Centre Number	Examination Number

5400695 6

EXAMINATIONS COUNCIL OF ZAMBIA

Examination for School Certificate Ordinary Level

Science

5124/2

Paper 2

Wednesday **17 NOVEMBER 2021**

Additional Material(s):
Electronic calculator (non programmable)
Graph paper
Soft clean eraser
Soft pencil (type B or HB is recommended)

Time: 2 hours **Marks: 85**

Instructions to Candidates

1 Write the **centre number** and your **examination number** on **every page** of this question paper and on the separate Answer Booklet/Paper provided.

2 There are **three** sections in this paper.

(i) Section A
There are **twenty** questions in this section. Answer **all** questions. For each question, there are four possible answers, **A, B, C** and **D.** Choose the best one and mark it with a cross (X) on the **answer grid provided** in this question paper.

(ii) Section B
Answer **all** questions. Write your answers in the **spaces provided** in this question paper.

(iii) Section C
Answer any **two** questions. Write your answers on a separate **Answer Booklet/Paper provided.**

Candidate's Use		Examiner's Use
Section A		
Section B		
Section C	1	
	2	
	3	
Total		

Information for candidates

1 Any rough working should be done in this question paper.

2 **At the end of the examination:**

(i) Fasten the separate Answer Booklet/Papers used securely to the question paper.

(ii) Circle the numbers of the section **C** questions you have answered in the grid below.

3 The Periodic Table is printed on **page 16.**

4 Cell phones are **not allowed** in the examination room.

This question paper consists of 16 printed pages

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SECTION A

Answer **all** the questions in this section. Choose the best answer from the letters **A**, **B**, **C** or **D** and then mark the letter with a cross **(X)**.

For example if the answer is **B**, it is shown as:

A	B	C	D

ANSWER GRID

1	A	B	C	D
2	A	B	C	D
3	A	B	C	D
4	A	B	C	D
5	A	B	C	D
6	A	B	C	D
7	A	B	C	D
8	A	B	C	D
9	A	B	C	D
10	A	B	C	D

11	A	B	C	D
12	A	B	C	D
13	A	B	C	D
14	A	B	C	D
15	A	B	C	D
16	A	B	C	D
17	A	B	C	D
18	A	B	C	D
19	A	B	C	D
20	A	B	C	D

SECTION A [20 marks]

Answer **all** the questions on the answer grid provided.

A1 The branch of Chemistry that deals with substances and processes in living things is known as ...

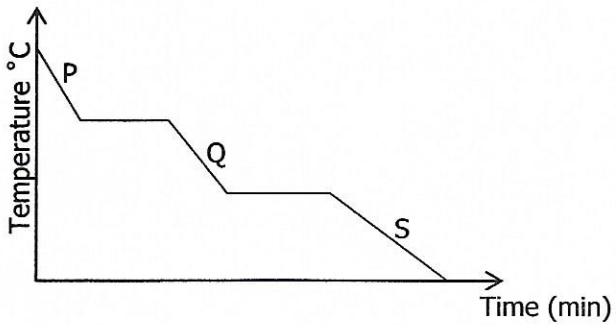
A bio chemistry.

B inorganic chemistry.

C organic chemistry.

D physical chemistry.

A2 The following graph shows the cooling curve for a substance.



Which of the following gives the correct states for a substance at **P**, **Q** and **S**?

	P	Q	S
A	Liquid	Liquid and gas	Solid
B	Gas	Gas and liquid	Liquid
C	Gas	Liquid	Solid
D	Solid	Liquid	Gas

A3 Which test could be used to show that a sample of water is pure? It ...

A freezes at exactly 0°C.

B is colourless and tasteless.

C is neutral to litmus.

D turns anhydrous copper (II) sulphate from white to blue.

A4 Oxygen atom and oxide ions ...

A are chemically identical.

B are isotopes of oxygen.

C have the same number of electrons.

D have the same number of protons.

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A5 Which set of properties describes those of an ionic compound?

	Conductivity in molten state	Solubility in water
A	Good	Soluble
B	Good	Not soluble
C	Poor	Soluble
D	Poor	Not soluble

A6 The relative formula mass of copper (II) sulphate penta hydrate, $CuSO_4.5H_2O$, is ...

A 160.

B 178.

C 185.

D 250.

A7 Why is ethanoic acid described as a weak acid? It ...

A is a poor conductor of electricity.

B is an organic acid.

C is only partially ionised in water.

D reacts only with very reactive metals.

A8 An aqueous solution of aluminium chloride is tested with some reagents.

Which of the following observations is correct?

	Reagent added to $AlCl_{3(aq)}$	Observation
A	Acidified barium nitrate	White precipitate
B	Aqueous ammonia	White precipitate, insoluble in excess
C	Aqueous sodium hydroxide	White precipitate, insoluble in excess
D	Powdered copper	Grey precipitate

A9 A solution of sulphuric acid has a concentration of 0.25 mol/dm^3. What is the mass of the acid in 25cm^3 of the solution?

A 0.6125g

B 1.250g

C 6.130g

D 6.250g

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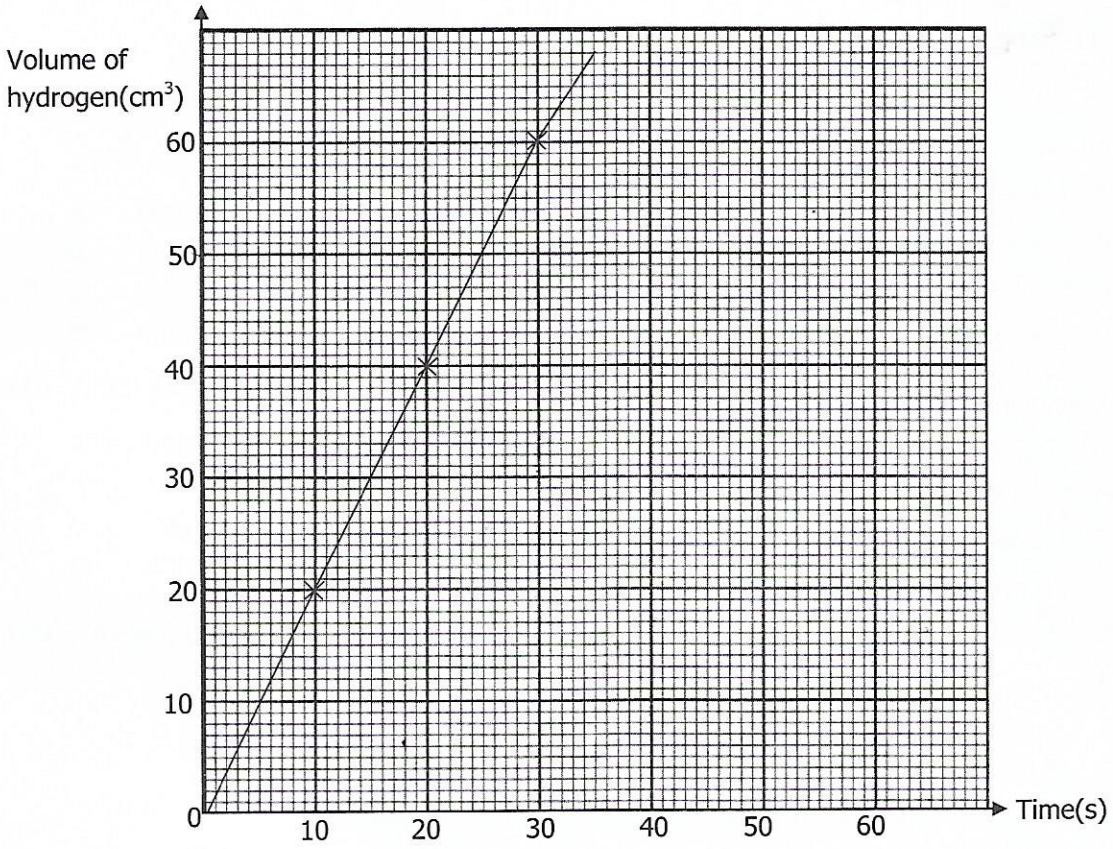
A10 The following graph was obtained in a reaction between dilute hydrochloric acid and magnesium ribbon.



What was the average rate of production of hydrogen?

A $0.2cm^3/s$

B $0.5cm^3/s$

C $2.0cm^3/s$

D $4.0cm^3/s$

A11 Element **T** forms an amphoteric oxide of the formula T_2O_3. In which group of the Periodic Table is **T** likely to be found?

A Group I

B Group II

C Group III

D Group V

A12 Which of the following is the distinctive property of a transition element? It ...

A forms coloured compounds.

B has a high melting point.

C has a variable valence.

D is a good conductor of electricity.

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A13 The following table shows the proton numbers of four elements represented by the letters **V**, **W**, **Y** and **Z**.

Element	**V**	**W**	**Y**	**Z**
Proton number	9	11	17	19

Which of the following statements is correct?

A **V** is a metal.

B **V** is more reactive than **Y**.

C **W** is more reactive than **Z**.

D **Y** and **Z** are in the same period.

A14 Aluminium is used in the manufacture of aeroplanes.
Which property of aluminium makes it possible for this use?

A Covered with an unreactive layer of aluminium carbonate

B Good conductor of electricity

C Low density

D Poor conductor of heat

A15 Gas **X** has the following properties.

1. Colourless
2. Turns red litmus blue
3. No effect on limewater
4. Soluble in water

What is gas **X**?

A Ammonia

B Carbon dioxide

C Hydrogen

D Oxygen

A16 Which of the following will react with ammonium chloride to produce ammonia gas?

A Calcium carbonate

B Calcium hydroxide

C Calcium metal

D Calcium oxide

A17 Which equation represents incomplete combustion of ethane?

A $C_2H_6 + O_2 \rightarrow 2CO + 3H_2$.

B $C_2H_6 + 2O_2 \rightarrow 2CO_2 + 3H_2$.

C $2C_2H_6 + 5O_2 \rightarrow 4CO + 6H_2O$.

D $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$.

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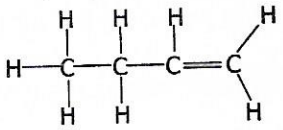
A18 The following diagram shows the structure of Butene, an alkene which is manufactured by cracking large hydrocarbons.



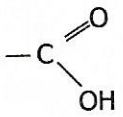
Which hydrocarbon can be cracked to make butene?

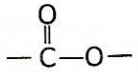
A Decane, $C_{10}H_{22}$
B Ethane, C_2H_6
C Methane, CH_4
D Propane, C_3H_8

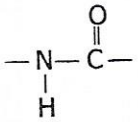
A19 Which polymer contains only three different elements?

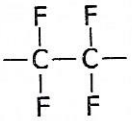
A Protein
B Poly (ethene)
C Poly (propene)
D Starch

A20 What is the linkage between the units in Terylene?

A 

B 

C 

D 

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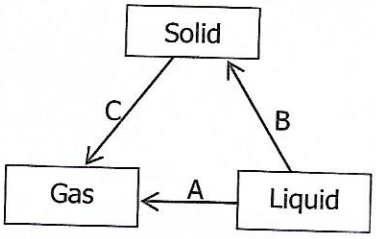
Section B [45 marks]

Answer **all** questions in this section.

Write your answers in the spaces provided in the question paper.

B1 The following diagram shows the changes of state in the three states of matter.



(a) Describe the arrangement of particles in

(i) solid, ...

..... [1]

(ii) liquid. .....

..... [1]

(b) **(i)** State the name of the change of state labeled **A** and **B**.

A: ..... [1]

B: ..... [1]

(ii) Which change of state **A** or **B**, is an exothermic process? Explain your answer.

Change of state: ..... [1]

Explanation: .....

..... [1]

[Total: 6 marks]

B2 The following is a list of methods used to separate mixtures.
Filtration, chromatography, crystallisation, distillation, fractional distillation, evaporation.
Choose from the list above the suitable method that would be used to

(a) obtain pure water from sodium chloride solution,

..... [1]

(b) separate a mixture of ethanol and water,

..... [1]

(c) obtain copper (II) sulphate crystals from saturated copper (II) sulphate solution,

..... [1]

(d) obtain barium sulphate from a mixture of barium sulphate and sodium nitrate,

..... [1]

(e) separate coloured substances in a sample of a soft drink.

..... [1]

[Total: 5 marks]

B3 The following table shows the structures of four particles; **P**, **Q**, **R** and **T**.

Particle	Number of		
	Protons	Neutrons	Electrons
P	11	12	11
Q	11	13	11
R	12	12	10
T	8	8	10

(a) Which particle is a neutral atom?

..... [1]

(b) Which particle is a negative ion? State its charge.

Particle: ..... [1]

Charge: ..... [1]

(c) Which **two** particles are isotopes? Give a reason for your answer.

Particle: ..... and ..... [1]

Reason: ..... [1]

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(d) Use the Periodic Table to identify particle **R**.

..... [1]

[Total: 6 marks]

B4 Ethyl ethanoate ($CH_3CO_2C_2H_5$) can be prepared from ethanol and ethanoic acid.

(a) Write the chemical equation for the reaction.

..... [1]

(b) Calculate the theoretical yield of ethyl ethanoate which can be obtained from 23g of ethanol.

[2]

(c) If 33g of ethyl ethanoate is produced, calculate the percentage yield.

[2]

(d) To which homologous series does ethyl ethanoate belong?

..... [1]

[Total: 6 marks]

B5 The pH scale is used to indicate how acidic or alkaline a solution is. Some numbers from the pH scale are given in the following list:

1 3 7 12 14

(a) What type of solution would have a pH of 1?

..... [1]

(b) Which pH value from the above list would be for

(i) lime water,

..... [1]

(ii) pure water,

..... [1]

(iii) vinegar?

..... [1]

(c) What would be the colour of a solution with pH value of 14 when tested with the universal indicator?

..... [1]

[Total: 5 marks]

B6 Some reactions of metals, **V**, **W**, **X** and **Y** are given in the following table:

Metal	**Reaction with water**	**Reaction with dilute hydrochloric acid**
V	A few bubbles form slowly in cold water	Vigorous reaction, gas given off
W	Vigorous reaction, gas given off	Explosive reaction
X	No reaction	No reaction
Y	Does not react with cold water. Hot metal reacts with steam.	Steady fizzing

(a) Arrange these metals in order of decreasing reactivity.

..... [2]

(b) Which of these metals could be

(i) magnesium,

..... [1]

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(ii) copper?

..... [1]

(c) The equation for the reaction of **W** with cold water is given below.

$2\mathbf{W}_{(s)} + 2\mathbf{H}_2O_{(l)} \rightarrow 2\mathbf{W}OH_{(aq)} + \mathbf{Z}_{(g)}$.

(i) Describe the test for gas **Z**.

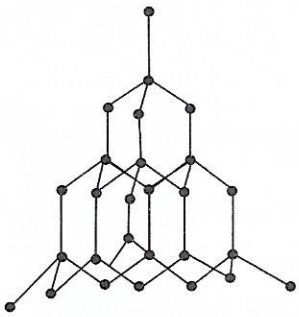
..... [1]

(ii) To which group of the Periodic Table does metal **W** belong?

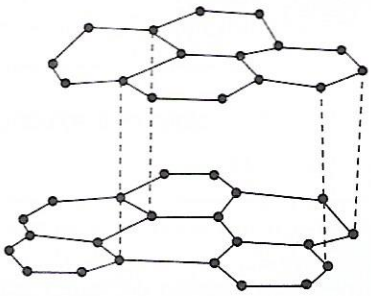
..... [1]

[Total: 6 marks]

B7 The following diagrams show two forms of carbon, **P** and **Q**.



P



Q

(a) Name the allotrope labelled

(i) **P**, ... [1]

(ii) **Q**. ..... [1]

(b) Explain the meaning of the term allotropes.

..... [1]

(c) What type of bonding is represented by these forms of carbon?

..... [1]

(b) **(i)** Which allotrope named in **(a)** has a physical property which is typical of metals?

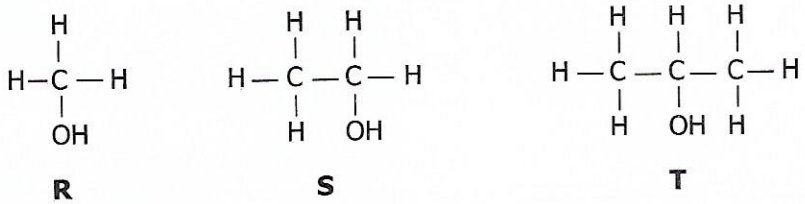
..... [1]

(ii) State the physical property.

..... [1]

[Total: 6 marks]

B8 The structures shown are members of one of the homologous series in organic chemistry.



R **S** **T**

(a) Give the general formula for this homologous series.

..... [1]

(b) What is the functional group for the homologous series?

..... [1]

(c) **S** is used as a fuel because it burns in oxygen.
Write a balanced chemical equation for this reaction.

..... [2]

(d) Which of the compounds **R**, **S** or **T** would have the highest boiling point?

..... [1]

[Total: 5 marks]

Section C [20 marks]

Answer any **two (2)** questions from this section. Write your answers in the separate Answer Booklet provided.

C1 In the Periodic Table, elements are arranged in vertical columns called groups.

(a) Potassium and sodium are both found in Group I of the Periodic Table.

(i) Give the electronic configurations of both elements. [1]

(ii) Which element would react more vigorously with water than the other?
Explain your answer. [2]

(iii) Write a balanced chemical equation for the reaction of sodium with water.
Include state symbols. [3]

(b) In Group VII, there are five elements.

(i) How many electrons do these elements have in their outermost shell? [1]

(ii) How do the atoms of Group VII elements react with the atoms of metals? [1]

(iii) Which of the Group VII elements is the most reactive?
Explain your answer. [2]

[Total: 10 marks]

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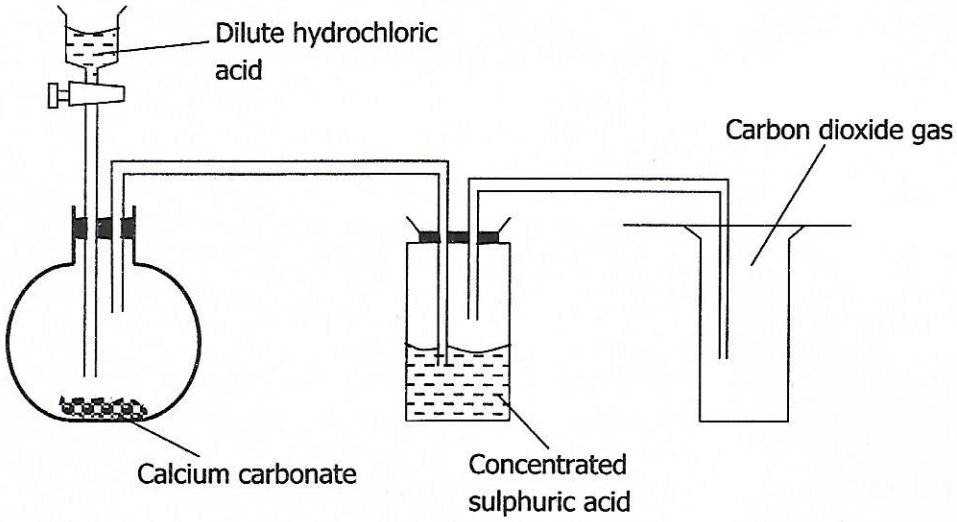
C2 Carbon dioxide can be prepared in the laboratory by adding dilute hydrochloric acid to calcium carbonate as shown in the following diagram:



(a) Name the **two** substances that would be produced in the reaction besides carbon dioxide. [2]

(b) Write a balanced chemical equation for the reaction. [2]

(c) **(i)** Name the method of collecting carbon dioxide shown in the diagram. [1]

(ii) Give the property of carbon dioxide that makes it possible to be collected by the method named in **C (i)**. [1]

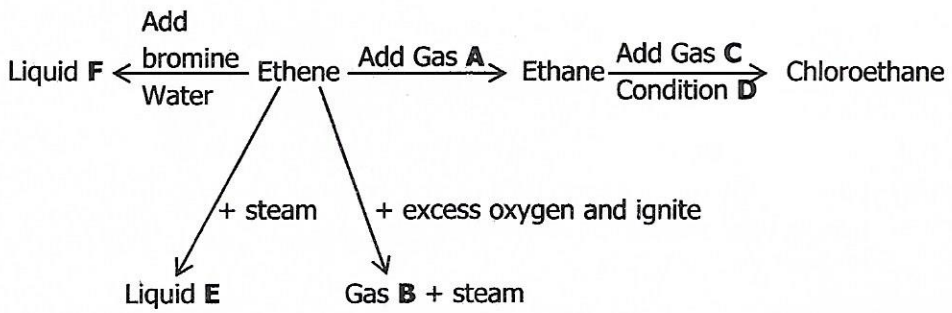
(d) What is the purpose of the concentrated sulphuric acid in the experiment? [1]

(e) Explain why carbon dioxide **cannot** be prepared using dilute sulphuric acid with calcium carbonate. [1]

(f) Give **two** industrial uses of carbon dioxide. [2]

[Total: 10 marks]

C3 Study the following series of reactions for ethene.



(a) Identify

(i) gas **A**,

(ii) gas **B**,

(iii) gas **C**,

(iv) condition **D**,

(v) liquid **E**,

(vi) liquid **F**, [6]

(b) Write a balanced chemical equation for the reaction of ethene with excess oxygen. [2]

(c) Give the structural formula of liquid **E**. [1]

(d) State the industrial application of the reaction of ethene with gas **A** to form ethane. [1]

[Total: 10 marks]

DATA SHEET

The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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	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 Sulphur 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	Tc Tchnetium 43	104 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 Mecury 80	204 Tl Thallium 81	207 Pb lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 +															

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

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	175 Lu Lutetium 71
232 Th Thorium 90	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

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 dm^3 at room temperature and pressure (r.t.p.).

$N_A = 6.0 \times 10^{23}$/mol; 1F = 96 500C.