



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE
NAME

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--



CHEMISTRY

5070/02

Paper 2 Theory

October/November 2009

1 hour 30 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 a soft 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.

Section A

Answer **all** questions.

Write your answers in the spaces provided in the Question Paper.

Section B

Answer any **three** questions.

Write your answers in the spaces provided in the Question Paper.

A copy of the Periodic Table is printed on page 20.

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	
Section A	
B7	
B8	
B9	
B10	
Total	

This document consists of **18** printed pages and **2** blank pages.



Section A

Answer **all** the questions in this section in the spaces provided.

The total mark for this section is 45

For
Examiner's
Use

A1 (a) Choose from the following compounds to answer the questions below.

ammonium sulfate
calcium oxide
copper(II) chloride
ethanoic acid
ethene
nitrogen dioxide
sodium iodide
sulfur dioxide

Each compound can be used once, more than once or not at all.

Which compound

(i) may be formed when alkanes are cracked,

..... [1]

(ii) forms a yellow precipitate with aqueous silver nitrate,

..... [1]

(iii) is used as a fertiliser,

..... [1]

(iv) is a pollutant arising from lightning activity,

..... [1]

(v) is used by farmers to reduce soil acidity,

..... [1]

(vi) forms an alkaline solution when it reacts with water?

..... [1]

(b) Define the term *compound*.

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

(c) Explain why sodium iodide will **not** conduct electricity when solid but will conduct when dissolved in water.

*For
Examiner's
Use*

.....

..... [2]

[Total: 9]

A2 In the presence of yeast, aqueous glucose, $C_6H_{12}O_6$, is changed into carbon dioxide and ethanol.

For
Examiner's
Use

(a) Write the equation for this reaction.

..... [1]

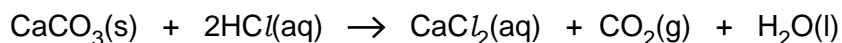
(b) Name this reaction.

..... [1]

(c) Suggest how the speed of this reaction varies as the temperature changes from 20 to 60°C.

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

(d) Carbon dioxide is also formed when calcium carbonate reacts with hydrochloric acid.



The graph shows how the volume of carbon dioxide changes when calcium carbonate powder reacts with excess 0.5 mol/dm³ hydrochloric acid.

On the same axes, sketch the curve you would expect when the experiment is repeated using the same amount of calcium carbonate and excess 1.0 mol/dm³ hydrochloric acid.

[2]

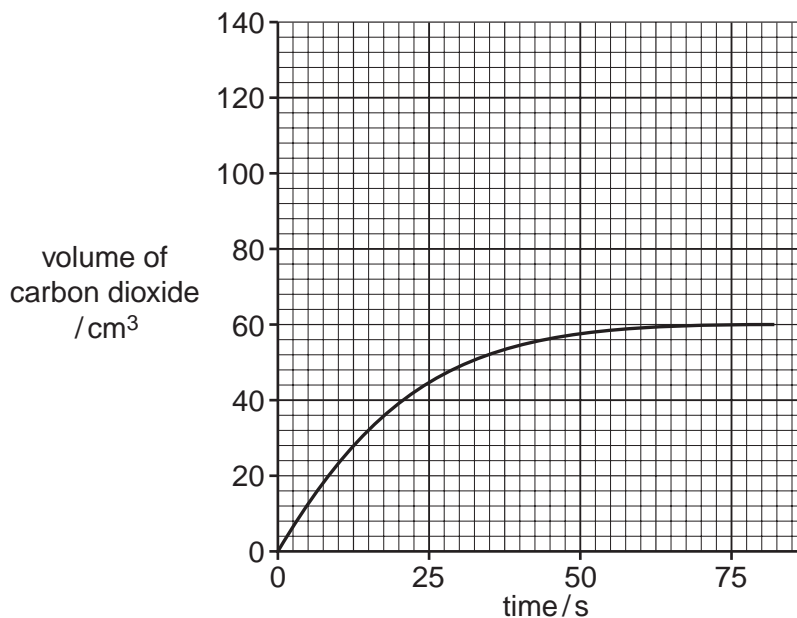


Fig. 1

[Total: 6]

A3 Dry air contains mainly nitrogen and oxygen together with small amounts of argon and carbon dioxide.

(a) State the approximate percentages of nitrogen and oxygen in dry air.

nitrogen% oxygen% [1]

(b) Dry air contains about 1% of the argon-40 isotope, ${}^{40}_{18}\text{Ar}$.

(i) What do you understand by the term *isotope*?

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

(ii) State the number of electrons and neutrons in this isotope of argon.

number of electrons
number of neutrons [1]

(c) Argon is used in the manufacture of titanium. In this process titanium(IV) chloride, TiCl_4 , is reduced with hot sodium. The products are titanium and sodium chloride.

(i) Write an equation for the reaction between titanium(IV) chloride and sodium.

..... [1]

(ii) During this reaction argon is blown over the mixture of sodium and titanium(IV) chloride.

Suggest why the reaction is carried out in an atmosphere of argon.

..... [1]

(d) A small amount of xenon is present in the air. Several compounds of xenon have been made in recent years.

A compound of xenon contained 9.825g of xenon, 1.200g of oxygen and 5.700g of fluorine.

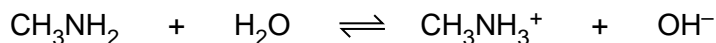
Determine the empirical formula of this compound.

[3]

[Total: 8]

- A4** Methylamine, CH_3NH_2 , is a base which has similar properties to ammonia. When methylamine dissolves in water, the following equilibrium is set up.

For
Examiner's
Use



- (a) Explain why methylamine behaves as a base in this reaction.

.....[1]

- (b) When aqueous methylamine is added to aqueous iron(III) chloride, a red-brown precipitate is observed. Suggest what you would observe when aqueous methylamine is added to aqueous iron(II) chloride.

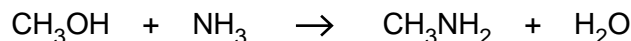
.....

.....[1]

- (c) Methylamine is a gas. Calculate the volume occupied by 6.2 g of methylamine at room temperature and pressure.

[2]

- (d) Methylamine is made by reacting methanol with excess ammonia under pressure in the presence of a catalyst.



- (i) Define the term *catalyst*.

.....[1]

- (ii) Calculate the theoretical yield of methylamine that can be obtained from 240 kg of methanol.

[2]

[Total: 7]

A5 Bromine is extracted by reacting the potassium bromide in seawater with chlorine.

(a) Write an equation for this reaction.

.....[1]

(b) The bromine is purified by treatment with sulfur dioxide.
Describe a test for sulfur dioxide.

test

result [2]

(c) Bromine is a halogen.
Complete the table to estimate both the density and boiling point of bromine.

halogen	density of solid halogen in g/cm ³	boiling point /°C
fluorine	1.51	-188
chlorine	1.56	-35
bromine		
iodine	4.93	184

[2]

(d) Bromine is a liquid with a low boiling point and a strong smell.
A technician spilt some bromine in the corner of a room which is free of draughts. After thirty seconds the bromine could be smelt on the other side of the room.

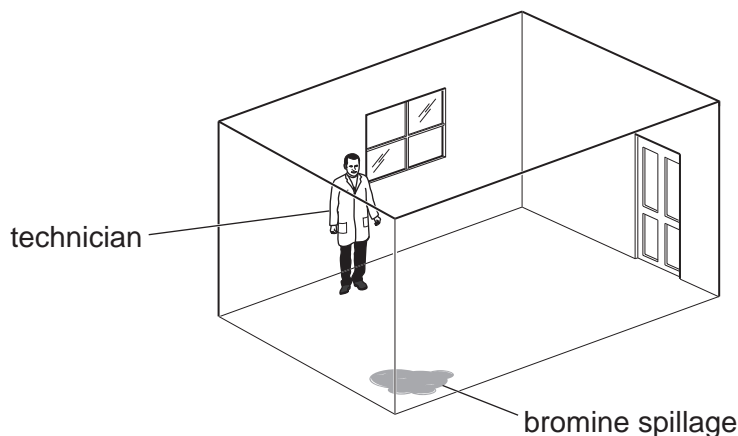


Fig. 2

Use the kinetic particle theory to explain why the bromine could be smelt on the other side of the room.

.....

 [3]

[Total: 8]

A6 A thin layer of ozone, O₃, is present high in the Earth's atmosphere.

(a) Explain why the ozone layer is important in terms of human health.

.....

 [2]

(b) Chlorofluorocarbons, CFCs, catalyse the conversion of ozone to oxygen.
 Write the equation for this reaction.

..... [1]

(c) The graphs show how both the world CFC production and the amount of high level ozone at the South Pole have changed over the last 26 years.

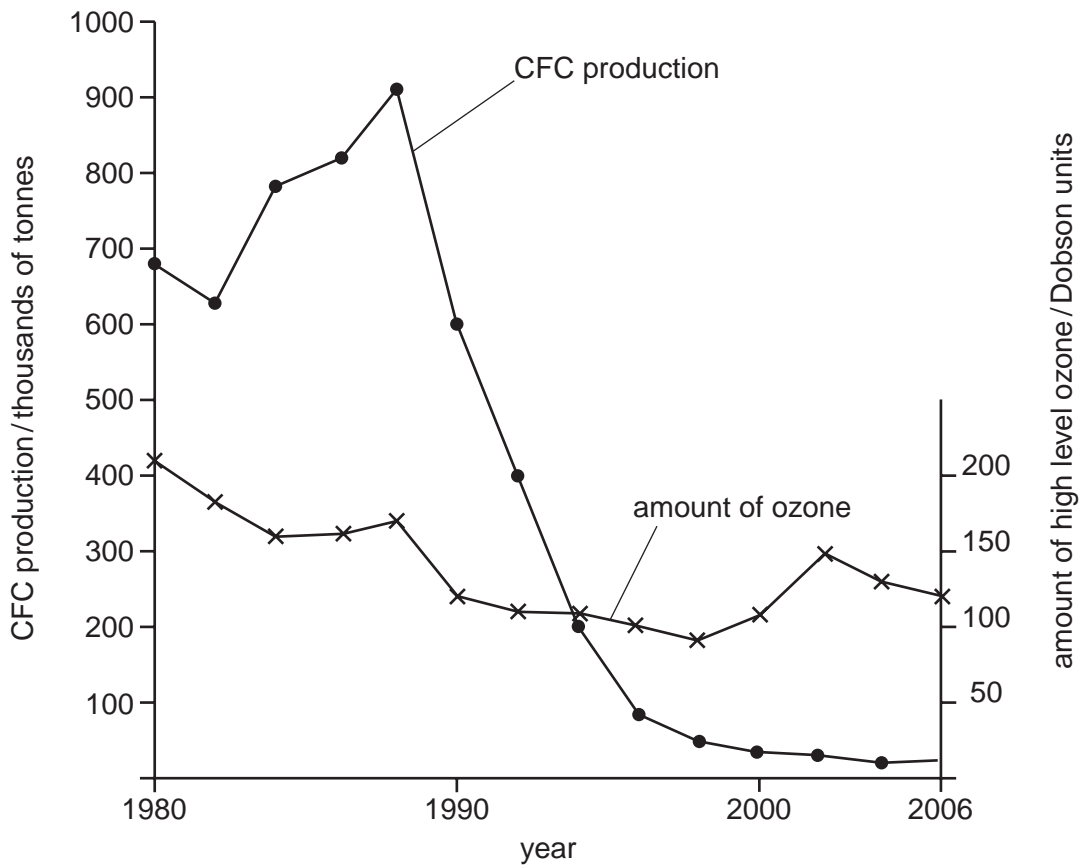


Fig. 3

(i) Describe how the world production of CFCs has changed over the last 26 years.

.....
 [2]

- (ii) What evidence, if any, is there to indicate a link between the world CFC production and the amount of high-level ozone in the atmosphere at the South Pole?

*For
Examiner's
Use*

Explain your answer.

.....

.....

.....

.....

..... [2]

[Total: 7]

Section B

Answer **three** questions from this section.

The total mark for this section is 30.

B7 Copper is purified by the electrolysis of aqueous copper(II) sulfate using copper electrodes.

(a) Explain how this process is carried out in the laboratory and give relevant equations for the electrode reactions.

.....
.....
.....
.....
.....
.....
.....
.....
.....
..... [4]

(b) Aqueous copper(II) sulfate can also be electrolysed using carbon electrodes.

(i) Write an equation for the reaction which takes place at the anode in this electrolysis.

..... [1]

(ii) Explain why the colour of the copper(II) sulfate solution fades during this electrolysis.

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

(c) Copper is a transition element.

(i) Name **two** transition elements, or compounds of transition elements, which are used as catalysts. For each catalyst name an industrial product made using the catalyst.

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

(ii) Other than acting as catalysts state **two** properties which are specific to transition elements.

*For
Examiner's
Use*

.....

..... [2]

[Total: 10]

B8 Fumaric acid is a colourless solid which can be extracted from plants.

For
Examiner's
Use

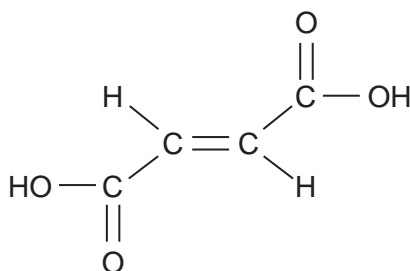


Fig. 4

- (a) Describe the reaction of aqueous fumaric acid with aqueous bromine, giving the equation for the reaction and stating any observations.

.....

.....

.....

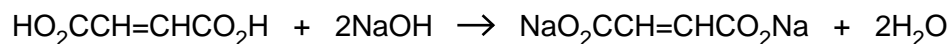
.....

.....

.....

..... [3]

- (b) A solution of fumaric acid was titrated against aqueous sodium hydroxide.



18.0 cm³ of 0.200 mol/dm³ sodium hydroxide were required to neutralise 60.0 cm³ of fumaric acid solution.

Calculate the concentration, in mol/dm³, of the fumaric acid solution.

.....

.....

.....

.....

.....

..... [3]

(c) Suggest the type of condensation polymer which is made when fumaric acid reacts with ethane-1,2-diol, $\text{HO}-\text{CH}_2-\text{CH}_2-\text{OH}$

..... [1]

(d) Nylon is a condensation polymer.
State **one** use of nylon.

..... [1]

(e) Describe **two** pollution problems caused by the disposal of non-biodegradable plastics.

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

[Total: 10]

B9 The diagram shows the carbon cycle.

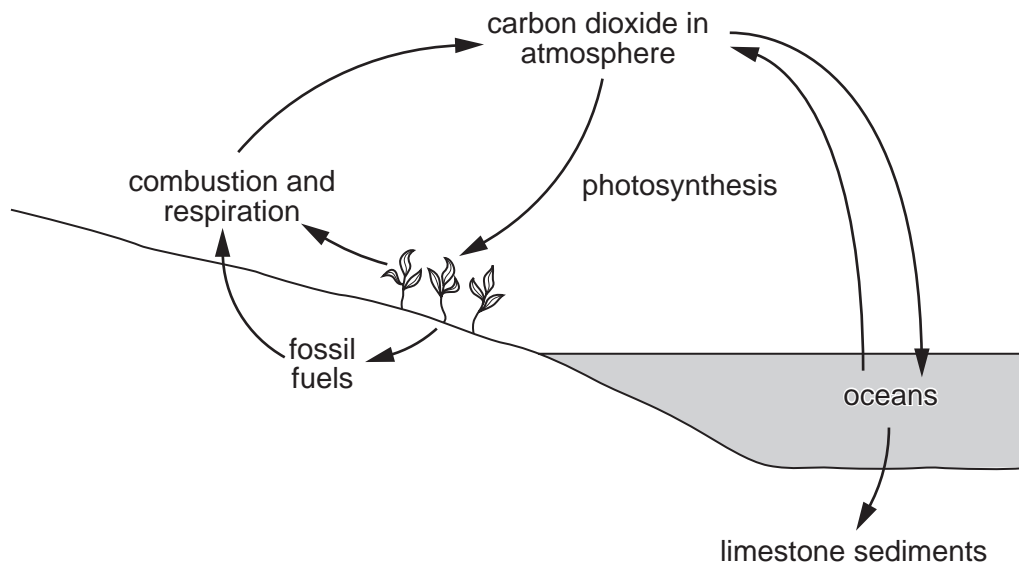


Fig. 5

(a) Describe the process of photosynthesis in simple terms.

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

(b) Draw a dot-and-cross diagram for carbon dioxide showing the outer electrons only.

[1]

(c) Many scientists think that the burning of hydrocarbons such as octane, C₈H₁₈, contributes to climate change.

(i) Write an equation for the complete combustion of octane.

.....[1]

(ii) Why do some scientists think that the burning of hydrocarbons contributes to climate change?

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

(d) In the oceans carbon dioxide reacts with carbonate ions in seawater to form hydrogencarbonate ions.



(i) Microscopic plants remove carbon dioxide from the surface waters of the oceans. What effect does this have on the reaction above? Explain your answer.

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

(ii) Name a carbonate compound which is soluble in water.

.....[1]

(e) Calcium carbonate is used in flue gas desulfurisation. Describe this process and explain why it is important for the environment.

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

[Total: 10]

B10 Iron is extracted by reducing iron ore in a blast furnace. The raw materials used are iron ore, coke, air and limestone.

(a) Name an ore of iron.

..... [1]

(b) Explain, by reference to the chemical reactions involved, why limestone is used in the blast furnace.

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
..... [3]

(c) Coke burns in oxygen to form carbon dioxide.
Explain, in terms of bond breaking and bond making, why this reaction is exothermic.

.....
.....
.....
.....
.....
.....
.....
..... [3]

(d) In the centre of the blast furnace iron(III) oxide, Fe_2O_3 , is reduced by carbon monoxide to form iron and carbon dioxide. Near the bottom of the blast furnace the remaining iron(III) oxide is reduced by carbon to form iron and carbon monoxide.
Write equations for both of these reactions.

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

(e) When cold, the iron obtained from the blast furnace is brittle.
How can this iron from the blast furnace be converted to mild steel?

*For
Examiner's
Use*

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

[Total: 10]

BLANK PAGE

BLANK PAGE

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.

University of 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.

DATA SHEET
The Periodic Table of the Elements

Group																																																																																																																																																																																																																																																																																				
I	II	III										IV	V	VI	VII	0																																																																																																																																																																																																																																																																				
		1 H Hydrogen 1															4 He Helium 2																																																																																																																																																																																																																																																																			
7 Li Lithium 3	9 Be Beryllium 4		11 B Boron 5	12 C Carbon 6	13 Al Aluminium 13	14 Si Silicon 14	15 P Phosphorus 15	16 S Sulfur 16	17 Cl Chlorine 17	18 Ar Argon 18	19 F Fluorine 9	20 Ne Neon 10																																																																																																																																																																																																																																																																								
23 Na Sodium 11	24 Mg Magnesium 12		27 Al Aluminium 13	28 Si Silicon 14	29 Sc Scandium 21	30 Ti Titanium 22	31 V Vanadium 23	32 Cr Chromium 24	33 Mn Manganese 25	34 Fe Iron 26	35 Co Cobalt 27	36 Ni Nickel 28	37 Cu Copper 29	38 Zn Zinc 30	39 Ga Gallium 31	40 Ge Germanium 32	41 As Arsenic 33	42 Se Selenium 34	43 Br Bromine 35	44 Kr Krypton 36																																																																																																																																																																																																																																																																
39 K Potassium 19	40 Ca Calcium 20		45 Sc Scandium 21	46 Ti Titanium 22	47 V Vanadium 23	48 Cr Chromium 24	49 Mn Manganese 25	50 Fe Iron 26	51 Co Cobalt 27	52 Ni Nickel 28	53 Cu Copper 29	54 Zn Zinc 30	55 Ga Gallium 31	56 Ge Germanium 32	57 As Arsenic 33	58 Se Selenium 34	59 Br Bromine 35	60 Kr Krypton 36	61 Rb Rubidium 37	62 Sr Strontium 38	63 Y Yttrium 39	64 Zr Zirconium 40	65 Nb Niobium 41	66 Mo Molybdenum 42	67 Tc Technetium 43	68 Ru Ruthenium 44	69 Rh Rhodium 45	70 Pd Palladium 46	71 Ag Silver 47	72 Cd Cadmium 48	73 In Indium 49	74 Sn Tin 50	75 Sb Antimony 51	76 Te Tellurium 52	77 I Iodine 53	78 Xe Xenon 54																																																																																																																																																																																																																																																
133 Cs Caesium 55	137 Ba Barium 56		139 La Lanthanum 57	140 Ce Cerium 58	141 Pr Praseodymium 59	142 Nd Neodymium 60	143 Pm Promethium 61	144 Sm Samarium 62	145 Eu Europium 63	146 Gd Gadolinium 64	147 Tb Terbium 65	148 Dy Dysprosium 66	149 Ho Holmium 67	150 Er Erbium 68	151 Tm Thulium 69	152 Yb Ytterbium 70	153 Lu Lutetium 71	154 Hf Hafnium 72	155 Ta Tantalum 73	156 W Tungsten 74	157 Re Rhenium 75	158 Os Osmium 76	159 Ir Iridium 77	160 Pt Platinum 78	161 Au Gold 79	162 Hg Mercury 80	163 Tl Thallium 81	164 Pb Lead 82	165 Bi Bismuth 83	166 Po Polonium 84	167 At Astatine 85	168 Rn Radon 86	169 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89	228 Th Thorium 90	229 Pa Protactinium 91	230 U Uranium 92	231 Np Neptunium 93	232 Pu Plutonium 94	233 Am Americium 95	234 Cm Curium 96	235 Bk Berkelium 97	236 Cf Californium 98	237 Es Einsteinium 99	238 Fm Fermium 100	239 Md Mendelevium 101	240 No Nobelium 102	241 Lr Lawrencium 103																																																																																																																																																																																																																																			
223 Fr Francium 87	226 Ra Radium 88		227 Ac Actinium 89	228 Th Thorium 90	229 Pa Protactinium 91	230 U Uranium 92	231 Np Neptunium 93	232 Pu Plutonium 94	233 Am Americium 95	234 Cm Curium 96	235 Bk Berkelium 97	236 Cf Californium 98	237 Es Einsteinium 99	238 Fm Fermium 100	239 Md Mendelevium 101	240 No Nobelium 102	241 Lr Lawrencium 103	242 Fr Francium 87	243 Ra Radium 88	244 Ac Actinium 89	245 Th Thorium 90	246 Pa Protactinium 91	247 U Uranium 92	248 Np Neptunium 93	249 Pu Plutonium 94	250 Am Americium 95	251 Cm Curium 96	252 Bk Berkelium 97	253 Cf Californium 98	254 Es Einsteinium 99	255 Fm Fermium 100	256 Md Mendelevium 101	257 No Nobelium 102	258 Lr Lawrencium 103	259 Lu Lutetium 71	260 Yb Ytterbium 70	261 Lu Lutetium 71	262 Yb Ytterbium 70	263 Lu Lutetium 71	264 Yb Ytterbium 70	265 Lu Lutetium 71	266 Yb Ytterbium 70	267 Lu Lutetium 71	268 Yb Ytterbium 70	269 Lu Lutetium 71	270 Yb Ytterbium 70	271 Lu Lutetium 71	272 Yb Ytterbium 70	273 Lu Lutetium 71	274 Yb Ytterbium 70	275 Lu Lutetium 71	276 Yb Ytterbium 70	277 Lu Lutetium 71	278 Yb Ytterbium 70	279 Lu Lutetium 71	280 Yb Ytterbium 70	281 Lu Lutetium 71	282 Yb Ytterbium 70	283 Lu Lutetium 71	284 Yb Ytterbium 70	285 Lu Lutetium 71	286 Yb Ytterbium 70	287 Lu Lutetium 71	288 Yb Ytterbium 70	289 Lu Lutetium 71	290 Yb Ytterbium 70	291 Lu Lutetium 71	292 Yb Ytterbium 70	293 Lu Lutetium 71	294 Yb Ytterbium 70	295 Lu Lutetium 71	296 Yb Ytterbium 70	297 Lu Lutetium 71	298 Yb Ytterbium 70	299 Lu Lutetium 71	300 Yb Ytterbium 70	301 Lu Lutetium 71	302 Yb Ytterbium 70	303 Lu Lutetium 71	304 Yb Ytterbium 70	305 Lu Lutetium 71	306 Yb Ytterbium 70	307 Lu Lutetium 71	308 Yb Ytterbium 70	309 Lu Lutetium 71	310 Yb Ytterbium 70	311 Lu Lutetium 71	312 Yb Ytterbium 70	313 Lu Lutetium 71	314 Yb Ytterbium 70	315 Lu Lutetium 71	316 Yb Ytterbium 70	317 Lu Lutetium 71	318 Yb Ytterbium 70	319 Lu Lutetium 71	320 Yb Ytterbium 70	321 Lu Lutetium 71	322 Yb Ytterbium 70	323 Lu Lutetium 71	324 Yb Ytterbium 70	325 Lu Lutetium 71	326 Yb Ytterbium 70	327 Lu Lutetium 71	328 Yb Ytterbium 70	329 Lu Lutetium 71	330 Yb Ytterbium 70	331 Lu Lutetium 71	332 Yb Ytterbium 70	333 Lu Lutetium 71	334 Yb Ytterbium 70	335 Lu Lutetium 71	336 Yb Ytterbium 70	337 Lu Lutetium 71	338 Yb Ytterbium 70	339 Lu Lutetium 71	340 Yb Ytterbium 70	341 Lu Lutetium 71	342 Yb Ytterbium 70	343 Lu Lutetium 71	344 Yb Ytterbium 70	345 Lu Lutetium 71	346 Yb Ytterbium 70	347 Lu Lutetium 71	348 Yb Ytterbium 70	349 Lu Lutetium 71	350 Yb Ytterbium 70	351 Lu Lutetium 71	352 Yb Ytterbium 70	353 Lu Lutetium 71	354 Yb Ytterbium 70	355 Lu Lutetium 71	356 Yb Ytterbium 70	357 Lu Lutetium 71	358 Yb Ytterbium 70	359 Lu Lutetium 71	360 Yb Ytterbium 70	361 Lu Lutetium 71	362 Yb Ytterbium 70	363 Lu Lutetium 71	364 Yb Ytterbium 70	365 Lu Lutetium 71	366 Yb Ytterbium 70	367 Lu Lutetium 71	368 Yb Ytterbium 70	369 Lu Lutetium 71	370 Yb Ytterbium 70	371 Lu Lutetium 71	372 Yb Ytterbium 70	373 Lu Lutetium 71	374 Yb Ytterbium 70	375 Lu Lutetium 71	376 Yb Ytterbium 70	377 Lu Lutetium 71	378 Yb Ytterbium 70	379 Lu Lutetium 71	380 Yb Ytterbium 70	381 Lu Lutetium 71	382 Yb Ytterbium 70	383 Lu Lutetium 71	384 Yb Ytterbium 70	385 Lu Lutetium 71	386 Yb Ytterbium 70	387 Lu Lutetium 71	388 Yb Ytterbium 70	389 Lu Lutetium 71	390 Yb Ytterbium 70	391 Lu Lutetium 71	392 Yb Ytterbium 70	393 Lu Lutetium 71	394 Yb Ytterbium 70	395 Lu Lutetium 71	396 Yb Ytterbium 70	397 Lu Lutetium 71	398 Yb Ytterbium 70	399 Lu Lutetium 71	400 Yb Ytterbium 70	401 Lu Lutetium 71	402 Yb Ytterbium 70	403 Lu Lutetium 71	404 Yb Ytterbium 70	405 Lu Lutetium 71	406 Yb Ytterbium 70	407 Lu Lutetium 71	408 Yb Ytterbium 70	409 Lu Lutetium 71	410 Yb Ytterbium 70	411 Lu Lutetium 71	412 Yb Ytterbium 70	413 Lu Lutetium 71	414 Yb Ytterbium 70	415 Lu Lutetium 71	416 Yb Ytterbium 70	417 Lu Lutetium 71	418 Yb Ytterbium 70	419 Lu Lutetium 71	420 Yb Ytterbium 70	421 Lu Lutetium 71	422 Yb Ytterbium 70	423 Lu Lutetium 71	424 Yb Ytterbium 70	425 Lu Lutetium 71	426 Yb Ytterbium 70	427 Lu Lutetium 71	428 Yb Ytterbium 70	429 Lu Lutetium 71	430 Yb Ytterbium 70	431 Lu Lutetium 71	432 Yb Ytterbium 70	433 Lu Lutetium 71	434 Yb Ytterbium 70	435 Lu Lutetium 71	436 Yb Ytterbium 70	437 Lu Lutetium 71	438 Yb Ytterbium 70	439 Lu Lutetium 71	440 Yb Ytterbium 70	441 Lu Lutetium 71	442 Yb Ytterbium 70	443 Lu Lutetium 71	444 Yb Ytterbium 70	445 Lu Lutetium 71	446 Yb Ytterbium 70	447 Lu Lutetium 71	448 Yb Ytterbium 70	449 Lu Lutetium 71	450 Yb Ytterbium 70	451 Lu Lutetium 71	452 Yb Ytterbium 70	453 Lu Lutetium 71	454 Yb Ytterbium 70	455 Lu Lutetium 71	456 Yb Ytterbium 70	457 Lu Lutetium 71	458 Yb Ytterbium 70	459 Lu Lutetium 71	460 Yb Ytterbium 70	461 Lu Lutetium 71	462 Yb Ytterbium 70	463 Lu Lutetium 71	464 Yb Ytterbium 70	465 Lu Lutetium 71	466 Yb Ytterbium 70	467 Lu Lutetium 71	468 Yb Ytterbium 70	469 Lu Lutetium 71	470 Yb Ytterbium 70	471 Lu Lutetium 71	472 Yb Ytterbium 70	473 Lu Lutetium 71	474 Yb Ytterbium 70	475 Lu Lutetium 71	476 Yb Ytterbium 70	477 Lu Lutetium 71	478 Yb Ytterbium 70	479 Lu Lutetium 71	480 Yb Ytterbium 70	481 Lu Lutetium 71	482 Yb Ytterbium 70	483 Lu Lutetium 71	484 Yb Ytterbium 70	485 Lu Lutetium 71	486 Yb Ytterbium 70	487 Lu Lutetium 71	488 Yb Ytterbium 70	489 Lu Lutetium 71	490 Yb Ytterbium 70	491 Lu Lutetium 71	492 Yb Ytterbium 70	493 Lu Lutetium 71	494 Yb Ytterbium 70	495 Lu Lutetium 71	496 Yb Ytterbium 70	497 Lu Lutetium 71	498 Yb Ytterbium 70	499 Lu Lutetium 71	500 Yb Ytterbium 70

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

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

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