Centre Number	Examination Number

EXAMINATIONS COUNCIL OF ZAMBIA

Examination for School Certificate Ordinary Level

Science

5124/2

Paper 2

2020

8900840B

Additional Materials:

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 (3)** sections in this paper.

(i) Section A

There are **twenty (20)** questions in this section. Answer all questions.
For each question, there are four possible answers, **A**, **B**, **C** and **D**. Choose the one you consider correct and record your choice by marking it with a cross (X) on the **answer grid provided** on the question paper.

(ii) Section B

Answer all questions. Write your answers in the **spaces provided** on the 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 15**.

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

This question paper consists of 15 printed pages

Centre Number	Examination Number

ANSWER GRID FOR SECTION A

Put a cross (X) on the letter indicating your choice of answer.

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

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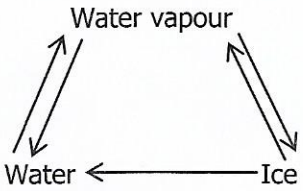
SECTION A

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

A1 A learner wanted an apparatus that he could use to accurately measure 10.5cm^3 of dilute hydrochloric acid to prepare a salt of sodium metal by neutralisation. Which one of the following apparatus would you advise him to use?

A Beaker
B Burette
C Pipette
D Volumetric flask

A2 In which conversion do water molecules lose energy?



A Ice ⟶ water
B Ice ⟶ water vapour
C Water vapour ⟶ ice
D Water ⟶ water vapour

A3 Which one of the following best describes metallic bonding? It is a force of attraction between ...

A two different types of metals.
B protons in the nucleus of a metal and the valence electrons of the metal.
C valence electrons and protons in the nucleus of a non-metal.
D valence electrons and metal ions.

A4 Lime water is a strong alkali. What would be the net ionic equation for a reaction between lime water and an acid solution of nitric acid?

A $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$
B $H^+_{(aq)} + NO_3^-{}_{(aq)} \rightarrow HNO_{3(l)}$
C $Ca^{2+}_{(aq)} + 2NO_3^-{}_{(aq)} \rightarrow Ca(NO_3)_{2(aq)}$
D $Ca^{2+}_{(aq)} + 2OH^-_{(aq)} \rightarrow Ca(OH)_{2(aq)}$

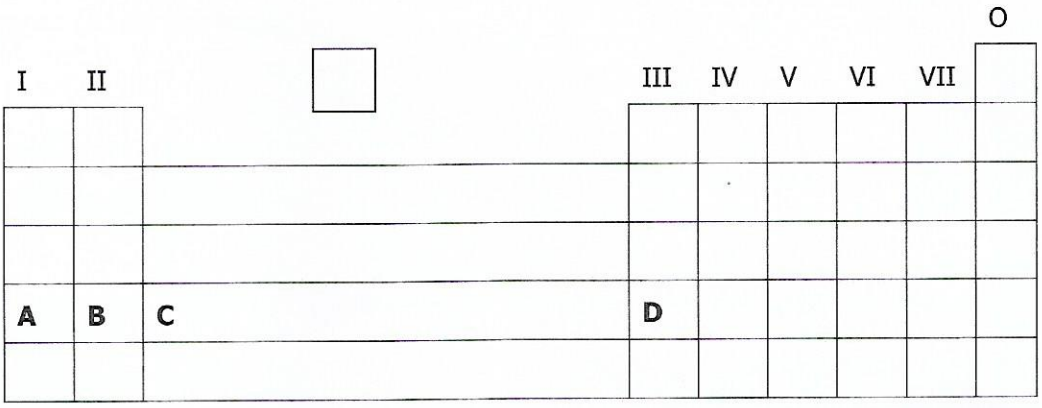
A5 A sample of an oxide of manganese is analysed and it is found that 11.0g of manganese combined with 4.8g of oxygen. What is the empirical formula of the oxide?

A Mn_2O
B Mn_2O_3
C Mno
D MnO

[Turnover

Centre Number				Examination Number								

A6 The diagram below shows a simplified Periodic Table.



The letters used are **not** symbols of the actual elements. Which element **A**, **B**, **C** or **D** is the least metallic?

A7 Which property shows a decreasing trend in the elements from Group I to Group VII across a period of a Periodic Table?

A Non-metallic character
B Number of electron shells
C Radius of the atoms
D Reactivity with water

A8 Which one of the following elements burns in air to give a compound which dissolves in water to form a solution of pH=2?

A Aluminium
B Hydrogen
C Sodium
D Sulphur

A9 Identify the ion which will give only a clear solution when treated with an excess of aqueous ammonia.

A Zn^{2+}
B Pb^{2+}
C Fe^{2+}
D Al^{3+}

A10 A learner titrates aqueous sodium hydroxide from a burette with dilute hydrochloric acid in a flask. After the titration, the flask is emptied. What is the correct procedure before the next titration?

A Rinse out the conical flask with dilute hydrochloric acid.
B Rinse out the conical flask with aqueous sodium hydroxide.
C Rinse out the conical flask with distilled water.
D Use the conical flask again without rinsing.

A11 The rate of a chemical reaction is affected by a number of factors. Which of the following would **not** increase the rate of the reaction between a lump of calcium carbonate and dilute hydrochloric acid?

A Reacting the acid with powdered calcium carbonate
B Increasing the concentration of the acid
C Increasing the temperature in the reaction vessel
D Increasing the pressure in the reaction vessel

A12 In four separate experiments, identical samples of magnesium ribbon were added, in excess to hydrochloric acid. Which experiment will give off hydrogen most slowly?

Experiment	Volume of acid/cm^3	Concentration of acid/mol/dm^3
A	50	0.1
B	10	5.0
C	20	0.5
D	30	2.0

A13 Which of the following is an endothermic reaction? The formation of ...

A a hydrogen-chlorine bond.
B silver from silver salts in photography.
C water from oxygen and hydrogen.
D water from steam.

A14 When carbon dioxide is bubbled in lime water, a white precipitate is produced which disappears with continuous bubbling of the gas into the solution. Identify the substance that causes the formation of a colourless solution.

	Substance that causes the formation of a white precipitate	Substance that causes the formation of a colourless solution
A	Calcium oxide	Calcium hydroxide
B	Calcium hydrogen carbonate	Calcium carbonate
C	Calcium carbonate	Calcium hydrogen carbonate
D	Calcium carbonate	Calcium hydroxide

A15 Which information given in the table below is true about the industrial preparation of nitric acid?

	Process	Starting raw materials	Catalyst used during its preparation
A	Ostwald process	Nitrogen dioxide (NO_2) and water (H_2O)	Platinum-Rhodium catalyst
B	Ostwald process	Ammonia (NH_3) and oxygen (O_2) gases	Platinum-Rhodium catalyst
C	Haber process	Nitrogen dioxide (NO_2) and water (H_2O)	Nickel-Iron catalyst
D	Haber process	Ammonia (NH_3) and oxygen (O_2) gases	Nickel-Iron catalyst

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A16 Iodine is one of the Group VII elements whose use in most everyday activities has increased. It is mainly ...

A used in water treatment.
B used to bleach wood pulp to make paper.
C used in medicine.
D added to toothpaste to prevent tooth decay.

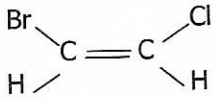
A17 What is the structural formula of the ester formed when ethanoic acid reacts with propanol?

A $CH_3CH_2CO_2CH_2CH_3$
B $CH_3CO_2CH_2CH_2CH_3$
C $CH_3CO_2CH_2CH_3$
D $CH_3CO_2CH_3$

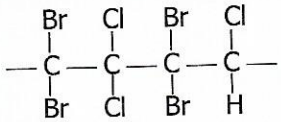
A18 The table below shows boiling point ranges of fractions collected from distillation of a sample of petroleum (crude oil). Which fraction contains the smallest molecules?

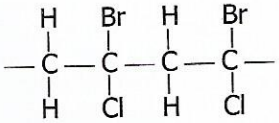
	Boiling point range
A	20°C – 50°C
B	50°C – 100°C
C	100°C – 150°C
D	150°C – 250°C

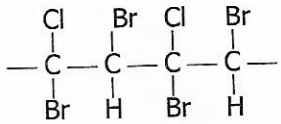
A19 The diagram below shows the structure of a monomer.

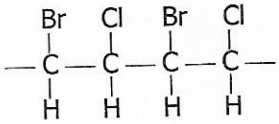


Select the polymer that can be formed from the monomer.

A


B


C


D


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A20 All of the following are condensation polymers except ...

A terylene.
B polystyrene.
C nylon.
D carbohydrates.

Section B [45 marks]

Answer **all** questions in this section.
Write your answers in the spaces provided on the question paper.

B1 Study **Figure B1.1** and **Table B1.1** below and answer the questions that follow.

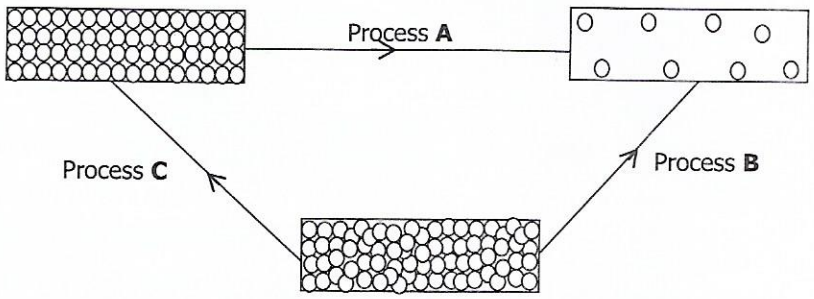


Figure B1.1: Changes of states of matter

Table B1.1: Common substances

Substance	Aluminium oxide	Ammonium chloride	Calcium hydroxide
Substance	Copper (II) sulphate	Iodine crystals	Water

(a) **(i)** Identify process **A** in **Figure B1.1**.

..... [1]

(ii) From **Table B1.1**, identify **two** substances that can undergo process **A**.

..... [2]

(b) State whether process **B** and **C** are endothermic or exothermic. Explain your answer.

.....

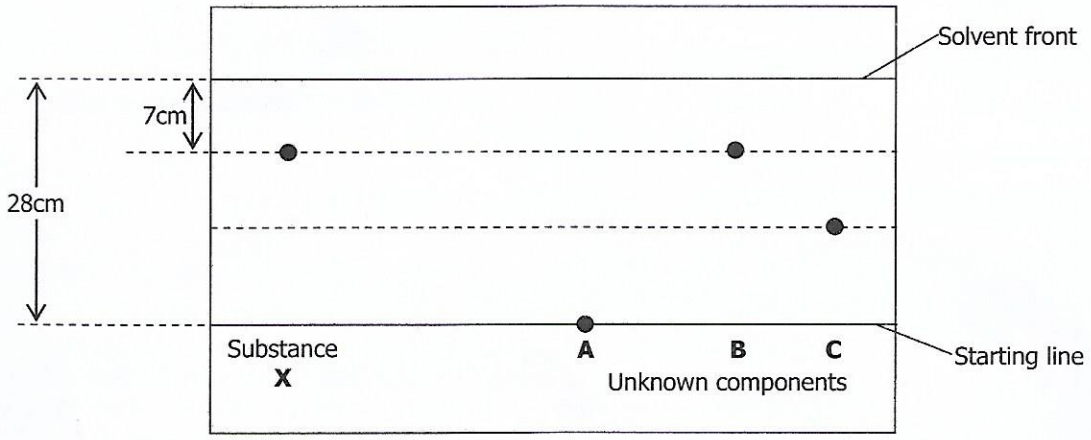
.....

..... [2]

[Total: 5 marks]

Centre Number	Examination Number

B2 A learner carried out a chromatography experiment to identify components of substance **X**. Water was used as a solvent. The results of the experiment are shown in the chromatogram below.



(a) Which one of the unknown components **A**, **B** or **C** is insoluble in water?

..... [1]

Explain your answer.

.....

..... [1]

(b) Which of the unknown component(s) was/were **not** contained in substance **X**?

..... [1]

(c) Calculate the R_f value for component **B**.

R_f value = ... [2]

[Total: 5 marks]

B3 In an experiment to prepare a salt, a learner reacted 3.0g of magnesium oxide with 40.0cm^3 of dilute nitric acid of concentration 2.0 mol/dm^3.

(a) Write a balanced chemical equation for the reaction.

..... [2]

(b) Calculate the number of moles of

(i) magnesium oxide,

.....

..... [1]

(ii) dilute nitric acid.

.....

..... [1]

(c) Determine the limiting reactant.

.....

.....

..... [2]

[Total: 6 marks]

B4 **Table B4.1** below shows the elements in a Period of a Periodic Table.

Table B4.1: Elements in a Period

Li	Be	B	C	N	O	F	Ne

(a) To which Period of the Periodic Table do these elements belong?

..... [1]

(b) What happens to the number of shells across the Period shown above?

.....

..... [1]

(c) Answer the following questions using only the elements shown in the **table B4.1**. Each element can be used once, more than once or not at all.

(i) Which two elements would form an ionic compound?

..... [1]

(ii) Which element has a valency of three?

..... [1]

(iii) Which element has allotropes?

..... [1]

[Total: 5 marks]

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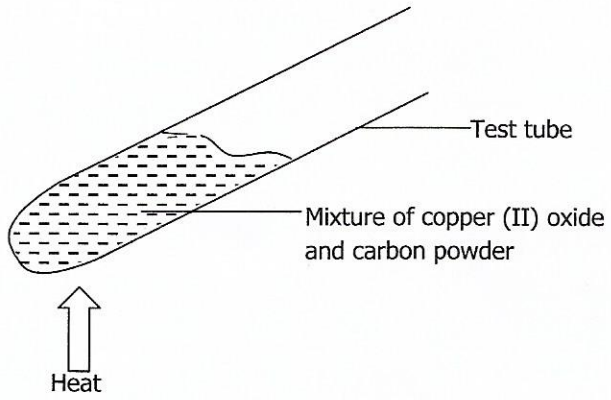
B5 A mixture of copper (II) oxide powder and coke or carbon was put in a test tube and heated as shown in the diagram below.



(a) **(i)** Describe what would be observed as the mixture is heated.

.....

..... [2]

(ii) Write a balanced chemical equation for the reaction that occurs in the test tube.

..... [2]

(b) What type of reaction occurs between copper (II) oxide and carbon? Give a reason for your answer.

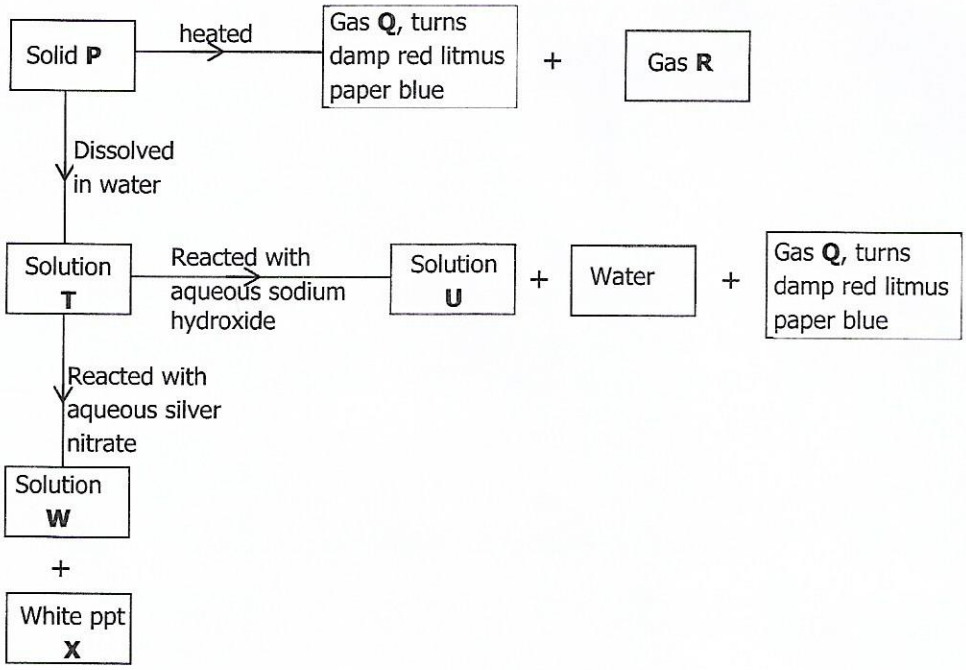
.....

..... [2]

[Total: 6 marks]

Centre Number	Examination Number

B6 Study the flow diagram below and answer questions that follow.



(a) Identify substances **P**, **Q** and **W**.

P ..... [1]

Q ..... [1]

W ..... [1]

(b) Write the balanced chemical equations for

(i) the decomposition of solid **P**,

..... [1]

(ii) the reaction between solutions **T** and aqueous sodium hydroxide.

..... [1]

[Total: 5 marks]

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B7 Atoms of elements **A**, **B** and **C** have 8, 17 and 20 electrons respectively.

(a) Using the letters, construct a chemical formula of a compound formed between atoms of elements **A** and **C**.

[1]

(b) Elements **B** and **C** can react to form a compound.

(i) Name the type of bond formed in the compound.

..... [1]

(ii) State **one** physical property of this compound.

..... [1]

(c) Draw the electronic structure of the product formed when atoms of element **A** combine.

[2]

(d) Give **one** industrial use of element **B**.

..... [1]

[Total: 6 marks]

Centre Number	Examination Number

B8 Urea, $CO(NH_2)_2$, and ammonium nitrate, NH_4NO_3, are two nitrogenous fertilizers commonly used by farmers.

(a) Calculate the percentage composition of nitrogen in urea.

[1]

(b) Explain the importance of nitrogenous fertilizers in agriculture.

.....

..... [1]

(c) Describe the effects of using nitrogenous fertilizers on the environment.

.....

..... [3]

(d) Apart from nitrogen, name an element needed for

(i) root development,

..... [1]

(ii) seed formation.

..... [1]

[Total: 7 marks]

Centre Number				Examination Number								

B7 Atoms of elements **A**, **B** and **C** have 8, 17 and 20 electrons respectively.

(a) Using the letters, construct a chemical formula of a compound formed between atoms of elements **A** and **C**.

[1]

(b) Elements **B** and **C** can react to form a compound.

(i) Name the type of bond formed in the compound.

..... [1]

(ii) State **one** physical property of this compound.

..... [1]

(c) Draw the electronic structure of the product formed when atoms of element **A** combine.

[2]

(d) Give **one** industrial use of element **B**.

..... [1]

[Total: 6 marks]

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(a) Calculate the percentage composition of nitrogen in urea.

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.....

..... [3]

(d) Apart from nitrogen, name an element needed for

(i) root development,

..... [1]

(ii) seed formation.

..... [1]

[Total: 7 marks]

Centre Number	Examination Number

SECTION C [20 marks]

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

C1 One major use of iron in everyday life is in making of alloys.

(a) Describe the structure of an alloy. Draw a labelled diagram to illustrate your answer. [3]

(b) Give **two** reasons why iron is alloyed. [2]

(c) **(i)** Name **two** alloys of iron. [2]

(ii) State **one** use of each alloy stated in **(c)(i).** [2]

(d) Give **one** use of iron other than making alloys. [1]

[Total: 10 Marks]

C2 Calcium oxide is an important compound that is manufactured from limestone.

(a) **(i)** State the method by which calcium oxide is made from limestone. [1]

(ii) Write a balanced chemical equation for the formation of calcium oxide from limestone, include state symbols. [2]

(b) What is the common name for calcium oxide? [1]

(c) During production of calcium oxide from limestone, a gas is evolved as a by-product.

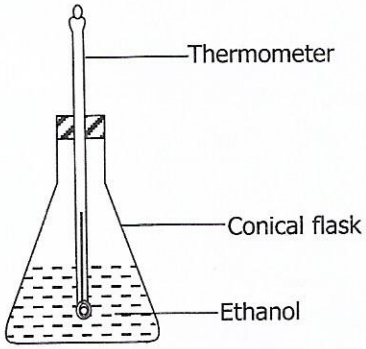
(i) Describe the chemical test for the gas. [2]

(ii) By what method is the gas collected when prepared in the laboratory? Give a reason for your answer. [2]

(iii) State **two** uses of the gas. [2]

[Total: 10 Marks]

C3 A learner used the apparatus shown below to determine the energy released when ethanol burns.



(a) Draw the displayed structure of ethanol. [2]

(b) **(i)** Write a balanced chemical equation for the complete combustion of ethanol. [2]

(ii) When 4.6g of ethanol is burnt, 5.4g of water is formed. Calculate the mass of water formed when 13.8g of ethanol is burnt? [3]

(c) **(i)** Define a fuel.

(ii) Hydrogen is said to be a clean fuel. Explain what this means. [3]

[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.).

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