



**BOTSWANA EXAMINATIONS COUNCIL**  
Botswana General Certificate of Secondary Education

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**SCIENCE : DOUBLE AWARD**

**0569/04**

Paper 4

**October/November 2014**

**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	
<b>Total</b>	

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



- 1 An experiment was performed to find the relationship between the load hung on a spring and the extension of the spring. Fig. 1.1 shows the spring with some of the loads used in the experiment.

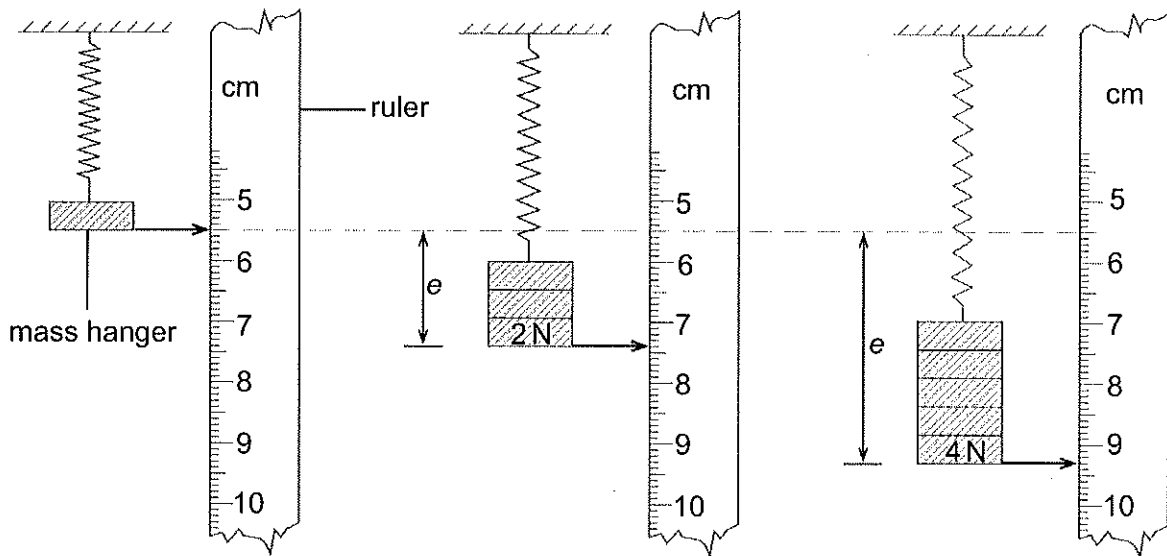


Fig. 1.1

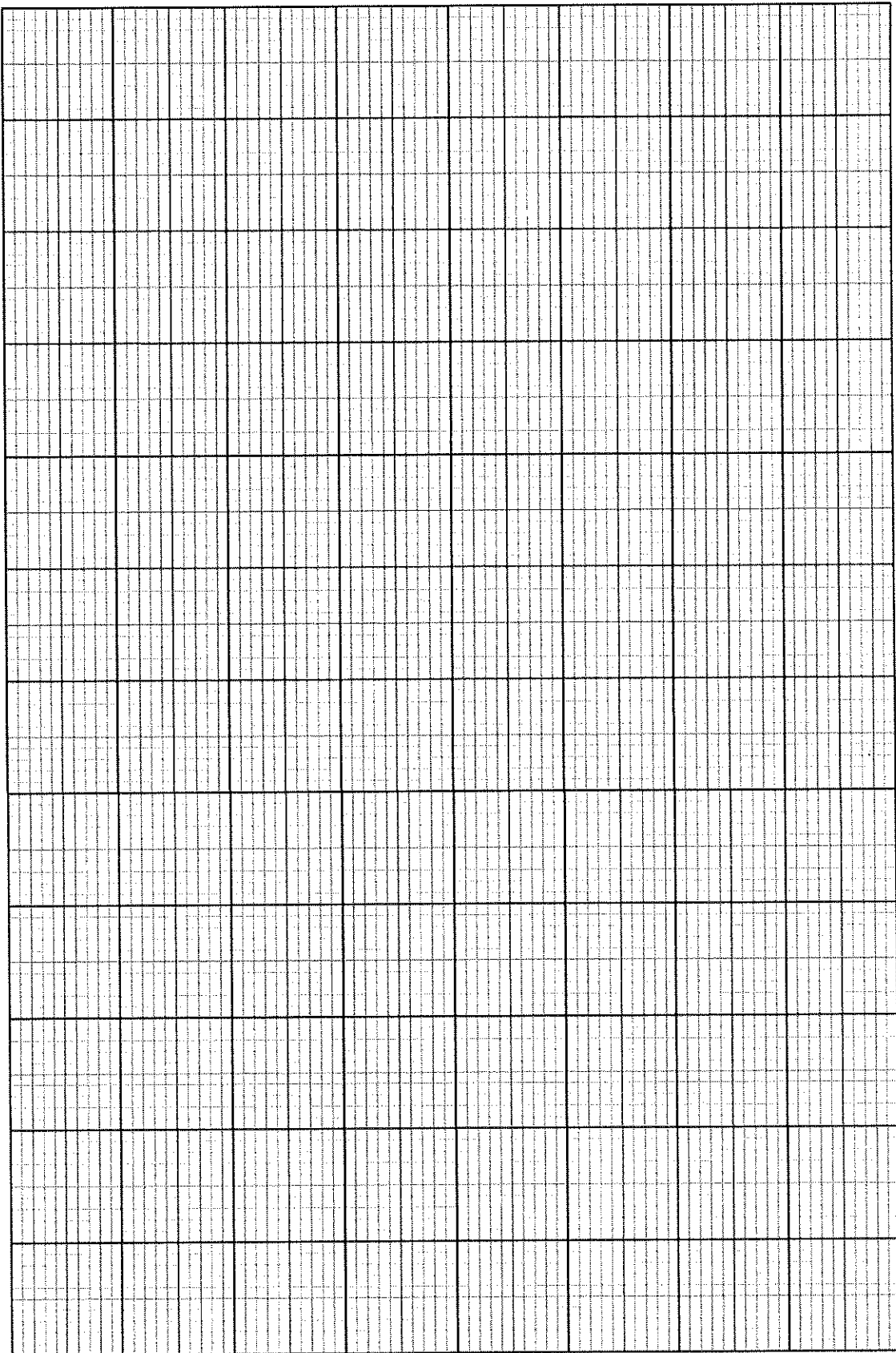
- (a) Record the extension,  $e$ , produced by the 2 N and the 4 N loads in Table 1.1.

Table 1.1

load / N	extension / cm
0.0	0.0
1.0	0.9
2.0	
3.0	2.7
4.0	
5.0	4.8
6.0	5.8

[2]

(b) Plot a graph of extension (y-axis) against load (x-axis).



[4]



(c) Calculate the gradient,  $G$ , of the graph.

$G = \dots\dots\dots$  [2]

(d) Calculate the force constant,  $k$ , using the equation shown.

$$k = \frac{1}{G}$$

$k = \dots\dots\dots$  [1]

(e) State **one** possible source of error for this experiment.

.....  
..... [1]

2 A student has a copper wire and a nichrome wire. He wishes to do an experiment to find which wire is the best conductor of electricity. To do so, he intends to measure the resistance of each wire.

(a) State **one** variable which should be kept the same throughout the experiment.

..... [1]

(b) Describe how the student should carry out an experiment to measure the resistance of each wire. Draw a diagram of the circuit he should use.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
..... [6]



- (c) Fig. 2.1 shows the ammeter and voltmeter readings for the experiment using one of the wires.

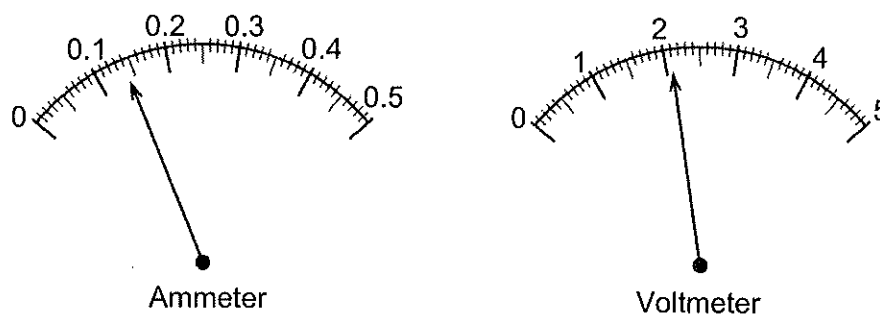


Fig. 2.1

- (i) Record the ammeter reading and the voltmeter reading for the experiment.

ammeter reading,  $I =$  .....

voltmeter reading,  $V =$  ..... [2]

- (ii) Calculate the resistance of the wire.  
Use the equation

$$R = \frac{V}{I}$$

$R =$  ..... [1]

- 3 A sample of water was collected and analysed to find the ions it contained. The sample was divided into four portions. Table 3.1 shows some tests, observations and conclusions made on the sample of water.

Complete Table 3.1 by writing in the missing test methods, observations and conclusions.

**Table 3.1**

test	observation	conclusion
<p>(a)(i) To the first portion of the sample, dilute hydrochloric acid was added.</p> <p>..... [1]</p>	<p>.....</p> <p>.....</p> <p>..... [1]</p>	<p>carbonate ions, <math>\text{CO}_3^{2-}</math>, are present</p>
<p>(ii) The gas given off was tested with limewater.</p> <p>..... [1]</p>	<p>.....</p> <p>.....</p> <p>..... [1]</p>	
<p>(b) To a second portion, dilute nitric acid and silver nitrate solution were added.</p> <p>..... [1]</p>	<p>white precipitate formed</p> <p>.....</p> <p>..... [1]</p>	<p>.....</p> <p>..... [1]</p>
<p>(c) .....</p> <p>..... [1]</p> <p>.....</p> <p>..... [1]</p>	<p>brown precipitate formed</p> <p>precipitate does not dissolve</p>	<p>.....</p> <p>..... [1]</p>
<p>(d) To the fourth portion,</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>..... [2]</p>	<p>.....</p> <p>.....</p> <p>..... [1]</p>	<p>sulphate ions, <math>\text{SO}_4^{2-}</math>, not present</p>

- (e) Suggest **one** of the compounds present in the sample of water.

..... [1]



- 4 Fig. 4.1 shows a set-up used to collect and measure the volume of gas produced during a reaction between excess dilute hydrochloric acid and calcium.

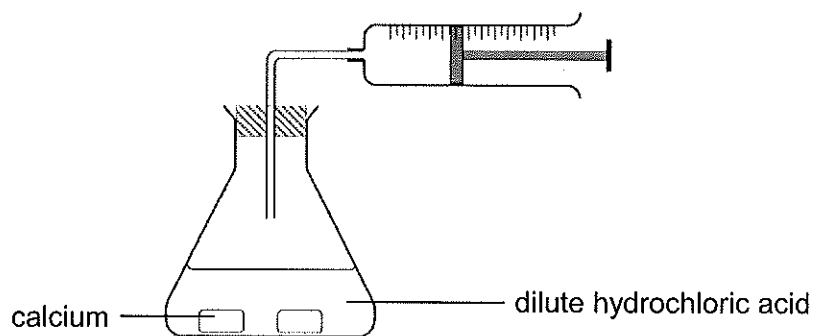


Fig. 4.1

Fig. 4.2 shows the gas syringe readings recorded at 1 minute intervals for 5 minutes.

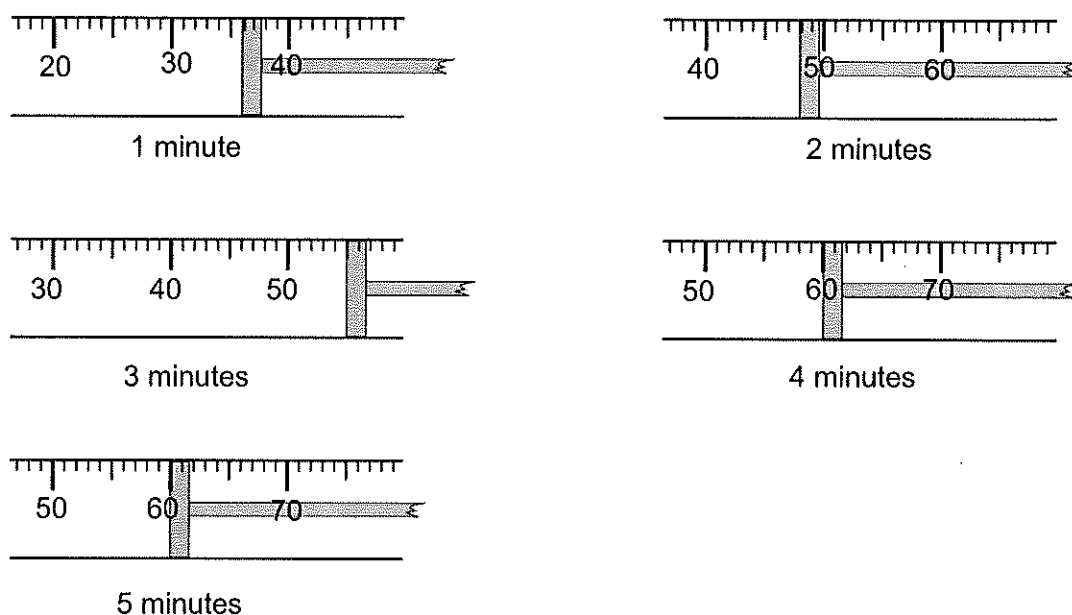


Fig. 4.2

- (a) (i) Record the gas syringe readings in Table 4.1.

Table 4.1

time / minutes	volume of gas / cm <sup>3</sup>
0	0
1	
2	
3	
4	
5	

[3]

(ii) Explain why the readings after 4 minutes and 5 minutes are the same.

.....  
..... [1]

(b) The student was asked to repeat the experiment using the same mass of calcium and excess dilute hydrochloric acid of the same concentration.

Fig. 4.3 shows the flasks containing the calcium used in both experiments.

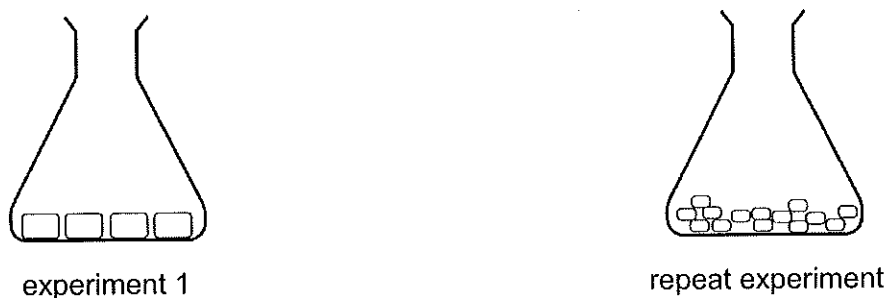


Fig. 4.3

(i) Predict the final volume of the gas collected in the repeat experiment.

..... [1]

(ii) Compare the rate of reaction for the second experiment with that of the first experiment. Explain your answer.

comparison .....

.....

explanation .....

..... [2]



5 Name the apparatus shown in Fig. 5.1.

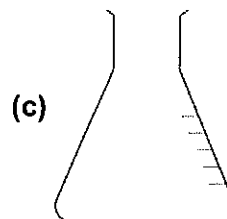
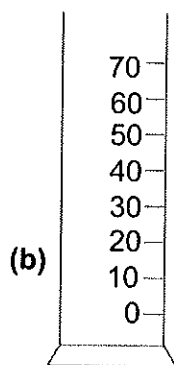
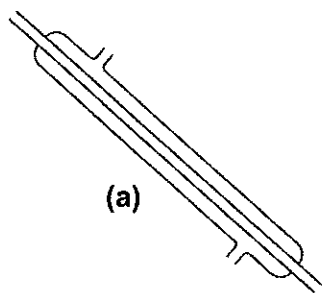


Fig. 5.1

(a) .....

(b) .....

(c) ..... [3]

**Question 6 starts on page 12.**



- 6 A student carried out an experiment using a mixture of yeast and 10% glucose solution to investigate anaerobic respiration, as shown in Fig. 6.1.

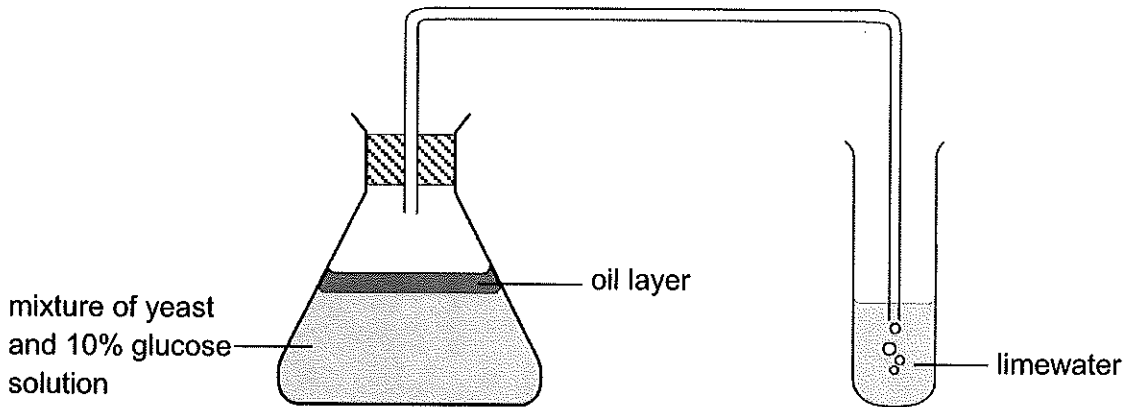


Fig. 6.1

- (a) Explain why it is important to have the layer of oil over the glucose and yeast mixture.

.....  
 ..... [1]

- (b) What observation will be made in the limewater after 15 minutes?

..... [1]

- (c) After 60 minutes, there were no bubbles coming out of the delivery tube.

Suggest a reason why the bubbles were not coming out of the delivery tube.

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

- (d) Suggest a control for this experiment.

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

(e) A similar experiment was carried out at varying temperatures. The volume of gas produced after 25 minutes for each experiment is recorded in Table 6.1.

Table 6.1

temperature / °C	volume of gas produced / cm <sup>3</sup>
15	6
	22
42	40
55	25

Fig. 6.2 shows the thermometer reading when the volume of gas produced was 22 cm<sup>3</sup>.

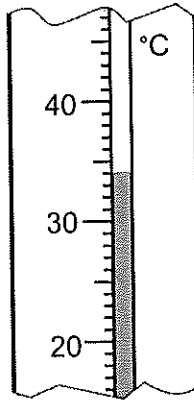
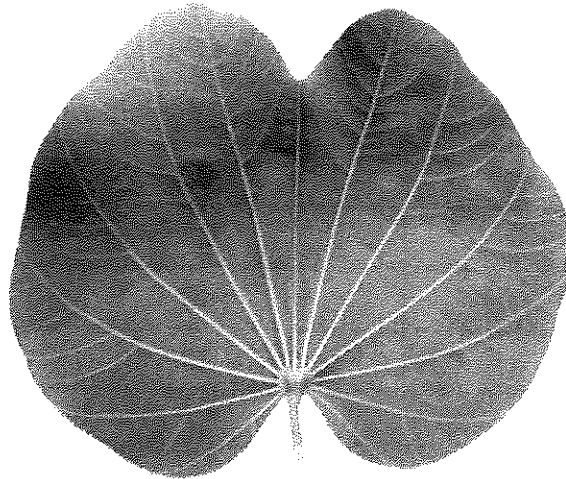


Fig. 6.2

- (i) Complete Table 6.1 by filling in the temperature shown on the thermometer scale. [1]
- (ii) Suggest the optimum temperature for anaerobic respiration in the yeast.  
 optimum temperature = ..... [1]
- (iii) Explain how you arrived at your answer in (e) (ii).  
 .....  
 ..... [1]



- 7 Fig. 7.1 shows a photograph of a leaf taken from a green plant.



**Fig. 7.1**

- (a)** Draw an enlarged diagram of the leaf in Fig. 7.1.

[3]

(b) Measure and record the length of the longest side of the photograph and your drawing. Draw a line on Fig. 7.1 and your drawing to indicate where each measurement was taken.

(i) photograph

longest length = .....

(ii) drawing

longest length = ..... [2]

(c) Calculate the magnification.

..... [2]

(d) Describe an experiment that can be performed to show that photosynthesis was taking place in the leaf before it was collected.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
..... [4]

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DATA SHEET  
The Periodic Table of the Elements

		Group															
I	II	III	IV	V	VI	VII	0					0					
1 <b>H</b> Hydrogen																	
7 <b>Li</b> Lithium	9 <b>Be</b> Beryllium	11 <b>B</b> Boron	12 <b>C</b> Carbon	13 <b>Al</b> Aluminium	14 <b>Si</b> Silicon	15 <b>P</b> Phosphorus	16 <b>S</b> Sulphur	17 <b>Cl</b> Chlorine	18 <b>Ar</b> Argon	19 <b>F</b> Fluorine	20 <b>Ne</b> Neon						
3 <b>Na</b> Sodium	4 <b>Mg</b> Magnesium	5 <b>B</b> Boron	6 <b>C</b> Carbon	7 <b>N</b> Nitrogen	8 <b>O</b> Oxygen	9 <b>F</b> Fluorine	10 <b>Ne</b> Neon	11 <b>B</b> Boron	12 <b>C</b> Carbon	13 <b>Al</b> Aluminium	14 <b>Si</b> Silicon	15 <b>P</b> Phosphorus	16 <b>S</b> Sulphur	17 <b>Cl</b> Chlorine	18 <b>Ar</b> Argon		
19 <b>K</b> Potassium	20 <b>Ca</b> Calcium	21 <b>Sc</b> Scandium	22 <b>Ti</b> Titanium	23 <b>V</b> Vanadium	24 <b>Cr</b> Chromium	25 <b>Mn</b> Manganese	26 <b>Fe</b> Iron	27 <b>Co</b> Cobalt	28 <b>Ni</b> Nickel	29 <b>Cu</b> Copper	30 <b>Zn</b> Zinc	31 <b>Ga</b> Gallium	32 <b>Ge</b> Germanium	33 <b>As</b> Arsenic	34 <b>Se</b> Selenium	35 <b>Br</b> Bromine	36 <b>Kr</b> Krypton
37 <b>Rb</b> Rubidium	38 <b>Sr</b> Strontium	39 <b>Y</b> Yttrium	40 <b>Zr</b> Zirconium	41 <b>Nb</b> Niobium	42 <b>Mo</b> Molybdenum	43 <b>Tc</b> Technetium	44 <b>Ru</b> Ruthenium	45 <b>Rh</b> Rhodium	46 <b>Pd</b> Palladium	47 <b>Ag</b> Silver	48 <b>Cd</b> Cadmium	49 <b>In</b> Indium	50 <b>Sn</b> Tin	51 <b>Sb</b> Antimony	52 <b>Te</b> Tellurium	53 <b>I</b> Iodine	54 <b>Xe</b> Xenon
55 <b>Cs</b> Caesium	56 <b>Ba</b> Barium	57 <b>La</b> Lanthanum	72 <b>Hf</b> Hafnium	73 <b>Ta</b> Tantalum	74 <b>W</b> Tungsten	75 <b>Re</b> Rhenium	76 <b>Os</b> Osmium	77 <b>Ir</b> Iridium	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	83 <b>Bi</b> Bismuth	84 <b>Po</b> Polonium	85 <b>At</b> Astatine	86 <b>Rn</b> Radon
87 <b>Fr</b> Francium	88 <b>Ra</b> Radium	89 <b>Ac</b> Actinium															

140 <b>Ce</b> Cerium	141 <b>Pr</b> Praseodymium	144 <b>Nd</b> Neodymium	150 <b>Sm</b> Samarium	152 <b>Eu</b> Europium	157 <b>Gd</b> Gadolinium	162 <b>Dy</b> Dysprosium	165 <b>Ho</b> Holmium	167 <b>Er</b> Erbium	169 <b>Tm</b> Thulium	173 <b>Yb</b> Ytterbium	175 <b>Lu</b> Lutetium
58 <b>Ce</b> Cerium	59 <b>Pr</b> Praseodymium	60 <b>Nd</b> Neodymium	62 <b>Sm</b> Samarium	63 <b>Eu</b> Europium	64 <b>Gd</b> Gadolinium	66 <b>Dy</b> Dysprosium	67 <b>Ho</b> Holmium	68 <b>Er</b> Erbium	69 <b>Tm</b> Thulium	70 <b>Yb</b> Ytterbium	71 <b>Lu</b> Lutetium
90 <b>Th</b> Thorium	91 <b>Pa</b> Protactinium	92 <b>U</b> Uranium	94 <b>Pu</b> Plutonium	95 <b>Am</b> Americium	96 <b>Cm</b> Curium	98 <b>Cf</b> Californium	99 <b>Es</b> Einsteinium	100 <b>Fm</b> Fermium	101 <b>Md</b> Mendelevium	102 <b>No</b> Nobelium	103 <b>Lr</b> Lawrencium

a	<b>X</b>
b	

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

\*58-71 Lanthanoid series  
190-103 Actinoid series

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