Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

CHEMISTRY **0620/21**

Paper 2 **October/November 2015**

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 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.

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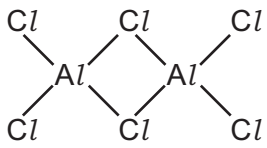
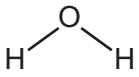
CAMBRIDGE International Examinations

1 The structures of six compounds are shown below.

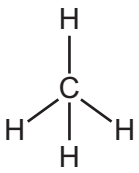
A



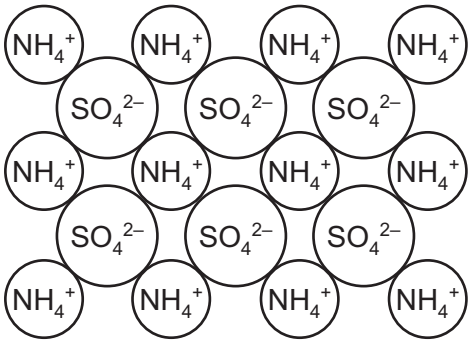
B



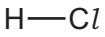
C



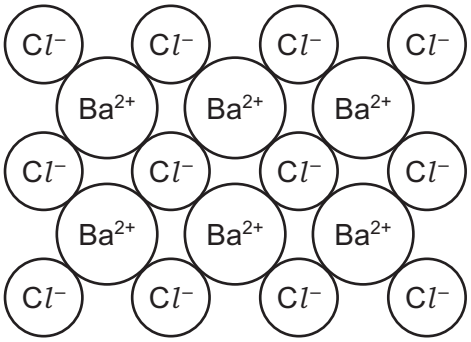
D



E



F



Answer the following questions about these substances.
Each compound may be used once, more than once or not at all.

View solution

(a) Which substance, **A**, **B**, **C**, **D**, **E** or **F**,

(i) gives a white precipitate on addition of an aqueous solution of sodium sulfate, ... [1]

(ii) is a component of many fertilisers, ... [1]

(iii) contains a Group III element, ... [1]

(iv) is an acidic gas at room temperature, ... [1]

(v) turns anhydrous cobalt chloride pink, ... [1]

(vi) is the main component of natural gas? ..... [1]

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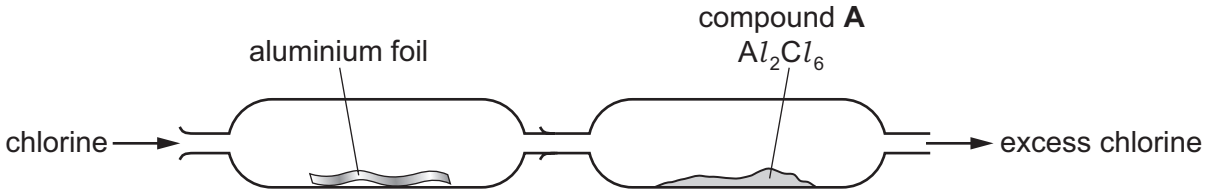
(b) Compound **A** can be made by direct combination of chlorine and aluminium using the apparatus shown below.

View solution



(i) On the diagram above, draw an arrow to show where heat is applied. [1]

(ii) Suggest **one** safety precaution that should be taken when carrying out this experiment.

..... [1]

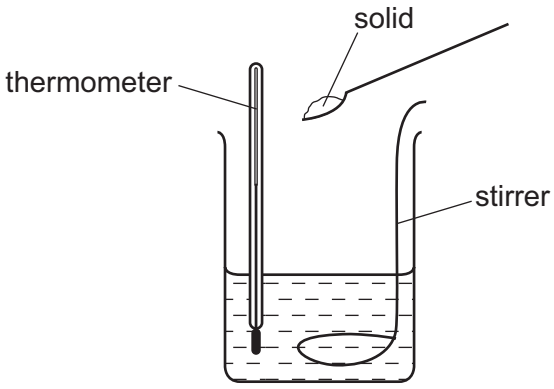
(iii) Complete the symbol equation for this reaction.

$$2Al + ...Cl_2 \rightarrow Al_2Cl_6$$

[1]

[Total: 9]

2 A student measures the maximum temperature changes when five different solids, **P**, **Q**, **R**, **S** and **T**, are dissolved separately in water. She uses the apparatus shown below.



(a) The student stirs the mixture as each solid is added.

View solution

Suggest why she does this.

.....

..... [1]

(b) Suggest **two** factors which should be kept the same to make the experiment a fair test.

View solution

1. .....

2. ..... [2]

(c) The table of results is shown below.

View solution

solid added	initial temperature of the water / °C	highest temperature of the solution / °C
P	20	24
Q	18	23
R	19	16
S	22	23
T	20	18

(i) Which solid gave the greatest temperature change when dissolved in water?

..... [1]

(ii) Which solids gave an endothermic energy change when dissolved in water?

View solution

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

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(d) Radioactive isotopes can be used as a source of energy.

View solution

(i) Which **one** of the following isotopes is a radioactive isotope?
Put a ring around the correct answer.

$^{12}_{6}C$ $^{235}_{92}U$ $^{1}_{1}H$ $^{65}_{30}Zn$

[1]

(ii) An isotope of radium, Ra, has 226 nucleons in its nucleus.

View solution

How many neutrons does this isotope contain?
Use your Periodic Table.

..... [1]

(iii) Give **one** use of radioactive isotopes in medicine.

View solution

..... [1]

(e) Fractions obtained from the distillation of petroleum are also sources of energy.

View solution

(i) Which **one** of the following fractions is used as a fuel for jet aircraft?
Put a ring around the correct answer.

bitumen **gasoline** **kerosene** **naphtha**

[1]

(ii) Heptadecane, $C_{17}H_{36}$, is present in the fuel oil fraction.

View solution

Complete the equation for the cracking of heptadecane to form two hydrocarbons.

$$C_{17}H_{36} \rightarrow C_{12}H_{26} + ...$$

[1]

[Total: 11]

3 **(a)** Nickel is extracted from nickel(II) oxide, NiO, by heating with carbon.

View solution

Complete the symbol equation for this reaction.

$$.....NiO + C \rightarrow 2Ni + ...$$

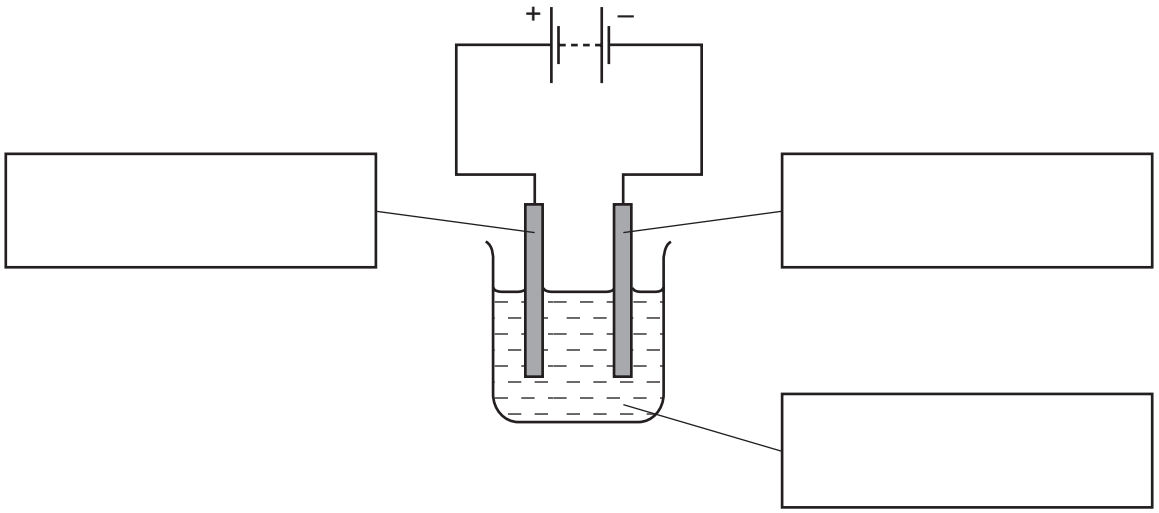
[2]

View solution

(b) Nickel is refined by electrolysis.

(i) Complete the boxes to label the diagram below to show

- the negative electrode (cathode),
- the positive electrode (anode),
- the electrolyte.



[2]

(ii) At which electrode is the pure nickel formed?

View solution

..... [1]

(c) Molten nickel(II) chloride can be electrolysed using graphite electrodes.

View solution

(i) Predict the products of this electrolysis at

the positive electrode (anode), ...

the negative electrode (cathode). .....

[2]

(ii) Give **two** reasons why graphite is used for electrodes.

View solution

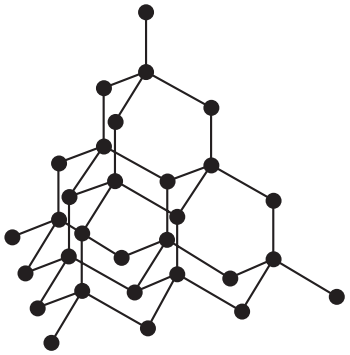
1. .....

2. .....

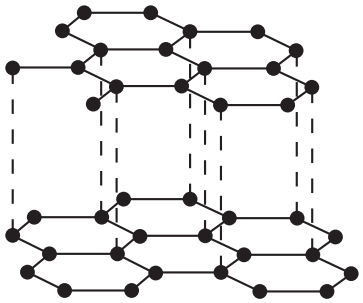
[2]

(d) The structures of diamond and graphite are shown below.

View solution



diamond



graphite

(i) Explain how the structure of diamond relates to its use in cutting hard materials.

.....

.....

..... [2]

(ii) Explain how the structure of graphite relates to its use as a lubricant.

View solution

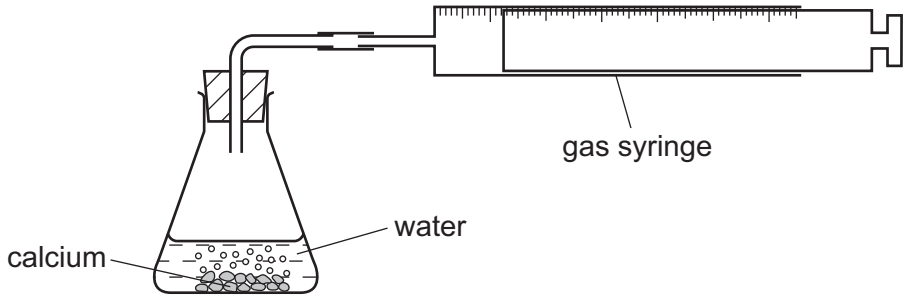
.....

.....

..... [2]

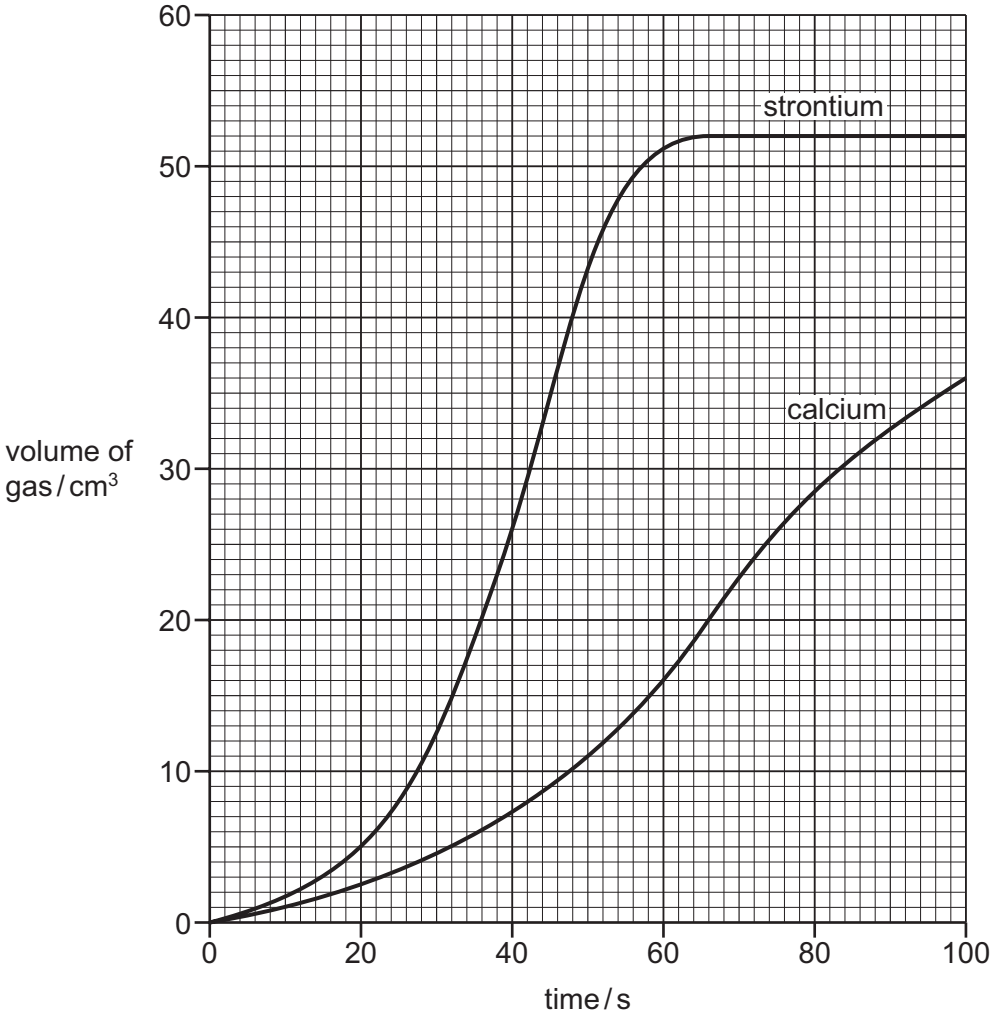
[Total: 13]

4 A teacher demonstrated the reactivity of calcium with water. He used the apparatus shown below.



(a) The teacher measured the volume of gas given off at various times during the reaction. He then repeated the experiment using strontium but keeping all the conditions the same. The graph obtained from the results is shown below.

View solution



(i) Explain how the graph shows that strontium is more reactive than calcium.

.....

..... [1]

(ii) For the reaction between calcium and water, deduce the volume of gas produced in the first 50 seconds.

..... cm^3 [1]

(iii) At what time was the reaction between strontium and water complete?

..... s [1]

(iv) How do you know from the graph that the reaction between calcium and water was **not** complete 100 seconds after the reaction started?

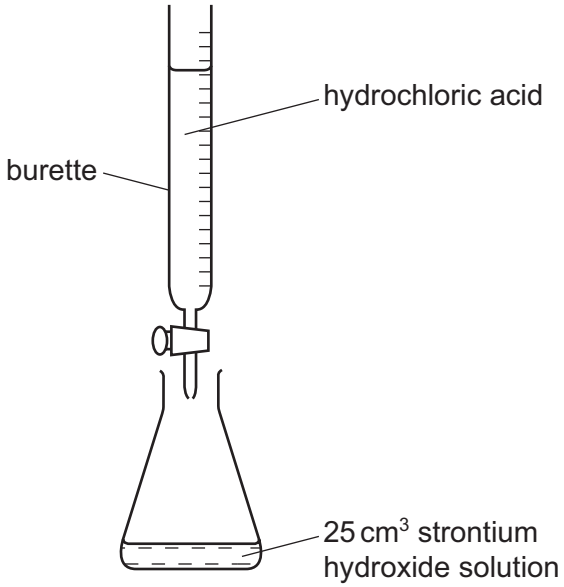
..... [1]

(v) Suggest how the rate of reaction changes when the same mass of calcium is used but in smaller pieces.

..... [1]

(b) The solution formed at the end of the reaction between strontium and water is alkaline. It is a solution of strontium hydroxide.
The teacher titrated this solution with hydrochloric acid using the apparatus shown below.

View solution



(i) What piece of apparatus should be used to put exactly 25.0 cm^3 of the strontium hydroxide solution into the flask?

..... [1]

(ii) A few drops of litmus solution was added to the flask.

Explain why litmus is added to the flask and describe what happens to the litmus as the titration proceeds.

.....

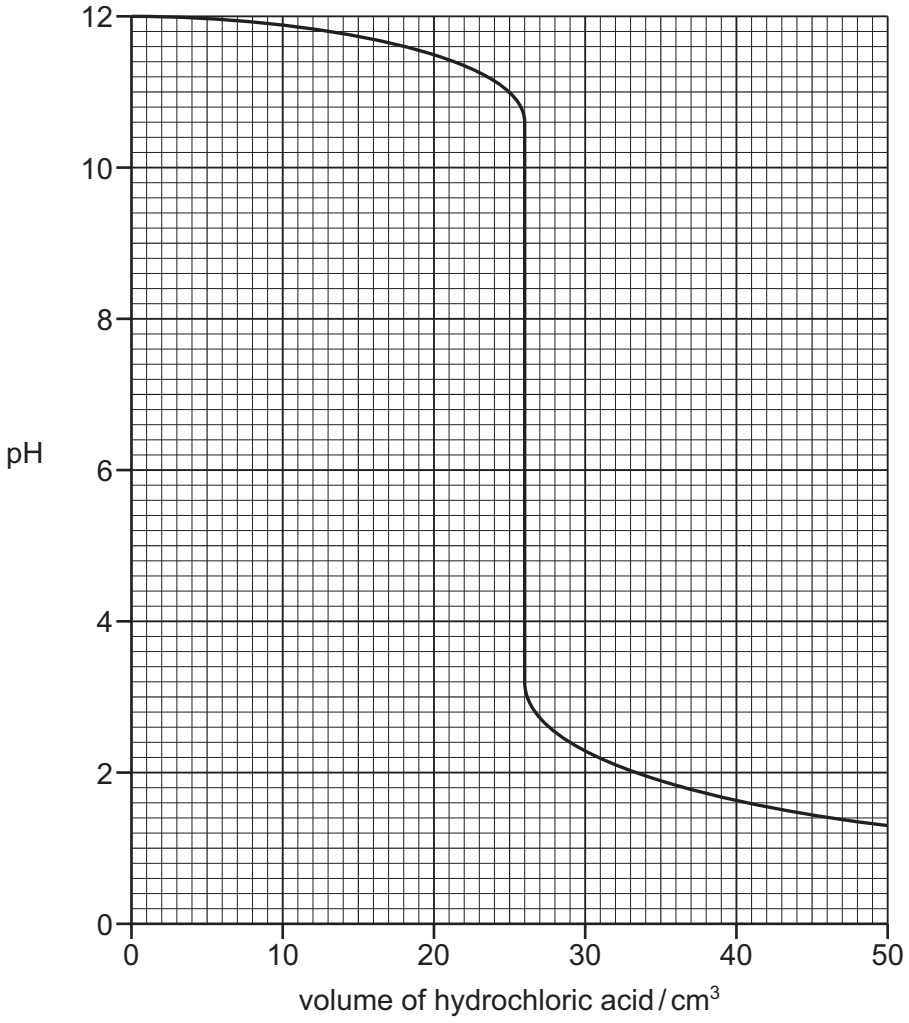
.....

..... [2]

View solution

(c) The graph below shows how the pH of the solution in the flask changes as the acid is added.

View solution



(i) Describe how the pH of the solution changes as the titration proceeds.

.....

.....

..... [3]

(ii) What volume of acid had been added when the solution had a neutral pH? View solution

..... [1]

(iii) The symbol equation for the reaction is View solution

$$Sr(OH)_2 + 2HCl \rightarrow SrCl_2 + 2H_2O$$

Give the name of the salt formed in this reaction.

..... [1]

[Total: 13]

5 A student left a cube of ice on a plate in a warm room. The diagrams below show what happened to the ice.



at the start | after 10 minutes | after 30 minutes

(a) Describe and explain what happened to the ice. In your answer,

View solution

- describe and explain the change of state which occurs,
- explain this change using the kinetic particle theory.

.....

.....

.....

.....

.....

..... [5]

(b) Water is used in industry and in the home.

View solution

(i) Give **one** use of water in industry.

..... [1]

(ii) Give **one** use of water in the home.

View solution

..... [1]

(c) The symbol equation for the reaction of lithium with water is shown below.

View solution

$$2Li(s) + 2H_2O(l) \rightarrow 2LiOH(aq) + H_2(g)$$

(i) Write the word equation for this reaction.

..... [1]

(ii) Describe **two** observations which can be made when lithium reacts with water.

.....

..... [2]

(iii) Describe how the reactivity of potassium with water compares with the reactivity of lithium with water.

..... [1]

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(d) Ethanol can be made by the reaction of steam with ethene.

View solution

(i) Draw the structure of ethene showing all atoms and all bonds.

[1]

(ii) Describe the conditions required for this reaction.

View solution

..... [2]

(e) The table below describes the reaction of water or steam with different metals.

View solution

metal	observations
calcium	reacts rapidly with cold water
cerium	reacts slowly with hot water and very rapidly with steam
cobalt	reacts with steam when cobalt powder is very hot
iron	reacts very slowly with hot water and readily with steam

Put these metals in order of their reactivity.

least reactive ⟶ most reactive

[2]

[Total: 16]

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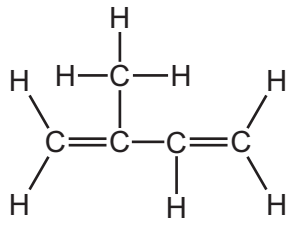
6 When rubber is distilled, a chemical called isoprene is formed.
The structure of isoprene is shown below.



(a) Deduce the molecular formula of isoprene.

View solution

..... [1]

(b) Isoprene is an unsaturated compound.

View solution

Describe a test for an unsaturated compound.

test .....

result ..... [2]

(c) Isoprene forms an addition polymer.

View solution

(i) What feature of the isoprene molecule is responsible for it forming an addition polymer?

..... [1]

(ii) Give the name of another addition polymer.

View solution

..... [1]

(d) Isoprene does **not** conduct electricity.

View solution

Explain why.

..... [1]

(e) State the names of **two** substances formed when isoprene undergoes incomplete combustion.

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

View solution

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(f) Isoprene can be prepared from 3-methylbutan-1-ol.

View solution

To which group of compounds does 3-methylbutan-1-ol belong?
Tick **one** box.

alcohols	☐
alkanes	☐
alkenes	☐
carboxylic acids	☐

[1]

[Total: 9]

7 **(a)** Sodium is in Group I of the Periodic Table.

View solution

Describe the structure of a sodium atom.
In your answer refer to,

- the type and number of each subatomic particle present,
- the charges on each type of subatomic particle,
- the position of each type of subatomic particle in the atom.

.....

.....

.....

.....

.....

.....

..... [5]

View solution

(b) Sodium carbide, Na_2C_2, reacts with water to form ethyne, C_2H_2.

(i) Complete the symbol equation for this reaction.

$$Na_2C_2 + ...H_2O \rightarrow .....NaOH + C_2H_2$$

[2]

View solution

(ii) Ethyne is a hydrocarbon.

What is the meaning of the term *hydrocarbon*?

..... [1]

View solution

(iii) Calculate the relative formula mass of sodium carbide.

[1]

[Total: 9]

DATA SHEET
The Periodic Table of the Elements

Group																	
I	II										III	IV	V	VI	VII	0
																4 He Helium 2
					1 H Hydrogen 1											
7 Li Lithium 3	9 Be Beryllium 4										11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12										27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25		56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42		101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83		131 Xe Xenon 54
226 Fr Francium 87	227 Ac Actinium 89 †														175 Lu Lutetium 71	175 Lu Lutetium 71

		140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70
		232 Th Thorium 90	238 Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102
														Lr Lawrencium 103

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

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

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

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