BOTSWANA EXAMINATIONS COUNCIL
Botswana General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

SCIENCE : DOUBLE AWARD **0569/04**

Paper 4 **October/November 2015**

4 **1 hour 30 minutes**

Candidates answer on the Question Paper.

Additional Materials: 300 mm ruler.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces provided at the top of this page.
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.

Answer **all** questions.
Write your answers in the spaces provided on the question paper.
The number of marks is given in brackets [ ] at the end of each question or part question.
You may use a calculator.

A copy of the Periodic Table is printed on page 16.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
Total	

This document consists of **16** printed pages.

[Turn over

For Examiner's Use

1 An experiment was performed to determine the relationship between the resistance of a wire and the heat energy lost from the wire when there is a current in it.

Fig. 1.1 shows the set-up that was used, with the wire connected between points P and Q.

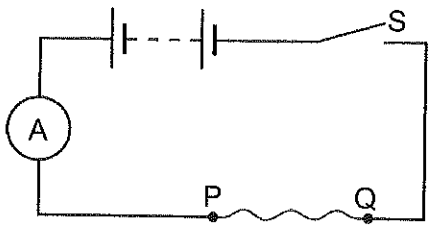

Fig. 1.1

(a) The diameter *d* and length *l* of the wire were measured.

(i) Fig. 1.2 shows the micrometer screw gauge when measuring the diameter *d* of the wire.

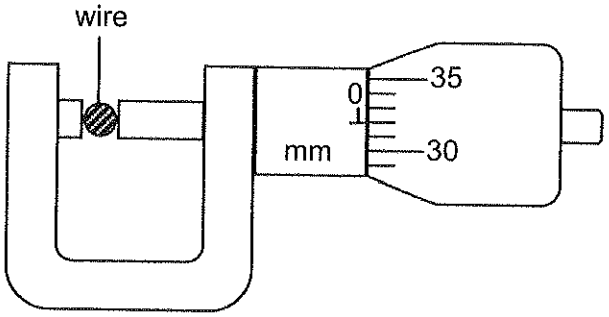

Fig. 1.2

What is the diameter *d* of the wire?

d = ... [1]

(ii) Fig. 1.3 shows a wire of length *l* drawn to scale.

Fig. 1.3

Measure and record the length *l* of the wire in mm.

l = ... [1]

For Examiner's Use

(iii) Calculate the resistance R of the wire. Use the equation

$$R = 0.0014 \times \frac{l}{d^2}$$ where l and d are in mm.

R = ... [2]

(b) **(i)** Fig. 1.4 shows the reading of the ammeter when the switch S was closed.

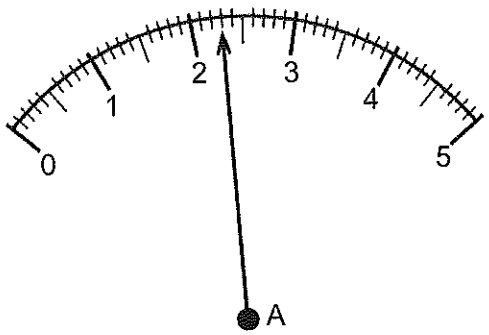

Fig. 1.4

Record the current I measured by the ammeter.

I = ... [1]

(ii) Fig. 1.5 shows a stop watch used to measure the time t for which the switch S was closed.

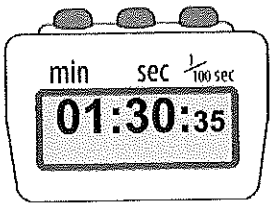

Fig. 1.5

Record the time t in seconds, for which the switch S was closed.

t = ... [1]

(iii) Calculate the heat energy E produced in the wire in time t.

Use the equation $E = I^2Rt$.

energy = ... [1]

For Examiner's Use

(c) You are provided with wires made of three different materials, copper, iron and nichrome. Each material is provided in two different diameters, 0.5 mm and 0.1 mm.

Describe how you would investigate the best material and diameter for a wire to make an electrical heater.

.....

.....

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.....

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.....

.....

..... [4]

2 An experiment was performed to determine the refractive index n of a glass block.

Fig. 2.1 shows the results obtained from the experiment.

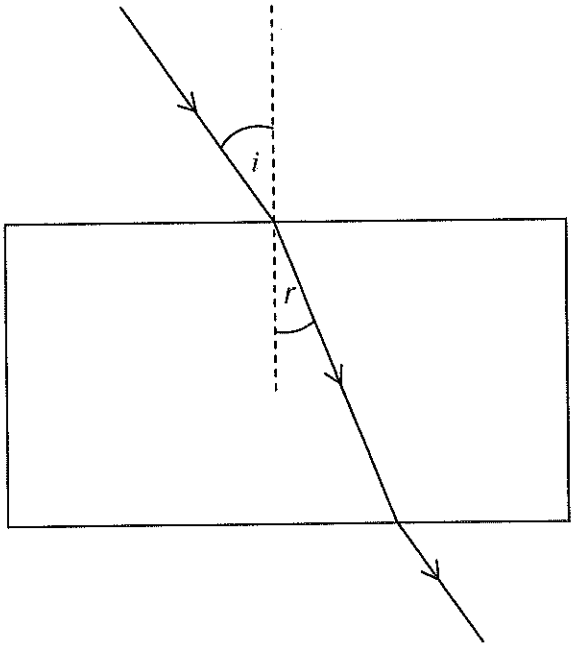


Fig. 2.1

(a) Measure and record

(i) the angle of incidence i,

i = ...

(ii) the angle of refraction r.

r = ...
[2]

(b) Calculate the refractive index n of the glass. Use the equation

$$n = \frac{\sin i}{\sin r}.$$

n = ... [1]

(c) The experiment is repeated using a larger angle of incidence i.

How will this affect the refractive index n?

..... [1]

(d) Suggest **one** source of error that may affect the accuracy of the measurement in **(a)**.

..... [1]

3 A student performed an experiment to find the type of wood which produces most heat energy when it is burned.

She heated equal volumes of water using equal masses of different types of wood chips labelled **P**, **Q** and **R**. The initial temperature of the water was 22 °C.

(a) Fig. 3.1 shows a measuring cylinder containing the volume of water that was used.

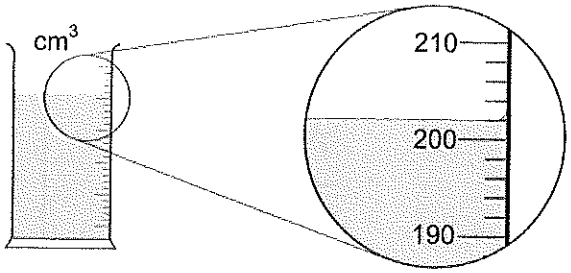
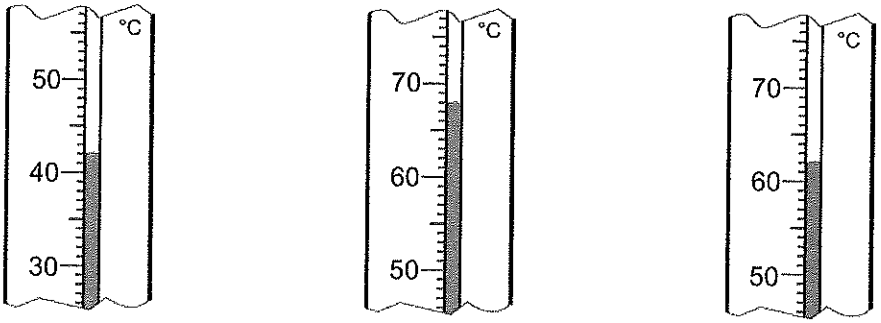


Fig. 3.1

Record the volume *V* of the water used.

V = ... [1]

(b) Fig. 3.2 shows the thermometer scale readings after heating the water using each type of wood for 5 minutes.



wood **P** wood **Q** wood **R**

Fig. 3.2

The student recorded the density of each wood in Table 3.1.

Complete Table 3.1 by writing the final temperatures of the water as shown by the thermometer scales.

Table 3.1

wood	density / (g / cm^3)	final temperature / °C
P	0.64	42
Q	1.27	
R	1.10	

[1]

(c) What conclusion can be drawn from these measurements?

..... [1]

(d) Suggest **one** other variable that would need to be kept constant in order to ensure that the experiment was a fair test.

..... [1]

For Examiner's Use

4 A student prepared potassium chloride, KC*l*, by neutralizing 25 cm^3 of a solution of potassium carbonate, K_2CO_3, with hydrochloric acid, HC*l*.

Fig. 4.1 shows the set-up used.

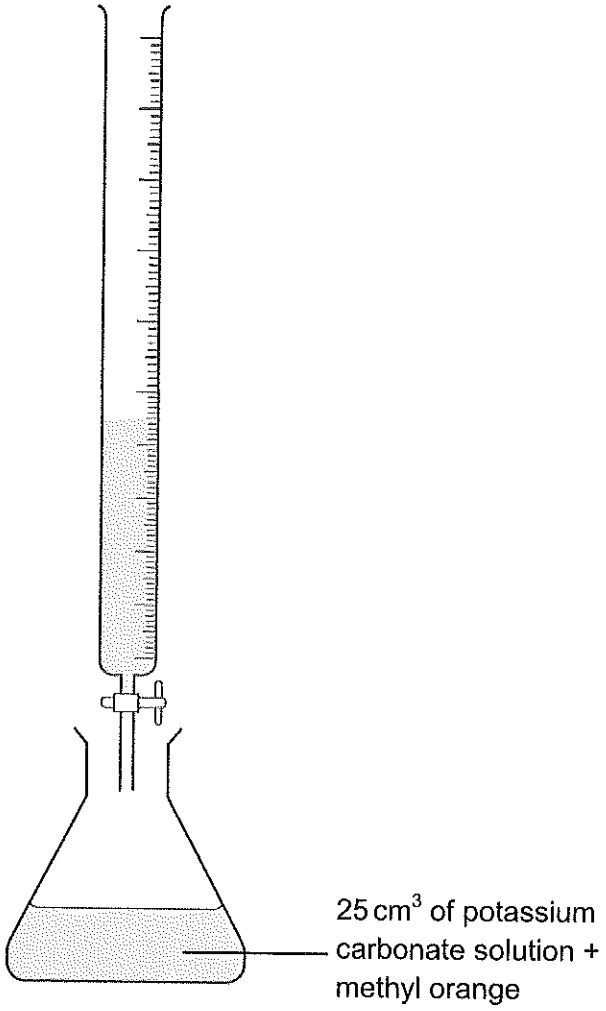


Fig. 4.1

(a) What is the colour of methyl orange

(i) at the beginning of the experiment,

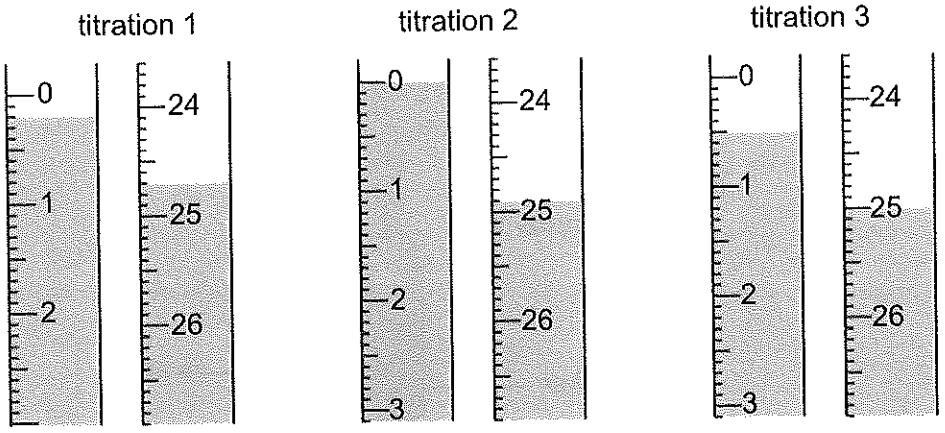
..... [1]

(ii) at the end of the experiment?

..... [1]

For Examiner's Use

(b) The diagrams show the burette readings before and at the end of three titrations.



(i) Use the burette diagrams to complete Table 4.1.

Table 4.1

titration	1	2	3
final burette reading / cm^3			
initial burette reading / cm^3			
volume used / cm^3			
tick the best results			

[5]

(ii) Using the two best results, calculate the average volume of the acid used for the titration.

average volume = ... [1]

(c) This average volume of the acid was mixed with 25 cm^3 of potassium carbonate solution to obtain potassium chloride solution.

Describe how you would obtain crystals of potassium chloride from the solution.

.....

.....

.....

.....

..... [3]

5 **(a)** Fig. 5.1 shows a set-up used in an experiment to prepare a solution of ammonia.

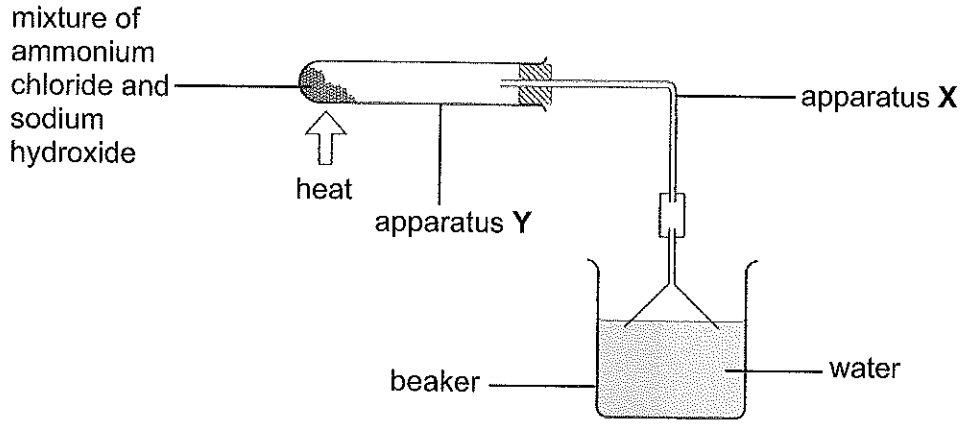


Fig. 5.1

Name the apparatus **X** and **Y**.

X.....

Y..... [2]

(b) The ammonia solution prepared in **(a)** is used to test a solution of copper(II) sulphate solution.

What will be observed when

(i) only a few drops of ammonia solution are added,

.....

..... [2]

(ii) excess ammonia solution is added to the mixture in **(b)(i)**?

.....

..... [2]

(c) Describe how to test for the sulphate ions in aqueous copper(II) sulphate solution.

.....

.....

.....

..... [3]

QUESTION 6 BEGINS ON PAGE 12

6 Three plants **E**, **F** and **G** of different species were selected randomly. Different insects which visited flowers of each plant between 0800 hrs and 1000 hrs were counted.

The results are shown in Fig. 6.1.

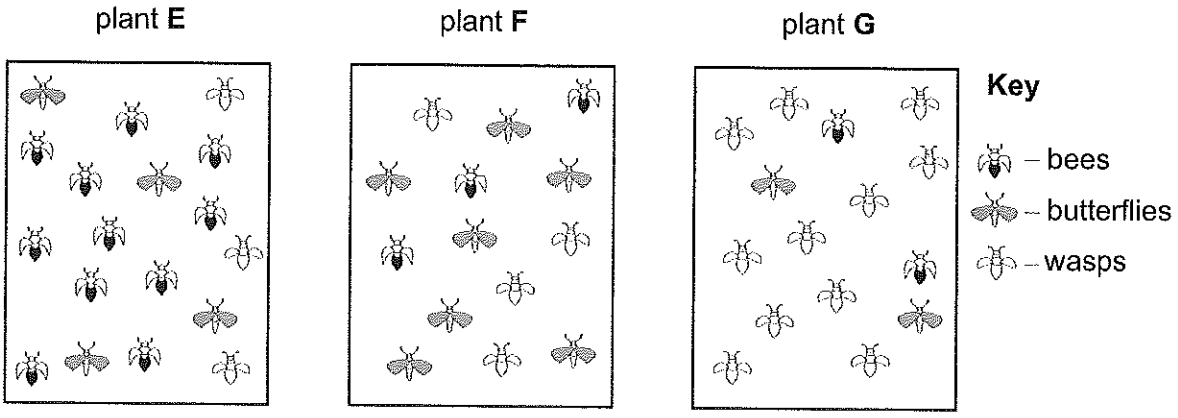


Fig. 6.1

(a) Count the number of insects which visited each plant and record the results in Table 6.1.

Table 6.1

flower	bees	butterflies	wasps
E			
F			
G			

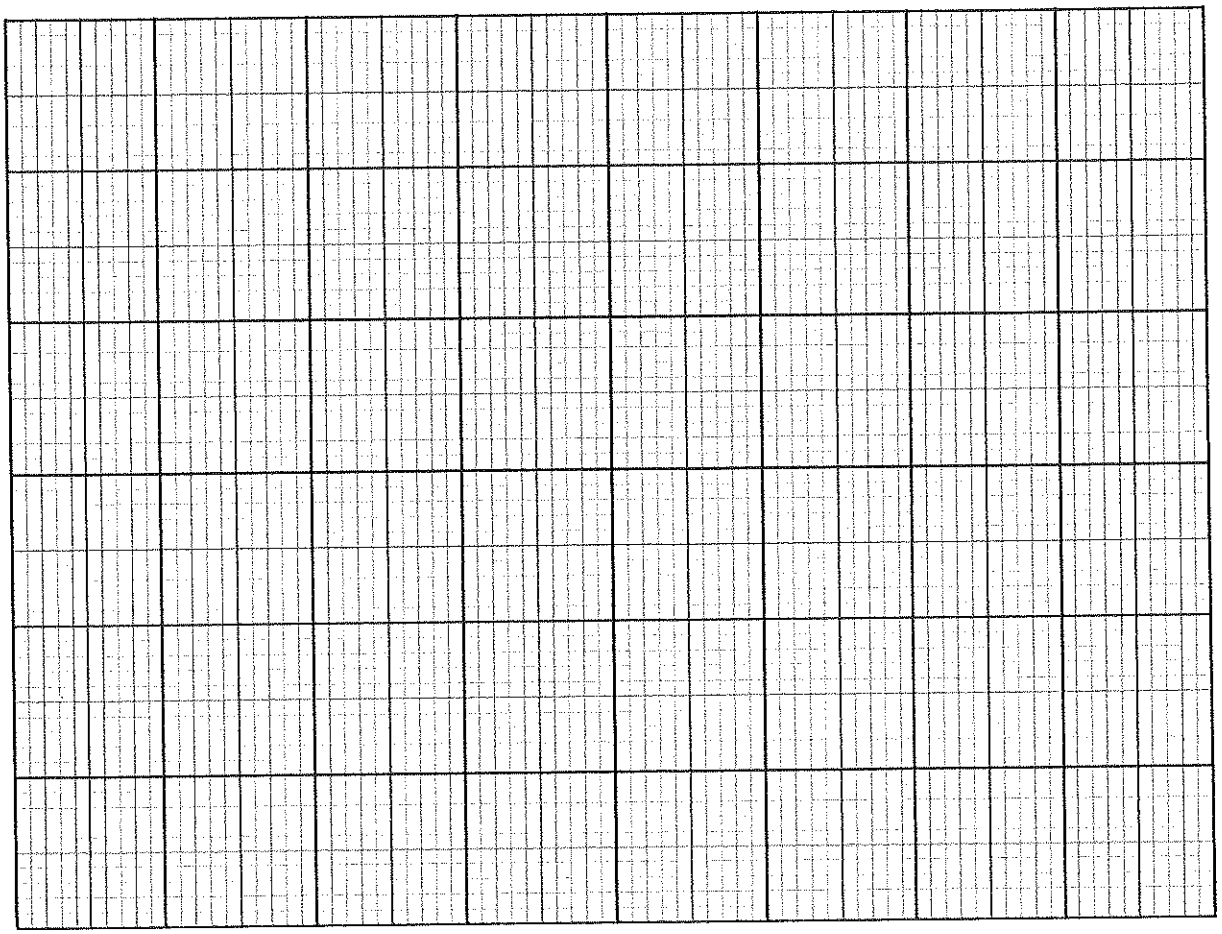
[3]

(b) Which plant is **mostly** visited by wasps?

..... [1]

For Examiner's Use

(c) Draw a bar chart to show the number of insects which visited plants **E** and **F**.



[4]

(d) How can the investigation be improved?

..... [1]

7 Fig. 7.1 shows a photograph of the cross-section of a paw-paw fruit.

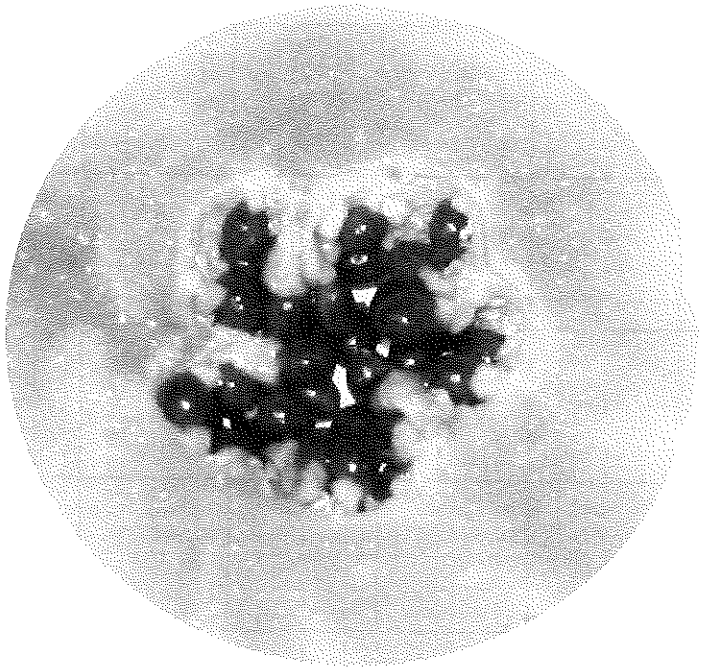


Fig. 7.1

(a) Make a large drawing of Fig. 7.1.

[4]

For Examiner's Use

(b) (i) Measure and record the longest diameter of the photograph.

longest diameter = ... [1]

(ii) The magnification of the fruit in the photograph is X0.8.

Calculate the actual diameter of the fruit.

actual diameter = ... [2]

(c) A small piece of the fruit was tested for fats.

Describe how the piece would be tested for fats.

.....

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.....

.....

..... [4]

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	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 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	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

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

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

Key

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

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