UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

PHYSICAL SCIENCE **0652/02**

Paper 2

May/June 2004

1 hour 15 minutes

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

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
A copy of the Periodic Table is printed on page 16.

FOR EXAMINER'S USE	
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14	
Total	

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

UNIVERSITY *of* CAMBRIDGE
International Examinations

[Turn over

1 Fig. 1.1(a) shows a spring used in the suspension of a cart.

Fig. 1.1(a)   **Fig. 1.1(b)**
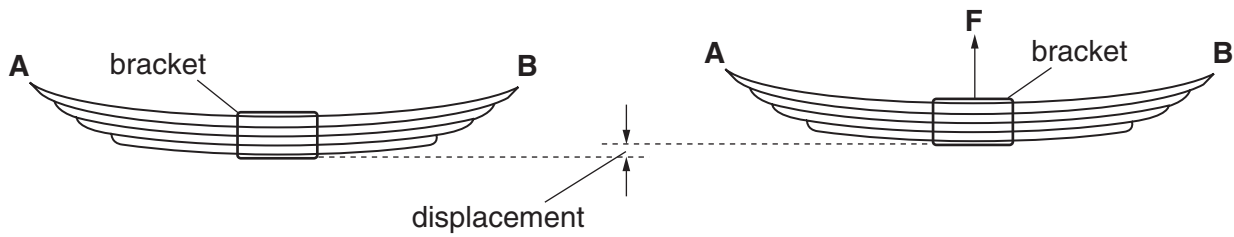
A student supports the ends **A** and **B**. He applies an upward force **F** to the bracket, as shown in Fig. 1.1(b), and records the displacement at the centre of the spring. The table in Fig. 1.2 shows the results.

force / N	displacement / cm
0	0
200	3.0
400	5.9
600	9.1
800	12.0
1000	15.1
1200	18.0

Fig. 1.2
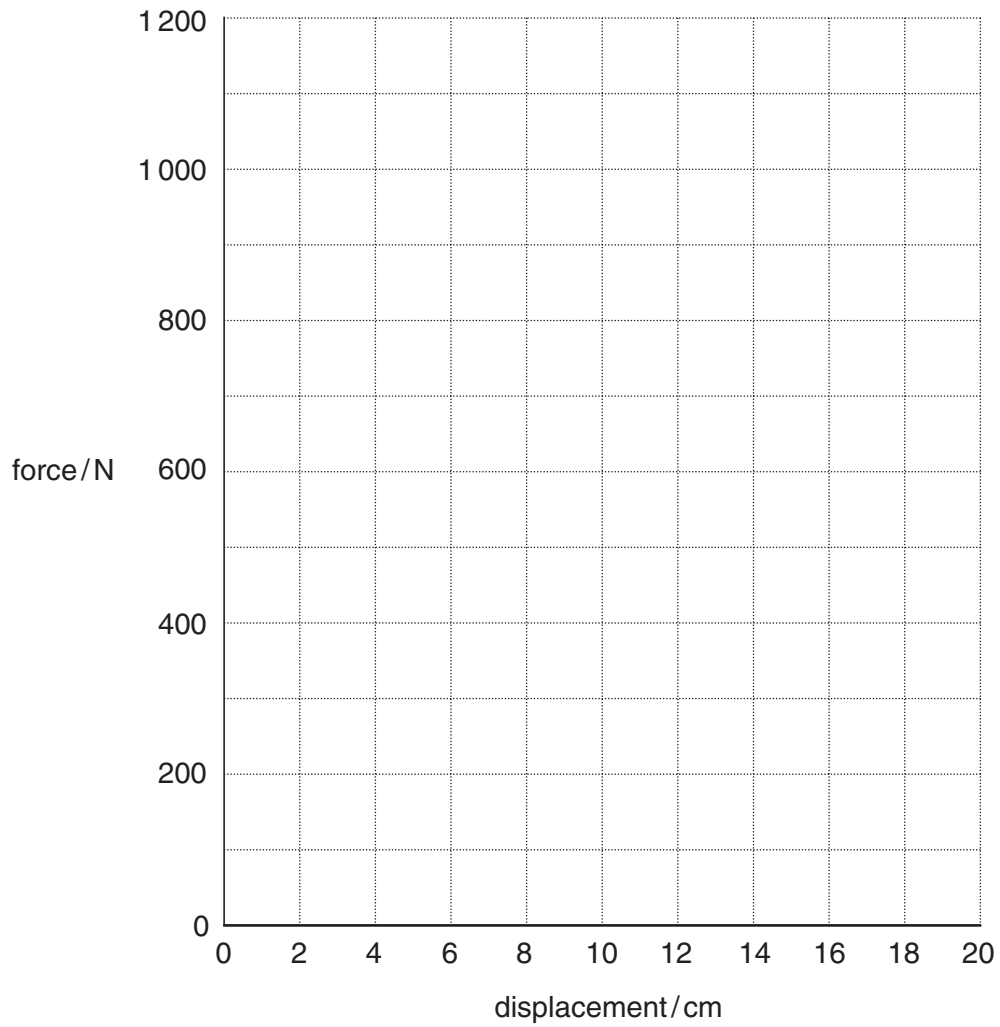
Fig. 1.3

(a) Plot a graph of the force against displacement using the grid in Fig. 1.3. [3]

(b) The instructions for building a cart state that the spring must not be displaced by more than 0.8 cm nor less than 0.6 cm for every 50 N that is added to the force.

Use the graph to help you to explain whether the spring is suitable.

....

....

....[3]

clearance
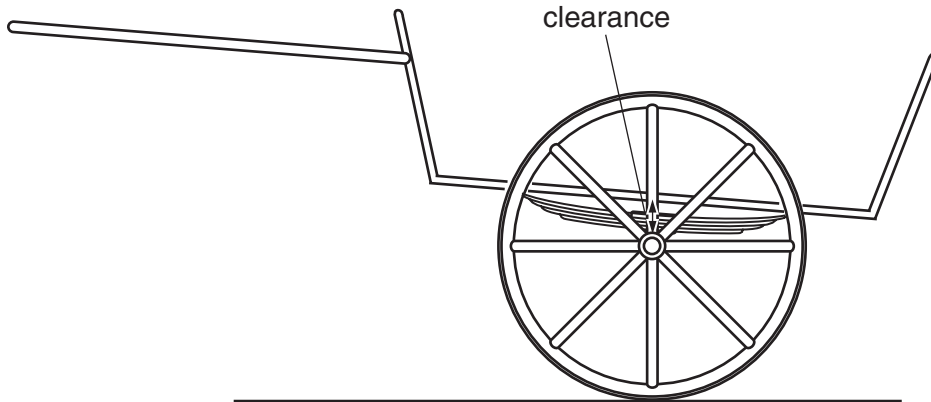
Fig. 1.4

(c) Fig. 1.4 shows the spring, which supports the axle, attached to the cart.

The maximum displacement that the spring can have is 14 cm.

Use your graph to find this load.

load = ... N [2]

2 **(a)** Oxygen in the air consists mainly of the isotope $^{16}_{8}O$ with some $^{18}_{8}O$.

Complete the table for these isotopes.

	$^{16}_{8}O$	$^{18}_{8}O$
number of protons in nucleus		
number of neutrons in nucleus		
arrangement of electrons in shells in the atom		

[2]

(b) In terms of covalent bonding, explain how oxygen and hydrogen form a molecule of water, H_2O. Draw a diagram to help your explanation.

....

....[2]

3 **(a)** Methanol, CH_3OH, burns in excess air to form carbon dioxide and water.

methanol + oxygen $\longrightarrow$ carbon dioxide + water
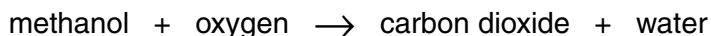
Balance the chemical equation for this reaction.

$2CH_3OH$ + ... O_2 $\longrightarrow$ $2CO_2$ + $4H_2O$ [1]
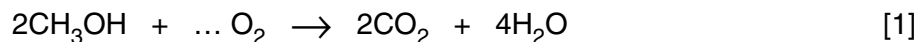
(b) Use the information in the Periodic Table on page 16 to calculate the relative molecular mass, M_r, of methanol.

Show your working.

M_r = ... [2]

(c) The relative molecular mass for carbon dioxide is greater than for methanol yet carbon dioxide is a gas and methanol a liquid at room temperature.

Suggest a reason for this physical difference.

....

....[1]

4 **(a)** Some solids are safe when they are in large lumps, but burn explosively in air when in a fine powder.

Explain why the size of the pieces has this effect.

....

....

....[2]

(b) Some solids can react explosively when added to an acid.
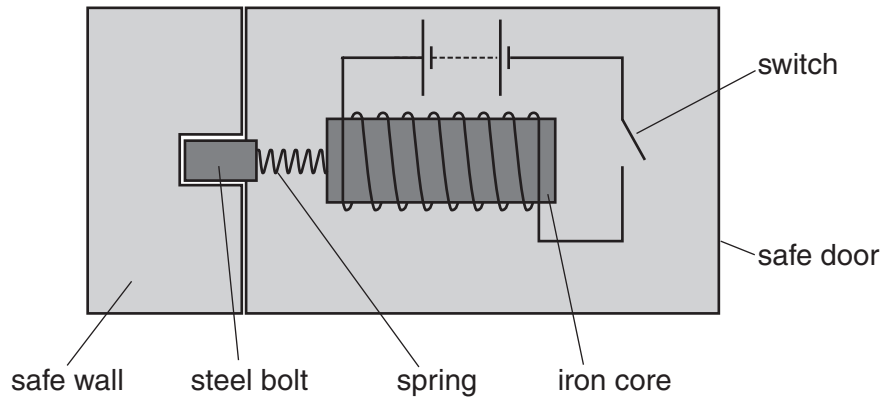
State how to make these reactions safer by altering

(i) the concentration of the acid,

....[1]

(ii) the temperature of the acid.

....[1]

5 Fig. 5.1 shows an electronic system for locking a safe door. The diagram shows the door in the locked position with the spring pushing the bolt firmly into the wall.

Fig. 5.1

(a) Explain why the door can be opened when the switch is closed.

....

....[2]

(b) Explain why iron is a suitable material from which to make the core.

....

....[2]

(c) A burglar attempts to open the safe by cutting the wires from the battery. Explain why this will **not** work.

....

....[2]

6 **(a)** Steam is condensed to water during a distillation experiment.

Use the kinetic particle theory of matter to explain why energy must be **removed** to condense a gas to form a liquid.

....

....

....[2]

(b) Two liquids **P** and **Q** are cooled to form solids. The temperature and time are recorded during each experiment and graphs are plotted, as shown in Fig. 6.1.
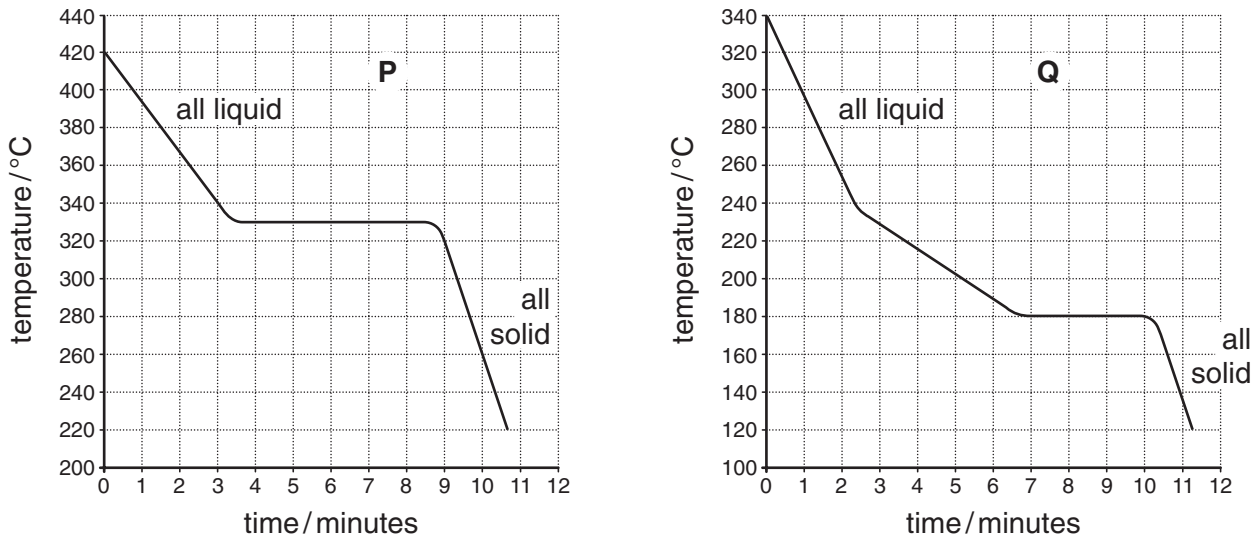
Fig. 6.1

(i) Use Fig. 6.1 to determine the melting point of **P**. .... °C [1]

(ii) Explain how these cooling curves show that **P** is a pure substance and that **Q** is a mixture of substances.

....

....

....[2]

7 Magnesium reacts slowly with water at room temperature.

Potassium reacts vigorously with water at room temperature.

(a) Explain this difference of reaction in terms of the reactivity series of metals.

....[1]

(b) The reaction between potassium and water is exothermic and produces an alkaline solution and hydrogen.

(i) Explain the meaning of *exothermic*.

....[1]

(ii) Describe how to test for the alkaline solution.

test ....

result ....[2]

(iii) A student collects some of the hydrogen in a test-tube.

Describe how to test for the hydrogen produced.

test ....

result ....[2]

8 Fig. 8.1 shows a child's toy aeroplane. The plane is powered by turning the propeller to twist a rubber band.
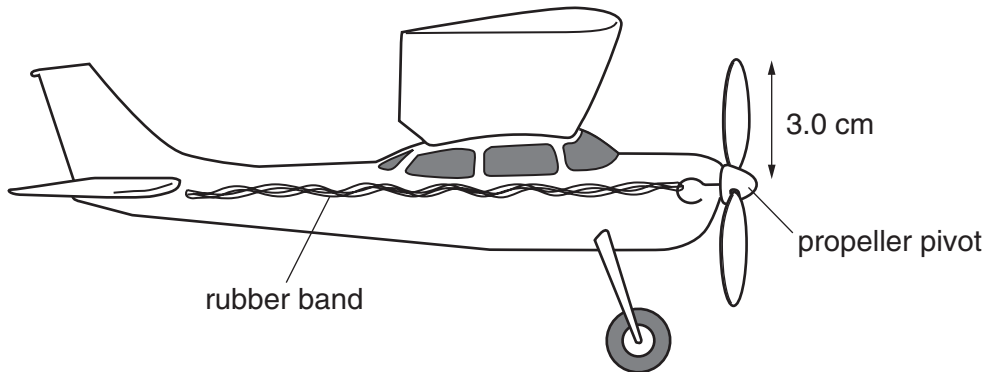
Fig. 8.1

(a) Complete the sentences below.

The twisted rubber band has .... energy. This is converted into mainly

.... energy as it begins to untwist and turn the propeller, although

some is lost to the surroundings as waste .... energy. To wind the

rubber band up again the child must do .... in twisting it.   [4]

(b) The child has to apply a perpendicular force of 2.5 N at 3 cm from the propeller pivot in order to turn the propeller.

Calculate the moment of this force about the pivot. Show your working and include the unit.

moment = ... [3]

(c) When the child releases the aeroplane it travels a distance of 48 m in 16 s.

Calculate the average speed at which the aeroplane travelled. Show your working and include the unit.

speed = ... [3]

9 Common pollutants in the air are carbon monoxide and sulphur dioxide.

(a) Explain why carbon monoxide can have an adverse effect on human health.

....

....

....[2]

(b) Explain why sulphur dioxide can have an adverse effect on buildings.

....

....

....[2]

10 (a) Draw the structures of ethanol, C_2H_6O, and ethanoic acid, $C_2H_4O_2$.

ethanol   ethanoic acid

[4]

(b) State two uses of ethanol.

1 ....

2 ....[2]

11 Fig. 11.1 shows a circuit which could be used to investigate the current-voltage characteristics of a metallic wire.
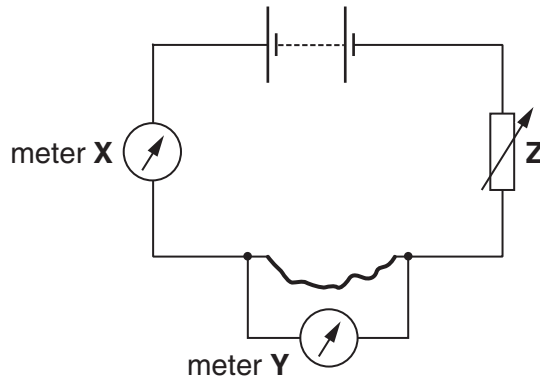
Fig. 11.1

(a) Name the components **X**, **Y** and **Z**.

X ....

Y ....

Z ....   [3]

(b) Explain the purpose of component **Z**.

....

....[2]

(c) On the axes in Fig. 11.2 complete the graph to show the characteristics of a metallic conductor.

[2]
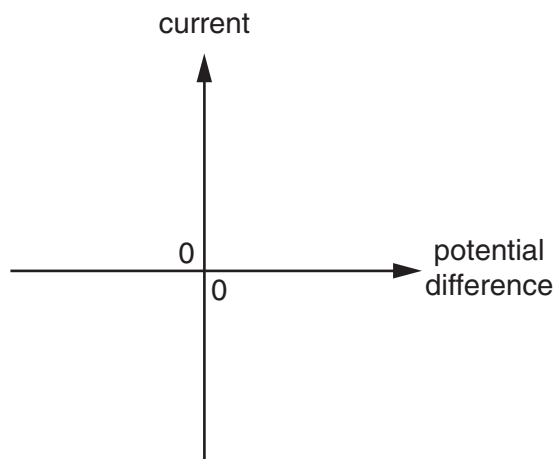
Fig. 11.2

12 A student adds a small quantity of a solid oxide to water in a test-tube. She tests the solution produced with Universal Indicator paper. The pH is 3.

Use words from the list below to complete the following sentences.

<div align="center">

acidic   basic   left   metal   non-metal   right

</div>

The type of oxide used in this experiment is .... The element forming

this oxide is a .... This element is likely to be found on the

.... of the Periodic Table. [3]

13 The tungsten wire in a lamp bulb is heated electrically to such a high temperature that it emits light.

(a) Explain why the bulb is filled with argon.

....

....

....[2]

(b) The atomic number of tungsten is 74, its density is $19\,g/cm^3$ and its melting point is $3400\,°C$.

How does this information support the fact that tungsten is a **transition** element?

....

....

....[2]

14 Fig. 14.1 shows a tube used to demonstrate thermionic emission.
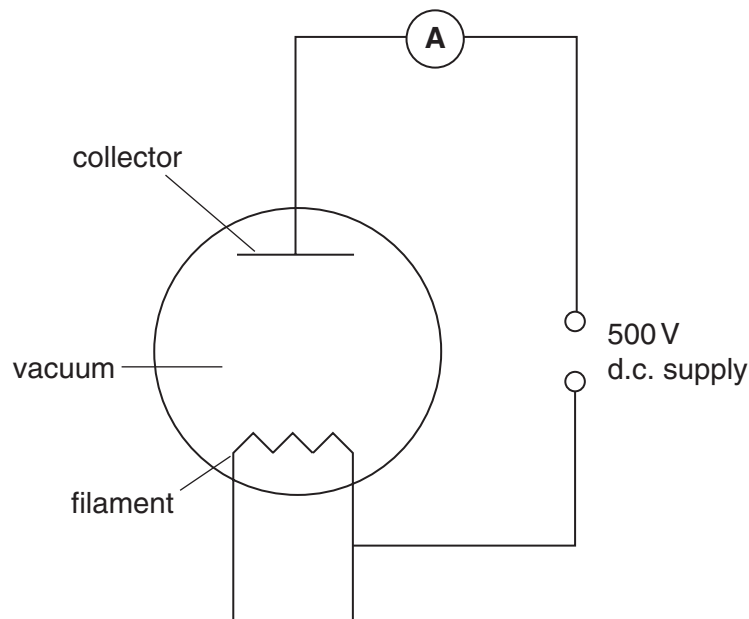
Fig. 14.1

The reading on the ammeter is zero when the collector electrode is negative, and 4.8 mA when the collector is positive.

(a) (i) State with a reason whether the charges emitted from the filament are positive or negative.

....

....

(ii) Name the particles that are emitted.

.... [3]

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Fig. 14.2 shows the outline of a cathode ray tube.
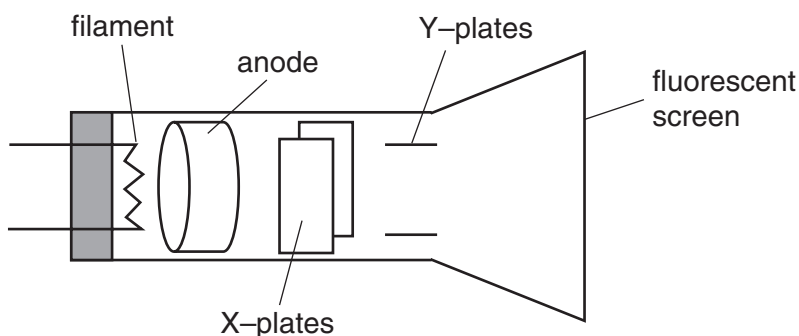
Fig. 14.2

(b) Explain the purpose of the X-plates and the Y-plates.

X-plates ....

....

Y-plates ....

....[3]

(c) Fig. 14.3(i) shows the screen of the cathode ray tube being used to display a waveform.
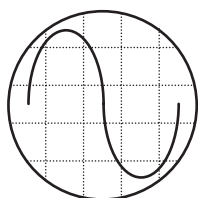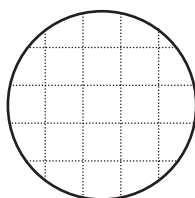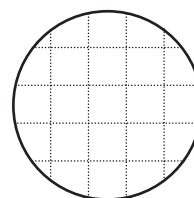
Fig. 14.3(i)　　　　**Fig. 14.3(ii)**　　　　**Fig. 14.3(iii)**

(i) On Fig. 14.3(ii) draw a wave of the same frequency as Fig. 14.3(i) but of smaller amplitude.

(ii) On Fig. 14.3(iii) draw a wave of the same amplitude as Fig. 14.3(i) but of greater frequency.

[3]

DATA SHEET
The Periodic Table of the Elements

Group

I	II												III	IV	V	VI	VII	0
																		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	231 **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
X
b

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

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).