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 2004

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	
3	
4	
5	
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7	
8	
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10	
11	
12	
13	
14	
15	
TOTAL	

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

For Examiner's Use

1 **(a)** Fig. 1.1 shows the speed-time graph of a ball thrown vertically upwards. ($g = 10\,m/s^2$).

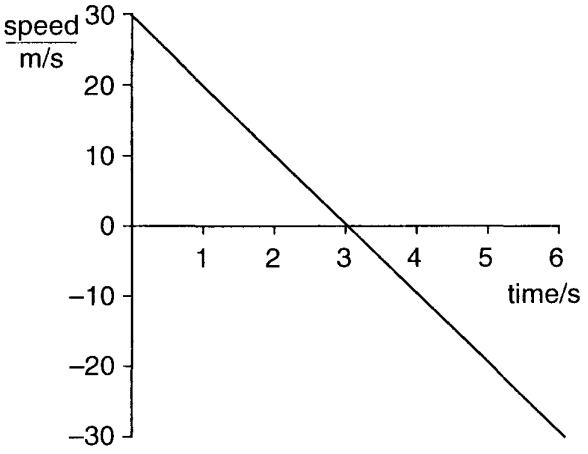


Fig. 1.1

(i) What is the speed of the ball at the highest point?

speed ..... [1]

(ii) Calculate the maximum height reached.

height ..... [2]

(iii) How long does the ball take to reach the highest point?

.....[1]

(iii) What is the energy transfer taking place as the ball falls from the maximum height back to the thrower?

from ..... to .....[1]

(b) A box is pushed by a force of 100 N along a surface at a constant speed of 0.5 m/s in 3 seconds.

(i) What is the friction force?

.....[1]

(ii) Calculate the work done in moving the box along the surface.

work done = ... [3]

For Examiner's Use

2 Fig. 2.1 shows a glass beaker containing water at 2 °C.

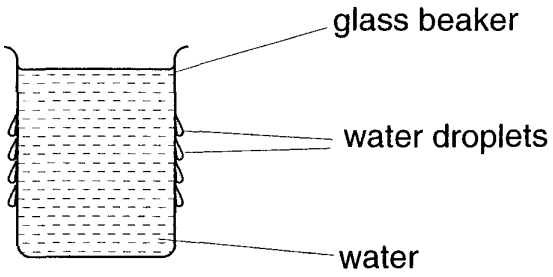


Fig. 2.1

After some time droplets of water are formed on the outer wall of the glass beaker.

Explain how the water droplets are formed on the outer wall.

.....

.....

.....

.....[3]

3 Fig. 3.1 shows a converging lens used as a magnifying lens.

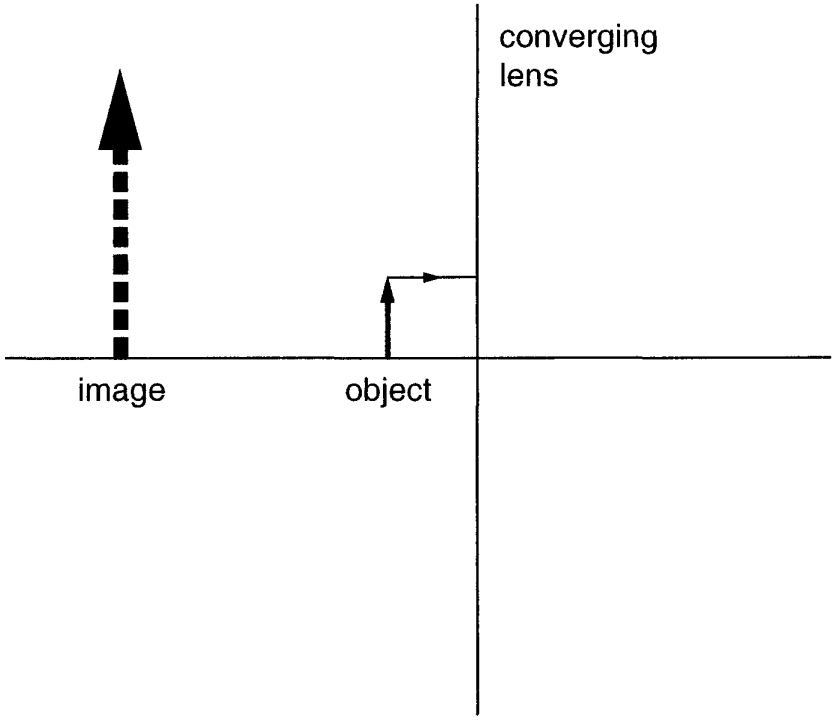


Fig. 3.1

(a) Complete the path of the ray after passing through the lens and find the principal focus. Label it *f*.

(b) What is the focal length of the lens?

..... mm [3]

(c) Fig. 3.2 shows a prism as used in a projector to make the image upright. (The diagram is not to scale).

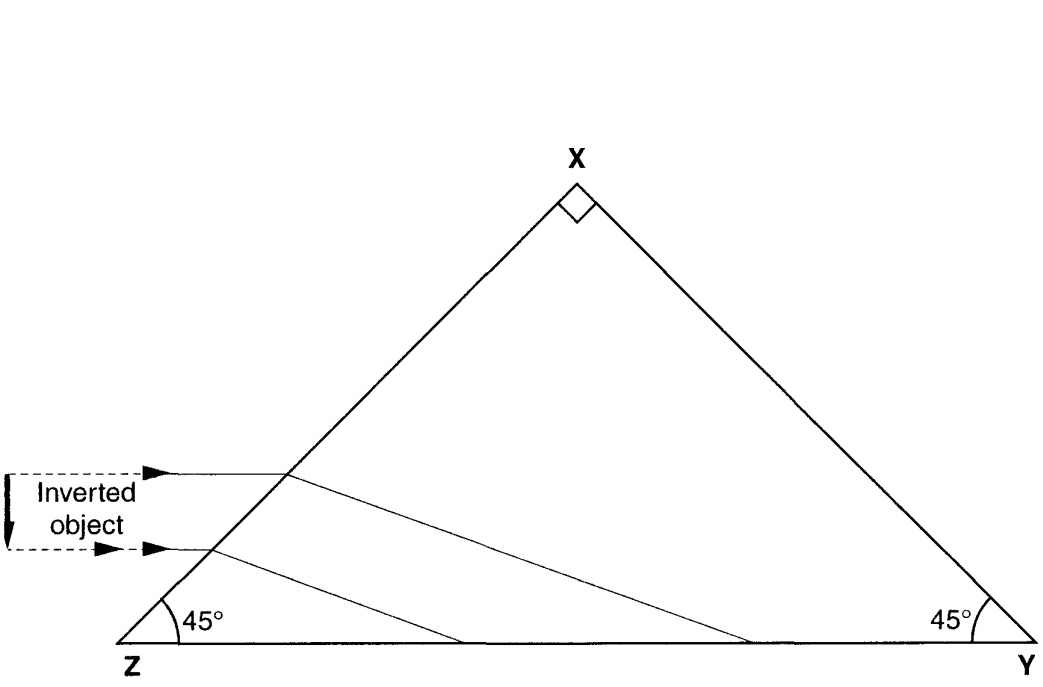


Fig. 3.2

(i) Complete the path of the rays to show how the image becomes upright on the screen.

(ii) Name the effect that the rays undergo along the side ZY.

.....[3]

4 Fig. 4.1 shows a practical application of echo sounding in mineral prospecting. (The average speed of sound in rocks = 4500 m/s.)

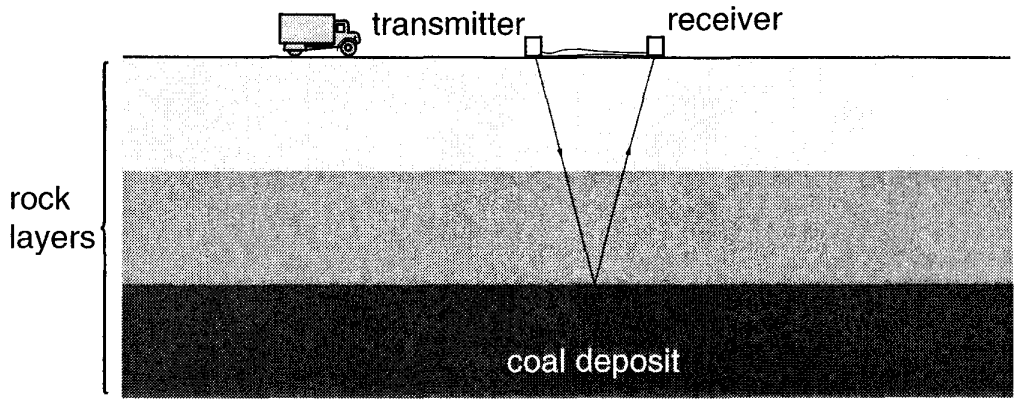


Fig. 4.1

(a) A transmitter sends out shock waves and the receiver detects an echo from the coal deposit 2 s later. How deep is the coal deposit in km?

depth = ... [3]

(b) The transmitter sends out a signal, but the receiver detects several signals in succession.
Suggest why the receiver picks up more than one signal.

.....

.....

.....[2]

For Examiner's Use

5 Fig. 5.1 shows two houses which have lightning conductors. In house **A**, the rod is attached to the roof while in house **B** the rod is attached to a metal plate buried underground.

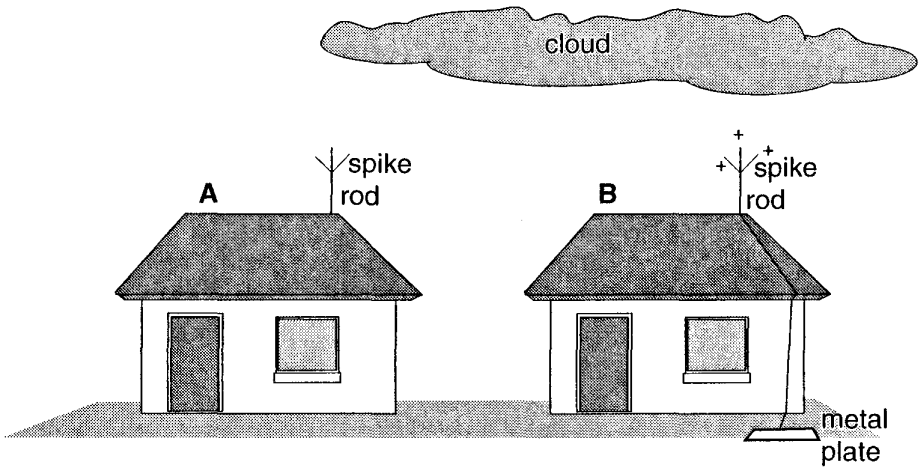


Fig. 5.1

(a) Name a suitable metal which could be used to make the rod.

.....[1]

(b) Explain why house **A** is more likely to be damaged by lightning.

.....

.....

.....[1]

(c) In a storm, the spikes have a positive charge as shown. Indicate on the diagram the sign and location of the charge on the cloud above the spikes. [2]

For Examiner's Use

6 Fig. 6.1 shows an electric circuit.

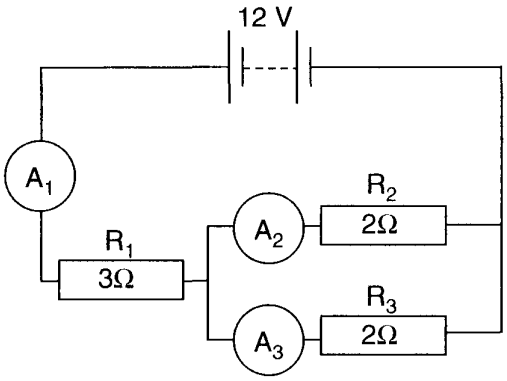


Fig. 6.1

The reading of A_3 = 1.5 A.

(a) State the current through

(i) R_2, ...

(ii) R_1. ..... [2]

(b) Calculate the voltage across each resistor.

(i) Voltage across R_1

..... [2]

(ii) Voltage across R_2

..... [1]

(iii) Voltage across R_3

..... [1]

For Examiner's Use

7 To improve crop yields, farmers add fertilisers like ammonium nitrate to their fields.

(a) (i) Write the chemical formula of ammonium nitrate.

.....

(ii) Calculate the percentage by mass of nitrogen in ammonium nitrate.
(N = 14, O = 16, H = 1).

.....[3]

(b) Lime, calcium oxide, (CaO), is sometimes added to neutralise acidic soils.

(i) Write an equation for the reaction between lime and dilute hydrochloric acid, HCl.

.....[2]

(ii) Write the ionic equation for the reaction in **(b)(i)**.

.....[2]

(iii) Explain why ammonium nitrate is regarded as a good fertiliser for plants, while lime is not.

.....

.....[1]

(c) Lime is obtained from the thermal decomposition of limestone, $CaCO_3$.
The equation shows the decomposition of 5 g of limestone.

$$CaCO_3(s) \longrightarrow CO_2(g) + CaO(s)$$

(i) What is meant by *thermal decomposition*?

.....[1]

(ii) State **one** use of calcium carbonate other than the production of lime.

.....[1]

(iii) Calculate the number of moles of calcium carbonate decomposed.

number of moles = ... [2]

(iv) How many moles of calcium oxide would be produced?

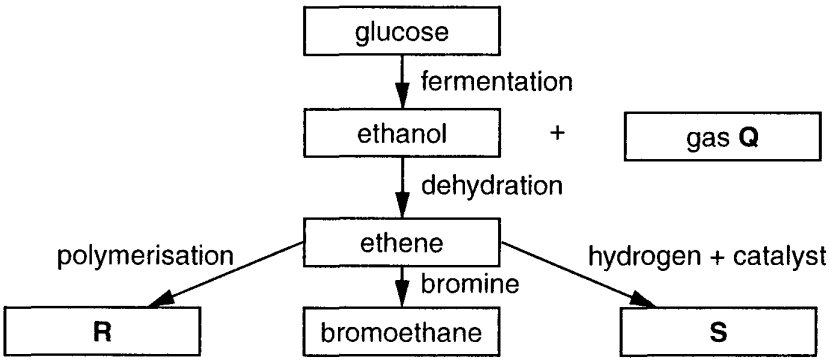
moles = ... [1]

(v) Calculate the volume of carbon dioxide produced at room temperature and pressure. (1 mole of a gas occupies 24 dm^3 at room temperature and pressure).

volume = ... [2]

For Examiner's Use

8 Study the flow chart shown.



(a) (i) What must be added to glucose to enable fermentation to take place?

.....[1]

(ii) State two conditions necessary for fermentation to occur.

1. .....

2. .....[2]

(b) Write the names of substances **R**, **S** and gas **Q**.

R .....

S .....

Q .....

[3]

(c) The equation shows the reaction between ethanol and ethanoic acid.

$$C_2H_5OH + CH_3COOH \longrightarrow CH_3COOCH_2CH_3 + H_2O$$

(i) Name the organic product for this reaction.

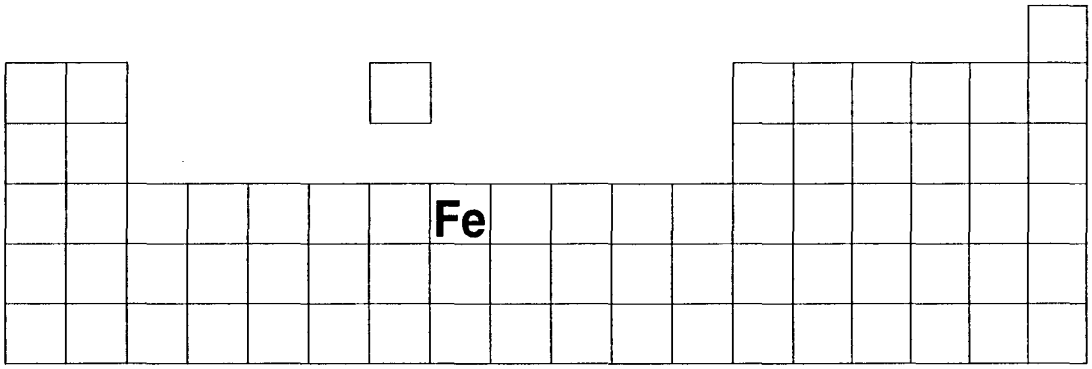
.....[1]

(ii) Draw the structural formula of the organic product of the reaction.

[1]

For Examiner's Use

9 The diagram shows the position of iron, Fe, in the Periodic Table.



(a) Name the group of metals to which iron belongs.

.....[1]

(b) State **two** properties of metals in the group named in **(a)** above.

1 .....

2 .....[2]

(c) Iron is used in the manufacture of ammonia, NH_3.

(i) Draw a dot and cross diagram to show the bonding in a molecule of ammonia.

[2]

(ii) What type of bonding is present in a molecule of ammonia?

.....[1]

(d) Ammonia dissolves in water to form a weak alkali, aqueous ammonia.

(i) Why is aqueous ammonia a weak alkali?

.....[1]

(ii) Suggest the pH of aqueous ammonia.

.....[1]

(iii) Describe how aqueous ammonia is used to test for the presence of aluminium ions in a solution.

.....

.....

.....

.....[2]

For Examiner's Use

10 To demonstrate uptake of water in plants Mpho sucked water from a glass using a straw as shown in Fig. 10.1.

Fig. 10.1

(a) Explain why water moves up the straw when Mpho sucks at the end.

.....

.....[1]

(b) **(i)** Name the part of the vascular bundles represented by the straw.

.....[1]

(ii) Name the process occurring through the structure named in **(b)(i)**.

.....[1]

For Examiner's Use

11 (a) Define *hormone*.

.....

.....[2]

(b) Complete Table 11.1 to show hormones, their sources and their functions.

Table 11.1

hormone	source	function in the body
(i)	pancreas	**(ii)** ....
(iii)	adrenal gland	prepares body for action

[3]

For Examiner's Use

12 Neo made dough using yeast. She took two equal masses of dough and placed them in two identical dishes at different temperatures as shown in Fig. 12.1A.

start of experiment

Fig. 12.1A

After one hour the dough in the two dishes is as shown in Fig. 12.1B.

after one hour

Fig. 12.1B

(a) (i) Using the information in Fig. 12.1, describe any changes that had taken place in each batch of dough in dishes **X** and **Y**, after one hour.

X .....

Y .....[2]

(ii) Explain the differences in the results for the two batches of dough.

.....

.....

.....

.....[4]

(b) Suggest why it is convenient to use microorganisms in biotechnology.

.....

.....

.....[1]

Question 13 starts on page 16

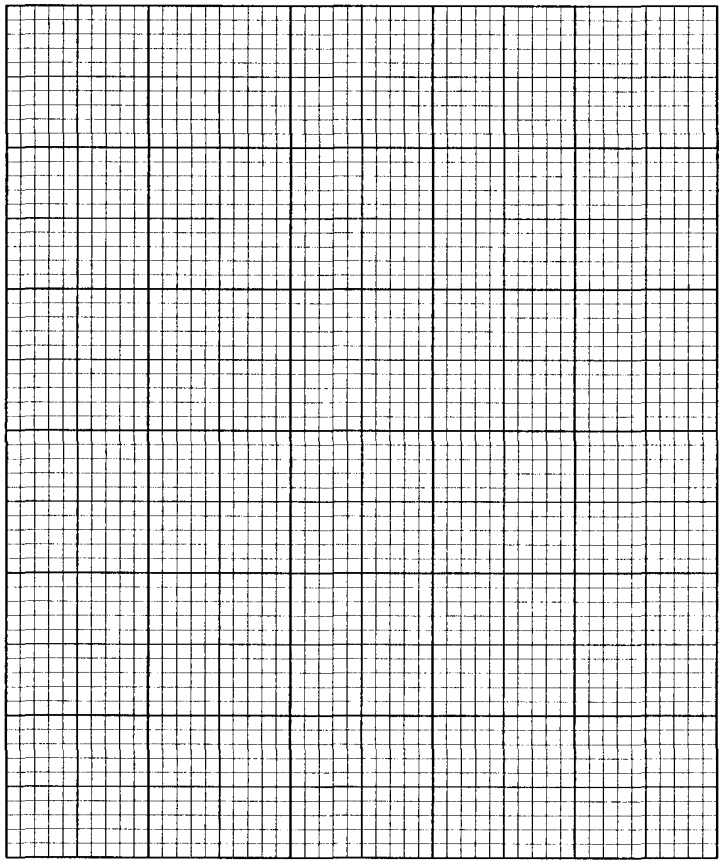
For Examiner's Use

13 Table 13.1 shows the results of an experiment to investigate the effect of temperature on a protein digesting enzyme.

Table 13.1

temperature/ °C	time taken for complete digestion/s
20	250
25	210
30	150
35	105
40	140
45	170

(a) Plot the results on the grid provided.



[3]

(b) (i) State the optimum temperature for the reaction.

.....

(ii) Give a reason for your answer in **(i)** .

.....

.....[2]

For Examiner's Use

(c) This experiment was carried out at pH 5, which is close to the optimum for this enzyme. Explain what will happen at the times taken for digestion to complete if the pH is changed to 9.

.....

.....[2]

For Examiner's Use

14 Fig. 14.1 shows a diagram of a kidney machine.

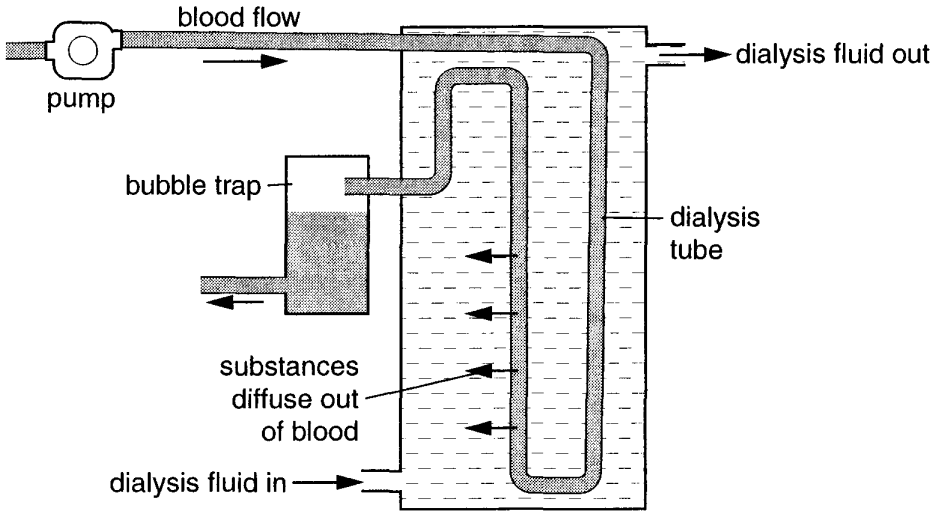


Fig. 14.1

(a) (i) Name the process by which waste products move from blood into the dialysis fluid.

.....[1]

(ii) State the property of the dialysis tube that makes it suitable for use in the kidney machine.

.....

.....[1]

(b) Explain how glucose is prevented from leaving the blood.

.....

.....[2]

(c) Suggest how the efficiency of the kidney machine can be improved.

.....

.....

.....[2]

15 **(a)** State **two** disadvantages of asexual reproduction.

.....

.....

.....[2]

(b) Complete Table 15.1 by filling in two named methods of asexual reproduction and examples of plants where they can be applied.

Table 15.1

method	example
1.	
2.	

[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 = relative atomic mass; X = atomic symbol; b = proton (atomic) number

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