UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3298779249

CO-ORDINATED SCIENCES **0654/03**

Paper 3 (Extended) **May/June 2007**

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 on all the work you hand in.
Write in dark blue or black pen.
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.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
A copy of the Periodic Table is printed on page 20.

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.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

This document consists of **20** printed pages.

For Examiner's Use

1 **(a)** Fig. 1.1 is a side view of the thorax during breathing out and breathing in. The lungs and heart are not shown.

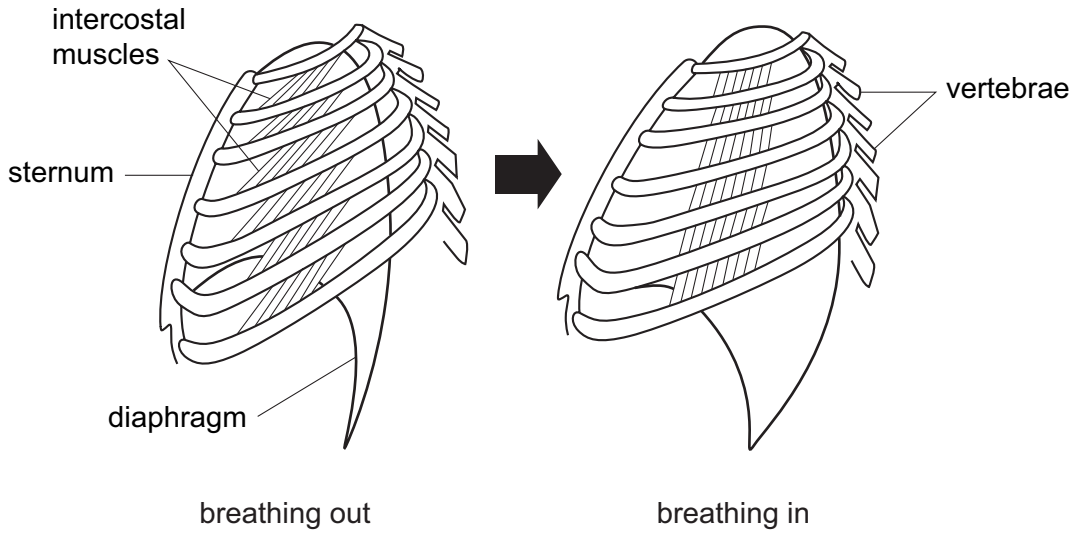

Fig. 1.1

(i) Describe how each of the following have changed between breathing out and breathing in.

the intercostal muscles .....

the diaphragm ..... [2]

(ii) Explain how the changes you have described help to draw air into the lungs.

.....

.....

.....

.....

..... [3]

(b) As air is drawn into the lungs, it flows through the trachea and bronchi. These are lined with a tissue containing goblet cells and ciliated cells.

Explain how this tissue helps to prevent infections in the lungs.

.....

.....

..... [2]

For Examiner's Use

(c) Describe the effects of smoking on

(i) the goblet cells and cilia,

.....

.....

..... [2]

(ii) the alveoli in the lungs.

.....

.....

..... [2]

For Examiner's Use

2 In the nineteenth century, the Russian scientist Dimitri Mendeleev, arranged the known elements in order of the relative masses of their atoms. His work led to the modern Periodic Table that we use today.

(a) (i) Explain why atoms of different elements have different masses.

.....

..... [1]

(ii) Explain, in terms of electron configuration, why the element with proton number 36 is unreactive.

.....

..... [1]

(iii) In the modern Periodic Table the elements with proton numbers 18 and 19 are **not** in order of their relative atomic masses.

Suggest a reason for this.

.....

..... [1]

(b) Magnesium reacts with dilute hydrochloric acid according to the equation below.

$$Mg + 2HCl \longrightarrow MgCl_2 + H_2$$

A student was asked to add 0.96 g of magnesium ribbon to 100 cm^3 of dilute hydrochloric acid which had a concentration of 0.5 mol/dm^3.

(i) Calculate the number of moles of magnesium in 0.96 g.

Show your working.

..... [1]

(ii) Calculate the number of moles of hydrochloric acid in 100 cm^3 of a solution which has a concentration of 0.5 mol/dm^3.

Show your working.

..... [1]

For Examiner's Use

(iii) Use the balanced equation for this reaction and your results from **(i)** and **(ii)** to predict whether there is enough acid to react with all of the magnesium.

.....

..... [2]

(c) Fluorine is a halogen produced by electrolysis of an electrolyte containing fluoride ions, F^-.

There were many attempts to produce fluorine during the nineteenth century and several scientists were seriously harmed when they succeeded in making fluorine. They attempted to collect fluorine in containers made of gold or platinum and they kept the containers at a very low temperature.

(i) State and explain at which electrode, cathode or anode, fluorine is produced during electrolysis.

.....

.....

..... [2]

(ii) Use your knowledge of the halogen group to suggest why fluorine caused harm to scientists who first produced it.

.....

..... [1]

(iii) Suggest why the scientists attempting to produce fluorine used gold or platinum containers at a very low temperature.

.....

.....

..... [2]

For Examiner's Use

3 **(a)** A car of mass 1200 kg is travelling forward at a constant speed of 20 m / s.
Fig. 3.1 shows the driving force and the frictional force acting on the car.

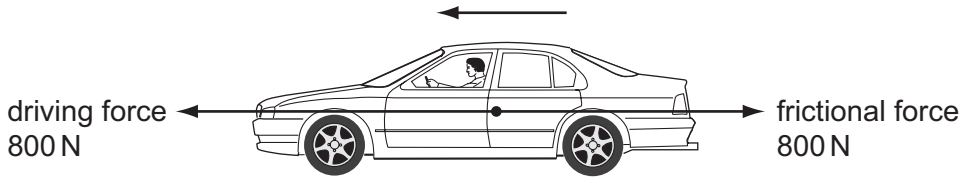

Fig. 3.1

(i) Calculate the work done by the driving force in 30 seconds.

State the formula that you use and show your working.

formula used

working

..... [3]

(ii) Calculate the kinetic energy of the car travelling at 20 m / s.

State the formula that you use and show your working.

formula used

working

..... [2]

For Examiner's Use

(b) A pedestrian steps into the path of the moving car. Fig. 3.2 shows a graph of how the speed of the car changes from the moment when the driver sees the pedestrian until the car stops.

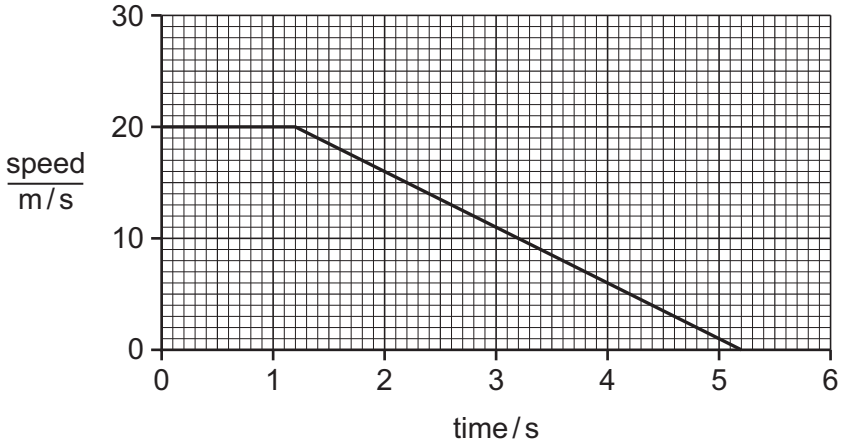

Fig. 3.2

(i) After 1.2 s the car slows down.

Calculate the deceleration of the car.

State the formula that you use and show your working.

formula used

working

..... [2]

(ii) Calculate the total distance travelled by the car between the driver seeing the pedestrian and the car stopping.

Show your working.

..... [3]

For Examiner's Use

4 An experiment was carried out into the effect of different doses of X-rays on the sperm cells produced by male fruit flies. Fig. 4.1 shows the results.

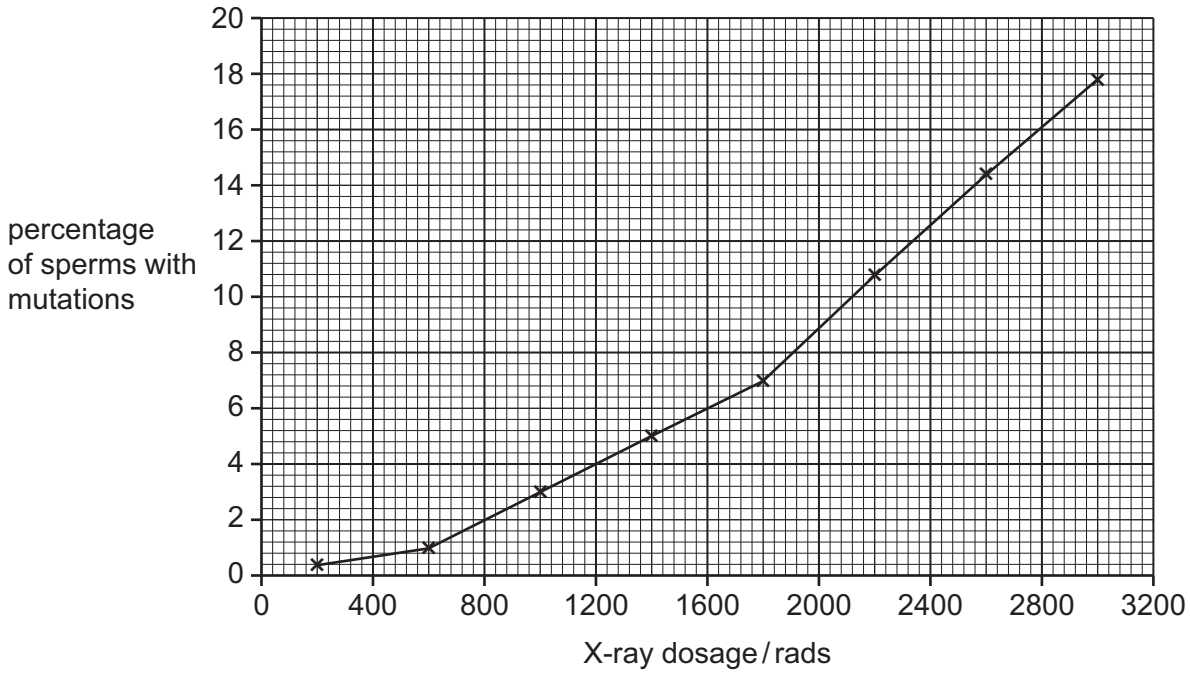

Fig. 4.1

(a) State what is meant by a *mutation*.

.....

..... [1]

(b) (i) Using Fig. 4.1, describe the effect of increasing the X-ray dosage on the percentage of mutated sperms.

.....

.....

..... [2]

(ii) Explain this effect.

.....

.....

.....

..... [2]

For Examiner's Use

(c) Fruit flies have four pairs of chromosomes in their cells.

Some of the mutations in the experiment above involved the loss of one chromosome.

If a fruit fly sperm that had lost one chromosome fertilised a normal egg, how many chromosomes would there be in the zygote?

..... [1]

(d) Explain why a mutation that occurs in a gamete-forming cell is more likely to be harmful than one that occurs elsewhere in a fruit fly's body.

.....

.....

.....

..... [2]

(e) Insects can be serious pests, for example by carrying disease or eating crops. Pesticides can be used to kill them, but many people are concerned about the harm that pesticides do and are trying other methods of controlling insect populations.

One new method that is being tested is to expose a large number of male insects of a harmful species to X-rays and then release them into the wild.

(i) Explain why people are concerned about the use of pesticides.

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..... [2]

(ii) Suggest how the new method might reduce the population of the harmful insects.

.....

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..... [2]

For Examiner's Use

5 **(a)** Glucose and starch are carbohydrates.

(i) The chemical formula of glucose is $C_6H_{12}O_6$.

State the total number of atoms which are combined in one molecule of glucose.

..... [1]

(ii) Explain why it is not possible to write a simple chemical formula for starch.

.....

.....

..... [2]

(b) Fig. 5.1 shows an experiment which was set up to investigate the action of a partially permeable membrane. A tube made from a partially permeable membrane was filled with iodine solution and placed into a beaker containing a mixture of glucose, starch and water.

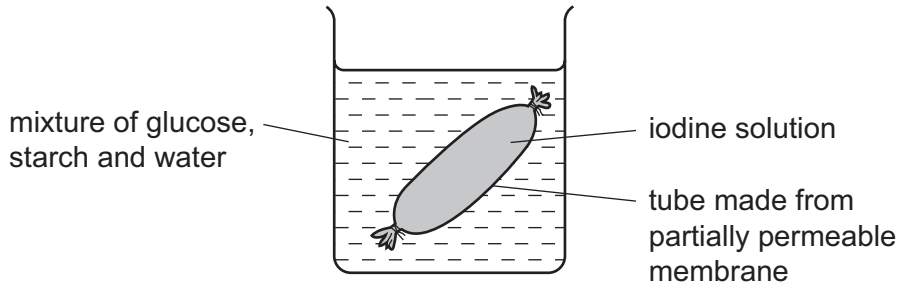

Fig. 5.1

(i) Explain the following observations which were made some time later.

The solution **inside** the tube gave a positive result with Benedict's solution.

.....

.....

.....

The solution **outside** the tube became blue-black in colour.

.....

.....

..... [4]

(ii) Predict and explain whether the solution **inside** the tube became blue-black in colour.

.....

..... [2]

(c) Plastics are materials made mainly from polymer molecules. Fig. 5.2 shows part of a polymer molecule. Molecules of this polymer are formed by addition polymerisation of an unsaturated monomer.

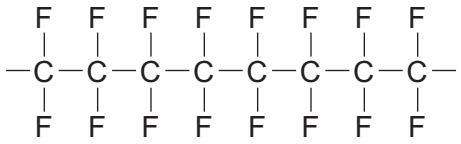

Fig. 5.2

(i) Draw the displayed formula of one of the monomer molecules which have joined to form this polymer.

[2]

(ii) Two different plastics, **A** and **B**, were heated. Plastic **A** melted easily but plastic **B** did not melt even when heated to a very high temperature.

Explain these observations. You may draw some simple diagrams to help your answer.

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..... [3]

For Examiner's Use

6 Fig. 6.1 shows a circuit containing four ammeters, $\mathbf{A_1}$, $\mathbf{A_2}$, $\mathbf{A_3}$ and $\mathbf{A_4}$.

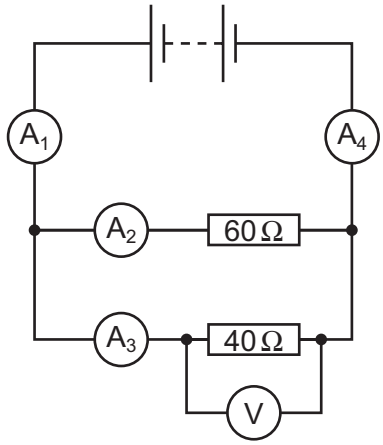

Fig. 6.1

Table 6.1 shows the readings on each ammeter.

Table 6.1

ammeter	reading on ammeter / amps
$\mathbf{A_1}$	
$\mathbf{A_2}$	0.2
$\mathbf{A_3}$	0.3
$\mathbf{A_4}$	0.5

(a) What is the reading on ammeter $\mathbf{A_1}$?

..... [1]

(b) Calculate the combined resistance of the two resistors in the circuit in Fig. 6.1.

State the formula that you use and show your working.

formula used

working

..... [3]

(c) Fig. 6.2 shows a magnet and coil of wire connected to a sensitive ammeter.

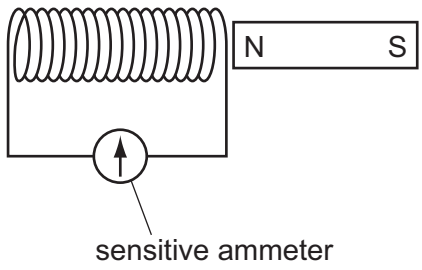

Fig. 6.2

(i) When the magnet is moved into the coil, the needle on the ammeter shows a deflection to the left.

Explain why a reading on the ammeter is produced.

.....

.....

..... [2]

(ii) Explain how this effect is used in a dynamo to produce an output voltage. You may use a diagram to help with your answer.

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..... [4]

For Examiner's Use

7 Fig. 7.1 shows a pyramid of numbers for a food chain.

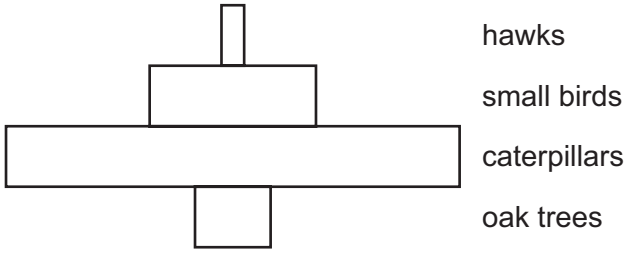

Fig. 7.1

(a) Explain why the pyramid of numbers is this shape.

.....

.....

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..... [2]

(b) Oak trees are the producers in this food chain. Describe how they transfer energy from sunlight into chemical energy that can be passed along the chain.

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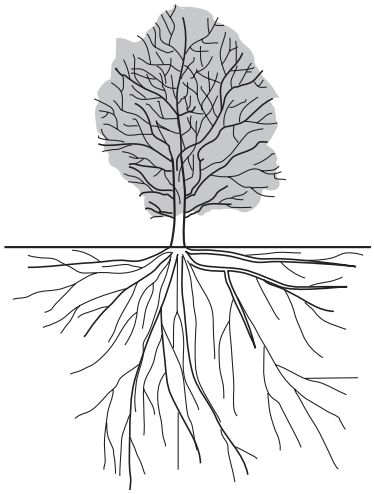
..... [4]

(c) An oak tree can be many metres tall.

For Examiner's Use



Describe and explain how water from the soil is transported up to the leaves at the top of the tree.

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..... [3]

For Examiner's Use

8 In many countries supplies of clean water for drinking are obtained from river water.

(a) State two processes that are used to convert river water into water which is safe for humans to drink.

1. .....

2. ..... [2]

(b) A sample of safe drinking water still contained dissolved calcium sulphate, $CaSO_4$, which helped to make the water hard.

(i) State the formula of the particle present in this water which causes hardness.

..... [1]

(ii) A student carried out an experiment to find out if boiling would remove the hardness from this sample of water.

The results of his experiment are shown in Table 8.1.

Table 8.1

water sample	volume of water tested / cm^3	volume of soap solution needed for lather / cm^3
distilled water	25.0	0.2
hard water control (unboiled)	25.0	8.0
hard water boiled for 5 minutes	25.0	3.0
hard water boiled for 10 minutes	25.0	3.0

What conclusions could the student draw from these results?

.....

.....

.....

..... [2]

(c) Some types of salt used to flavour food are mixtures of sodium chloride and potassium chloride. Sodium chloride and potassium chloride are both ionic compounds.

(i) Potassium chloride can be formed by reacting potassium directly with chlorine.
Fig. 8.1 shows the electron arrangements in a potassium atom and a chlorine atom.

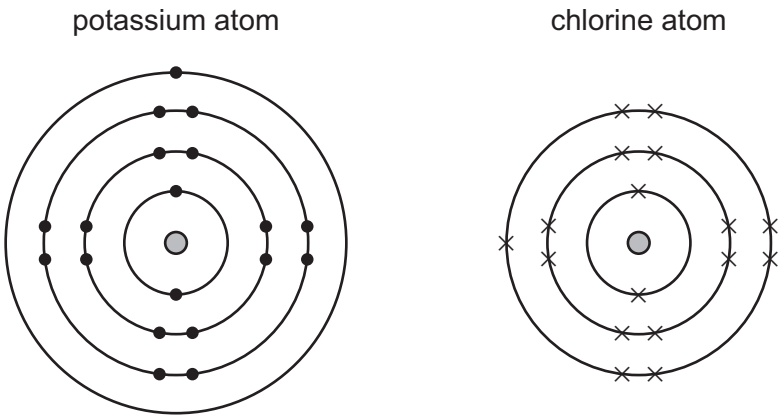

Fig. 8.1

In the space below, draw diagrams similar to those in Fig. 8.1 which show the electron arrangements of the two particles when combined in potassium chloride.

[2]

(ii) Explain briefly why potassium chloride is a solid with a high melting point at room temperature.

.....

.....

..... [2]

For Examiner's Use

9 A police car uses a siren and a blue light to alert people.

(a) (i) Explain why sound needs a medium, such as air, to travel through.

.....

.....

..... [2]

(ii) How will the sound of the siren change if the amplitude of the sound waves emitted is increased?

..... [1]

(iii) Suggest a suitable frequency for the sound emitted by the siren to alert people.

..... [1]

(b) The police communicate using radio waves. Both blue light and radio waves are part of the electromagnetic spectrum.

(i) State **one** property which all electromagnetic waves have in common.

..... [1]

(ii) State **one** difference between blue light waves and radio waves.

..... [1]

(iii) The radio waves used have a frequency of 10 000 000 Hz and a wavelength of 30 m.

Calculate the speed of these waves.

State the formula that you use and show your working.

formula used

working

..... [2]

For Examiner's Use

(c) As the police car drives along the temperature of the air in the tyres increases.

(i) Use the ideas of the kinetic theory to explain why this will result in an increase in tyre pressure.

.....

.....

..... [2]

(ii) The original temperature of the air in the tyres was 10 °C and the final temperature was 30 °C.

Calculate the final pressure of the air in the tyres if the original pressure was 200 000 N / m^2.

State the formula that you use and show your working.

formula used

working

..... [3]

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 †															

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

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

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 dm^3 at room temperature and pressure (r.t.p.).