muscle cells during exercise.  
The structure of lactic acid is shown.



- (i) On the structure, draw a circle around the carboxylic acid functional group. [1]
- (ii) Deduce the molecular formula of lactic acid showing the number of carbon, hydrogen and oxygen atoms.

..... [1]

- (d) Lactic acid can form a polymer.

Complete the sentence about polymers using words from the list.

**atomic    large    molecular    monomers    polymers    small**

During polymerisation ..... molecules called ..... join together to form long-chain molecules with a very high relative ..... mass.

[3]

[Total: 11]

- 3 (a) The table gives information about the solubility of copper and selenium in an organic solvent and in water. The organic solvent boils at 30 °C.

element	solubility in organic solvent	solubility in water
copper	insoluble	insoluble
selenium	soluble	insoluble

- (i) Use the information in the table to suggest how you could obtain pure, dry samples of copper and selenium from a mixture of copper powder and selenium powder.

.....

.....

.....

.....

.....

.....

..... [4]

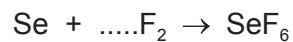
- (ii) Ethanol is an organic solvent.

Draw the structure of ethanol. Show all of the atoms and all of the bonds.

[2]

- (iii) Selenium reacts with fluorine to form selenium(VI) fluoride.

Balance the chemical equation for this reaction.

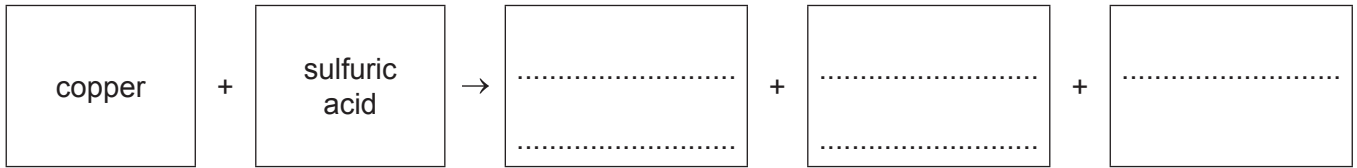


[1]

(b) The chemical equation for the reaction of copper with hot concentrated sulfuric acid is shown.



(i) Complete the word equation for this reaction.



[2]

(ii) One of the compounds in this equation is a pollutant gas which contributes to acid rain.

Identify the pollutant gas and state a common source of it.

pollutant gas .....

source .....

[2]

(c) Solid hydrated copper(II) sulfate decomposes to anhydrous copper(II) sulfate when it is continuously heated.

Is this an endothermic or an exothermic reaction?  
Explain your answer.

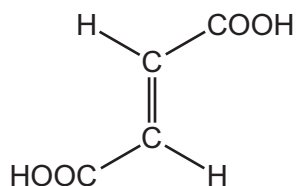
.....

..... [1]

[Total: 12]

4 This question is about acids.

(a) The structure of fumaric acid is shown.



Fumaric acid is an unsaturated compound.

(i) What feature of the structure of fumaric acid shows that it is unsaturated?

..... [1]

(ii) Describe a test for an unsaturated compound.

test .....

result .....

[2]

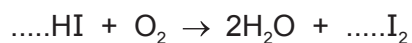
(b) Hydroiodic acid can be used for the reduction of some carboxylic acids.

(i) What is meant by the term *reduction*?

..... [1]

(ii) Hydroiodic acid is oxidised by oxygen.

Balance the chemical equation for this reaction.

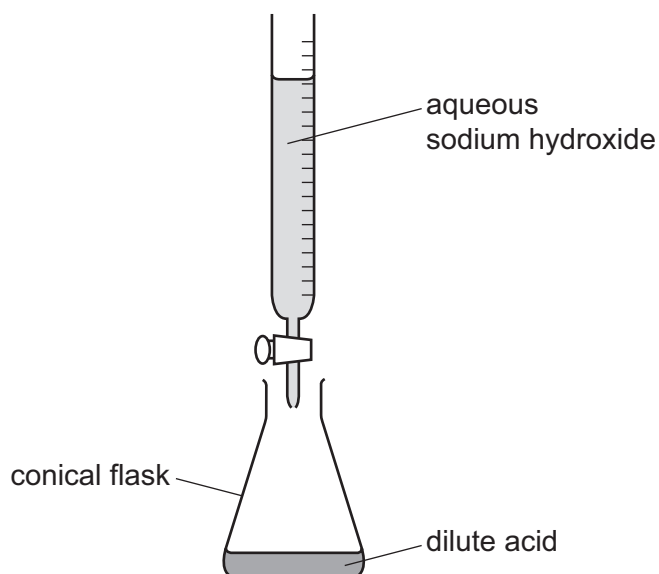


[2]

(iii) What percentage of clean, dry air is oxygen?

..... [1]

- (c) The concentration of a dilute acid can be found by reacting it with aqueous sodium hydroxide using the apparatus shown.



- (i) What piece of apparatus should be used to add exactly  $25.0\text{cm}^3$  of dilute acid to the conical flask?

..... [1]

- (ii) A few drops of litmus solution are added to the conical flask.

Explain why litmus solution is added to the conical flask.

.....  
 ..... [1]

- (iii) Aqueous sodium hydroxide is then added to the dilute acid until it is in excess.

Describe the change in the colour of the litmus solution in the conical flask.

from ..... to ..... [2]

[Total: 11]



5 Bromine is a volatile liquid. Potassium bromide is a compound made from bromine.

(a) Use the kinetic particle model to describe the arrangement **and** motion of the particles in bromine when it is:

- a liquid

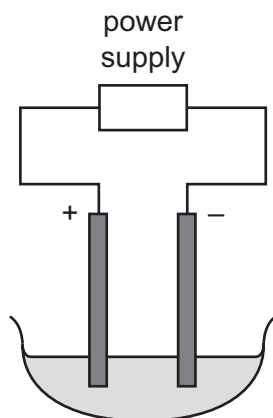
.....  
 .....

- a gas

.....  
 .....

[4]

(b) Molten potassium bromide can be electrolysed using the apparatus shown.



(i) On the diagram, label:

- the anode
- the electrolyte

[2]

(ii) Predict the products of this electrolysis at:

the positive electrode .....

the negative electrode. ....

[2]

(iii) Give **one** observation that is made at the positive electrode.

..... [1]

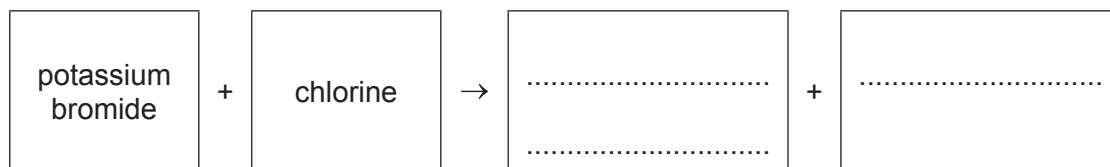
(iv) Suggest why the electrodes are made of graphite and **not** of magnesium.

.....

..... [1]

(c) Aqueous potassium bromide reacts with aqueous chlorine.

(i) Complete the word equation for this reaction.



[2]

(ii) Using ideas about the reactivity of the halogens, explain why aqueous potassium bromide does **not** react with aqueous iodine.

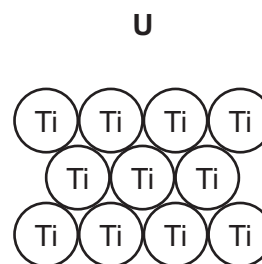
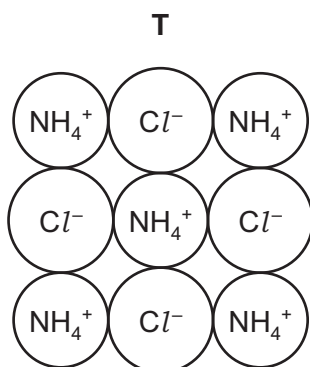
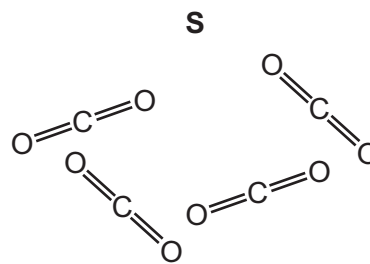
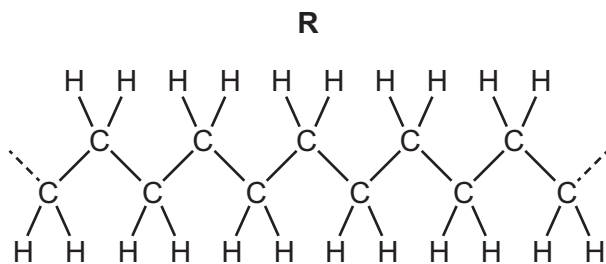
.....  
..... [1]

(iii) Describe what you would observe when aqueous silver nitrate is added to aqueous potassium bromide.

..... [2]

[Total: 15]

6 (a) The diagrams show the structures of four substances, **R**, **S**, **T** and **U**.



State which **one** of these substances, **R**, **S**, **T** or **U**:

- (i) is an element ..... [1]
- (ii) contains ionic bonds ..... [1]
- (iii) is a gas at room temperature ..... [1]
- (iv) is a polymer. .... [1]

(b) Ammonium chloride is present in some fertilisers.

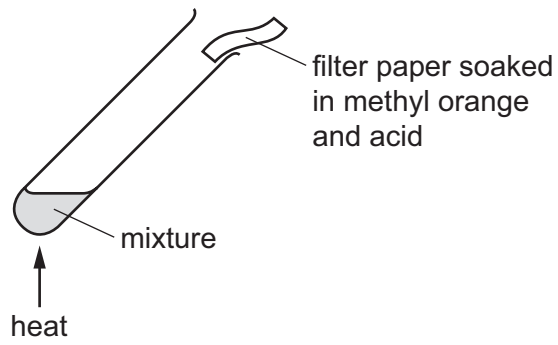
Which **two** of the following compounds are also present in many fertilisers?

Tick **two** boxes.

- |                     |  |
|---------------------|--|
| hydrogen sulfide    |  |
| calcium phosphate   |  |
| copper(II) fluoride |  |
| nickel(II) oxide    |  |
| potassium nitrate   |  |

[2]

(c) A mixture of ammonium chloride and aqueous sodium hydroxide is heated as shown.



The filter paper changes colour from red to yellow.

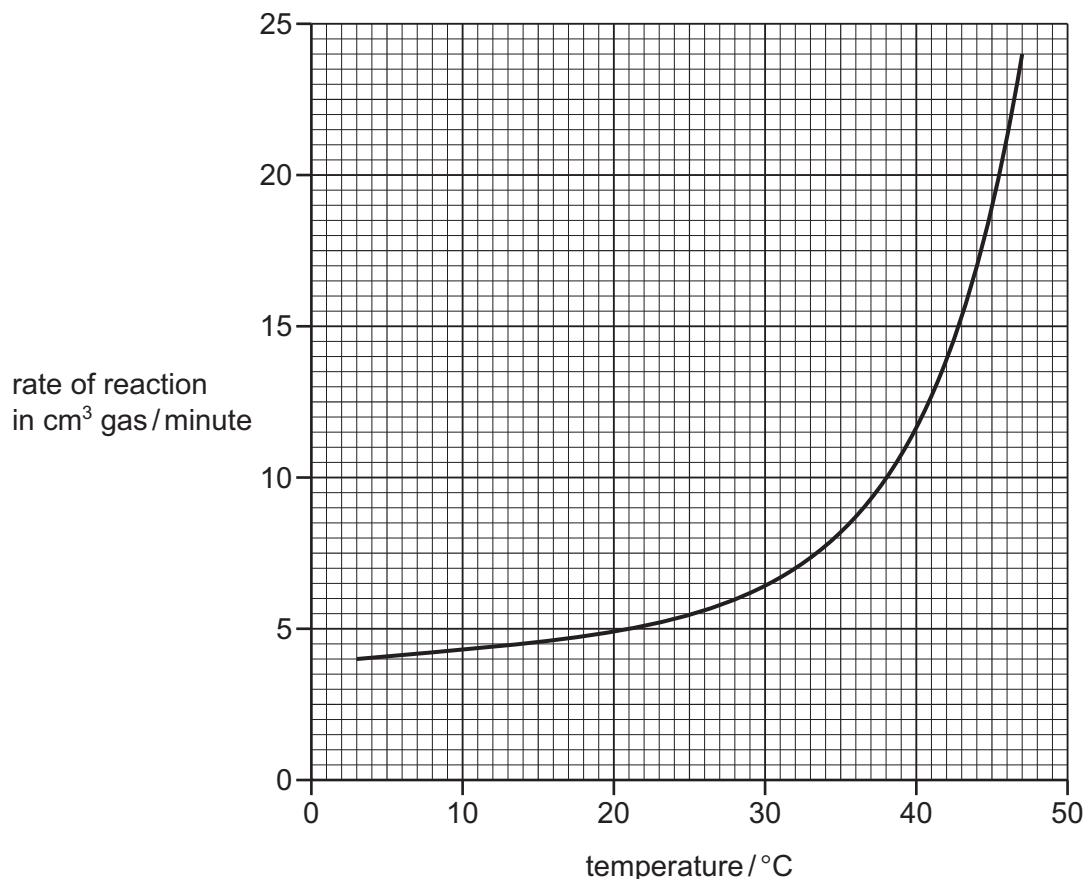
Explain why.

.....

..... [2]

[Total: 8]

- 7 (a) The graph shows the effect of temperature on the rate of reaction of dilute hydrochloric acid with zinc powder.



- (i) Determine the rate of reaction at 40 °C.

rate of reaction = ..... cm<sup>3</sup> gas/minute [1]

- (ii) The experiments were repeated using small lumps of zinc instead of zinc powder. All other conditions were kept the same.

**On the grid**, draw a graph to show how the rate of reaction changes with temperature when small lumps of zinc are used instead of zinc powder. [2]

- (b) What effects do these factors have on the rate of a chemical reaction?

- (i) decreasing the concentration of a reactant

..... [1]

- (ii) adding a catalyst

..... [1]

(c) Zinc and iron are both metals.

Give **two** physical properties which are characteristic of metals.

1 .....

2 ..... [2]

(d) Stainless steel is an alloy of iron.

(i) What is meant by the term *alloy*?

..... [1]

(ii) Give **one** common use of stainless steel.

..... [1]

[Total: 9]

8 The table shows the properties of some Group I elements.

element	density in g/cm <sup>3</sup>	melting point in °C	relative hardness
sodium	0.97	98	4.9
potassium	0.86	63	2.6
rubidium	1.53		1.6
caesium		29	1.0

(a) (i) Describe the trend in the relative hardness of the Group I elements.

..... [1]

(ii) Predict the melting point of rubidium.

..... [1]

(iii) Explain why it is difficult to predict the density of caesium.

.....  
 ..... [1]

(b) When potassium reacts with water, it floats and melts into a ball. A flame is observed.

(i) What colour does potassium give to the flame?

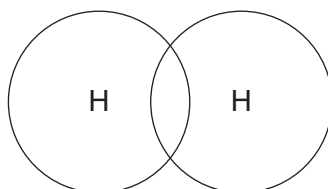
..... [1]

(ii) Use the information in the table to suggest why potassium floats on water.

..... [1]

(iii) Hydrogen is produced when potassium reacts with water.

Complete the dot-and-cross diagram to show the electron arrangement in a molecule of hydrogen.



[1]

[Total: 6]

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.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at [www.cie.org.uk](http://www.cie.org.uk) after the live examination series.

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.

## The Periodic Table of Elements

		Group							
I	II	III	IV	V	VI	VII	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
11 <b>Na</b> sodium 23	12 <b>Mg</b> magnesium 24	<b>Key</b> atomic number atomic symbol name relative atomic mass							
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	54 <b>Xe</b> xenon 131	
55 <b>Cs</b> caesium 133	56 <b>Ba</b> barium 137	49 <b>In</b> indium 115	48 <b>Cd</b> cadmium 112	50 <b>Sn</b> tin 119	51 <b>Sb</b> antimony 122	52 <b>Te</b> tellurium 128	53 <b>I</b> iodine 127	86 <b>Rn</b> radon —	
87 <b>Fr</b> francium —	88 <b>Ra</b> radium —	81 <b>Tl</b> thallium 204	80 <b>Hg</b> mercury 201	82 <b>Pb</b> lead 207	83 <b>Bi</b> bismuth 209	84 <b>Po</b> polonium —	85 <b>At</b> astatine —	—	
57 <b>La</b> lanthanum 139	58 <b>Ce</b> cerium 140	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
89 <b>Ac</b> actinium —	90 <b>Th</b> thorium 232	47 <b>Ag</b> silver 108	46 <b>Pd</b> palladium 106	45 <b>Rh</b> rhodium 103	44 <b>Ru</b> ruthenium 101	43 <b>Tc</b> technetium —	42 <b>Mo</b> molybdenum 96	41 <b>Nb</b> niobium 93	40 <b>Zr</b> zirconium 91
—	—	89–103 actinoids	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>Y</b> yttrium 89
—	—	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 —
lanthanoids	lanthanoids	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
actinoids	actinoids	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
—	—	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 —
—	—	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

lanthanoids

actinoids

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