



BOTSWANA EXAMINATIONS COUNCIL  
 in collaboration with  
 UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE  
 Botswana General Certificate of Secondary Education

CANDIDATE  
NAME

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CENTRE  
NUMBER

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CANDIDATE  
NUMBER

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**SCIENCE : DOUBLE AWARD**

**0569/03**

Paper 3

**October/November 2010**

**2 hours**

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 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 20.

For Examiner's Use	
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<b>Total</b>	

This document consists of **18** printed pages and **2** blank pages.

- 1 A crane is used to lift a load of 1000 N with a constant speed as shown in Fig. 1.1.

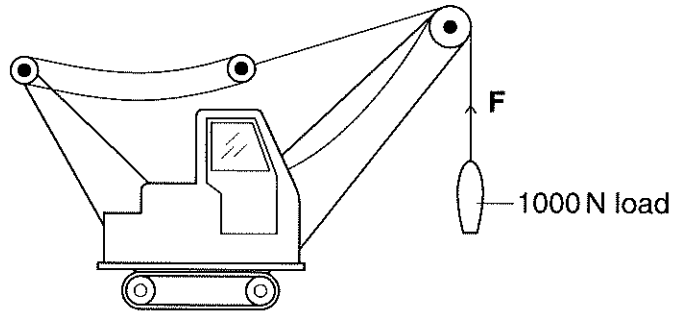


Fig. 1.1

The load takes 15 seconds to lift by 3 metres.

- (a) Calculate the speed of the load.

speed = .....[2]

- (b) State the tension,  $F$ , in the rope.

.....[1]

- (c) Calculate

- (i) the work done in lifting the load by 3 metres,

work done = .....[2]

- (ii) the power output of the crane while lifting the load.

power = .....[2]

21) Fig. 2.1 shows a plug of water in a capillary tube fitted to an empty flask.

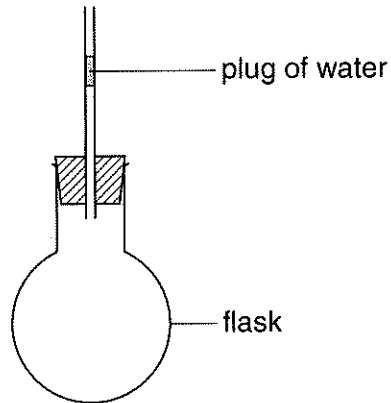


Fig. 2.1

(a) State and explain what will be observed when the flask is placed in hot water.

Observation .....

Explanation .....

.....[2]

(b) The experiment is repeated with the flask placed 25 cm from a heater. A second identical flask is painted black on the outside, and also placed 25 cm from the same heater. The heater is then switched on.

Suggest and explain what will be observed in the two flasks.

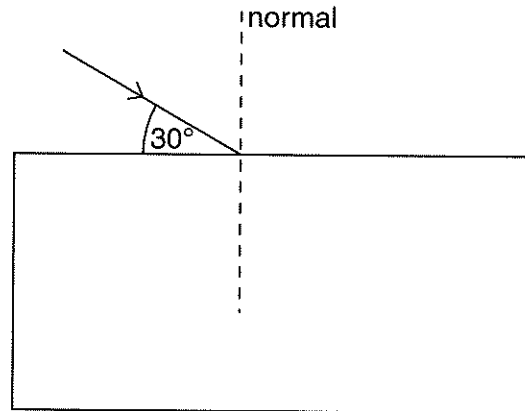
Observation .....

.....

Explanation .....

.....[3]

- 3 Fig. 3.1 shows a ray of light entering a parallel sided glass block.



**Fig. 3.1**

- (a) Complete the path of the ray in Fig. 3.1. [3]
- (b) (i) State the value of the angle of incidence of the ray on the block.  
 ..... [1]
- (ii) Calculate the value of the angle of refraction,  $r$ . (The refractive index,  $n = 1.5$ ).

$r = \dots\dots\dots$  [2]

(NEXT PAGE AS WELL)

- (c) Fig. 3.2 shows a ray of light entering a semi-circular glass block of refractive index 1.5.

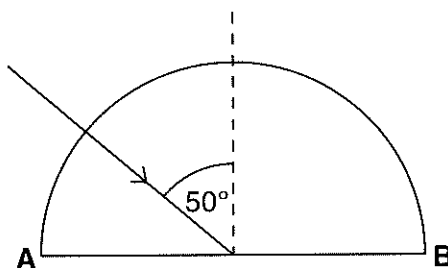


Fig. 3.2

- (i) Explain why the ray does not bend when it enters the glass block.

.....[1]

- (ii) Calculate the critical angle of the glass block.

critical angle = .....[2]

- (iii) How will the ray proceed when it reaches side **AB**?

.....[1]

- 4 Fig. 4.1 shows two resistors connected in series. The reading of voltmeter  $V_1$  is 6V and the reading of voltmeter  $V_2$  is 4V.

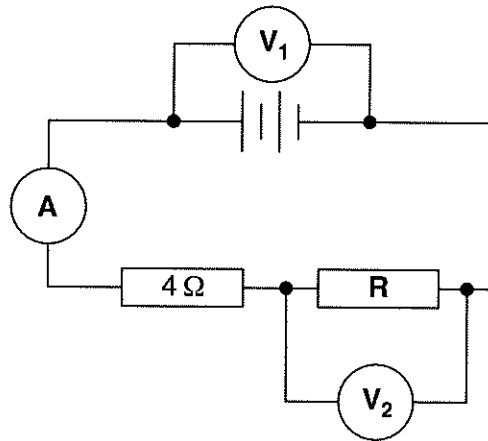


Fig. 4.1

- (a) (i) Calculate the voltage drop across the  $4\ \Omega$  resistor.

.....[1]

- (ii) Calculate the current through the resistors.

.....[2]

- (b) Fig. 4.2 shows the interior of a three-pin fused plug.

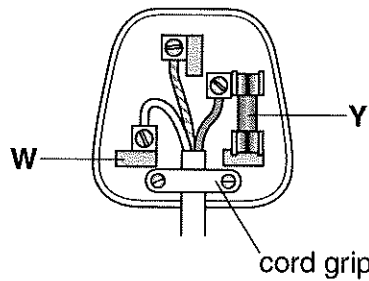


Fig. 4.2

- (i) What are the names of the parts labelled W and Y?

W .....

Y .....[2]

- (ii) What is the purpose of the cord grip?

.....

.....[1]

- 5 Fig. 5.1 shows the industrial method of gauging the thickness of paper using beta particles.

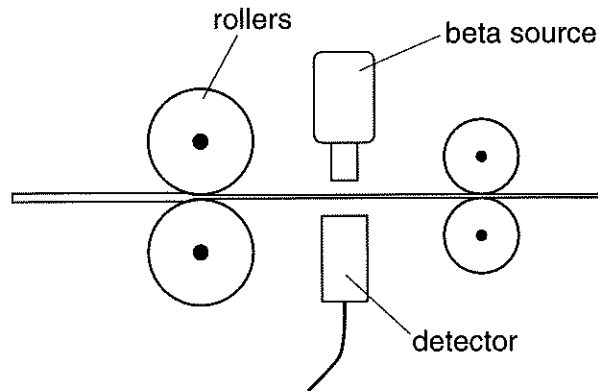


Fig. 5.1

- (a) State the nature and charge of beta particles.

Nature: .....

Charge: ..... [2]

- (b) The measurement of the paper thickness is used to control the pressure applied by the rollers so that the thickness of the paper produced is kept as constant as possible.

Table 5.1 shows the changes that can happen when the paper passes through the rollers.

Complete Table 5.1 using the words, *increases* or *decreases*.

Table 5.1

thickness of paper	radiation detected	pressure applied by rollers
increases		
decreases		decreases

[3]

6 An element **X** has the symbol  ${}_{16}^{35}\text{X}$ .

(a) What is the atomic number of element **X**?

.....[1]

(b) Write the electronic arrangement of element **X**.

.....[1]

(c) Suggest a group and period for element **X** in the Periodic Table.

Group .....

Period .....[1]

(d) Predict how the reactivity of element **X** would compare to that of oxygen. Explain your answer.

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

(e) (i) Element **X** reacts with chlorine to form a compound. Use your answer to (b) and the Periodic Table to predict the electronic structure of a molecule of this compound.

[3]

(ii) Suggest **two** properties of the compound of chlorine and element **X**.

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

- 7 An unknown dye mixture was analysed against known dye mixtures **Q**, **R**, **S** and **T**. The five dyes were spotted along the bottom edge which was then dipped into a liquid. The results obtained are shown in Fig. 7.1.

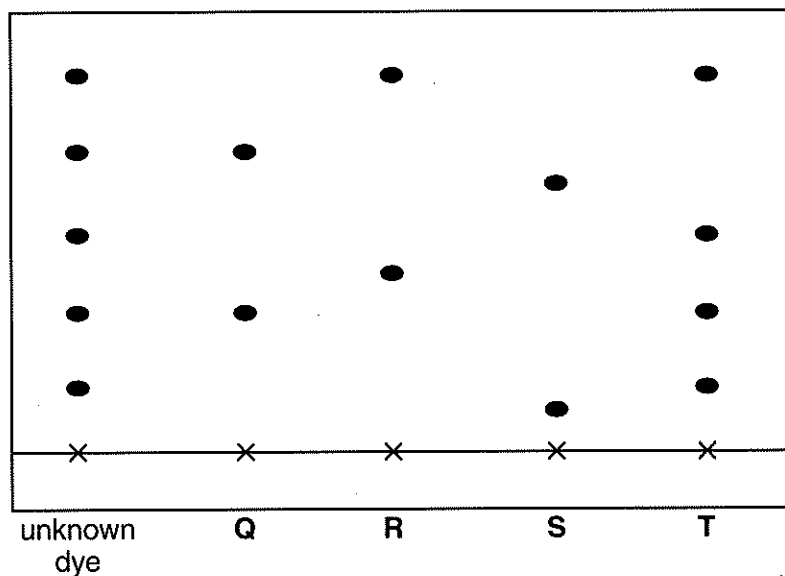


Fig. 7.1

- (a) Name the method of analysis.

.....[1]

- (b) State **one** characteristic of the liquid used.

.....[1]

- (c) Which of the known dye mixtures contains components which are all also present in the unknown dye mixture?

.....[2]

- (d) Which of the known dye mixtures does **not** contain any component found in the other dyes?

.....[1]

- (e) Explain why a ball point pen should **not** be used to rule the line indicating the starting point of the dyes on the filter paper.

.....

.....[1]

- 8 Sodium chlorate(I) solution decomposes into sodium chloride and oxygen gas when a few drops of cobalt(II) nitrate are added in excess. The cobalt(II) nitrate is **not** changed by this process.

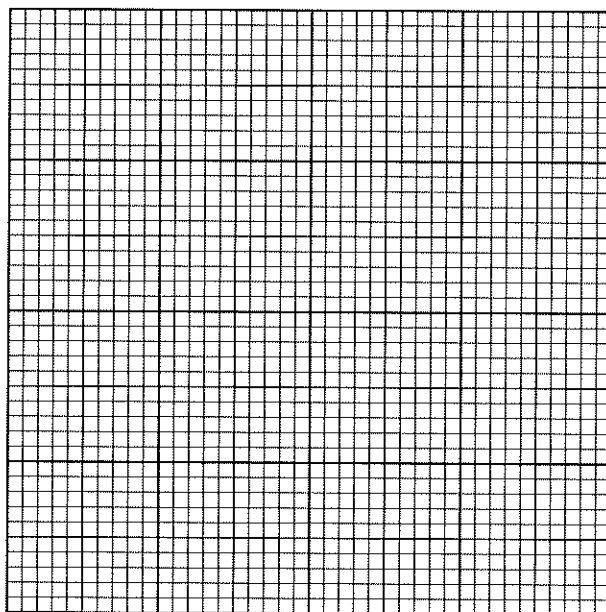
In an experiment 20 cm<sup>3</sup> of sodium chlorate(I) solution was used, and the volume of oxygen gas produced was recorded at various intervals as shown.

time/min	0	0.5	1.0	1.5	2.0	2.5	3.0
volume of oxygen / cm <sup>3</sup>	0	47	62	71	75	75	75

- (a) Balance the equation for the formation of sodium chloride and oxygen.



- (b) On the grid below plot a graph of volume of oxygen evolved against time.



[4]

- (c) What term is used to describe the cobalt(II) nitrate?

.....[1]

(d) Describe a test that could be carried out to show that the solution at the end of the experiment contained chloride ions.

.....  
.....  
.....  
.....[3]

(e) Ozone, O<sub>3</sub>, is a form of oxygen. State the importance of the ozone layer in the upper atmosphere.

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

- 9 Fig. 9.1 shows some reactions of ethene,  $C_2H_4$ .

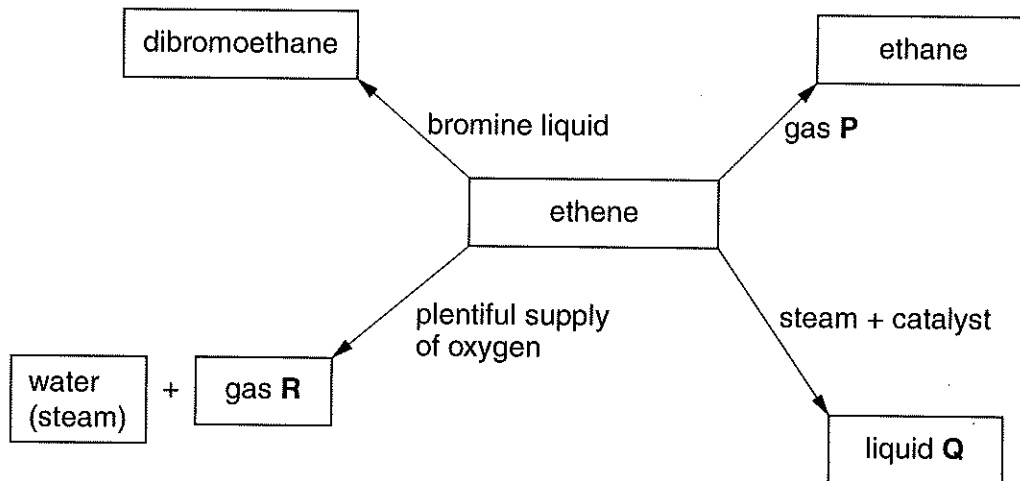


Fig. 9.1

- (a) Name the homologous series to which ethene belongs.

.....[1]

- (b) Give the names of,

(i) gas P, .....

(ii) liquid Q, .....

(iii) gas R. ....[3]

- (c) State the colour change observed when ethene reacts with aqueous bromine.

from ..... to ..... [2]

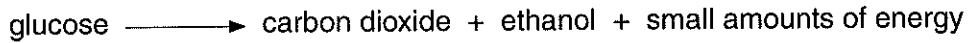
- (d) Draw the structural formula of ethene.

[1]

- (e) Give **one** use of ethene.

.....[1]

10 The word equation below represents a certain form of respiration.



(a) State the form of respiration represented by the equation.

.....[1]

(b) Explain why the energy released is small.

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

(c) The reaction in the equation is controlled by enzymes. Suggest the microorganism from which the enzymes are obtained when producing traditional beer (chibuku).

.....[1]

(d) Describe how abuse of chibuku could affect the human body over a long period of time.

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

- 11 Fig. 11.1 is a graph showing the oxygen released and taken up by a tree during a 24 hour period.

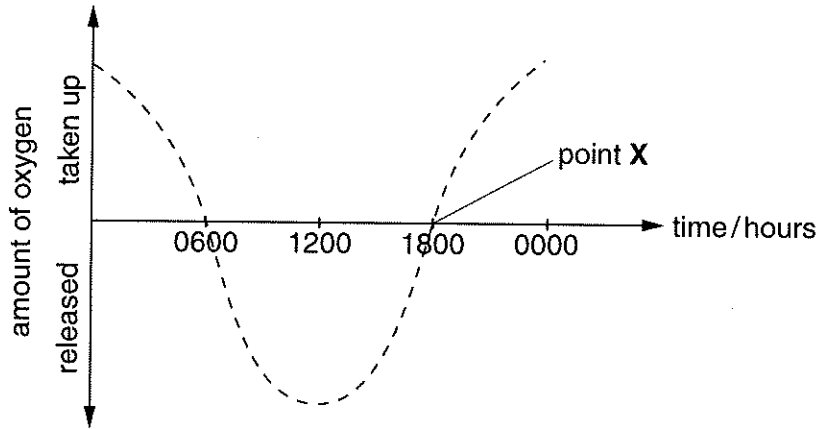


Fig. 11.1

- (a) With reference to Fig. 11.1, name the process that produces oxygen from 0600 hours to 1800 hours.

.....[1]

- (b) State the length of time in the 24 hour period during which the tree took up oxygen.

.....[1]

- (c) Explain why the value of oxygen taken up or released is 0 at point X.

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

- (d) The data in Fig. 11.1 was collected on a day when the environmental temperature was 28°C at midday. Suggest how an increase to 42°C in environmental temperature at midday would affect the release of oxygen by the tree.

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

12 Fig. 12.1 shows a section through human skin.

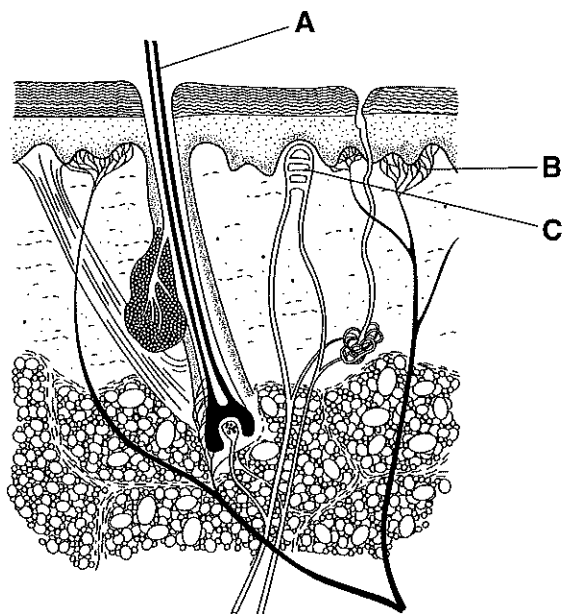


Fig. 12.1

(a) Identify structures B and C.

B .....

C ..... [2]

(b) Suggest the function of structure A in mammals like dogs.

.....

..... [2]

(c) Explain how the human body benefits from sweating during a hot and dry day.

.....

..... [2]

13 Fig. 13.1 shows two white blood cells **P** and **Q** which destroy bacteria in the human body.

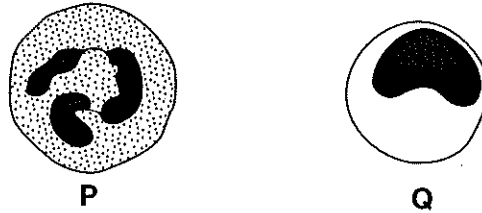


Fig. 13.1

(a) Identify the cells **P** and **Q**.

(i) **P** .....

(ii) **Q** ..... [2]

(b) Describe how each cell destroys bacteria.

**P** .....

.....

**Q** .....

..... [2]

(c) Describe how blood clotting occurs.

.....

.....

.....

.....

..... [3]

(d) Name **two** substances other than oxygen and carbon dioxide which are transported by blood.

1 .....

2 ..... [2]

14 Fig. 14.1 is a bar graph for the percentages of different types of household waste from surveys in 2001 and 2007.

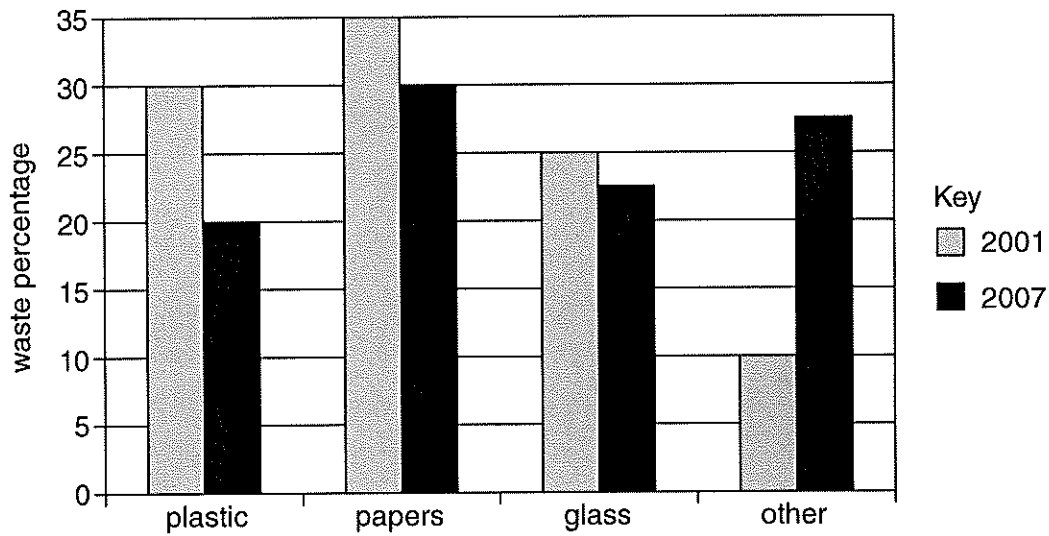


Fig. 14.1

(a) Which material formed the largest percentage of waste in 2001?

.....[1]

(b) (i) Describe how the percentage of plastic waste changed between 2001 and 2007.

.....[1]

(ii) Suggest a reason for the change.

.....[1]

(iii) State **one** disadvantage of plastic waste.

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

(c) Describe how recycling paper can benefit the environment.

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





**DATA SHEET**  
**The Periodic Table of the Elements**

		Group																	
I	II	III	IV	V	VI	VII	0					0							
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4	11 <b>Na</b> Sodium 11	12 <b>C</b> Carbon 6	13 <b>Al</b> Aluminium 13	14 <b>N</b> Nitrogen 7	15 <b>O</b> Oxygen 8	16 <b>F</b> Fluorine 9	17 <b>Ne</b> Neon 10	19 <b>F</b> Fluorine 9	35.5 <b>Cl</b> Chlorine 17	80 <b>Br</b> Bromine 35	131 <b>Xe</b> Xenon 54	4 <b>He</b> Helium 2						
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12	27 <b>Co</b> Cobalt 27	28 <b>Si</b> Silicon 14	31 <b>P</b> Phosphorus 15	32 <b>S</b> Sulphur 16	35.5 <b>Cl</b> Chlorine 17	40 <b>Ar</b> Argon 18	59 <b>Co</b> Cobalt 27	56 <b>Fe</b> Iron 26	55 <b>Mn</b> Manganese 25	58 <b>Ni</b> Nickel 28	64 <b>Cu</b> Copper 29	65 <b>Zn</b> Zinc 30	75 <b>As</b> Arsenic 33	76 <b>Se</b> Selenium 34	79 <b>Br</b> Bromine 35	84 <b>Kr</b> Krypton 36	85 <b>At</b> Astatine 85	
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20	45 <b>Sc</b> Scandium 21	48 <b>Ti</b> Titanium 22	51 <b>V</b> Vanadium 23	52 <b>Cr</b> Chromium 24	55 <b>Mn</b> Manganese 25	58 <b>Ni</b> Nickel 28	64 <b>Cu</b> Copper 29	65 <b>Zn</b> Zinc 30	73 <b>Ge</b> Germanium 32	75 <b>As</b> Arsenic 33	79 <b>Se</b> Selenium 34	80 <b>Br</b> Bromine 35	84 <b>Kr</b> Krypton 36	85 <b>At</b> Astatine 85	86 <b>Rn</b> Radon 86	87 <b>Fr</b> Francium 87	88 <b>Ra</b> Radium 88	89 <b>Ac</b> Actinium 89
87 <b>Fr</b> Francium 87	88 <b>Ra</b> Radium 88	89 <b>Ac</b> Actinium 89	91 <b>Zr</b> Zirconium 40	93 <b>Nb</b> Niobium 41	96 <b>Mo</b> Molybdenum 42	101 <b>Ru</b> Ruthenium 44	106 <b>Pd</b> Palladium 46	108 <b>Ag</b> Silver 47	112 <b>Cd</b> Cadmium 48	119 <b>Sn</b> Tin 50	122 <b>Sb</b> Antimony 51	128 <b>Te</b> Tellurium 52	127 <b>I</b> Iodine 53	131 <b>Xe</b> Xenon 54	136 <b>Ba</b> Barium 56	137 <b>Cs</b> Caesium 55	138 <b>Ba</b> Barium 56	139 <b>La</b> Lanthanum 57	140 <b>Ce</b> Cerium 58
133 <b>Cs</b> Caesium 55	137 <b>Cs</b> Caesium 55	138 <b>Ba</b> Barium 56	141 <b>Pr</b> Praseodymium 59	144 <b>Nd</b> Neodymium 60	147 <b>Pm</b> Promethium 61	150 <b>Sm</b> Samarium 62	152 <b>Eu</b> Europium 63	157 <b>Gd</b> Gadolinium 64	162 <b>Dy</b> Dysprosium 66	165 <b>Ho</b> Holmium 67	167 <b>Er</b> Erbium 68	169 <b>Tm</b> Thulium 69	173 <b>Yb</b> Ytterbium 70	175 <b>Lu</b> Lutetium 71	226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	228 <b>Th</b> Thorium 90	232 <b>Th</b> Thorium 90	238 <b>U</b> Uranium 92
191 <b>Th</b> Thorium 90	192 <b>Pa</b> Protactinium 91	194 <b>U</b> Uranium 92	197 <b>Np</b> Neptunium 93	201 <b>Pu</b> Plutonium 94	206 <b>Am</b> Americium 95	210 <b>Cm</b> Curium 96	215 <b>Bk</b> Berkelium 97	226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	228 <b>Th</b> Thorium 90	232 <b>Th</b> Thorium 90	238 <b>U</b> Uranium 92	244 <b>Pu</b> Plutonium 94	250 <b>Am</b> Americium 95	255 <b>Cm</b> Curium 96	261 <b>Bk</b> Berkelium 97	267 <b>Cf</b> Californium 98	271 <b>Es</b> Einsteinium 99	285 <b>Fm</b> Fermium 100
261 <b>Bk</b> Berkelium 97	267 <b>Cf</b> Californium 98	271 <b>Es</b> Einsteinium 99	285 <b>Fm</b> Fermium 100	289 <b>Md</b> Mendelevium 101	293 <b>No</b> Nobelium 102	297 <b>Lr</b> Lawrencium 103	298 <b>Uu</b> Ununseptium 104	301 <b>Uub</b> Ununbium 105	303 <b>Uut</b> Ununtrium 106	307 <b>Uuq</b> Ununquadium 107	309 <b>Uuq</b> Ununquadium 107	311 <b>Uuq</b> Ununquadium 107	313 <b>Uuq</b> Ununquadium 107	315 <b>Uuq</b> Ununquadium 107	317 <b>Uuq</b> Ununquadium 107	319 <b>Uuq</b> Ununquadium 107	321 <b>Uuq</b> Ununquadium 107	323 <b>Uuq</b> Ununquadium 107	325 <b>Uuq</b> Ununquadium 107

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

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

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