EXAMINATIONS COUNCIL OF LESOTHO
Lesotho General Certificate of Secondary Education

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

PHYSICAL SCIENCE

Paper 3 Extended Theory

0181/03
October/November 2018
1 hour 30 minutes
Marks: 80

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 20.
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.

1 Fig. 1.1 shows two identical razor blades, A and B, dropped at the same time from the top of a building 4 m high.

Blade A is dropped on its face while blade B is dropped on its edge.

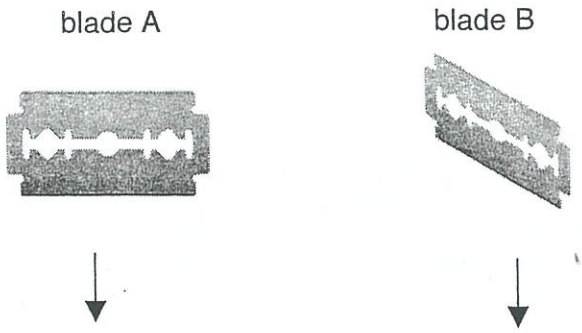

Fig. 1.1

(a) State the force which pulls the blades down.

..... [1]

(b) Describe how the speed of blade B varies during its fall.

.....

.....

.....

..... [2]

(c) Fig. 1.2 shows the velocity-time graph for blade A.

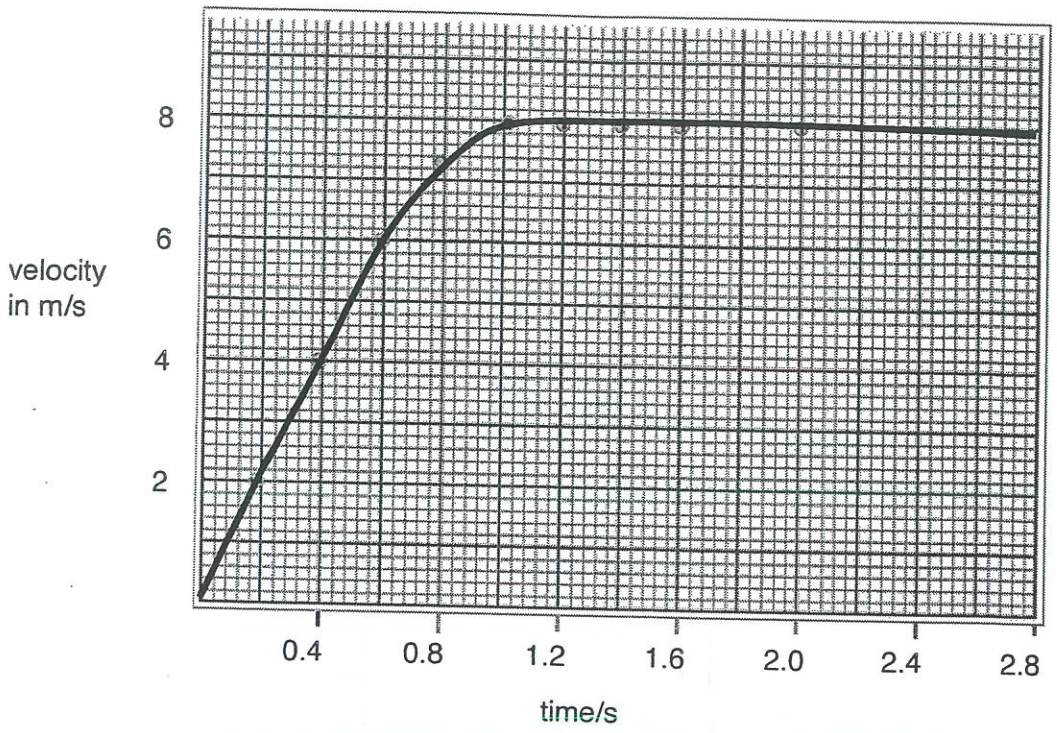

Fig. 1.2

(i) Calculate the acceleration of blade A between t = 0 s and t = 0.6 s.

acceleration = ... [2]

(ii) On Fig. 1.2 sketch the velocity-time graph for blade B. [2]

[Total: 7]

2 An experiment is set up to heat a solid iron block by using an immersion heater connected to a 12 V supply.

A student uses the apparatus in Fig. 2.1 to measure the temperature of the iron block as it is heated.

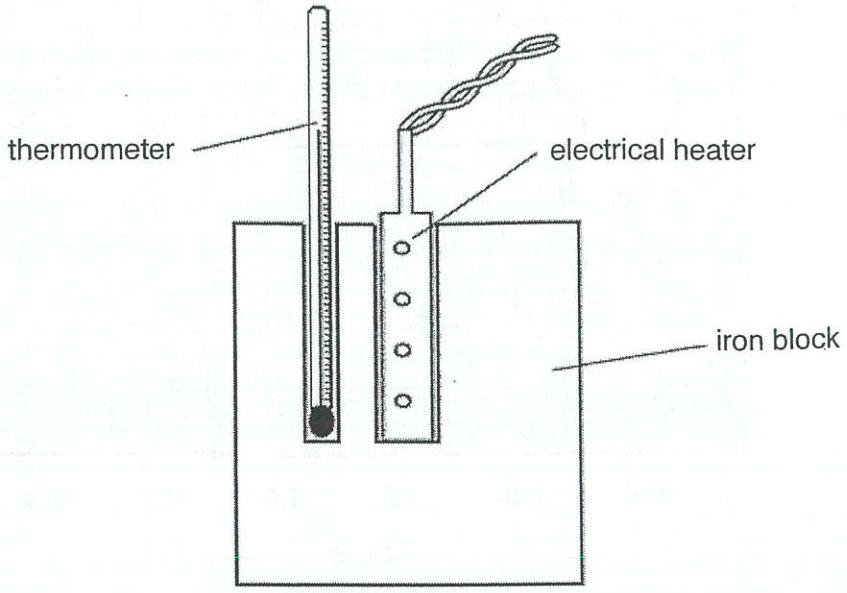

Fig. 2.1

(a) Describe how the loss of thermal energy(heat) from the iron block can be reduced.

.....

..... [1]

(b) The student connected an ammeter and a voltmeter in the circuit in order to determine the power supplied by the heater.

Name the quantity measured by the voltmeter.

..... [1]

(c) Table 2.1 shows the results of the experiment.

Table 2.1

voltage/V	current/A	mass of the metal cylinder/kg	increase in temperature/°C	time for which heater is **on** min
12.0	2.5	1.5	20	5

Calculate:

(i) the power of the heater,

power: ..... [2]

(ii) the total thermal energy gained by the iron block, (assuming no heat loss)

energy: ..... [3]

(iii) the specific heat capacity of the iron block.

specific heat capacity: ..... [3]

[Total: 10]

3 A man standing 50 m away from a high wall beats a drum.
The atmospheric temperature is 20 °C.

(a) Calculate the time it will take for the man to hear the echo of the beat.
(speed of sound in air at 20 °C is about 330 m/s)

time = ... [2]

(b) Predict how the speed of sound would change if the air was at 10 °C. Explain your answer.

.....

.....

.....

..... [2]

(c) Fig. 3.1 represents a sound wave produced by a vibrating turning fork in air.

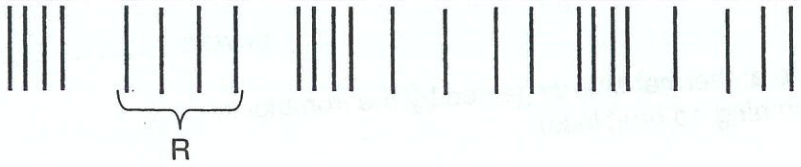

Fig. 3.1

(i) State what the letter R represents.

..... [1]

(ii) The frequency of the tuning fork is 600 Hz.

Calculate the wavelength of the sound waves in centimetres.
(Use speed of sound in air as 330 m/s).

wavelength: ..... cm [2]

[Total: 7]

4 Fig. 4.1 shows a negatively charged rod placed near two metal cans A and B each placed on wooden platform.
The two metal cans are in contact.

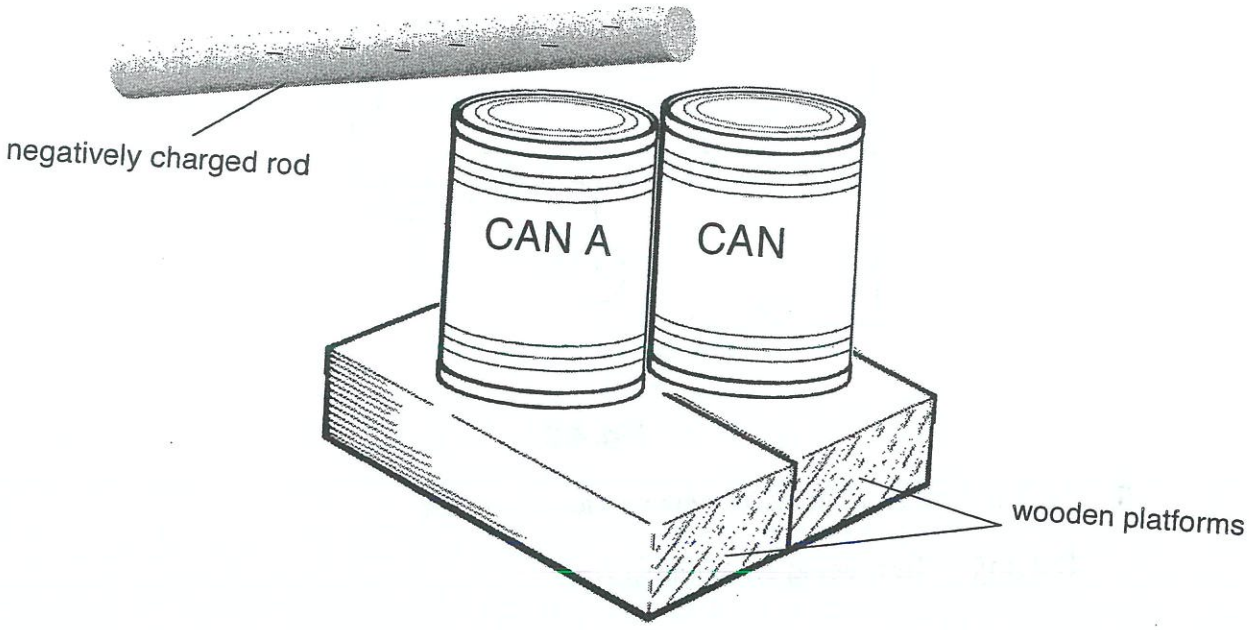

Fig. 4.1

(a) Can B is separated from can A by moving the wooden platform from which it is placed while the charged rod is still held in the position shown in Fig. 4.1.

Explain in terms of electron transfer why can B is negatively charged.

.....

.....

.....

.....

..... [2]

(b) Can A is brought close to the metal cap of a positively charged gold-leaf electroscope by moving the wooden platform on which it is placed.

Explain what happens to the leaf of the gold-leaf electroscope.

.....

.....

.....

..... [2]

(c) Fig. 4.2 shows a 12 V car battery connected to two identical lamps and two ammeters in a circuit.

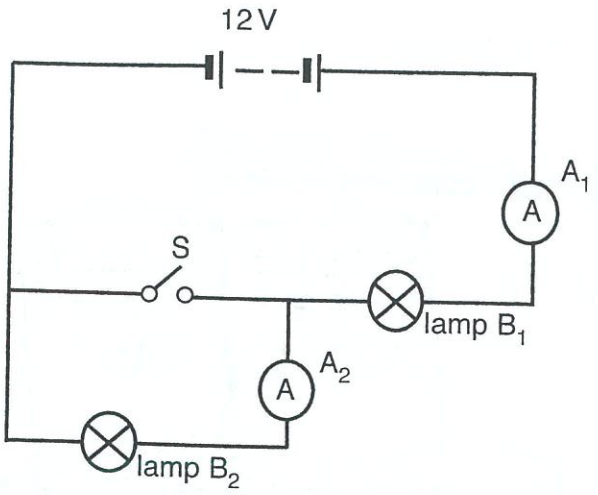

Fig. 4.2

(i) An Ammeter A_1 reads 2.0 A when switch S is open.

Determine the reading on Ammeter A_2.

ammeter reading: ..... [1]

(ii) Switch S is closed.

State and explain what happens to the brightness of lamp B_2.

effect on brightness: .....

.....

explanation: .....

..... [2]

(d) Fig. 4.3 shows an 11 W fluorescent bulb supplied with 240 V.

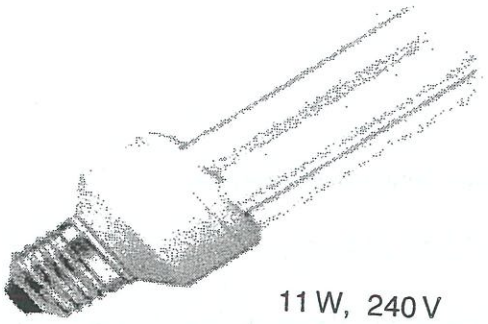

Fig. 4.3

(i) Explain why fluorescent bulbs are preferred to filament bulbs.

.....

.....

.....

..... [2]

(ii) State the energy change that takes place in the bulb.

.....

..... [2]

[Total: 11]

5 In a nuclear power station, fission of $^{235}_{92}U$ is used to produce electricity.

(a) Define fission

.....

..... [1]

(b) Complete the fission reaction of uranium.

$$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{144}_{56} + {}_{36}KR + 2{}^{1}_{0}n$$ [2]

(c) State **two** disadvantages of using nuclear power stations.

.....

..... [2]

[Total: 5]

6 Fig. 6.1 shows plants grown in a transparent plastic house and fed with a nutrient solution.

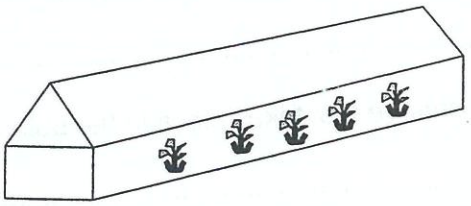

Fig. 6.1

(a) The plants in Fig. 6.1 produce carbohydrates by photosynthesis.

(i) Name the form of energy required for this process

..... [1]

(ii) Write a balanced symbol equation for photosynthesis.

.....

..... [2]

(b) Table 6.1 shows the concentration of the ions in the nutrient solution used to feed the plants.

Table 6.1

element	ionic formula	common source	concentration in mg/l
nitrogen	NO_3^-	ammonium nitrate	200
phosphorus	PO_4^{3-}	potassium phosphate	40
potassium	K^+	potassium hydroxide	140

(i) Explain why it is advisable to prepare the nutrient solution only when the plants are fed.

.....

.....

.....

..... [2]

(ii) Draw a labelled diagram of apparatus that could be used to demonstrate that the nutrient solution conducts electricity.

[3]

[Total: 8]

7 Fig. 7.1 shows how water from a well is treated for use at school.

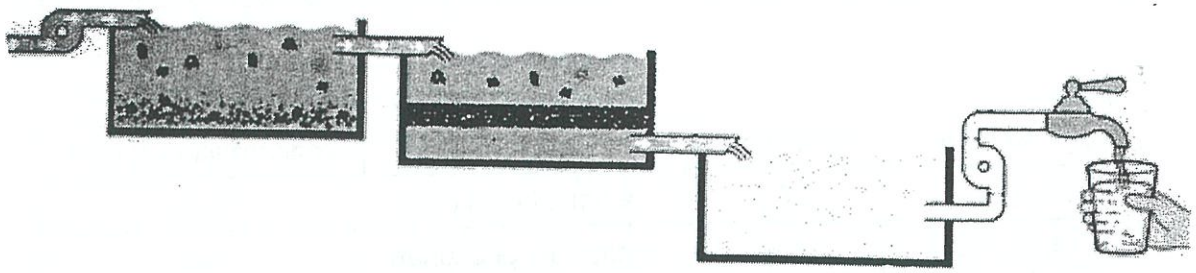

Fig. 7.1

(a) Suggest **one** reason why water should be treated before drinking.

.....

..... [1]

(b) The water collected in the tank is impure.

(i) Explain why the water collected in the tank is impure.

.....

..... [1]

(ii) Describe a physical test for the pure water.

.....

..... [1]

(c) Explain why some people prefer using rain water over the water from the well for laundry.

.....

..... [1]

[Total: 4]

8 A student performed an experiment to investigate how a reaction rate changes as the reaction progresses.

Excess diluted hydrochloric acid reacted with 8 g zinc granules.

(a) Fig. 8.1 is an **incomplete** diagram that represents the apparatus used.

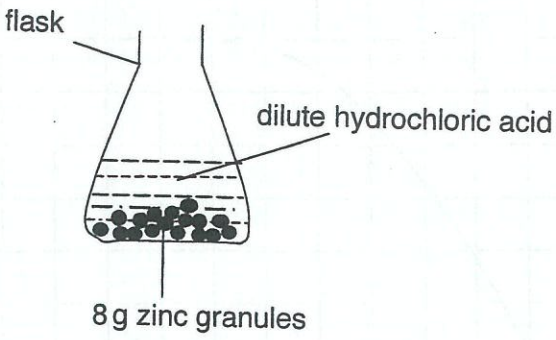

Fig. 8.1

(i) Name the gas produced in this experiment.

..... [1]

(ii) Complete Fig. 8.1 to show how the student collected and measured the volume of the gas produced.
[2]

(b) Fig. 8.2 displays a sketch of the results obtained during the experiment.

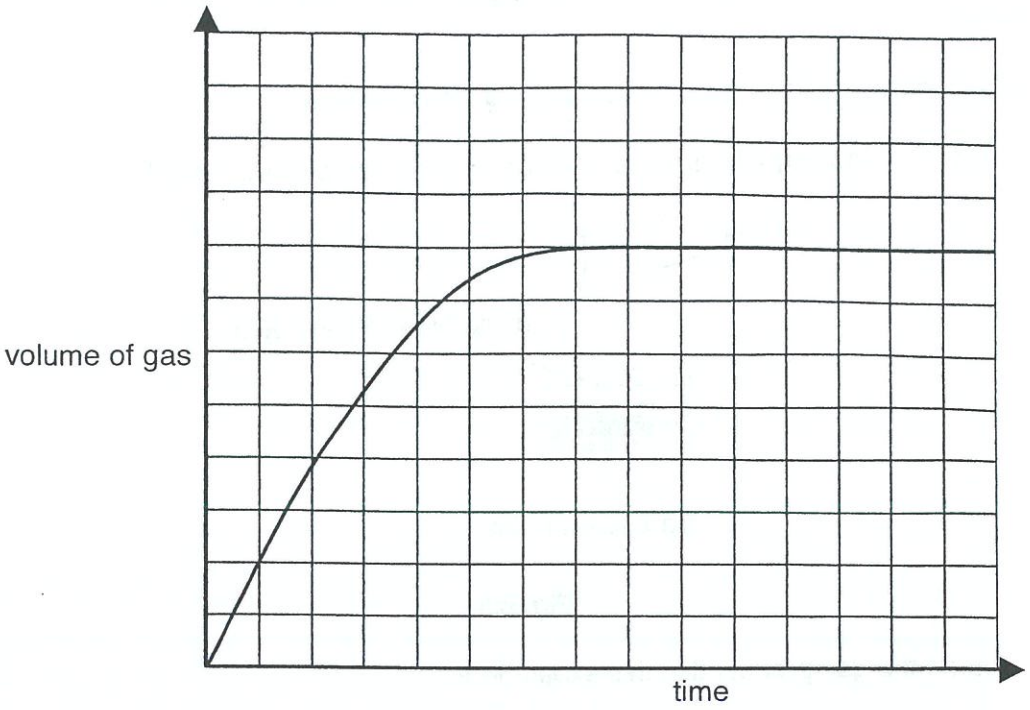

Fig. 8.2

(i) Name another piece of apparatus required to give the results in Fig. 8.2.

..... [1]

(ii) Use Fig. 8.2 to draw a conclusion from the investigation.

.....

..... [1]

(iii) Explain the results in terms of particle collision theory.

.....

.....

.....

.....

.....

..... [3]

(c) 8.00 g of zinc was reacted with 50 cm^3 of dilute acid solutions and at the end of the experiment 7.35 g of zinc remained.

The reaction in the flask is represented by the equation;

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

Calculate;

(i) Mass of zinc chloride formed.
(Relative formula mass of zinc chloride is 136)
Show your working.

..... g [3]

(ii) Concentration, in g/dm^3, of the zinc chloride.

Show your working.

..... g/dm^3 [2]

[Total: 13]

9 Lime (CaO) is manufactured industrially by thermal decomposition of limestone ($CaCO_3$) in a high temperature oven called a kiln.

(a) State **one** use of lime

..... [1]

(b) Use a 'dot and cross' diagram to show the electronic structure and bonding in lime.

Show **all** the electron shells.

[2]

(c) Decomposition temperature, around 1000 °C, is reached by burning fossil fuel(s) in the kiln.

Describe how **one** of the gases emitted from the lime factory is formed. State the environmental impact of the emission of this gas.

formation .....

.....

impact .....

..... [2]

[Total: 5]

10 Table 10.1 shows some physical properties of hydrocarbons **P**, **Q**, **R** and **S**.

Table 10.1

compound	relative molecular formula	boiling point/°C
P	42	−48
Q	30	−89
R	58	−0.5
S	44	−42

(a) The hydrocarbons, **except** one, belong to the same homologous series.

(i) Identify the homologous series to which these hydrocarbons belong, using the information in Table 10.1.

.....

.....

.....

.....

.....

..... [3]

(ii) The compound which is not a member of the same homologous series as others is used to make a macromolecule for use as a plastic material.

Describe how molecules of this compound react to form the macromolecule.
Draw the structural formula of the macromolecule.

Description .....

..... [2]

Structural formula

[2]

(b) Use information in Table 10.1 to describe and explain a trend in boiling points in the homologous series named in (a) (ii).

.....

.....

.....

.....

.....

..... [3]

[Total: 10]

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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 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	Tc Technetium 43	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	209 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 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
232 Th Thorium 90	231 Pa Protactinium 91	238 U Uranium 92

147 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63
237 Np Neptunium 93	244 Pu Plutonium 94	243 Am Americium 95

157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66
247 Cm Curium 96	247 Bk Berkelium 97	251 Cf Californium 98

165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69
252 Es Einsteinium 99	257 Fm Fermium 100	258 Md Mendelevium 101

173 Yb Ytterbium 70	175 Lu Lutetium 71
259 No Nobelium 102	260 Lr Lawrencium 103

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

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