



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
NUMBER

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CHEMISTRY

0620/23

Paper 2

May/June 2010

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 in the spaces at the top of this page.

Write in dark blue or black pen.

You may need to use a pencil for any diagrams, graphs or rough working.

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

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

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

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.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
Total	

This document consists of **15** printed pages and **1** blank page.

1 The diagram shows part of the Periodic Table.
Only some of the elements are shown.

Li				
Na	Mg			
K	Ca		Ti	V
			Zr	Nb

(a) Answer the following questions by choosing only from the elements shown in the diagram.
You can use each element once, more than once or not at all.

(i) State the names of **two** transition elements shown in the diagram.
..... and [2]

(ii) State the name of an element which is in Period 3 of the Periodic Table.
..... [1]

(iii) Which element has the electronic structure 2,8,1?
..... [1]

(iv) Which element has the fastest reaction with water?
..... [1]

(v) Which element has 23 protons in its nucleus?
..... [1]

(b) Sodium reacts with oxygen to form sodium peroxide, Na₂O₂.
Complete the symbol equation for this reaction.



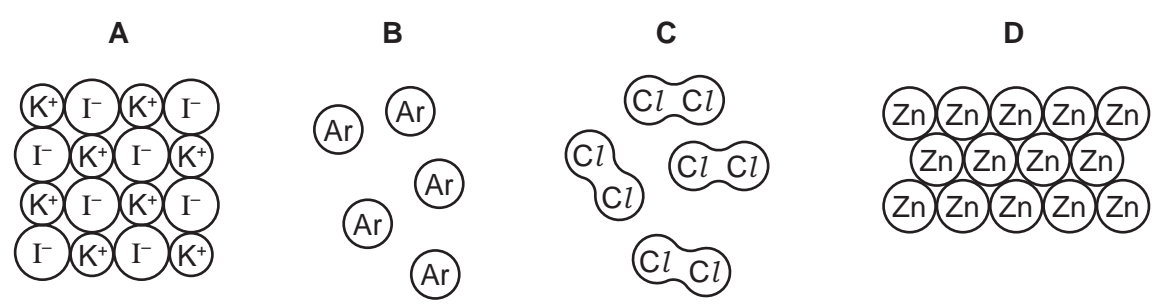
[2]

[Total: 8]

2 The list describes five types of chemical structures.

- giant covalent
- giant ionic
- metallic
- simple atomic
- simple molecular

(a) The diagrams below show four types of chemical structures.



(i) Use the list to match these structures with the diagrams.

- structure **A** is [1]
- structure **B** is [1]
- structure **C** is [1]
- structure **D** is [1]

(ii) Which **two** of the structures **A**, **B**, **C** or **D** have low melting points?

..... and [1]

(b) Sodium chloride is an ionic solid.
Complete the following sentences using words from the list.

- electrons ionic molecular molten solid**

Sodium chloride does not conduct electricity when it is a

because the ions cannot move. When it is sodium chloride does

conduct electricity because the ions are free to move. [2]

[Total: 7]

3 Water is an important raw material in industry.

(a) State **one** use of water in industry.

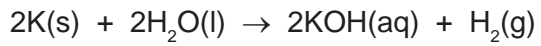
..... [1]

(b) Describe a chemical test for water.

test

result [2]

(c) A small piece of potassium was placed in a beaker of water.
The equation for the reaction is



(i) Describe a test for the gas given off in this reaction.

test

result [2]

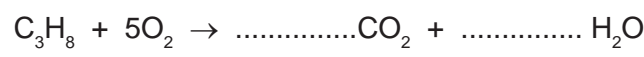
(ii) What is the most likely pH of the solution in the beaker when the reaction is complete?
Put a ring around the correct answer.

pH2 pH6 pH7 pH8 pH12

[1]

(d) Water is formed when propane burns.

(i) Complete the equation for this reaction.



[2]

(ii) Which of the following best describes this reaction?
Put a ring around the correct answer.

carbonisation combustion dehydration hydrogenation

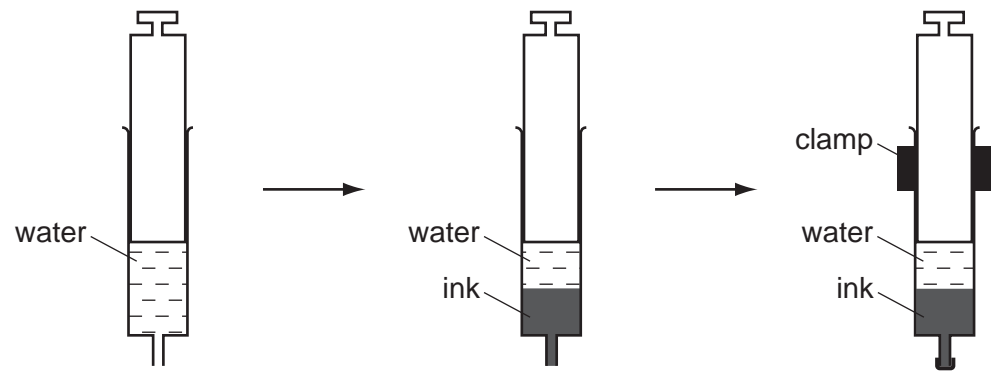
[1]

(iii) When 4.4 g of propane are burnt in excess oxygen, 7.2 g of water are formed.
Calculate the mass of water formed when 22 g of propane are burnt.

[1]

[Total: 10]

- 4 A student half-filled a syringe with water. She then carefully drew up some blue ink into the syringe so that it formed a separate layer below the water. She then left the syringe in a clamp for twenty hours.



After twenty hours the blue colour of the ink had spread throughout the water.

- (a) Use the kinetic particle theory to explain these observations.

.....

 [2]

- (b) Ink is a mixture of many chemicals. What do you understand by the term *mixture*?

.....
 [1]

- (c) The list shows some of the substances present in ink.

- carboxylic acids
- cobalt(II) ions
- ethanol
- iron(II) ions
- nickel(II) ions
- tannins
- water

- (i) Water is a good solvent. From the list choose **one** other substance that is a good solvent.

..... [1]

(ii) What is the meaning of the symbol (II) in iron(II)?
Tick **one** box.

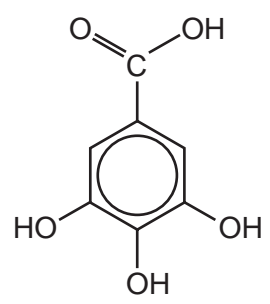
- the number of outer shell electrons
- the difference between the neutron and proton number
- the oxidation state
- the type of isotope

[1]

(iii) Tannins are polymers.
What do you understand by the term *polymer*?

.....
..... [2]

(d) One of the carboxylic acids present in ink is gallic acid.
The structure of gallic acid is shown below.



(i) On the structure above, put a ring around the carboxylic acid functional group. [1]

(ii) Gallic acid is a good reducing agent.
What do you understand by the term *reduction*?

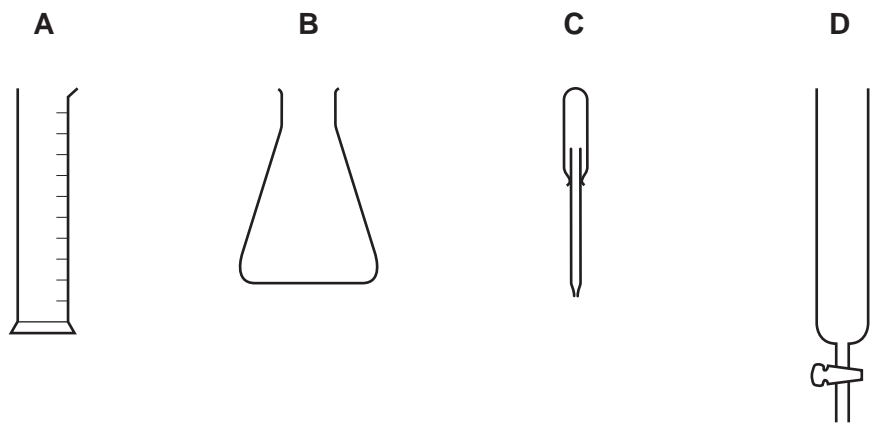
..... [1]

[Total: 9]

5 A student wants to separate the coloured pigments in a plant leaf by chromatography. He grinds the plant leaf and separates the solids from the green solution.

(a) What method can he use to separate the solids from the solution?
..... [1]

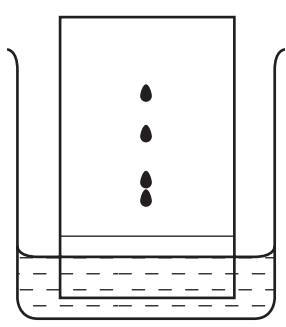
(b) The student takes a drop of the green solution and puts a spot of it onto a piece of chromatography paper. From the diagrams below choose the letter for the most suitable piece of apparatus for this task.



letter [1]

(c) The student sets up the chromatography apparatus as shown.

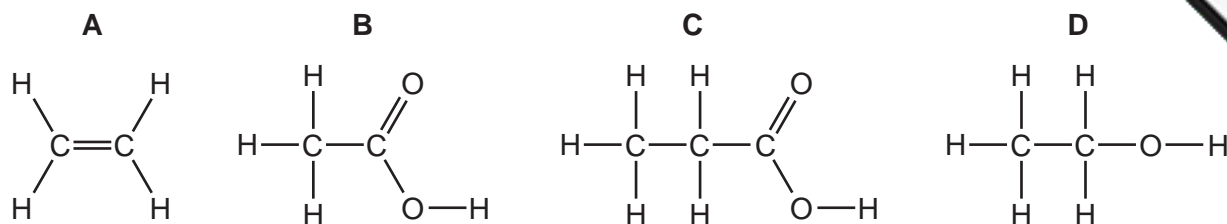
- (i) Label the diagram to show:
- the solvent,
 - the original position of the spot of green solution,
 - the chromatography paper.



[3]

(ii) How many different pigments were present in the plant leaf?
..... [1]

(d) The structure of some organic compounds found in plant leaves are shown below.



(i) Which one of these compounds is an unsaturated hydrocarbon?

..... [1]

(ii) Describe a chemical test for an unsaturated hydrocarbon.

test

result [2]

(iii) What do you understand by the term *hydrocarbon*?

..... [1]

(iv) State the name of compound **B**.

..... [1]

(v) To which homologous series does compound **D** belong?

..... [1]

[Total: 12]

6 Lead is a grey metal.

(a) State **two** physical properties which are characteristic of metals.

.....
..... [2]

(b) To which Group in the Periodic Table does lead belong?

..... [1]

(c) An isotope of lead has the mass number 208.
Complete the table to show the number of subatomic particles in an atom of this isotope of lead.
Use the Periodic Table to help you.

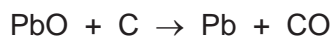
type of particle	number of particles
electrons	
protons	
neutrons	

[3]

(d) When lead is heated in oxygen, lead(II) oxide is formed.
Write a word equation for this reaction.

..... [1]

(e) When lead(II) oxide is heated with carbon, lead and carbon monoxide are formed.



(i) Which substance becomes oxidised during this reaction?

..... [1]

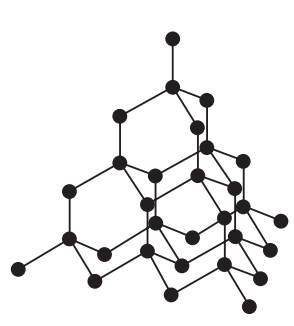
(ii) Carbon monoxide is a covalent compound.
Which one of these statements about carbon monoxide is correct?
Tick **one** box.

- It is a solid with a high melting point.
- It conducts electricity when it is a liquid.
- It is a gas at room temperature.
- It forms about 1 % of the atmosphere.

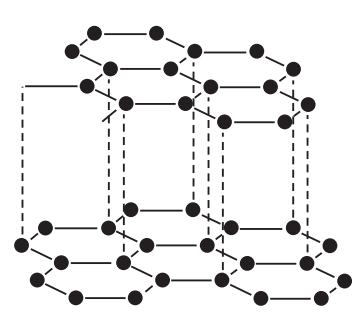
[1]

[Total: 9]

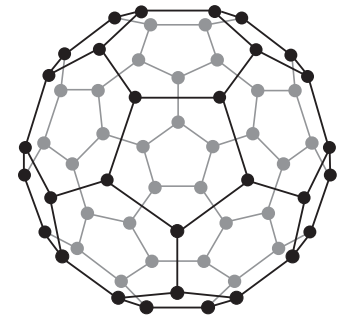
7 Three forms of carbon are diamond, graphite and Buckminsterfullerene.



diamond



graphite



Buckminsterfullerene

● carbon atom

(a) (i) State **one** difference in structure between Buckminsterfullerene and diamond.

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

(ii) State **two** differences in structure between graphite and diamond.

.....
.....
..... [2]

(b) State the type of bonding between the carbon atoms in diamond.

..... [1]

(c) Suggest why graphite is used as a lubricant.
Refer to the layers in your answer.

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

(d) State **one** use for diamond.

..... [1]

(e) Coal is a fuel containing carbon.
When coal is burnt, carbon dioxide is produced.
Explain how the increase in carbon dioxide concentration in the atmosphere affects the world's climate.

.....
.....
..... [2]

(f) Coal also contains small amounts of sulfur.
Explain how burning coal leads to acid rain.

.....
.....
..... [2]

(g) Methane is a fuel.

(i) Which one of the following is a natural source of methane?
Tick **one** box.

- waste gases from respiration in plants
- waste gases from digestion in animals
- gases from photosynthesis in plants
- gases from forest fires

[1]

(ii) Draw a diagram to show the arrangement of the electrons in a molecule of methane, CH₄.

Use

- for an electron from a carbon atom
- × for an electron from a hydrogen atom

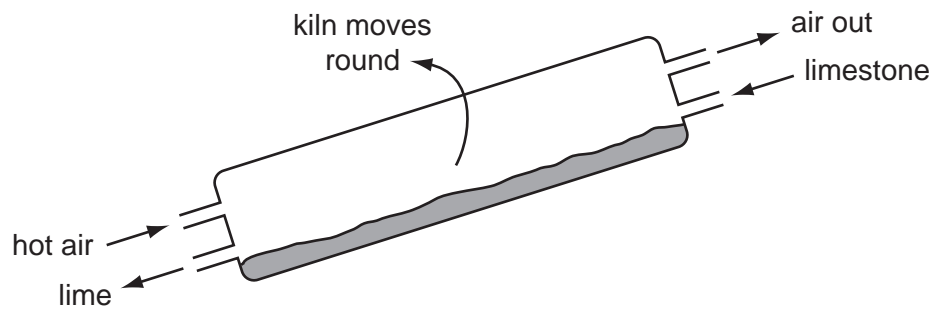
[1]

(iii) Methane belongs to the alkane homologous series.
Name **one** other alkane.

..... [1]

[Total: 13]

8 The diagram shows a rotary kiln used to make lime from limestone. Limestone is fed in at the top of the kiln and lime comes out at the bottom.



(a) What is the chemical name for lime?

..... [1]

(b) State the name of the type of chemical reaction that takes place in the rotary lime kiln.

..... [1]

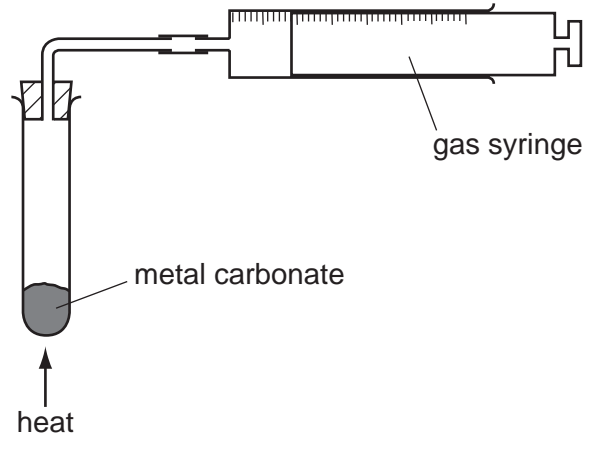
(c) Suggest why the air coming out of the rotary kiln has a greater percentage of carbon dioxide than the air entering the kiln.

..... [1]

(d) State **one** use for lime.

..... [1]

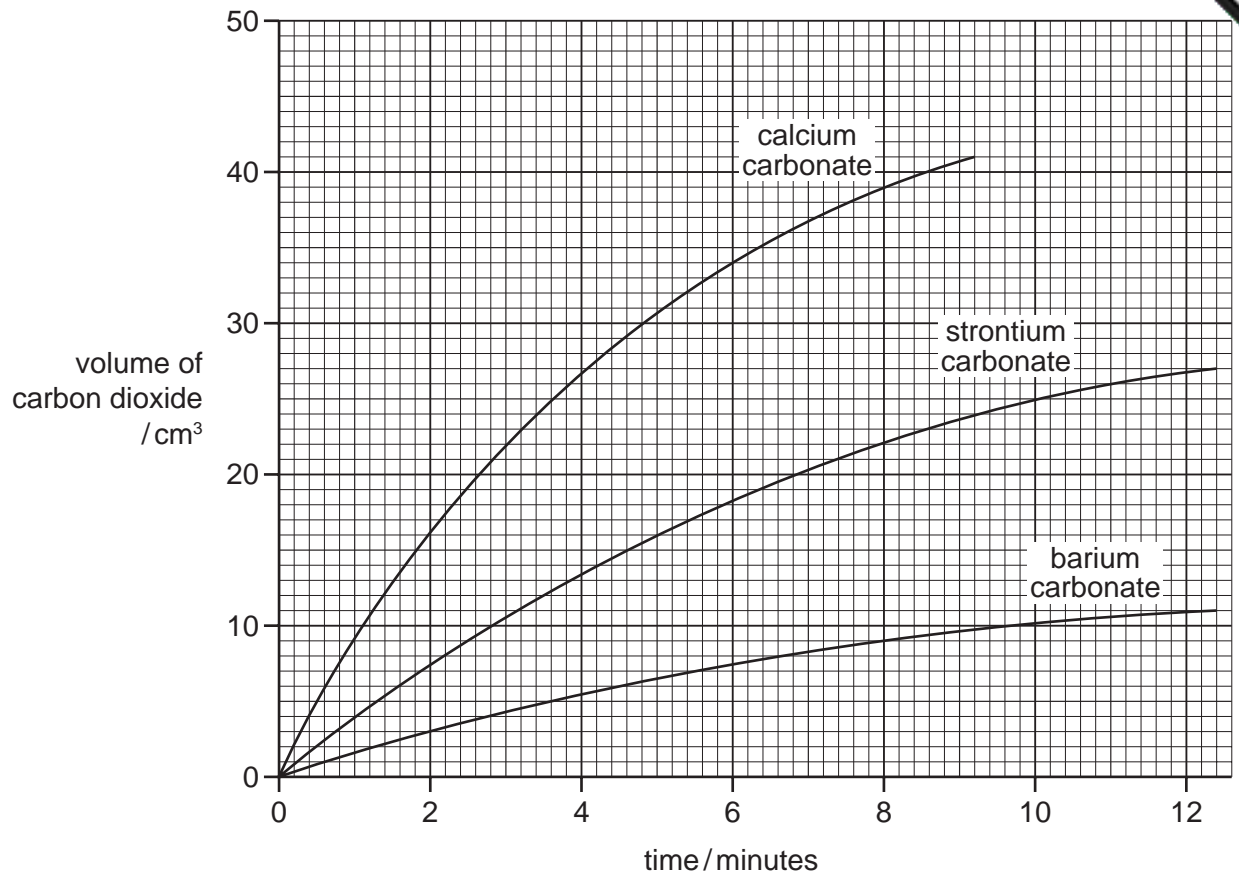
(e) A student compared the speed of reaction of three metal carbonates. She measured the volume of gas released using the apparatus shown.



State **one** thing that must be kept constant if the speeds of these reactions are to be compared in a fair way.

..... [1]

(f) The graph shows the volume of carbon dioxide released when the three metal carbonates are heated.



(i) Which carbonate produced carbon dioxide the fastest?
..... [1]

(ii) What volume of carbon dioxide was produced by strontium carbonate in ten minutes?
..... [1]

(iii) How does the speed of the reaction of these three metal carbonates relate to the position of calcium, strontium and barium in the Periodic Table?
.....
..... [2]

(g) Describe how hydrochloric acid and limewater can be used to show that carbonate ions are present in calcium carbonate.
.....
.....
..... [3]

DATA SHEET
The Periodic Table of the Elements

		Group																																																																																																																																																																																																																																																																																				
I	II	III	IV	V	VI	VII	0																																																																																																																																																																																																																																																																															
7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1	11 B Boron 5	12 C Carbon 6	13 Al Aluminium 13	14 N Nitrogen 7	15 O Oxygen 8	16 F Fluorine 9	17 Ne Neon 10	18 Ar Argon 18	19 K Potassium 19	20 Ca Calcium 20	21 Sc Scandium 21	22 Ti Titanium 22	23 V Vanadium 23	24 Cr Chromium 24	25 Mn Manganese 25	26 Fe Iron 26	27 Co Cobalt 27	28 Ni Nickel 28	29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36	37 Rb Rubidium 37	38 Sr Strontium 38	39 Y Yttrium 39	40 Zr Zirconium 40	41 Nb Niobium 41	42 Mo Molybdenum 42	43 Tc Technetium 43	44 Ru Ruthenium 44	45 Rh Rhodium 45	46 Pd Palladium 46	47 Ag Silver 47	48 Cd Cadmium 48	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54	55 Cs Caesium 55	56 Ba Barium 56	57 La Lanthanum 57	72 Hf Hafnium 72	73 Ta Tantalum 73	74 W Tungsten 74	75 Re Rhenium 75	76 Os Osmium 76	77 Ir Iridium 77	78 Pt Platinum 78	79 Au Gold 79	80 Hg Mercury 80	81 Tl Thallium 81	82 Pb Lead 82	83 Bi Bismuth 83	84 Po Polonium 84	85 At Astatine 85	86 Rn Radon 86	87 Fr Francium 87	88 Ra Radium 88	89 Ac Actinium 89 †	90 Th Thorium 90	91 Pa Protactinium 91	92 U Uranium 92	93 Np Neptunium 93	94 Pu Plutonium 94	95 Am Americium 95	96 Cm Curium 96	97 Bk Berkelium 97	98 Cf Californium 98	99 Es Einsteinium 99	100 Fm Fermium 100	101 Md Mendelevium 101	102 No Nobelium 102	103 Lr Lawrencium 103	104 Rf Rutherfordium 104	105 Db Dubnium 105	106 Sg Seaborgium 106	107 Bh Bohrium 107	108 Hs Hassium 108	109 Mt Meitnerium 109	110 Ds Darmstadtium 110	111 Rg Roentgenium 111	112 Cn Copernicium 112	113 Nh Nihonium 113	114 Fl Flerovium 114	115 Lv Livermorium 115	116 Ts Tennessine 116	117 Og Oganesson 117	118 Uu Ununseptium 118	119 Uub Ununseptium 119	120 Uuq Unquadium 120	121 Uub Unbinilium 121	122 Uut Untrium 122	123 Uuq Unquadium 123	124 Uub Unbinilium 124	125 Uut Untrium 125	126 Uuq Unquadium 126	127 Uub Unbinilium 127	128 Uut Untrium 128	129 Uuq Unquadium 129	130 Uub Unbinilium 130	131 Uut Untrium 131	132 Uuq Unquadium 132	133 Uub Unbinilium 133	134 Uut Untrium 134	135 Uuq Unquadium 135	136 Uub Unbinilium 136	137 Uut Untrium 137	138 Uuq Unquadium 138	139 Uub Unbinilium 139	140 Uut Untrium 140	141 Uuq Unquadium 141	142 Uub Unbinilium 142	143 Uut Untrium 143	144 Uuq Unquadium 144	145 Uub Unbinilium 145	146 Uut Untrium 146	147 Uuq Unquadium 147	148 Uub Unbinilium 148	149 Uut Untrium 149	150 Uuq Unquadium 150	151 Uub Unbinilium 151	152 Uut Untrium 152	153 Uuq Unquadium 153	154 Uub Unbinilium 154	155 Uut Untrium 155	156 Uuq Unquadium 156	157 Uub Unbinilium 157	158 Uut Untrium 158	159 Uuq Unquadium 159	160 Uub Unbinilium 160	161 Uut Untrium 161	162 Uuq Unquadium 162	163 Uub Unbinilium 163	164 Uut Untrium 164	165 Uuq Unquadium 165	166 Uub Unbinilium 166	167 Uut Untrium 167	168 Uuq Unquadium 168	169 Uub Unbinilium 169	170 Uut Untrium 170	171 Uuq Unquadium 171	172 Uub Unbinilium 172	173 Uut Untrium 173	174 Uuq Unquadium 174	175 Uub Unbinilium 175	176 Uut Untrium 176	177 Uuq Unquadium 177	178 Uub Unbinilium 178	179 Uut Untrium 179	180 Uuq Unquadium 180	181 Uub Unbinilium 181	182 Uut Untrium 182	183 Uuq Unquadium 183	184 Uub Unbinilium 184	185 Uut Untrium 185	186 Uuq Unquadium 186	187 Uub Unbinilium 187	188 Uut Untrium 188	189 Uuq Unquadium 189	190 Uub Unbinilium 190	191 Uut Untrium 191	192 Uuq Unquadium 192	193 Uub Unbinilium 193	194 Uut Untrium 194	195 Uuq Unquadium 195	196 Uub Unbinilium 196	197 Uut Untrium 197	198 Uuq Unquadium 198	199 Uub Unbinilium 199	200 Uut Untrium 200	201 Uuq Unquadium 201	202 Uub Unbinilium 202	203 Uut Untrium 203	204 Uuq Unquadium 204	205 Uub Unbinilium 205	206 Uut Untrium 206	207 Uuq Unquadium 207	208 Uub Unbinilium 208	209 Uut Untrium 209	210 Uuq Unquadium 210	211 Uub Unbinilium 211	212 Uut Untrium 212	213 Uuq Unquadium 213	214 Uub Unbinilium 214	215 Uut Untrium 215	216 Uuq Unquadium 216	217 Uub Unbinilium 217	218 Uut Untrium 218	219 Uuq Unquadium 219	220 Uub Unbinilium 220	221 Uut Untrium 221	222 Uuq Unquadium 222	223 Uub Unbinilium 223	224 Uut Untrium 224	225 Uuq Unquadium 225	226 Uub Unbinilium 226	227 Uut Untrium 227	228 Uuq Unquadium 228	229 Uub Unbinilium 229	230 Uut Untrium 230	231 Uuq Unquadium 231	232 Uub Unbinilium 232	233 Uut Untrium 233	234 Uuq Unquadium 234	235 Uub Unbinilium 235	236 Uut Untrium 236	237 Uuq Unquadium 237	238 Uub Unbinilium 238	239 Uut Untrium 239	240 Uuq Unquadium 240	241 Uub Unbinilium 241	242 Uut Untrium 242	243 Uuq Unquadium 243	244 Uub Unbinilium 244	245 Uut Untrium 245	246 Uuq Unquadium 246	247 Uub Unbinilium 247	248 Uut Untrium 248	249 Uuq Unquadium 249	250 Uub Unbinilium 250	251 Uut Untrium 251	252 Uuq Unquadium 252	253 Uub Unbinilium 253	254 Uut Untrium 254	255 Uuq Unquadium 255	256 Uub Unbinilium 256	257 Uut Untrium 257	258 Uuq Unquadium 258	259 Uub Unbinilium 259	260 Uut Untrium 260	261 Uuq Unquadium 261	262 Uub Unbinilium 262	263 Uut Untrium 263	264 Uuq Unquadium 264	265 Uub Unbinilium 265	266 Uut Untrium 266	267 Uuq Unquadium 267	268 Uub Unbinilium 268	269 Uut Untrium 269	270 Uuq Unquadium 270	271 Uub Unbinilium 271	272 Uut Untrium 272	273 Uuq Unquadium 273	274 Uub Unbinilium 274	275 Uut Untrium 275	276 Uuq Unquadium 276	277 Uub Unbinilium 277	278 Uut Untrium 278	279 Uuq Unquadium 279	280 Uub Unbinilium 280	281 Uut Untrium 281	282 Uuq Unquadium 282	283 Uub Unbinilium 283	284 Uut Untrium 284	285 Uuq Unquadium 285	286 Uub Unbinilium 286	287 Uut Untrium 287	288 Uuq Unquadium 288	289 Uub Unbinilium 289	290 Uut Untrium 290	291 Uuq Unquadium 291	292 Uub Unbinilium 292	293 Uut Untrium 293	294 Uuq Unquadium 294	295 Uub Unbinilium 295	296 Uut Untrium 296	297 Uuq Unquadium 297	298 Uub Unbinilium 298	299 Uut Untrium 299	300 Uuq Unquadium 300

*58-71 Lanthanoid series
†90-103 Actinoid series

Key

a	X
b	

 a = relative atomic mass
 X = atomic symbol
 b = proton (atomic) number

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