Cambridge IGCSE

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

| | |
|---|---|
| CANDIDATE NAME | |
| CENTRE NUMBER | |
| CANDIDATE NUMBER | |

*5703974316*

**CHEMISTRY** **0620/33**

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 20.
You may lose marks if you do not show your working or if you do not use appropriate units.

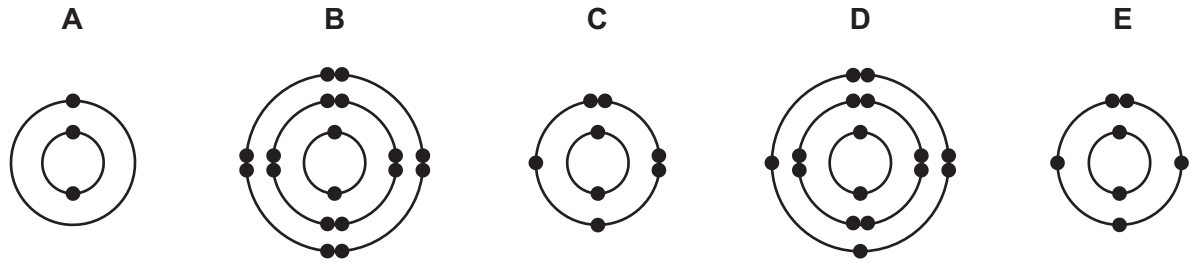
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.



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 **18** printed pages and **2** blank 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 with a total of eight electrons ..... [1]

**(ii)** an atom in Group V of the Periodic Table ..... [1]

**(iii)** an atom with a complete outer shell of electrons ..... [1]

**(iv)** an atom of a metallic element ..... [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 neon atom and copper ion shown.

| | number of electrons | number of neutrons | number of protons |
|---|---|---|---|
| $^{22}_{10}Ne$ | 10 | | |
| $^{65}_{29}Cu^{+}$ | | 36 | |

[3]

[Total: 8]

**2** **(a)** The table shows the concentrations of the ions present in the solution obtained from squid nerve cells and in human blood plasma.

| ion present | solution obtained from squid nerve cells | human blood plasma |
|---|---|---|
| | concentration in g / 1000 $cm^3$ | concentration in g / 1000 $cm^3$ |
| sodium | 1.15 | 3.25 |
| potassium | 15.60 | 0.16 |
| magnesium | 0.03 | 0.04 |
| chloride | 3.55 | 3.65 |
| hydrogencarbonate | trace | 1.50 |

Answer these questions using only information from the table.

**(i)** Give **two** major differences between the concentrations of the ions present in the solution obtained from squid nerve cells and in human blood plasma.

1 .....

2 .....
[2]

**(ii)** Calculate the mass of potassium ions present in 250 $cm^3$ of the solution obtained from squid nerve cells.

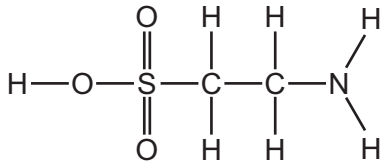
mass of potassium ions = ..... g [1]

**(b)** Describe a test for sodium ions.

test .....

result .....
[2]

**(c)** Squid produce an ink which contains a compound called taurine.
The structure of taurine is shown.



Deduce the molecular formula of taurine showing the number of carbon, hydrogen, oxygen, nitrogen and sulfur atoms.

..... [1]

**(d)** The ink used for writing is a mixture of dyes.
These dyes can be separated by paper chromatography.

Describe how to separate a mixture of dyes using paper chromatography.
Include a labelled diagram in your answer.

.....

.....

.....

.....

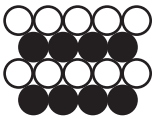
.....
[4]

[Total: 10]

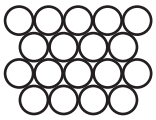
**3** **(a)** Brass is an alloy of copper and zinc.

**(i)** Which **one** of the following diagrams best represents an alloy?

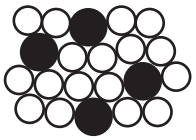
**J**



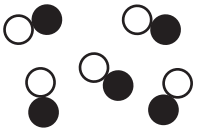
**K**



**L**



**M**



..... [1]

**(ii)** Brass is used to make the propellers of ships rather than pure copper or pure zinc.

Suggest a property of brass which explains this.

.....

..... [1]

**(b)** The chemical equation for the reaction of zinc with concentrated nitric acid is shown.

$$Zn + 4HNO_3 \rightarrow Zn(NO_3)_2 + 2NO_2 + 2H_2O$$

**(i)** Complete the word equation for this reaction.

| | | | | | | |
|---|---|---|---|---|---|---|
| zinc | + | nitric acid | → | ..... ..... | + | ..... ..... | + | ..... |

[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)** Zinc oxide is reduced by heating it with carbon.

$$ZnO + C \rightarrow Zn + CO$$

How does this equation show that zinc oxide is reduced?

.....

..... [1]

**(d)** When green iron(II) sulfate is heated it loses its water of crystallisation.
The reaction is reversible.

**(i)** Complete the following equation by writing the sign for a reversible reaction in the box.

$$\underset{\text{green}}{FeSO_4.7H_2O} \quad \square \quad \underset{\text{white}}{FeSO_4} + 7H_2O$$

[1]

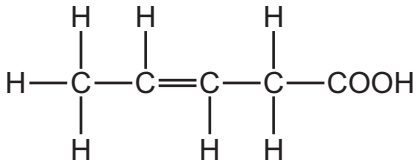
**(ii)** Use the information in the equation to suggest how to change white iron(II) sulfate into green iron(II) sulfate.

..... [1]

[Total: 9]

**4** **(a)** The structure of compound **P** is shown.

compound **P**



**(i)** What feature of the structure of compound **P** shows that it is unsaturated?

..... [1]

**(ii)** Describe the colour change when an excess of compound **P** is added to aqueous bromine.

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

**(iii)** Compound **P** has a –COOH functional group.

Draw the structure of the –COOH functional group. Show all of the atoms and all of the bonds.

[1]

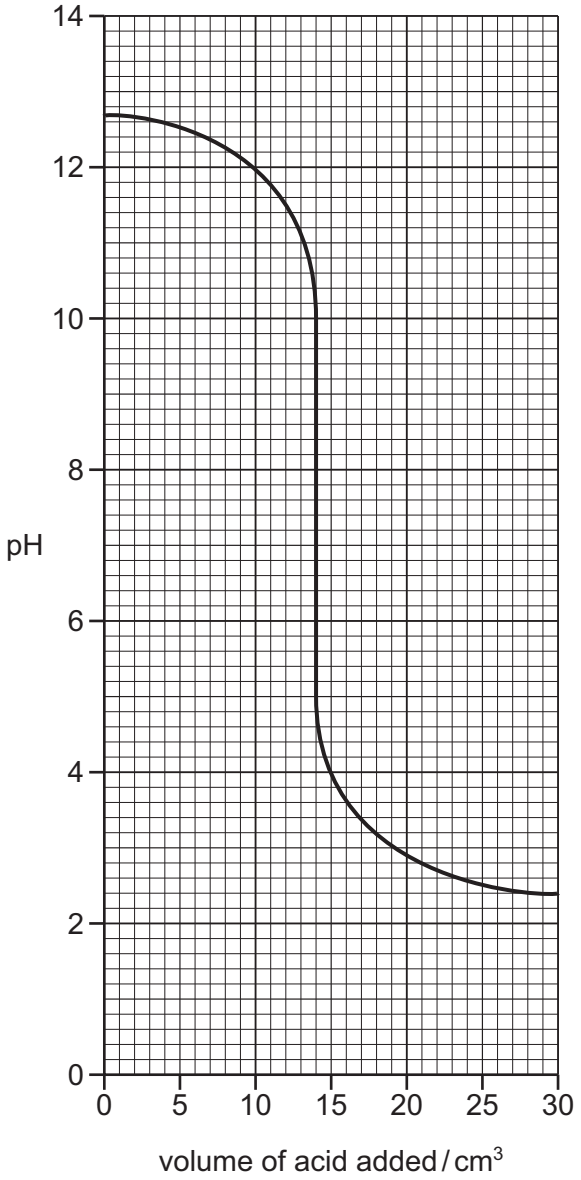
**(iv)** What effect would compound **P** have on litmus solution?

..... [1]



**[Turn over**

**(b)** The concentration of aqueous sodium hydroxide can be found by reacting it with an acid of known concentration.
The graph shows how the pH of aqueous sodium hydroxide in a conical flask changes as acid is added to it.




**(i)** Describe how the pH changes as the acid is added.

.....

.....

..... [2]

**(ii)** What is the pH of the aqueous sodium hydroxide before the acid is added?

..... [1]

**(iii)** What volume of acid has been added when the solution reaches neutral pH?

..... [1]

[Total: 9]

**5** **(a)** When sulfur vapour falls on to a cold surface, small crystals of solid sulfur form.

Use the kinetic particle model to describe the arrangement **and** motion of the particles in sulfur when it is:

- a gas

.....

.....

- a solid

.....

.....

[4]

**(b)** Sulfur dioxide is formed when copper reacts with hot concentrated sulfuric acid.

Balance the chemical equation for this reaction.

$$Cu + .....H_2SO_4 \rightarrow CuSO_4 + SO_2 + .....H_2O$$

[2]

**(c)** Hot copper reacts with chlorine to form copper(II) chloride.

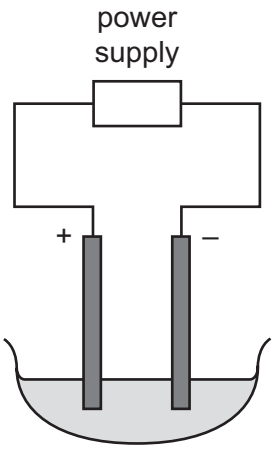
Describe a test for chloride ions.

test .....

result .....

[2]

**(d)** Molten copper(II) chloride can be electrolysed using the apparatus shown.




**(i)** On the diagram label:
- the cathode
- the electrolyte

[2]

**(ii)** Predict the products of this electrolysis at:

the positive electrode .....

the negative electrode. .....

[2]

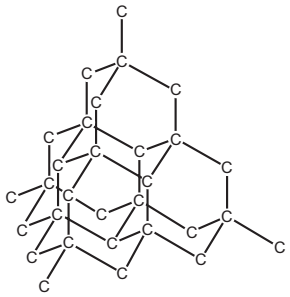
**(iii)** Give **one** observation that is made at the positive electrode.

..... [1]

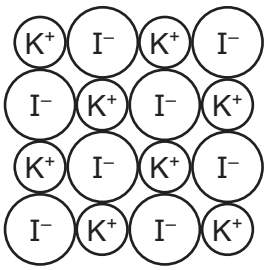
[Total: 13]

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

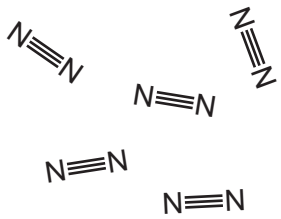
**R**



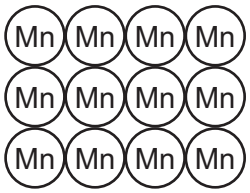
**S**




**T**




**U**




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

**(i)** is a compound

..... [1]

**(ii)** conducts electricity when solid

..... [1]

**(iii)** has the lowest melting point

..... [1]

**(iv)** is a macromolecule

..... [1]

**(v)** can act as a catalyst.

..... [1]

**(b)** Substance **S** is potassium iodide.
When aqueous potassium iodide reacts with aqueous chlorine, the solution turns brown.

Name the brown substance that forms. Using ideas about the reactivity of the halogens, suggest why the brown substance forms.

.....

..... [2]

**(c)** Potassium salts are present in many fertilisers.

Which **one** of the following compounds is also present in many fertilisers?
Tick **one** box.

| | |
|---|---|
| lead(II) bromide | ☐ |
| calcium phosphate | ☐ |
| copper(II) sulfide | ☐ |
| tin(IV) oxide | ☐ |

[1]

**(d)** Many fertilisers contain ammonium salts.

Explain why farmers do **not** add calcium hydroxide (slaked lime) to the soil at the same time as fertilisers containing ammonium salts.

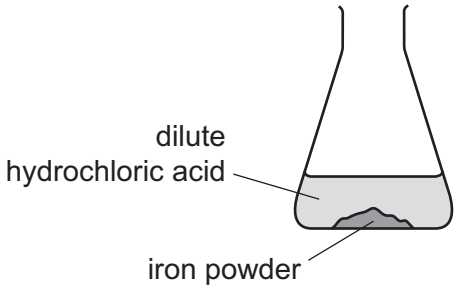
.....

.....

..... [2]

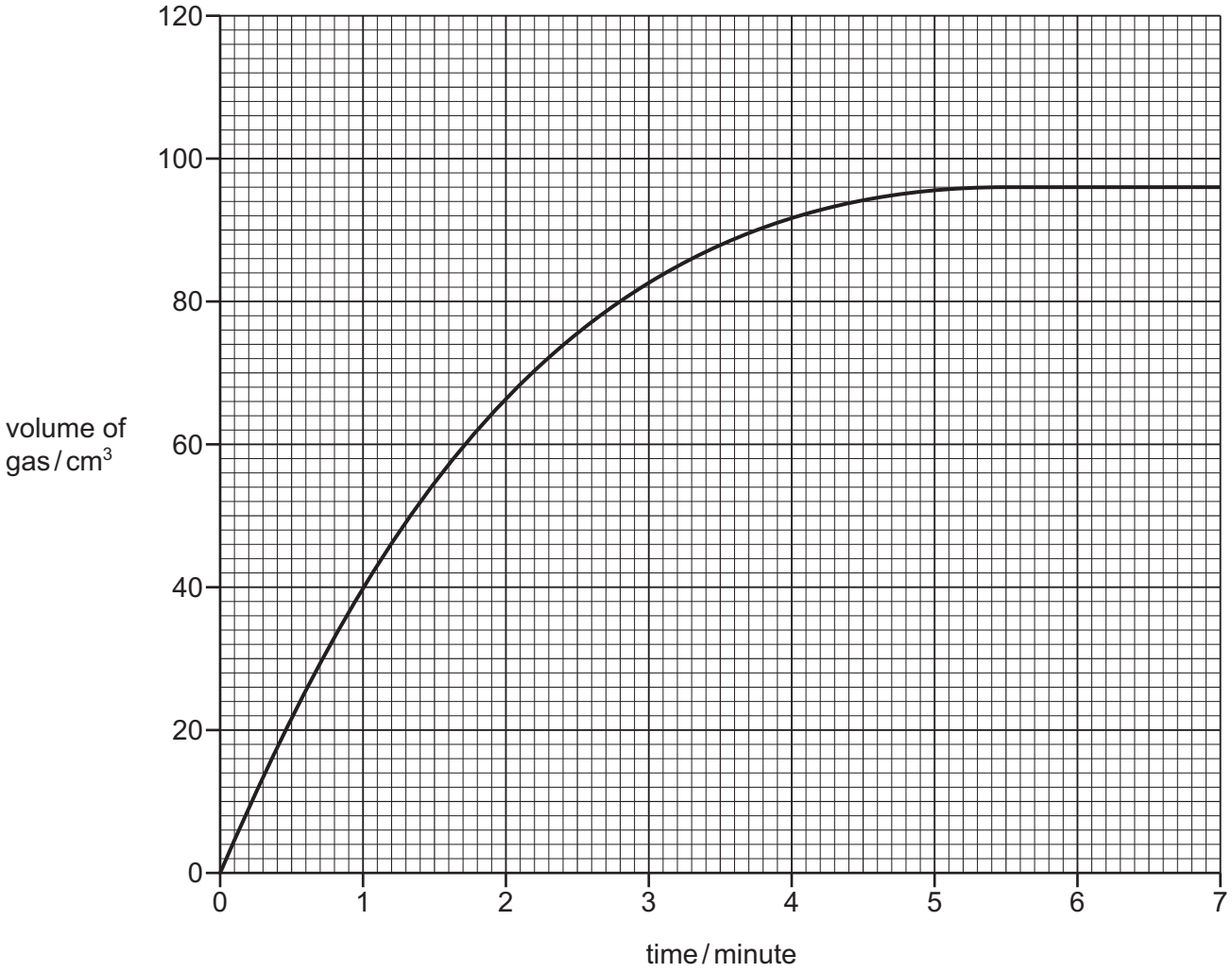
[Total: 10]

**7** A student investigates the rate of reaction of iron powder with dilute hydrochloric acid.




**(a)** Complete the diagram to show the apparatus the student could use to collect and measure the gas produced.
Label your diagram. [3]

**(b)** The graph shows the results the student obtained using dilute hydrochloric acid of concentration 0.2 mol / $dm^3$ and an **excess** of iron powder.




Use the graph to deduce:

**(i)** the time that the reaction was complete

..... [1]

**(ii)** the volume of gas produced when the reaction was complete.

..... [1]

**(c)** The student repeated the experiment using a lower concentration of dilute hydrochloric acid. All other conditions were kept the same.

**On the grid**, draw a graph to show how the volume of gas changes with time when a lower concentration of dilute hydrochloric acid is used. [2]

**(d)** Iron is extracted from iron ore using a blast furnace.
The solid substances added to the blast furnace are iron ore, coke and limestone (calcium carbonate).

**(i)** State the name of an ore of iron.

..... [1]

**(ii)** Complete the sentences about the reactions which occur in a blast furnace using words from the list.

**air** **decomposes** **dioxide** **monoxide**

**nitrogen** **oxidises** **slag** **tetrachloride**

The coke burns in a blast of hot ..... to form carbon dioxide. This reacts with further hot coke to form carbon ..... . This gas reduces the iron(III) oxide in the iron ore to iron.

The limestone ..... to form lime (calcium oxide) which reacts with impurities in the iron to form ..... .

[4]

[Total: 12]



**[Turn over**

**8** The table shows the properties of some Group VII elements.

| element | boiling point in °C | density at room temperature in g / cm$^3$ | physical state at room temperature |
|---|---|---|---|
| fluorine | –188 | 0.0017 | |
| chlorine | | 0.0032 | gas |
| bromine | 59 | 3.1 | liquid |
| iodine | 184 | 4.9 | solid |

**(a) (i)** Use this information to:

- identify the physical state of fluorine at room temperature

.....

- estimate the boiling point of chlorine.

.....
[2]

**(ii)** Suggest why the density of chlorine is much lower than the densities of bromine and iodine.

.....

..... [1]

**(b)** Chlorine is used in water treatment.

**(i)** Why is chlorine added to water?

..... [1]

**(ii)** State **one** major use of water in industry.

..... [1]

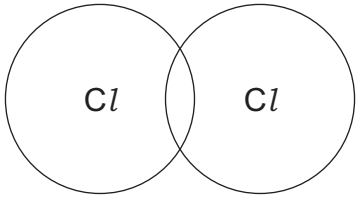
**(c)** Chlorine reacts with phosphorus to form phosphorus(III) chloride.

Balance the chemical equation for this reaction.

$$\text{.....P} + \text{.....C}l_2 \rightarrow 2\text{PC}l_3$$

[2]

**(d)** Complete the dot-and-cross diagram to show the electron arrangement in a molecule of chlorine. Show outer shell electrons only.




[2]

[Total: 9]

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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 – | | 114 Fl flerovium – | | 116 Lv livermorium – | | |

**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.).