Centre Number	Candidate Number	Name

MINISTRY OF EDUCATION, BOTSWANA

in collaboration with

UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE

Botswana General Certificate of Secondary Education

SCIENCE : DOUBLE AWARD **0569/03**

Paper 3 October/November 2005

2 hours

Candidates answer on the Question Paper.
No Additional Materials are required.

Read the following carefully before you start.

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

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

Do not use staples, paper clips, highlighters, glue or correction fluid.

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	
1	
2	
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10	
11	
12	
13	
14	
TOTAL	

This question paper consists of **19** printed pages and **1** blank page.

1 **(a)** **(i)** Define acceleration.

.....

.....[1]

(ii) A bus stops to pick up a passenger. Its speed decreases from 22 m/s to 0 in 10 s. Calculate its deceleration.

deceleration = ...[2]

(b) Fig. 1.1 shows a distance-time graph for a car journey from **A** to **C**.

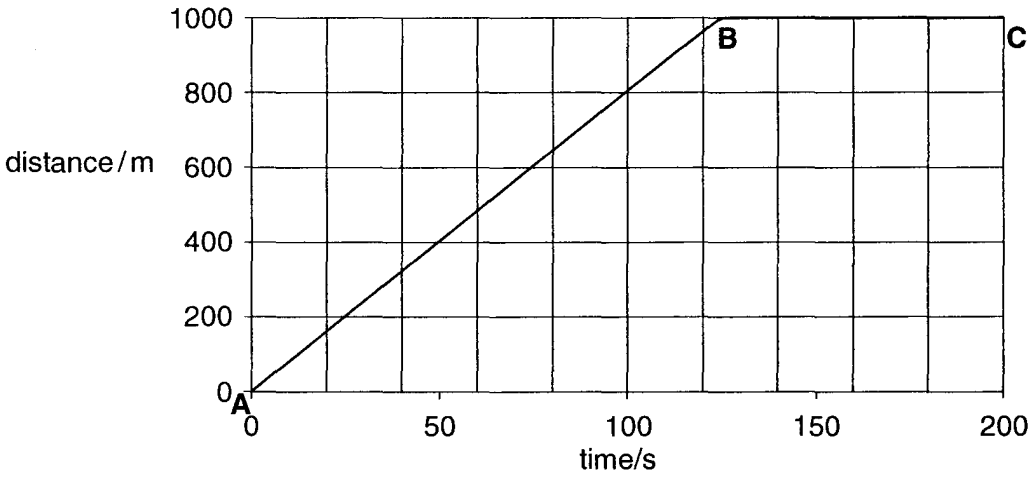

Fig. 1.1

(i) In which region of the graph is the speed of the car constant?

.....

(ii) For how long is the car at rest?

.....

[2]

(c) A ball is dropped from the roof of a building. It reaches the ground in 3 s. ($g = 10\ m/s^2$). Calculate

(i) the height of the building,

height = ...

(ii) the speed of the ball as it touches the ground.

speed = ...

[4]

2 **(a)** Fig. 2.1 shows waves on the surface of a liquid.

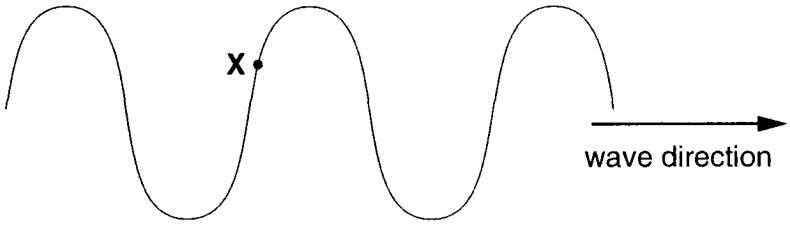

Fig. 2.1

(i) What type of wave is illustrated?

.....

(ii) On the diagram, show one wavelength and label it **λ**.

(iii) **X** is a particle on the surface of the liquid.

On the diagram, draw an arrow to show the direction in which the particle is moving. [3]

(b) Table 2.2 shows critical angles of water, diamond and glass.

Table 2.2

material	critical angle
water	48.8°
diamond	24.4°
glass	41.8°

(i) What is *critical angle*?

.....

.....[1]

(ii) **X** and **Y** are materials in Table 2.2. Use the information from the Table and the paths of the rays in Fig. 2.3 to identify materials **X** and **Y**.

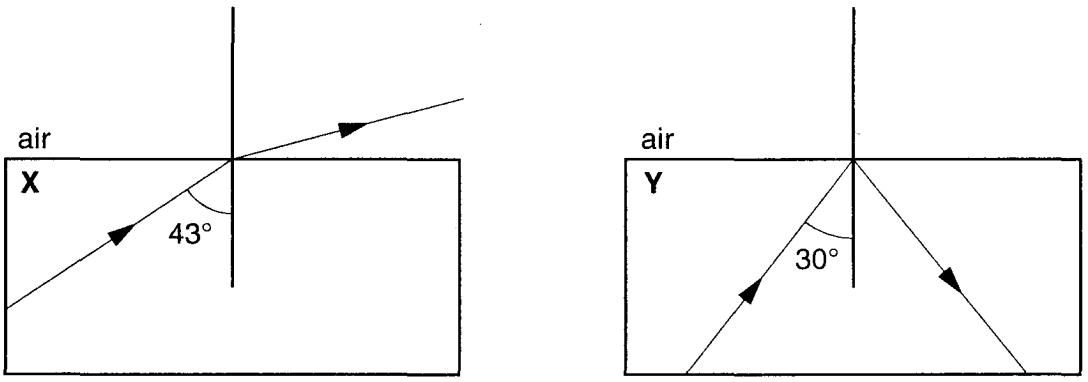

Fig. 2.3

X ..... **Y** ..... [2]

3 Fig. 3.1 shows two magnets.

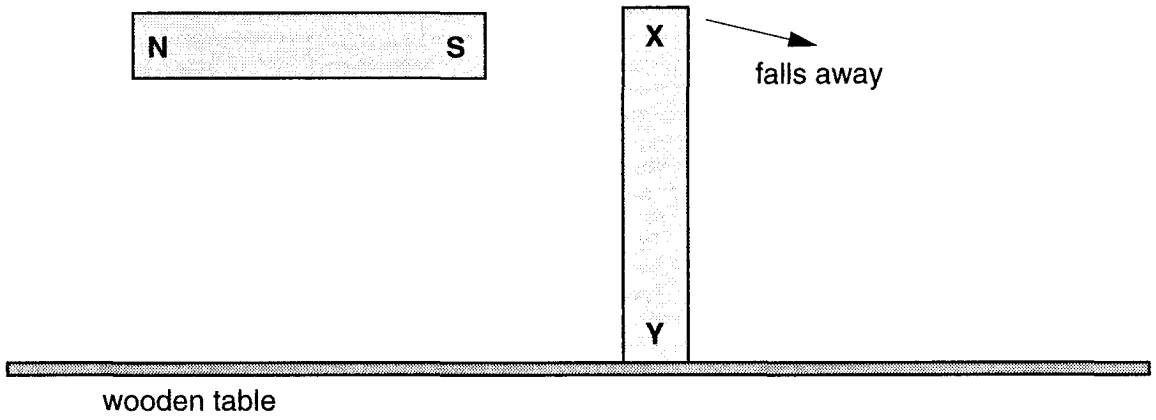

Fig. 3.1

(a) On the diagram below draw the magnetic field around magnet **XY**.

[2]

(b) Fig. 3.2 shows an electromagnet next to four cubes, **A** aluminium, **B** lead, **C** nickel and **D** cobalt.

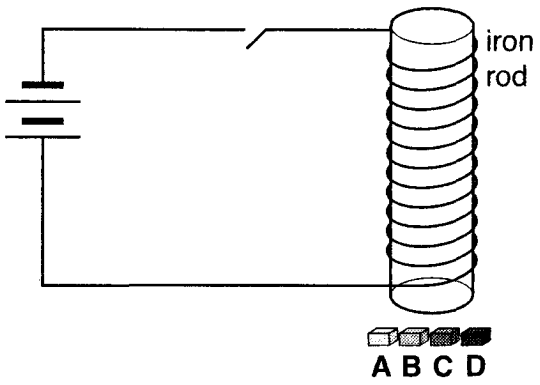

Fig. 3.2

(i) Which two cubes will the magnet pick up when the switch is closed?

1 .....

2 .....

(ii) Suggest two changes that could be made to make the magnet stronger.

1 .....

2 .....

[4]

4 **(a)** Fig. 4.1 shows a transformer connected to a power supply and a milliammeter.

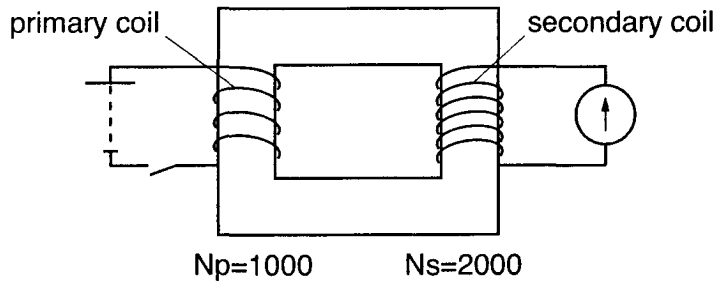

Fig. 4.1

(i) What type of transformer is this?

.....

[1]

(ii) Explain why the milliammeter deflects momentarily when the switch is closed.

.....

.....[2]

(iii) Explain why there is no deflection when the switch remains closed.

.....

.....[2]

(iv) A 240 V a.c. source replaces the supply shown in Fig. 4.1.

Calculate the output voltage.

output = ...[2]

(v) State the advantage of transmitting power at a high voltage.

.....[1]

(b) Fig. 4.2 shows a mains plug.

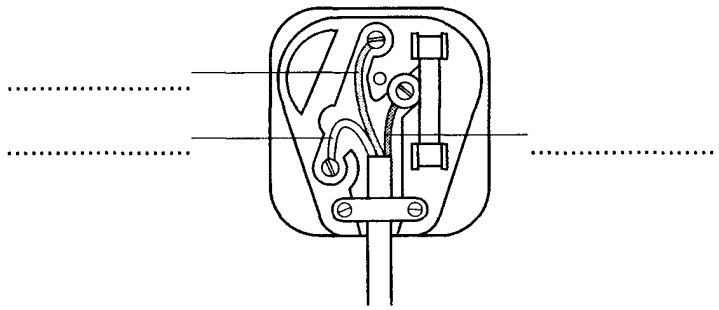

Fig. 4.2

(i) Label the three wires. [3]

(ii) Which wire would be connected to the metal body of an appliance?

.....

Explain why.

.....

.....[2]

5 Several water samples were taken from each of three different sources, **X**, **Y** and **Z**.

A sample from each source was tested for the total concentration of calcium and magnesium ions present.

Further samples were then treated in two different ways before testing again for their concentrations of calcium and magnesium ions.

- A sample from each source was boiled.
- A sample from each source was treated with sodium carbonate.

The results of all these tests are shown in Table 5.1.

Table 5.1

source	total calcium and magnesium ion concentration before treatment / parts per million (ppm)	total calcium and magnesium ion concentration after boiling / parts per million (ppm)	total calcium and magnesium ion concentration after adding sodium carbonate / parts per million (ppm)
X	30	19	0
Y	30	0	0
Z	10	1	0

(a) (i) Explain how boiling removes hardness from water. Include a balanced chemical equation for the reaction that occurs.

explanation .....

.....

.....

.....

equation .....[4]

(ii) Suggest a reason why boiling removed all of the hardness from source **Y** but only part of the hardness of water from sources **X** and **Z**.

.....

.....[1]

(b) Explain why adding sodium carbonate removed all the hardness of the water from all sources.

.....

.....[1]

(c) State a problem which might be caused by water from source **X** in the home.

.....

.....[1]

6 The equation shows the decomposition of magnesium carbonate.

$$MgCO_3(s) \longrightarrow MgO(s) + CO_2(g)$$

(a) Calculate the mass of carbon dioxide formed when 0.1 moles of magnesium carbonate is completely decomposed.

[A_r: Mg = 24, C = 12, O = 16]

mass = ...[3]

(b) Magnesium carbonate reacts with dilute hydrochloric acid as shown by the equation.

$$MgCO_3(s) + 2HCl(aq) \longrightarrow MgCl_2(aq) + CO_2(g) + H_2O(l)$$

(i) How many moles of hydrochloric acid react with 1 mole of magnesium carbonate?

..... [1]

(ii) Calculate the number of moles in 25 cm^3 of 0.1 mol / dm^3 hydrochloric acid.

number of moles = ...[2]

(iii) What volume of carbon dioxide would be produced when 0.1 moles of magnesium carbonate completely reacts with dilute hydrochloric acid at room temperature and pressure?

(1 mole of any gas occupies 24 dm^3 at r.t.p.).

volume = ...[2]

7 Fig. 7.1 shows a fractionating column used to separate the fractions of crude oil.

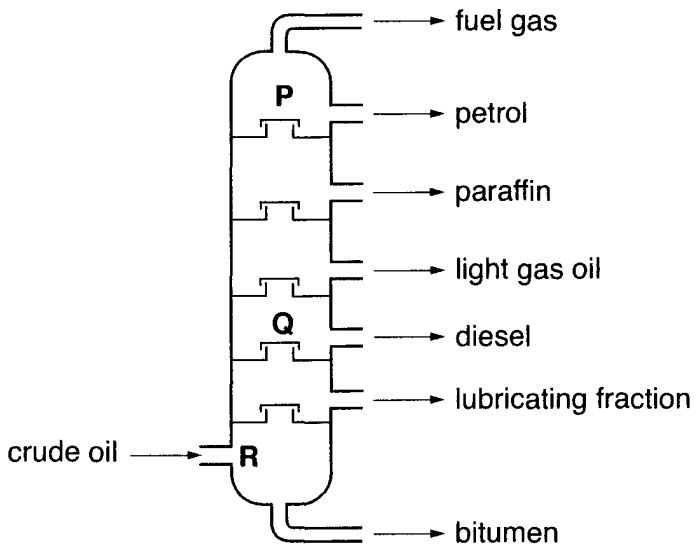

Fig. 7.1

(a) (i) At which point, **P**, **Q** or **R**, is the column at the lowest temperature?

..... [1]

(ii) Which fraction on the diagram contains the largest hydrocarbon molecules?

..... [1]

(b) Crude oil is a mixture of alkanes which are saturated hydrocarbons.

What type of reactions do alkanes undergo?

.....[1]

(c) The fuel gas fraction contains the hydrocarbon propane, C_3H_8.

(i) Draw the structural formula of propane, C_3H_8, showing all the bonds around all the atoms.

[1]

(ii) Write a balanced equation for the burning of propane in a plentiful supply of oxygen.

.....[2]

(iii) When propane is burnt in a limited supply of oxygen a poisonous gas is produced.

Name the gas and explain how it is poisonous.

gas .....

explanation .....

.....[2]

(d) When propane is passed over a hot catalyst, the molecule breaks down to form hydrogen and an alkene.

(i) Name the alkene.

..... [1]

(ii) Describe a test you would carry out to distinguish an alkene from propane.

test .....

result for propane .....

result for alkene .....[3]

8 Samples of two different gases are allowed to diffuse through a small hole, in air at room temperature and pressure. The time taken by each gas is shown in Table 8.1.

Table 8.1

gas	time / s	relative molecular mass
ammonia	20	
nitrogen	26	28

(a) Use the Periodic Table to calculate the relative molecular mass of ammonia, NH_3.

Write the answer in Table 8.1. [1]

(b) What is meant by *diffusion*?

.....

.....[1]

(c) Explain why, at the same temperature, nitrogen takes longer than ammonia to diffuse through a small hole.

.....

.....

.....[2]

(d) Suggest what would happen to the time taken for the ammonia sample to diffuse if the temperature was dropped to 10 °C.

.....

Explain your answer.

.....

.....[2]

9 Fig. 9.1 shows how two hormones **A** and **B** control the levels of glucose in the blood.

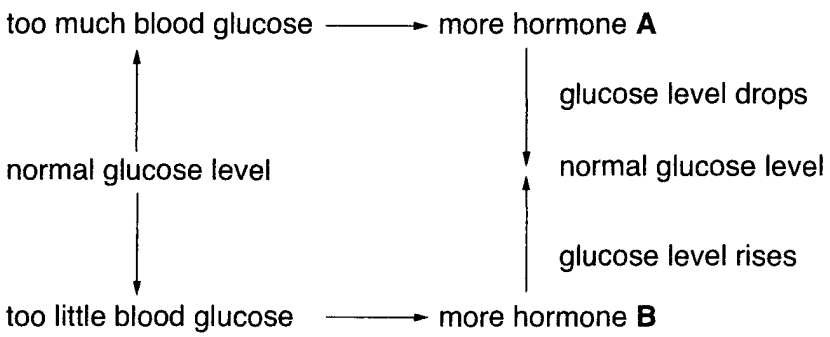

Fig. 9.1

(a) Identify hormones **A** and **B**.

A .....

B .....[2]

(b) Name the gland that produces hormones **A** and **B**.

.....[1]

(c) How does the presence of hormone **A** lead to the drop in glucose level?

.....

.....

.....[2]

[Turn over

10 Fig. 10.1 shows some parts of the digestive system.

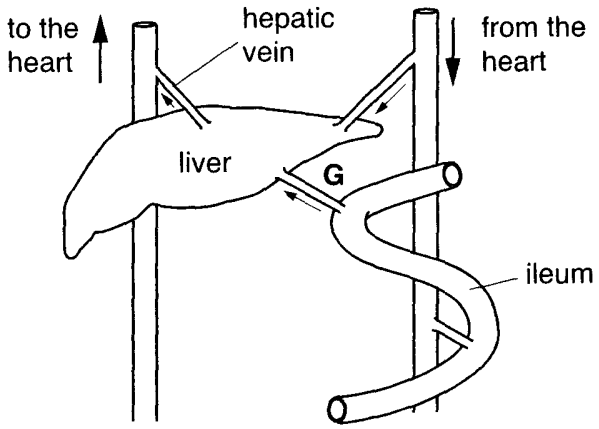

Fig. 10.1

(a) Identify blood vessel **G**.

.....[1]

(b) Why is there a lesser amount of amino acids in the hepatic vein than in vessel **G**?

.....[1]

(c) Bile is an excretory product. State two advantages of releasing bile into the duodenum.

1 .....

2 .....[2]

11 Fig. 11.1 shows a longitudinal section of a bean seed.

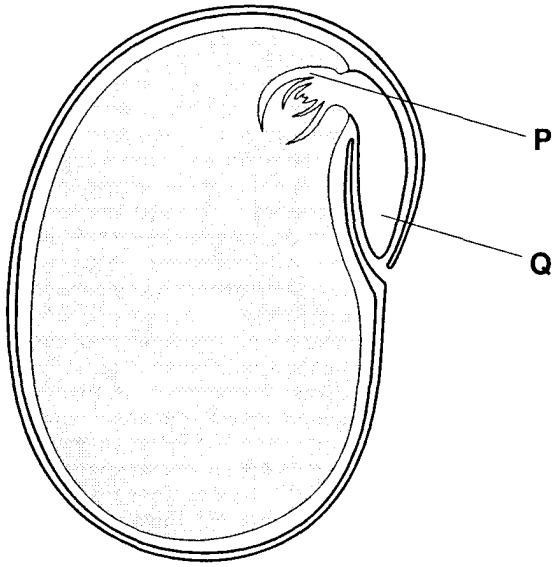

Fig. 11.1

(a) Name the structures **P** and **Q**.

P .....

Q .....[2]

(b) Describe how you would show that the cotyledons contain protein.

.....

.....

.....

.....

.....[3]

(c) Describe how structures **P** and **Q** are able to use the starch stored in the cotyledons.

.....

.....

.....[3]

(d) The seed in Fig. 11.1 formed inside the ovary of a flower. As the seed develops in the flower, water is withdrawn from it so that it becomes almost dry. Suggest why this is important.

.....

.....[2]

12 Fig. 12.1 shows a longitudinal section of the heart.

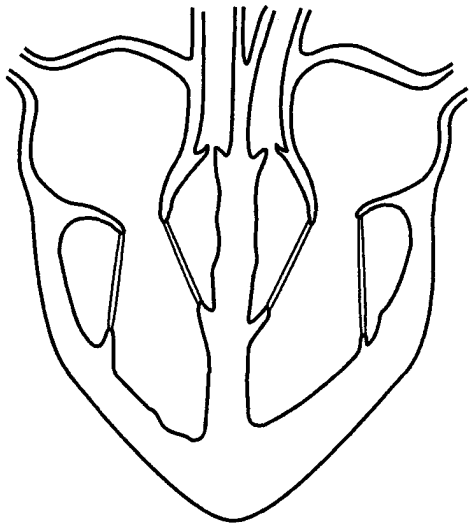

Fig. 12.1

On the diagram, label the following parts:

pulmonary vein **right auricle (atrium)** **left ventricle** [3]

13 Fig. 13.1 shows a commercial application of asexual reproduction.

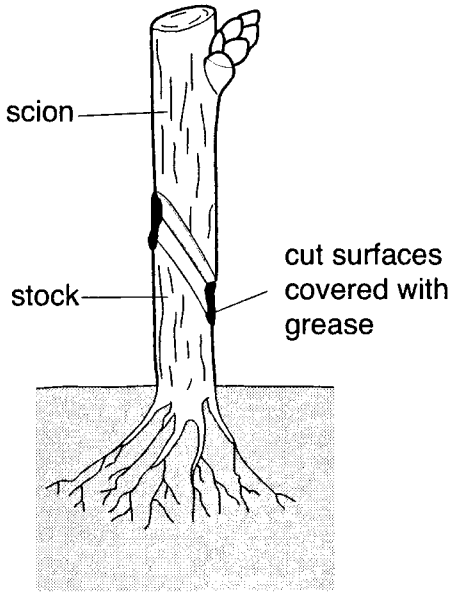

Fig. 13.1

(a) Name this type of asexual reproduction.

.....[1]

(b) Why is this method regarded as asexual reproduction?

.....[1]

(c) Give two reasons why the bark around the cut surfaces is covered with grease.

1 .....

2 .....[2]

(d) Why is it important for the woody parts of the scion and stock to be in contact before tying the two together?

.....

.....[1]

14 Fig. 14.1 shows how the pulse rate of a student changes during and after vigorous exercise. The exercise took five minutes.

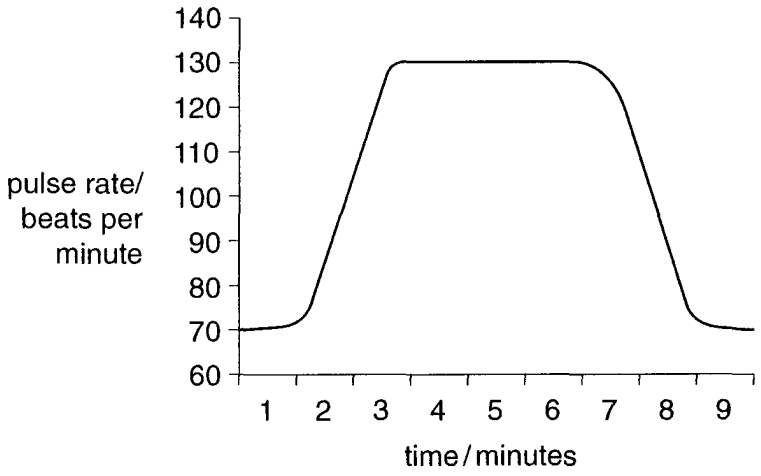

Fig. 14.1

(a) Explain why the pulse rate increases during the early stage of the exercise.

.....

.....

.....

.....[3]

(b) Explain why the pulse rate does not return to normal immediately after the exercise.

.....

.....

.....

.....[3]

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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.).