

Centre Number	Candidate Number	Name
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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

**COMBINED SCIENCE**

**0653/03**

Paper 3

October/November 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.  
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 20.

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

If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

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



1 (a) Blood contains red cells, white cells and platelets.

(i) Describe how you can recognise red blood cells, apart from their colour, if you are looking at a blood sample using a microscope.

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

(ii) What is the function of platelets?

.....[1]

(b) White blood cells can destroy harmful micro-organisms. Fig. 1.1 shows how two different types of white blood cells work together to destroy bacteria in a person's body.

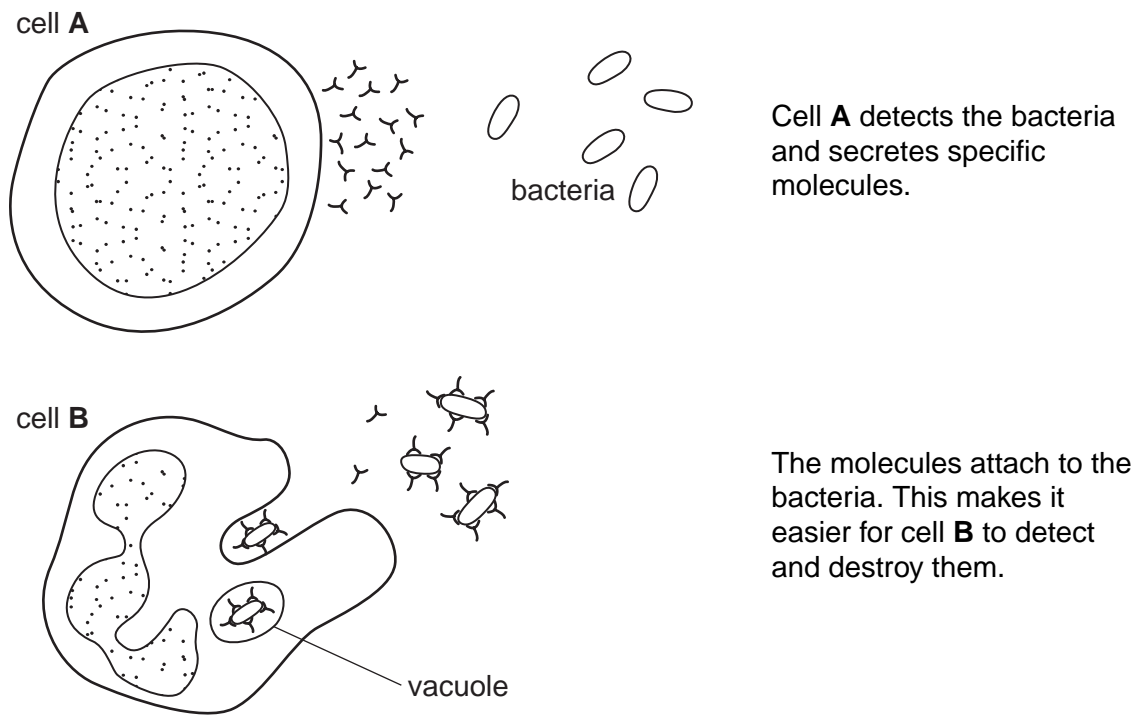


Fig. 1.1

(i) Name

cell A, .....

cell B, .....

the molecules secreted by cell A. ....

[3]

- (ii) The first time that a person is infected by a particular kind of bacterium he may become ill. However, if these bacteria get into the body a second time, the person will probably be immune to this illness.

Explain how the person becomes immune.

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

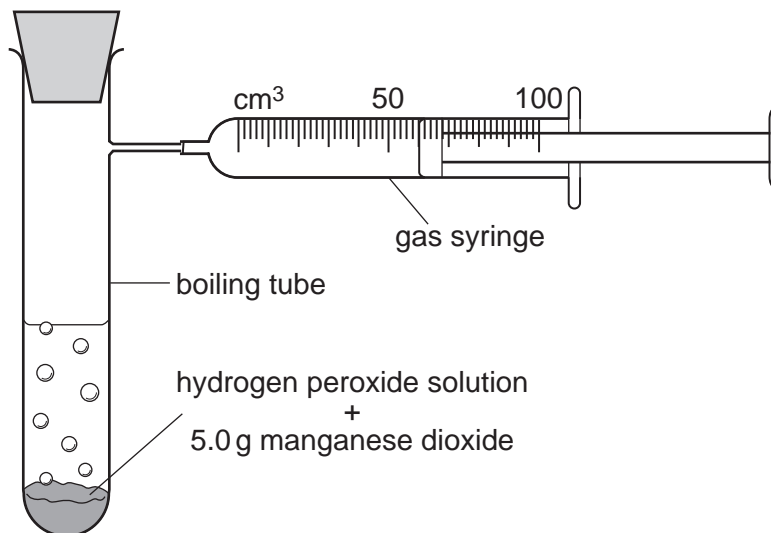
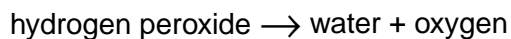
- (iii) Cell B secretes enzymes into the vacuole containing the bacteria. These include proteases.

Suggest how proteases can help to destroy the bacteria.

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

- 2 Fig. 2.1 shows apparatus that a student used to study the rate of reaction when hydrogen peroxide decomposes.

The equation for this reaction is shown below.



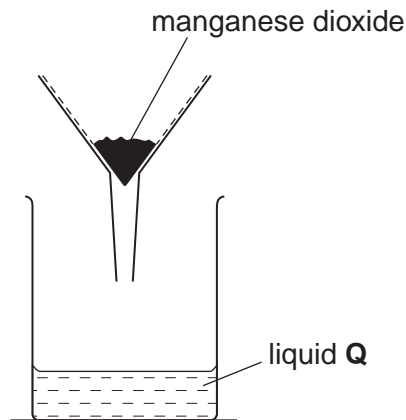
**Fig. 2.1**

The student added 5.0 g of the insoluble solid manganese dioxide which acted as a catalyst.

- (a) Describe how the student could test the gas produced in this reaction to show that it is oxygen.

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

- (b) When the reaction was complete, the student separated the substances which were left in the boiling tube. Fig. 2.2 shows the result of the separation.



**Fig. 2.2**

- (i) Name the method of separation shown in Fig. 2.2.

.....[1]

- (ii) Name liquid Q.

.....[1]

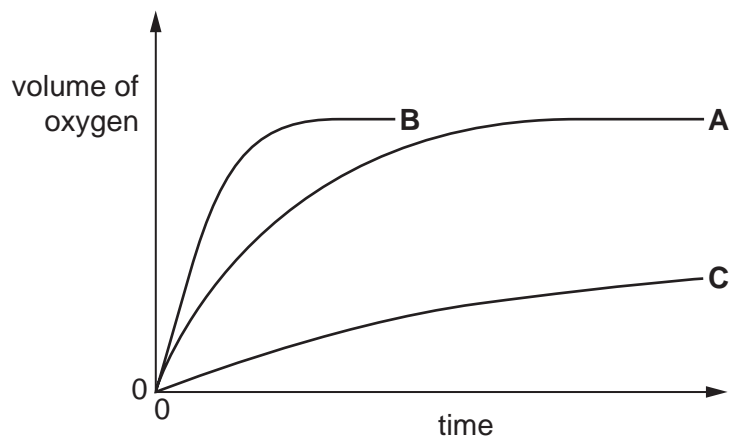
- (iii) Predict the mass of dry manganese dioxide which the student obtained and explain your answer.

mass .....

explanation .....

.....[2]

- (c) Fig. 2.3 shows the results of three experiments, **A**, **B** and **C**, which the student obtained using the apparatus in Fig. 2.1. In each experiment the mass of manganese dioxide and the volume and concentration of hydrogen peroxide solution were kept constant.



**Fig. 2.3**

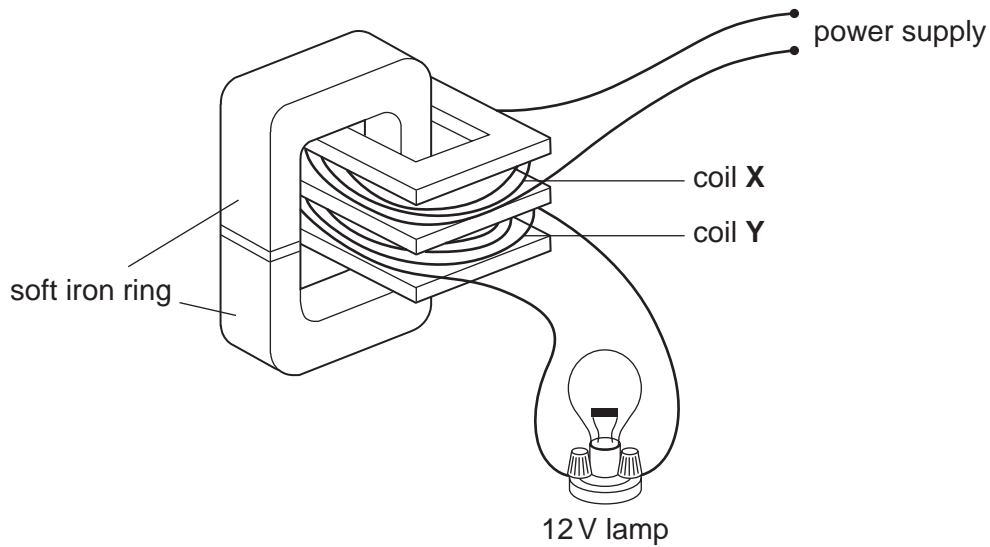
- (i) Explain how the results shown in Fig. 2.3 show that the rate of reaction was the lowest for experiment **C**.

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

- (ii) Explain which experiment, **A**, **B** or **C**, used manganese dioxide which had the highest surface area.

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

- 3 (a) Fig. 3.1 shows a soft iron ring. Two coils, X and Y, each of 200 turns are wound around the ring. Coil X is connected to a power supply and coil Y is connected to a 12 V lamp.



**Fig. 3.1**

Describe and explain what happens to the lamp when

- (i) the power supply is 12 V a.c.

.....  
 .....

- (ii) the power supply is 12 V d.c.

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

- (b) Electricity is transmitted at a very high voltage and relatively low current. This is because it is cheaper than sending it at a lower voltage and higher current. Explain why it is cheaper.

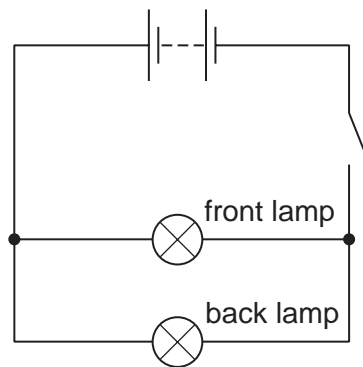
.....  
 .....  
 .....[1]

(c) Fig. 3.2 shows a bicycle with lights and reflectors.



**Fig. 3.2**

Fig. 3.3 shows a circuit used to power the two lamps on the bicycle from one battery.



**Fig. 3.3**

(i) What is the name given to this method of connecting two lamps together?

.....[1]

(ii) If the filament in the back lamp breaks, current can no longer flow through the lamp. Will the front lamp stay alight or go out? Explain your answer.

.....

.....[1]



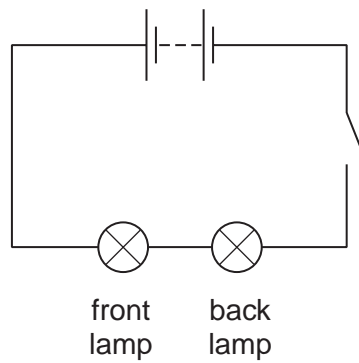
- (iii) The resistance of each lamp in this circuit is 4 ohms. Calculate the combined resistance of the two lamps. Show your working and state the formula that you use.

formula used

working

.....[2]

- (d) Another method of connecting the lamps is shown in Fig. 3.4.



**Fig. 3.4**

- (i) In this circuit, what happens to the front lamp if the filament in the back lamp breaks?

Explain your answer.

.....[1]

- (ii) State the combined resistance of the two lamps in this circuit.

.....[1]

- (e) The reflectors on bicycles are made of clear red plastic and use the idea of total internal reflection.

Fig. 3.5 shows light hitting part of a reflector.

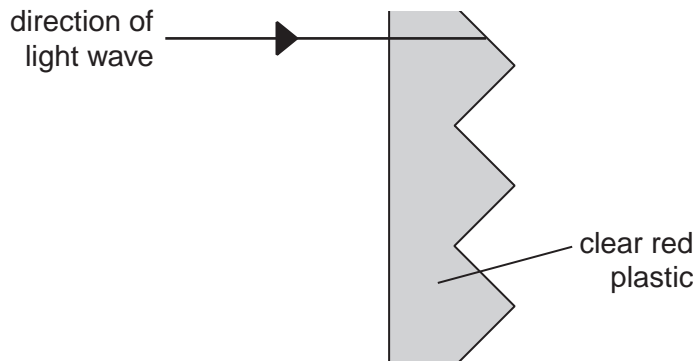


Fig. 3.5

Complete the diagram above to show how light leaves the reflector. [2]

- 4 Fig. 4.1 shows an insect-pollinated flower.

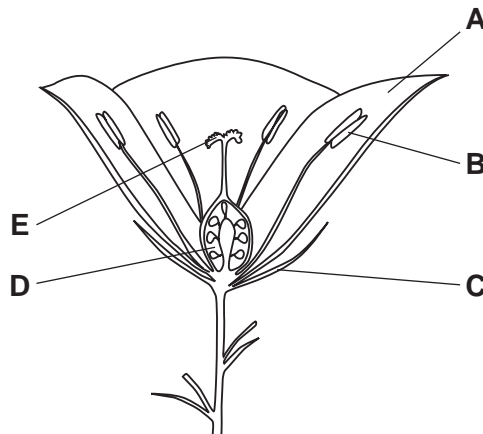


Fig. 4.1

- (a) Give the **letter** of the part of the flower which attracts insects to the flower; .....  
contains the female gametes. .... [2]

- (b) Describe how this flower could be pollinated.  
.....  
.....  
.....  
..... [3]

(c) (i) Describe how the stamens of a wind-pollinated flower would differ from the stamens of the flower in Fig. 4.1.

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

(ii) Wind-pollinated flowers tend to produce much larger quantities of pollen than insect-pollinated flowers.

Suggest a reason for this difference.

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

(d) The type of reproduction which involves flowers is sexual reproduction.

Explain **one** advantage to a plant of sexual reproduction, as compared to asexual reproduction.

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

5 Malachite is a compound of copper found in the Earth's crust. The chemical formula of malachite is  $\text{Cu}_2\text{CO}_3(\text{OH})_2$ .

(a) (i) State the number of different elements shown in the formula of malachite.

.....[1]

(ii) State the total number of atoms shown in the formula of malachite.

.....[1]

(b) (i) The formulae of four substances are shown below. Underline the formula of the substance that does **not** react with dilute hydrochloric acid to form copper chloride solution.

CuO      Cu       $\text{CuCO}_3$        $\text{Cu}(\text{OH})_2$  [1]

(ii) Copper chloride solution contains copper ions,  $\text{Cu}^{2+}$ , and chloride ions,  $\text{Cl}^-$ .

Explain why the formula of copper chloride is  $\text{CuCl}_2$ .

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

(c) Table 5.1 shows the results obtained by a student who added small pieces of different metals to copper chloride solution.

**Table 5.1**

metal added	observations
magnesium	<ul style="list-style-type: none"> <li>• magnesium dissolves</li> <li>• brown insoluble solid produced</li> </ul>
silver	no reaction
zinc	<ul style="list-style-type: none"> <li>• zinc dissolves</li> <li>• brown insoluble solid produced</li> </ul>

Explain why magnesium and zinc reacted but silver did not.

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

- (d) Fig. 5.1 shows the electrolysis of copper chloride solution. In this process copper forms on one of the electrodes and chlorine is produced at the other.

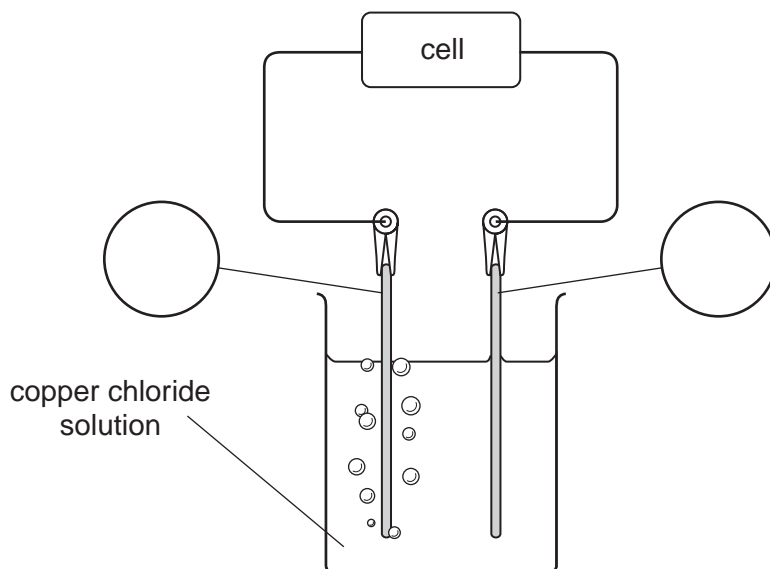


Fig. 5.1

- (i) Show the electrical charges of the electrodes by writing the symbols  $+$  and  $-$  in the circles and explain your answer.

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

- (ii) In this process copper ions,  $\text{Cu}^{2+}$ , are changed into copper atoms,  $\text{Cu}$ . Explain the difference, in terms of electrons, between a copper ion and a copper atom.

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

- 6 Penguins can swim underwater. When swimming, they can accelerate from 0 m/s to 6 m/s in 1.0 s.

Seals can accelerate from 0 m/s to their maximum speed of 2 m/s in 0.6 s.

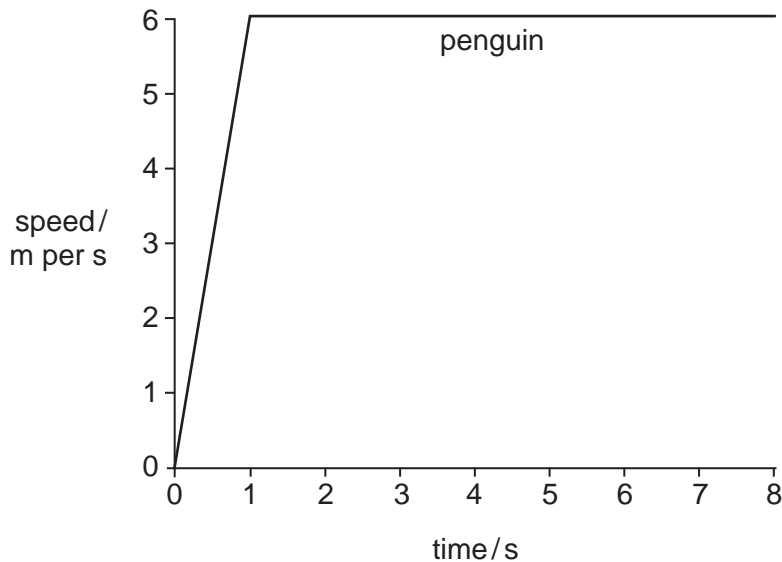
- (a) The acceleration of a penguin is  $6 \text{ m/s}^2$ . Calculate the acceleration of a seal. Show your working and state the formula that you use.

formula used

working

.....[2]

- (b) Fig. 6.1 shows the speed-time graph for a penguin starting from rest. On the same axes draw a speed-time graph for a seal starting from rest.



[2]

Fig. 6.1

- (c) A seal starts to chase a penguin. The penguin immediately swims away.

The seal and the penguin are both at rest before the chase starts.

Use your graph to determine how much further the penguin will travel than the seal in the first four seconds of the chase. Show your working.

.....[3]

7 Fig trees grow in tropical rainforests. Fig trees provide food for monkeys and birds such as toucans. These animals may be eaten by eagles.

(a) Construct a food web showing the feeding relationships between these four organisms.

[2]

(b) Fig trees are the producers in this food web.

Describe how plants such as fig trees transfer energy from sunlight into chemical energy.

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

(c) Food chains rarely have more than four or five links in them.

Explain why this is so.

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

(d) Tropical rainforests in many parts of the world are being destroyed by logging. Give **two** reasons why the conservation of tropical rainforests is important.

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

8 The metallic element potassium and the non-metallic element chlorine react together to form the compound potassium chloride.

(a) Complete Table 8.1 by writing names of substances in the left-hand column, chosen from the list below.

potassium      chlorine      potassium chloride

Table 8.1

substance	description
	used to kill harmful micro-organisms in water
	reacts with water to form an alkali
	dissolves in water to form an electrolyte

[2]

(b) Fig. 8.1 shows a diagram of a chlorine atom.

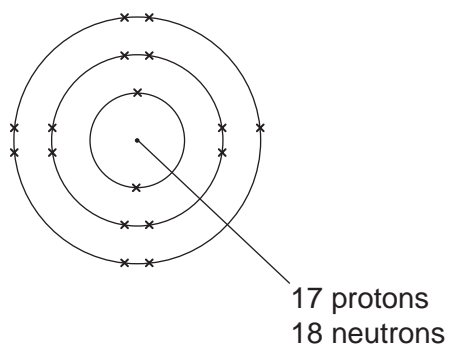


Fig. 8.1

(i) State the number of **complete** electron energy levels shown in the atom in Fig. 8.1.

.....[1]

(ii) Explain why this atom is electrically neutral.

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



(c) Chlorine joins with hydrogen to make the covalent compound, hydrogen chloride.

(i) Write the balanced symbolic equation for the reaction.

.....[2]

(ii) Draw a diagram of a hydrogen chloride molecule showing how the outer electrons are arranged.

[2]

**Question 9 is found on page 18**

9 Explain each of the following.

(a) Alpha and beta radiations are affected by electric fields but gamma radiation is not.

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

(b) Used aerosol cans may explode if they are thrown into a fire.

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

(c) The heater element in a kettle is placed at the bottom of the kettle but all the water reaches boiling point.

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

(d) A satellite is able to orbit the Earth without falling to its surface.

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



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

		Group																																			
I	II	III	IV	V	VI	VII	O					O																									
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4	1 <b>H</b> Hydrogen 1	11 <b>B</b> Boron 5	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	18 <b>Ar</b> Argon 18	19 <b>Cl</b> Chlorine 17	20 <b>He</b> Helium 2																									
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12	27 <b>Al</b> Aluminium 13	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	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	56 <b>Fe</b> Iron 26	59 <b>Co</b> Cobalt 27	59 <b>Ni</b> Nickel 28	64 <b>Cu</b> Copper 29	65 <b>Zn</b> Zinc 30	70 <b>Ga</b> Gallium 31	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														
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	56 <b>Fe</b> Iron 26	59 <b>Co</b> Cobalt 27	59 <b>Ni</b> Nickel 28	64 <b>Cu</b> Copper 29	65 <b>Zn</b> Zinc 30	70 <b>Ga</b> Gallium 31	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>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38	89 <b>Y</b> Yttrium 39	91 <b>Zr</b> Zirconium 40	93 <b>Nb</b> Niobium 41	96 <b>Mo</b> Molybdenum 42	101 <b>Ru</b> Ruthenium 44	103 <b>Rh</b> Rhodium 45	106 <b>Pd</b> Palladium 46	108 <b>Ag</b> Silver 47	112 <b>Cd</b> Cadmium 48	115 <b>In</b> Indium 49	119 <b>Sn</b> Tin 50	122 <b>Sb</b> Antimony 51	127 <b>I</b> Iodine 53	131 <b>Xe</b> Xenon 54				
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	139 <b>La</b> Lanthanum 57	178 <b>Hf</b> Hafnium 72	181 <b>Ta</b> Tantalum 73	184 <b>W</b> Tungsten 74	186 <b>Re</b> Rhenium 75	190 <b>Os</b> Osmium 76	192 <b>Ir</b> Iridium 77	195 <b>Pt</b> Platinum 78	197 <b>Au</b> Gold 79	201 <b>Hg</b> Mercury 80	204 <b>Tl</b> Thallium 81	207 <b>Pb</b> Lead 82	209 <b>Bi</b> Bismuth 83	209 <b>Po</b> Polonium 84	210 <b>At</b> Astatine 85	222 <b>Rn</b> Radon 86	226 <b>Fr</b> Francium 87	226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	232 <b>Th</b> Thorium 90	238 <b>U</b> Uranium 92	238 <b>Pa</b> Protactinium 91	232 <b>Ce</b> Cerium 58	140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	144 <b>Nd</b> Neodymium 60	150 <b>Sm</b> Samarium 62	152 <b>Eu</b> Europium 63	157 <b>Gd</b> Gadolinium 64	159 <b>Tb</b> Terbium 65	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

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

**Key**

a	<b>X</b>
b	

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.).