UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	

* 1 7 8 8 8 0 7 6 9 *

CO-ORDINATED SCIENCES **0654/32**

Paper 3 (Extended) **May/June 2013**

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 pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
A copy of the Periodic Table is printed on page 32.

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.

This document consists of **30** printed pages and **2** blank pages.

IB13 06_0654_32/4RP

UNIVERSITY *of* CAMBRIDGE International Examinations

1 Most of the elements in the Periodic Table can be classified as either metals or non-metals.

For Examiner's Use

Fig. 1.1 shows the elements in Group 4 of the Periodic Table.

C
Si
Ge
Sn
Pb

Fig. 1.1

(a) Use the classification of metal or non-metal to describe how the Group 4 elements differ from both Group 1 (alkali metals) and Group 7 (halogens).

....

....

.... [2]

(b) Carbon occurs naturally in the Earth's crust as the uncombined element. Diamond and graphite are different forms of carbon (carbon allotropes) that have very different physical properties.

A small section of the structure of one of the carbon allotropes is shown in Fig. 1.2.

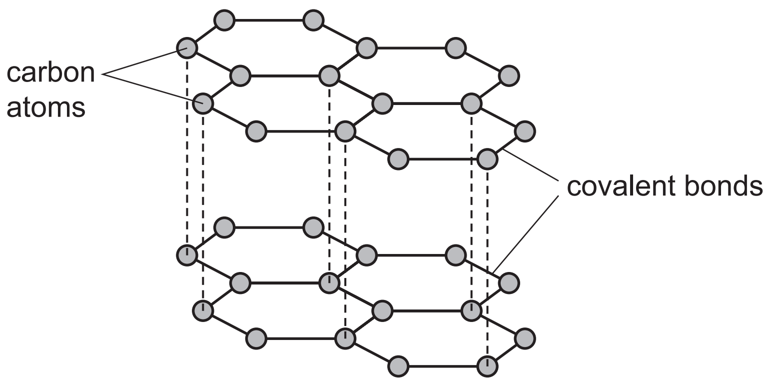


Fig. 1.2

State and explain **one** use of the carbon allotrope shown in Fig. 1.2.

....

....

.... [2]

(c) Fig. 1.3 shows apparatus used to extract lead from lead oxide, PbO.

For Examiner's Use

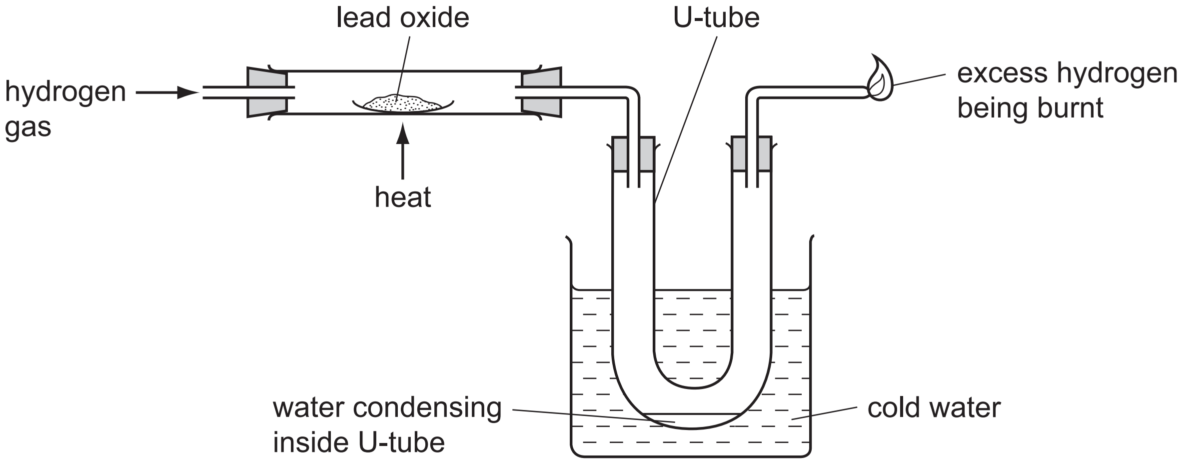


Fig. 1.3

(i) Construct a balanced symbolic equation for the reaction between hydrogen and lead oxide.

.... [2]

(ii) Suggest why the method shown in Fig. 1.3 could **not** be used to extract calcium from calcium oxide.

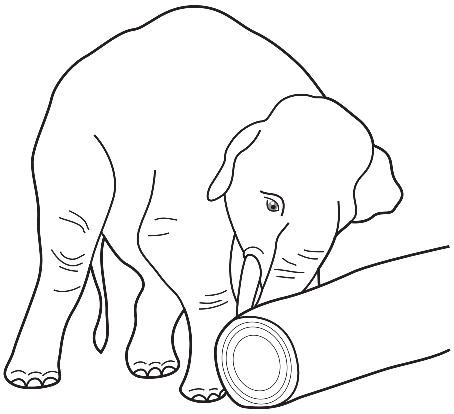
....

....

.... [2]

For Examiner's Use

2 **(a)** An elephant of mass 5000 kg exerts a constant force of 1400 N to push a tree trunk along at a steady speed of 1.5 m / s.



(i) Calculate the work done by the elephant when the tree trunk moves 10 m.

State the formula that you use and show your working.

formula

working

.... [2]

(ii) Calculate the kinetic energy of the elephant when it is moving at 1.5 m / s.

State the formula that you use and show your working.

formula

working

.... [2]

For Examiner's Use

(b) The elephant has a weight of 50 000 N and stands with all four feet in contact with the ground. Each foot of the elephant has an area of $0.2\,m^2$.

Calculate the pressure exerted by the elephant on the ground.

State the formula that you use and show your working.

formula

working

.... [2]

(c) The volume of the elephant is $5\,m^3$. Its mass is 5000 kg.

Calculate the density of the elephant.

State the formula that you use and show your working.

formula

working

.... [2]

For Examiner's Use

3 Fig. 3.1 shows an animal cell just before it divides.

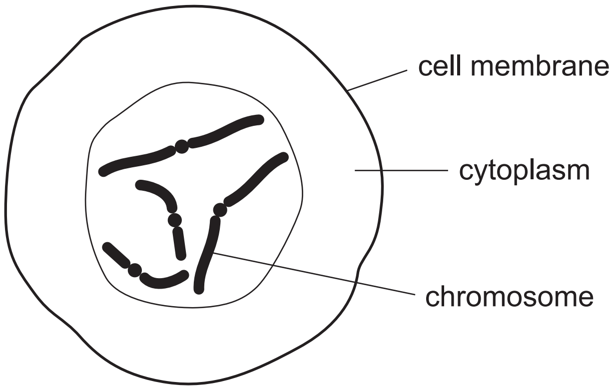


Fig. 3.1

(a) Define the term *chromosome*.

....

....

.... [2]

(b) The cell in Fig. 3.1 is a diploid cell.

State the number of chromosomes that there will be in each of the daughter cells if this cell divides by

mitosis, ...

meiosis. .... [2]

(c) Describe the roles of mitosis in an animal's body.

....

....

.... [2]

(d) Some cattle have horns, but other cattle do not. This is determined by a gene that has two alleles. The recessive allele, **h**, produces horns.

(i) Complete Table 3.1 to show the phenotypes of cattle with each of the possible genotypes for this gene.

Table 3.1

genotype	phenotype
HH	
Hh	
hh	

[2]

(ii) A farmer has a bull with no horns. He wants to make sure that the bull does not have the recessive allele, **h**, for horns.

Suggest and explain what the farmer can do to find out whether the bull has the allele **h**.

You should use a genetic diagram as part of your answer.

....

....

....

....

.... [4]

4 Fig. 4.1 shows a microwave oven. The energy of microwaves is used to cook food by heating up the water molecules in the food.

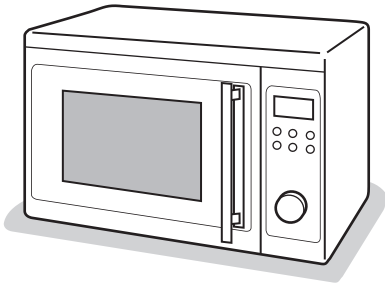


Fig. 4.1

(a) A student heated some water in a microwave oven for five minutes. Fig. 4.2 shows how the temperature of the water changed.

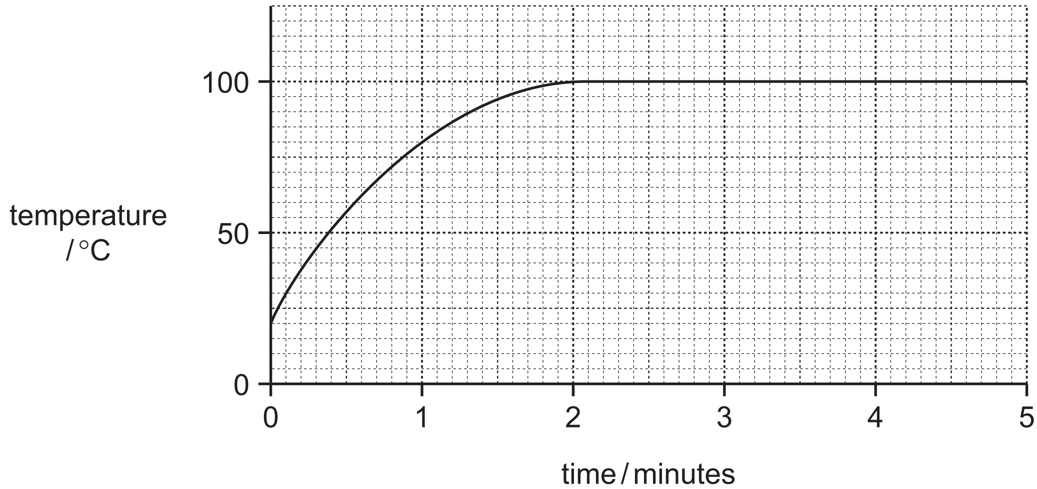


Fig. 4.2

The temperature of the water stops increasing after two minutes.

Explain what happened to the water molecules during the five minutes.

....

....

....

....

....

....

.... [3]

(b) 0.5 kg of water is heated in the microwave from 10 °C to 50 °C. The specific heating capacity of water is 4200 J / kg °C.

Calculate the energy needed to heat the water.

State the formula that you use and show your working.

formula used

working

.... [3]

For Examiner's Use

(c) The following label is found on a cooker that combines a microwave oven and a grill.

voltage	220 V
microwave power	0.60 kW
grill power	1.20 kW

Some meat is cooked using both the microwave oven and the grill. Both are switched on at full power for 30 minutes.

Calculate the total energy transferred by the cooker.

Show your working.

.... [3]

(d) Fig. 4.3 shows a reed relay being used in the door of a microwave oven.

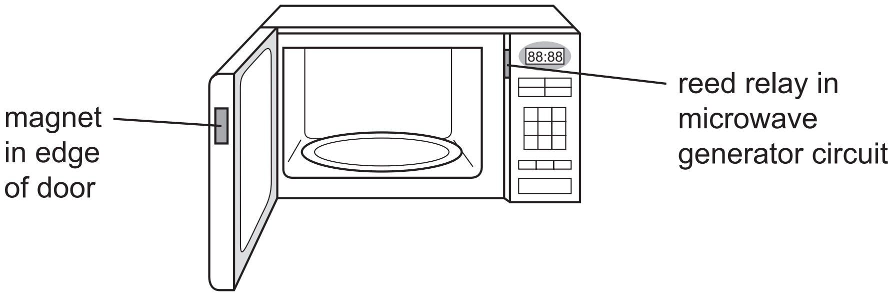


Fig. 4.3

Describe how the relay ensures that the oven only operates when the oven door is shut.

....

....

....

.... [2]

For Examiner's Use

5 **(a)** When sodium is burned in air a mixture of solid products, which contains the ionic compound sodium oxide, is produced.

Fig. 5.1 shows diagrams of a sodium atom and an oxygen atom as they exist just before sodium oxide starts to form.

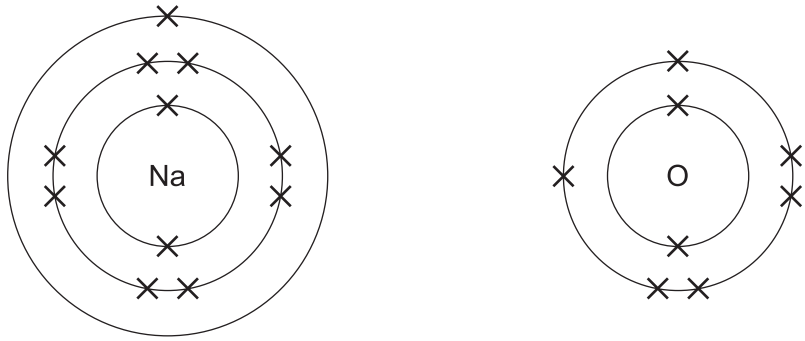


Fig. 5.1

(i) Describe how sodium and oxygen atoms become bonded together. Your answer should explain why the formula of sodium oxide is Na_2O.

....

....

....

....

....

.... [3]

(ii) Describe **two** differences in the properties of a typical ionic compound and a typical covalent compound.

1 ....

....

2 ....

....

[2]

(b) Fig. 5.2 shows apparatus a student used to investigate the electrolysis of dilute sulfuric acid.

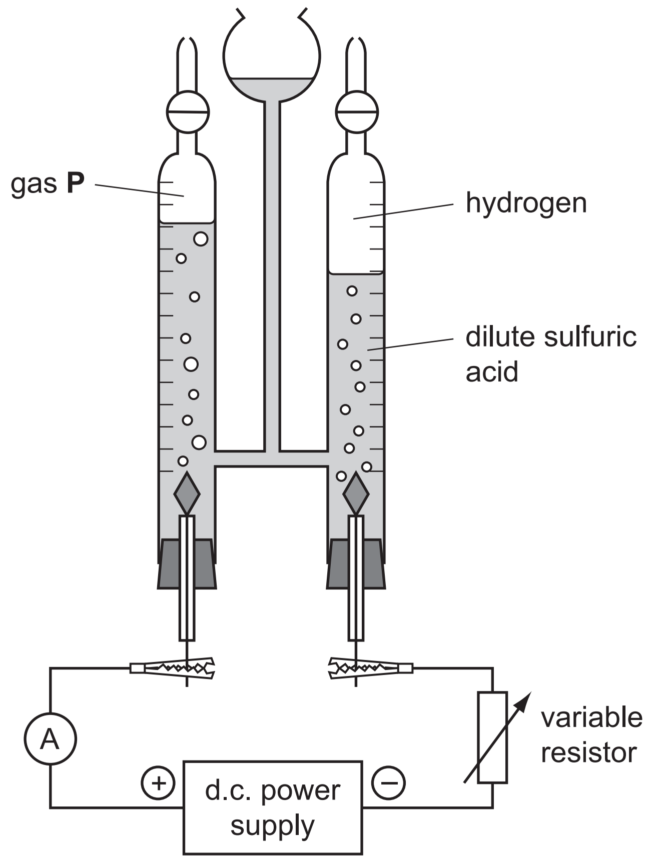


Fig. 5.2

The variable resistor was included in the electrolysis circuit so that the student could alter the current.

Table 5.1 shows some of the measurements the student made in his investigation.

Table 5.1

experiment number	current / A	time current was passed / seconds	volume of hydrogen collected / cm^3
1	0.48	400	24
2	0.24	400	12

(i) Name gas **P**. .... [1]

For Examiner's Use

(ii) Calculate the rate at which hydrogen was produced in experiment **1**.

Show your working and state the units.

.... [2]

(iii) Calculate the number of moles of hydrogen produced in experiment **2**.

Assume that the volume of one mole of a gas under the conditions of the experiment is 24 dm^3.

Show your working.

.... [2]

(iv) All dilute solutions of acids contain hydrogen ions, H^+.

Explain the difference between the results for experiments **1** and **2** in terms of electrons, ions, atoms and electric current.

....

....

....

....

....

....

.... [3]

6 Fig. 6.1 shows a section through a blood capillary.

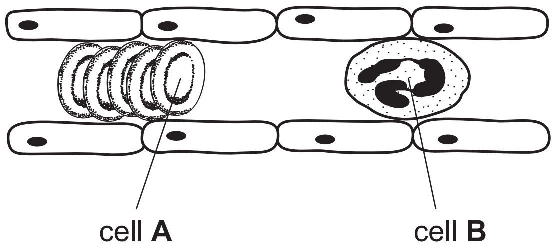


Fig. 6.1

(a) Describe how cell **A** transports oxygen.

....

....

....

.... [2]

(b) Explain how the structure of the blood capillary helps oxygen to be provided easily to the body tissues.

....

....

....

.... [2]

(c) Describe the function of cell **B**.

....

....

....

.... [2]

For Examiner's Use

7 **(a)** A resistor of 1200 Ω is connected in parallel with another resistor of 2400 Ω.

Calculate the combined resistance of these two resistors.

State the formula that you use and show your working.

formula

working

.... [3]

(b) Torches (flashlights) are usually powered by electrical cells. They can also be powered by energy from the Sun (solar energy).

Solar energy is a renewable energy resource.

(i) Write the energy resources below into Table 7.1 to show which are renewable and which are non-renewable.

coal	**geothermal**	**hydroelectric**	**natural gas**
oil	**tidal**	**wave**	**wind**

Table 7.1

renewable resource	non-renewable resource

[1]

(ii) Name the process that releases energy within the Sun.

.... [1]

(iii) Energy is transferred from the Sun to the Earth by radiation.

Explain why energy cannot be transferred from the Sun to the Earth by conduction.

....

.... [1]

(c) Fig. 7.1 shows a torch that works without electrical cells.

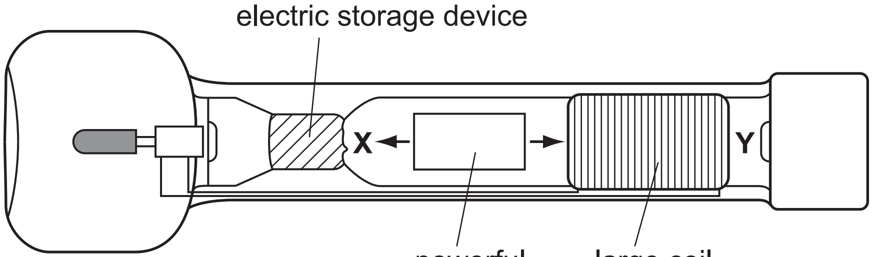


Fig. 7.1

To use the torch, it is first shaken for 40 seconds. This moves the magnet backwards and forwards inside the torch. The magnet can move between points **X** and **Y**.

Explain why shaking the torch produces an electric current.

....

....

....

....

....

.... [4]

For Examiner's Use

8 **(a)** The ovary of a flower contains one or more ovules. The ovules contain female gametes. After fertilisation, an ovule becomes a seed containing an embryo plant.

Fig. 8.1 shows a pea seed developing inside a pod.

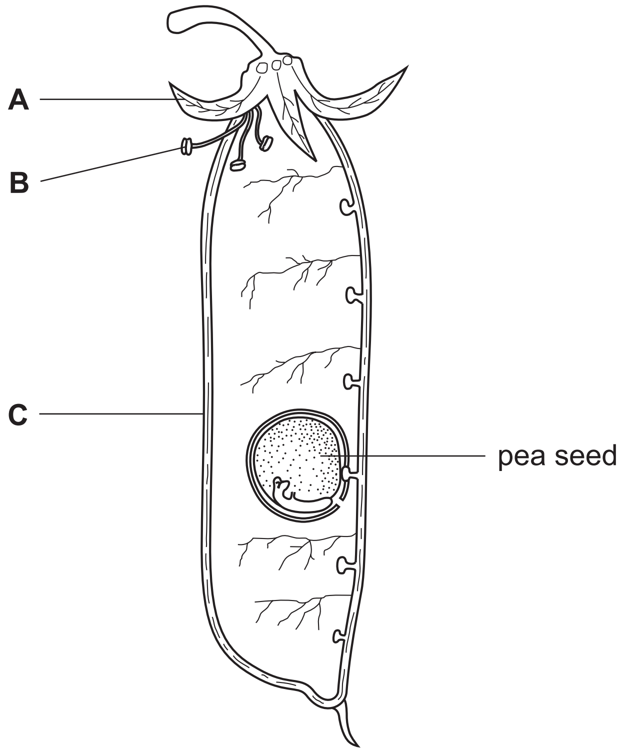


Fig. 8.1

(i) Explain the meaning of each of the following terms.

gamete ....

fertilisation ....

[2]

(ii) Parts **A** and **B** in Fig. 8.1 remain from the flower.

State the name and function of each of these parts **in the flower**.

name of part **A** ....

function ....

name of part **B** ....

function ....

[4]

(iii) Suggest the part of the flower from which structure **C** developed.

.... [1]

For Examiner's Use

(b) A pea seed was planted in a pot. When the seed had grown into a young plant, the pot was placed on its side in a room where light was coming from all sides.

Fig. 8.2 shows the young pea plant three days after the pot had been placed on its side.

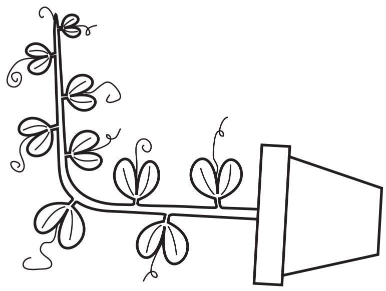


Fig. 8.2

(i) Name the response shown by the pea plant in Fig. 8.2.

.... [2]

(ii) Suggest how this response will help the plant to reproduce sexually when it has grown to maturity.

....

....

.... [2]

(iii) On one of the days when the pot was placed on its side, a scientist measured

- the increase in length of the upper surface and the lower surface of the stem of the pea plant,
- the concentration of auxin in the cells on the upper surface and lower surface of the stem of the pea plant.

His results are shown in Fig. 8.3.

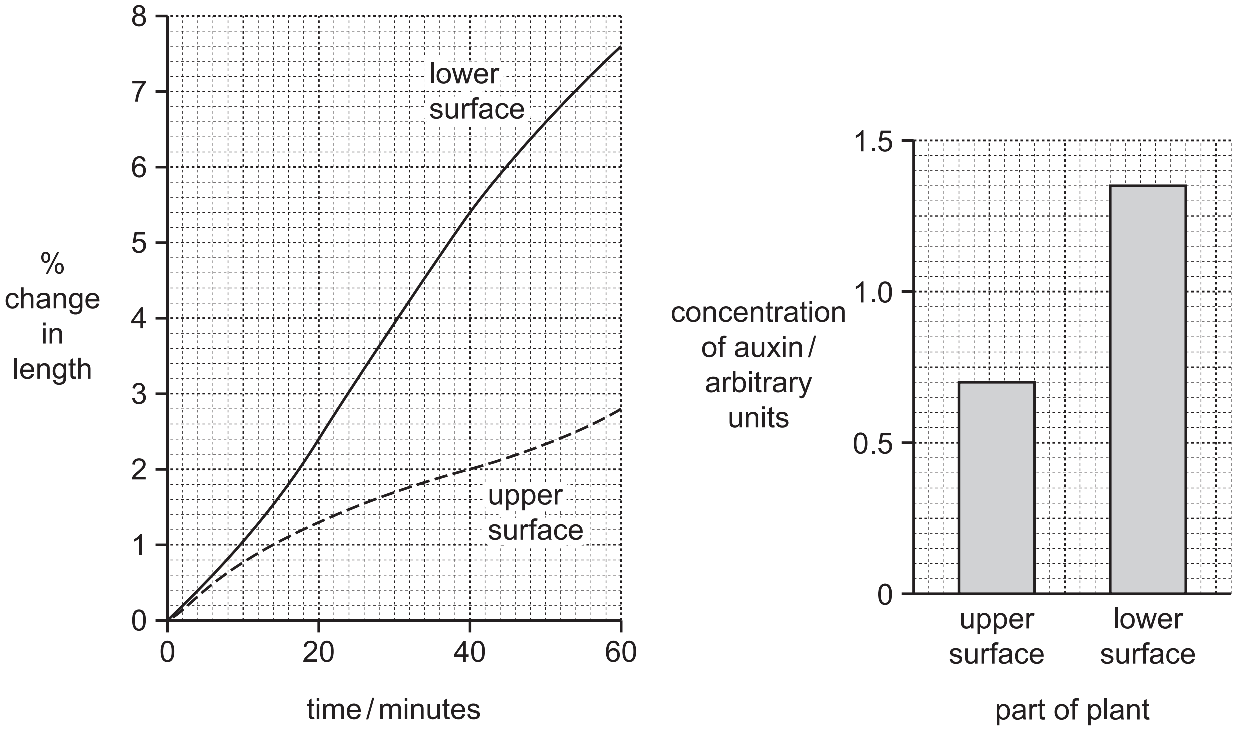


Fig. 8.3

Use the results in Fig. 8.3 to explain what has caused the stem of the pea plant to grow upwards.

....

....

....

....

....

.... [3]

For Examiner's Use

9 (a) Nylon is a synthetic polymer which can be made by mixing solutions as shown in Fig. 9.1. The simplified diagrams of molecules show the compounds that are contained in the solutions.

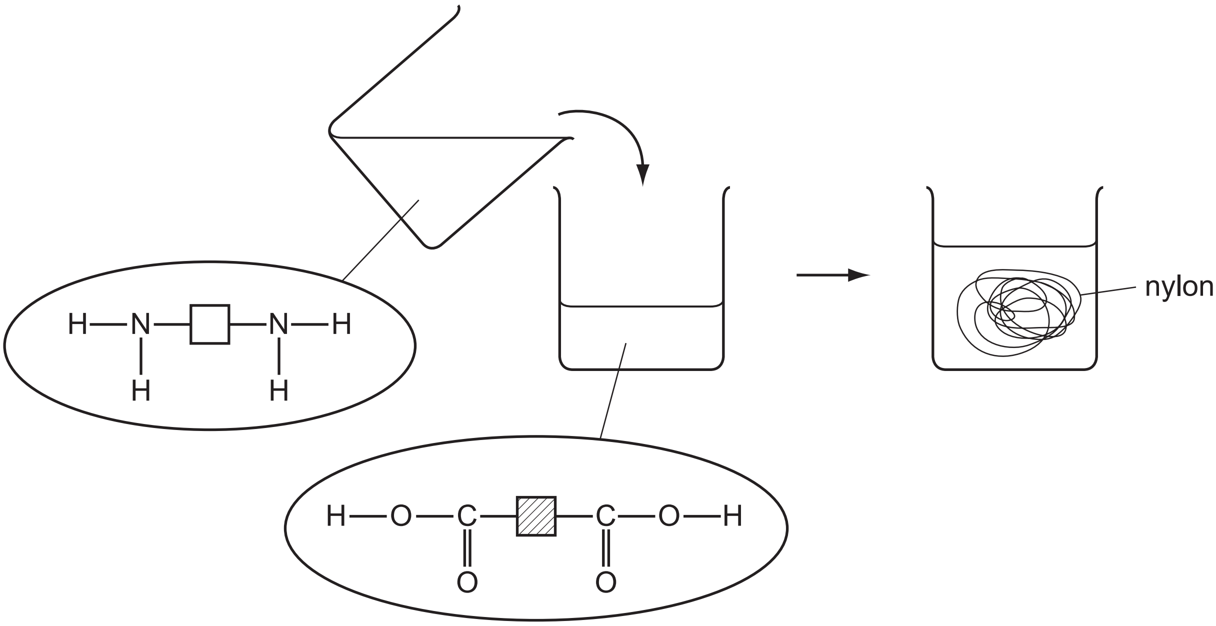


Fig. 9.1

(i) What general name is given to small molecules that link together to form polymers?

.... [1]

(ii) Draw a short section of the nylon molecule that forms when the molecules shown in Fig. 9.1 react together. Use the same symbols that are used in Fig. 9.1.

[3]

(iii) State

- the full name of the type of chemical reaction that occurs to form nylon,

....

- the chemical formula of the compound which is produced in addition to nylon (the by-product).

.... [2]

For Examiner's Use

(b) Proteins are polymers that occur in nature.

(i) Name the type of compounds that link together to form proteins.

.... [1]

(ii) Describe briefly how the polymer chains in proteins may be broken down into small molecules.

....

.... [2]

(iii) Name the type of chemical reaction which occurs in **(ii)**.

.... [1]

10 **(a)** X-rays and γ (gamma) rays are both examples of ionising radiation.

Explain what is meant by the term *ionising radiation*.

....

.... [1]

(b) Fig. 10.1 is a graph showing how the count rate of a radioactive isotope decreases with time.

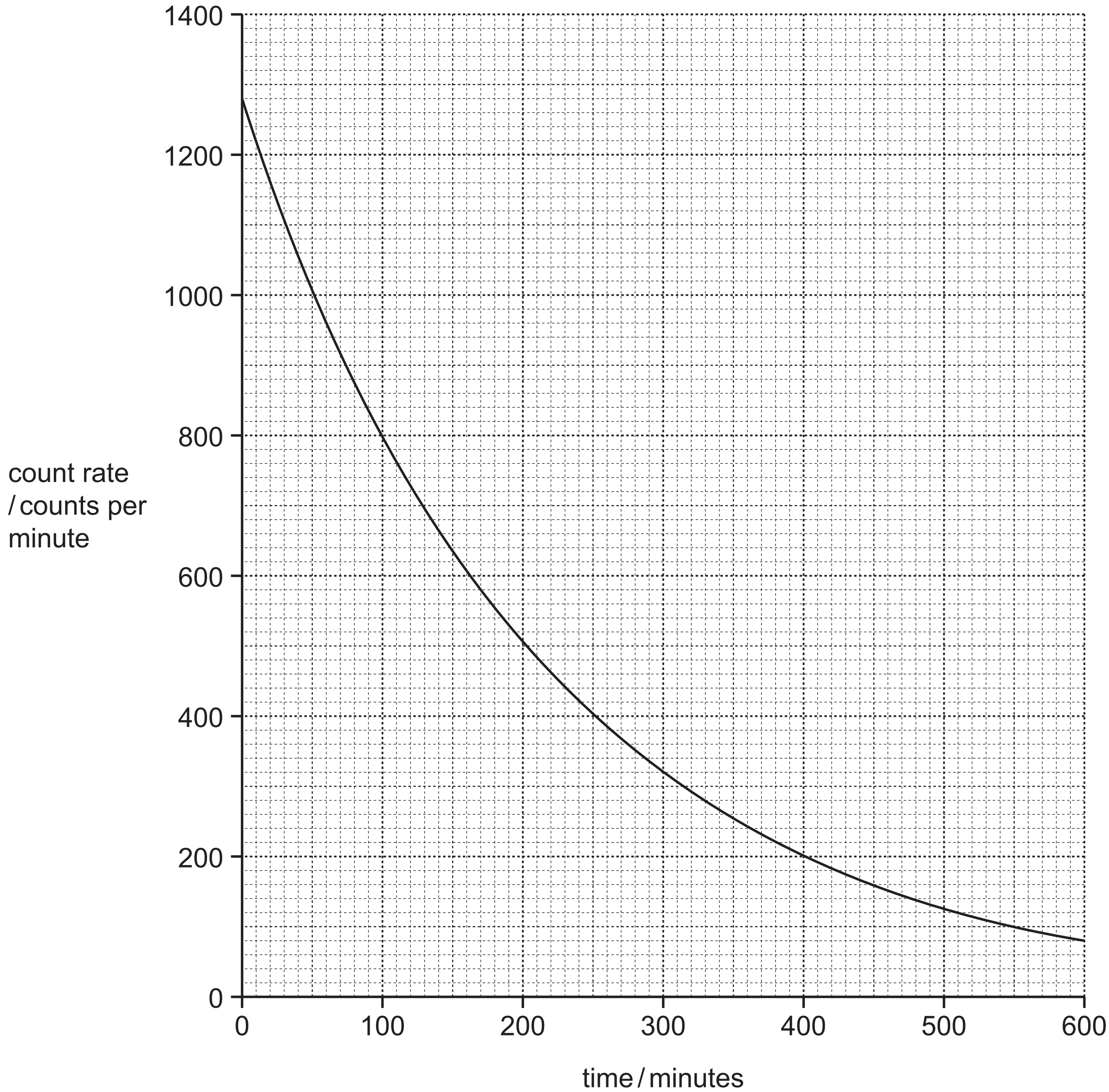


Fig. 10.1

For Examiner's Use

(i) Calculate the half-life of this isotope.

Show your working.

.... [2]

(ii) What percentage of the original radioactive nuclei will still be present after 250 minutes?

Show your working.

.... % [2]

[Turn over

For Examiner's Use

(c) A teacher demonstrated how the count rate detected by a Geiger-Müller tube depends on the distance between the front of the tube and a radioactive α (alpha) source.

Fig. 10.2 shows how the equipment was set up.

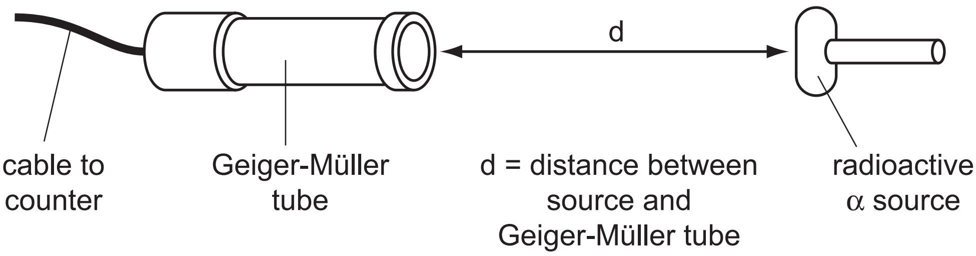


Fig. 10.2

Fig. 10.3 shows a graph of the results of the experiment.

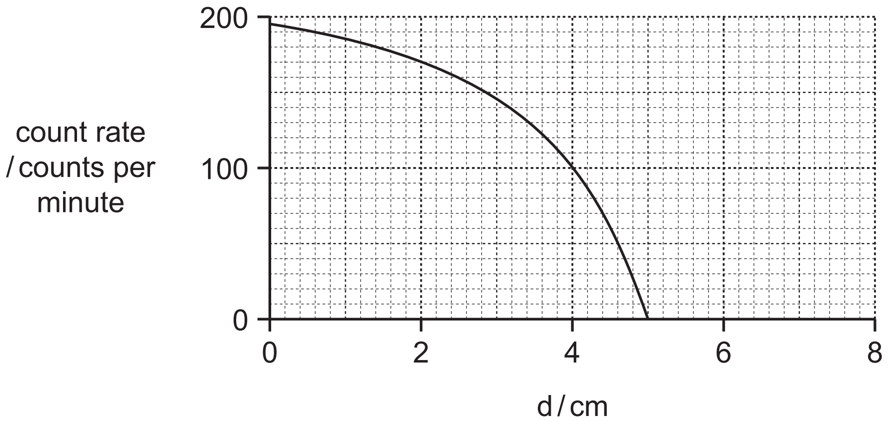


Fig. 10.3

(i) State the range of the alpha particles. .... [1]

(ii) Describe how you would use the apparatus to obtain these results.

....

....

....

.... [3]

(iii) Before carrying out the experiment the teacher discussed how to reduce her exposure to radiation.

Which idea below would **not** help reduce the radiation exposure of the teacher during the experiment? Explain your answer.

idea 1 Hold the source with long tongs and wear gloves.

idea 2 Place a lead shield between the source and the teacher.

idea 3 Wear a photographic badge that detects radiation.

idea .... because ....

....

....

.... [2]

11 Fig. 11.1 shows a food chain. The arrows show how energy flows from one organism to another along the chain.

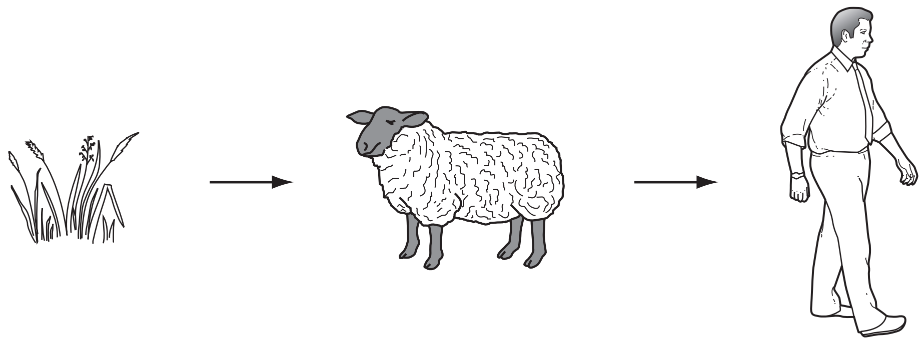


Fig. 11.1

(a) The grass is the producer in this food chain.

Explain how plants produce a supply of chemical energy at the start of the food chain.

....

....

....

....

....

.... [4]

(b) Energy is lost between the trophic levels in a food chain.

Describe **one** way in which energy is lost from this food chain.

....

....

.... [2]

(c) Outline how the cells in the man's body obtain useful energy from the food that has been digested and absorbed into them.

....

....

....

.... [2]

For Examiner's Use

12 (a) A student added a solution of the same dilute acid to each of the test-tubes **P** to **T** shown in Fig. 12.1.

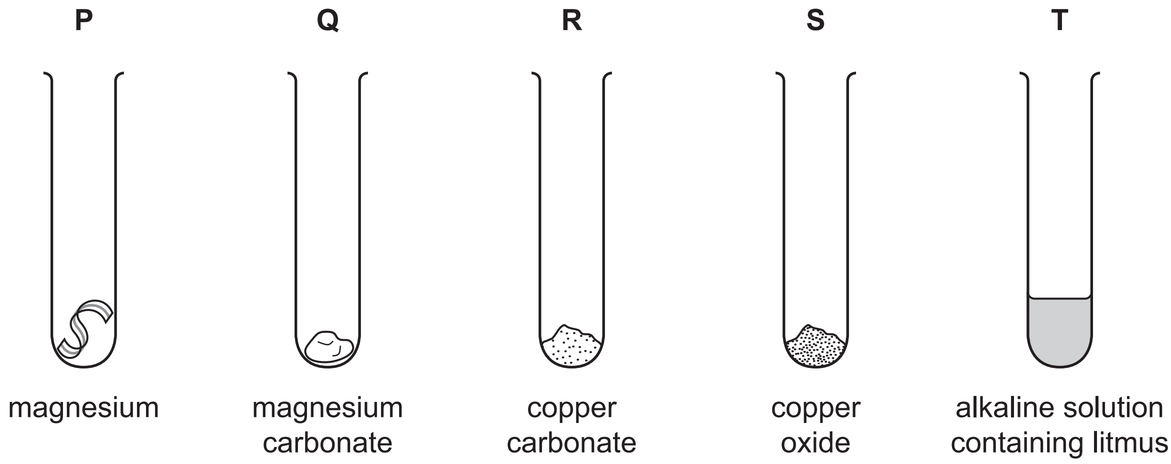


Fig. 12.1

Complete Table 12.1 by matching the test-tubes, **P**, **Q**, **R**, **S** and **T**, with the observations which are made when the dilute acid reacts with the contents.

Some of the observations apply to more than one of the test-tubes. You may use each letter once, more than once or not at all.

Table 12.1

observations	test-tube(s)
The mixture turns red when excess acid has been added.	
A colourless gas is given off.	
A blue solution is formed.	
A colourless gas which pops when ignited is given off.	

[4]

(b) The student used the apparatus shown in Fig. 12.2 to investigate neutralisation reactions involving two acids, **A** and **B**.

For Examiner's Use

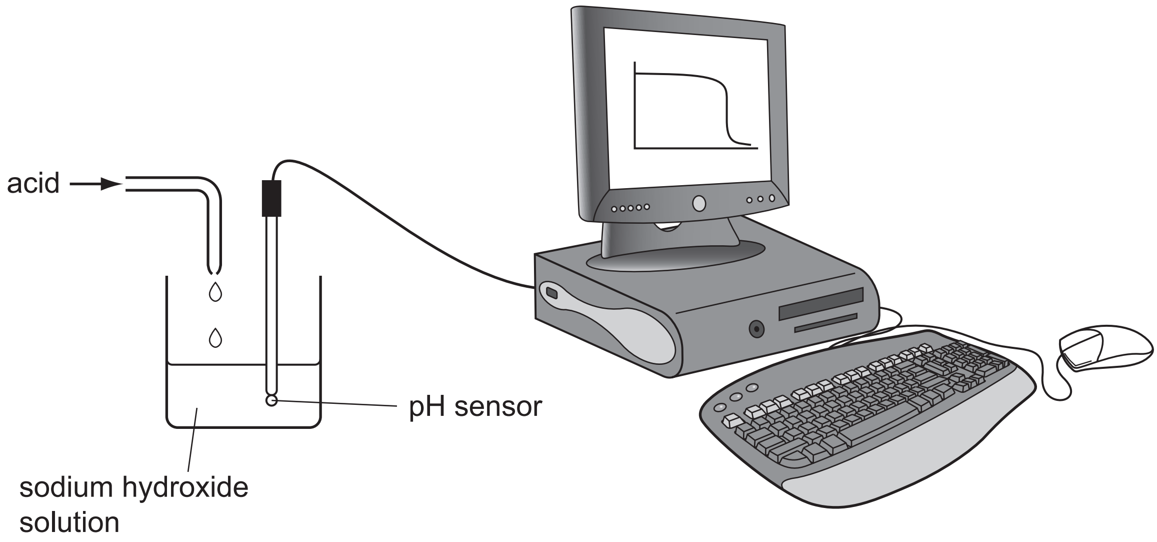


Fig. 12.2

In each experiment, 25.0 cm^3 of the same solution of sodium hydroxide were placed into a beaker. The acid was added at a constant rate until it was in excess.

The measurements were displayed on the computer screen as a graph of pH of the reaction mixture against volume of acid that had been added.

The results for the two acids are shown in Fig. 12.3.

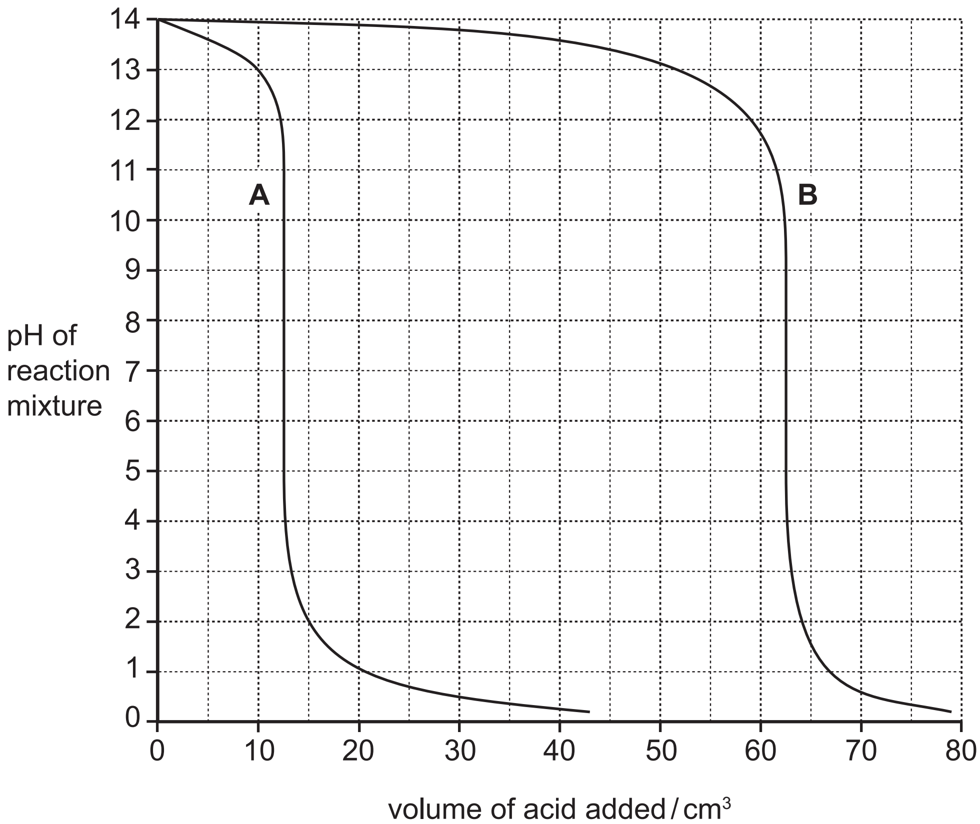


Fig.12.3

For Examiner's Use

(i) Describe how the pH of the mixture in the beaker changes as the volume of acid **A** increases.

....

....

.... [2]

(ii) The student found that 12.5 cm^3 of acid **A** and 62.5 cm^3 of acid **B** were needed to neutralise the sodium hydroxide in the beaker.

Explain how the student obtains these results from the graph shown in Fig. 12.3.

....

.... [1]

(iii) Acids **A** and **B** are different concentrations of hydrochloric acid, HCl. Acid **B** had a concentration of 1.0 mol / dm^3.

Use the results the student obtained to calculate the concentration of acid **A**.

Explain your answer briefly.

....

.... [2]

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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** Sulfur 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.).