Candidate Name Mark Scheme

Centre Number	Candidate Number

International General Certificate of Secondary Education

UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE

CO-ORDINATED SCIENCES **0654/2**

PAPER 2

Thursday **20 MAY 1999** Morning 2 hours

Candidates answer on the question paper.
Additional materials:
Ruler (cm/mm)

Bid ✓
Chem ✓
Phys ✓

TIME 2 hours

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

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 24.

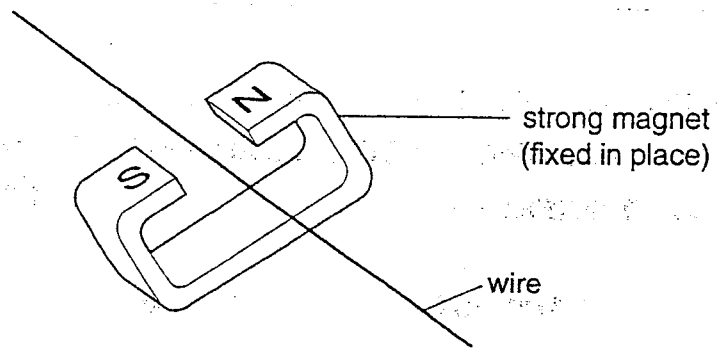
You may use a calculator.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
TOTAL	

This question paper consists of 24 printed pages.

[Turn over

1 A wire is placed between the poles of a strong magnet.



(a) (i) Choose from the words below to complete the sentences.

current **force** **move** **power** **voltage**

When a large electric current flows along the wire, a ..force.. acts on the wire. This makes the wire ..move.. upwards. [2]

(ii) Describe what you would expect to see if the current flows the other way along the wire.

..The wire moves downwards..

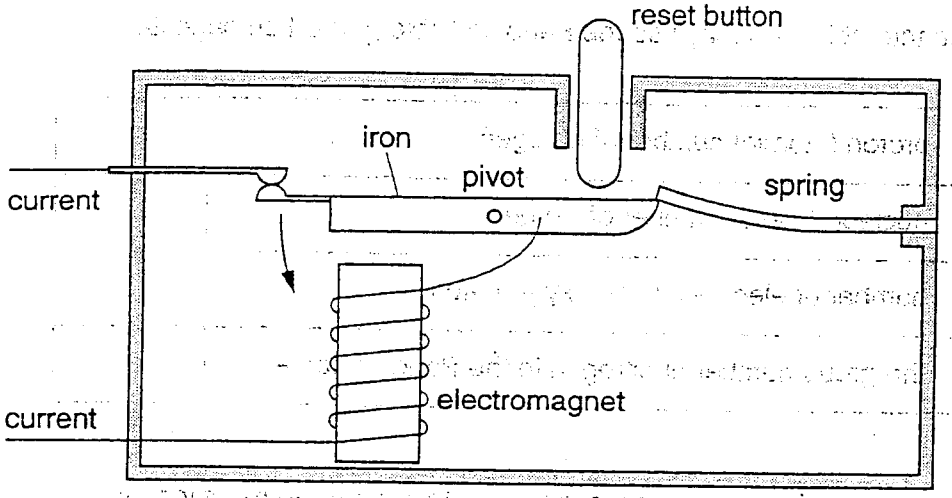
.....[1]

(b) Explain why relays are sometimes used when switching on an electric motor.

..Motors often take large currents/voltages..
..A relay allows a low current/voltage..
..switch circuit to control the motor..[2]

For Examiner's Use

(c) The device shown in the diagram below is a circuit breaker, which uses an electromagnet. It is designed to switch off the current in the circuit if the current becomes too large.

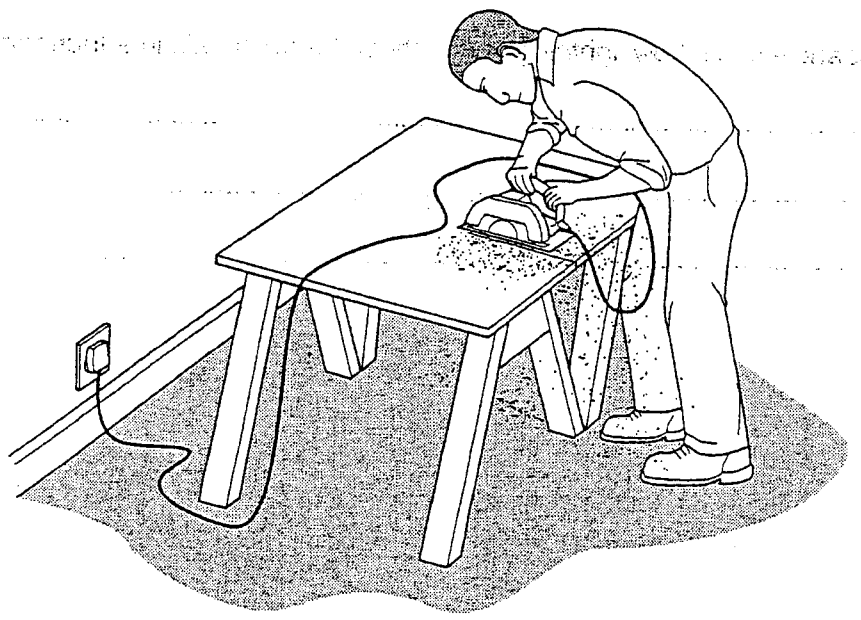


(i) Explain how this device switches off the current if the current becomes too large.

- More Current makes the electromagnet stronger
- The iron is attracted towards the magnet
- The iron rotates anticlockwise
- Breaks the Contacts and switches off the Current

.....[4]

(ii) Suggest why such a device should always be in the circuit when an electric saw is being used.



The saw could cut through the Cable

.....[1]

2 **(a)** Two chemical symbols are shown below.

$^{14}_{7}\mathbf{N}$ $^{16}_{8}\mathbf{O}$

Complete the table. You may use the Periodic Table printed on page 24.

proton (atomic) number of nitrogen	7
nucleon (mass) number of oxygen	16
number of electrons in an oxygen atom	8
the group number of nitrogen in the Periodic Table	5

[4]

(b) Lightning causes nitrogen and oxygen in the atmosphere to react together.

(i) Explain how this can benefit growing plants.

nitrogen dioxide formed dissolves in rain water to form nitric acid which contains nitrate ion (HNO_3) a useful nutrient for plants. [2]

One gaseous compound which forms is dinitrogen tetroxide, N_2O_4, which is soluble in water.

(ii) What is the total number of atoms in one molecule of dinitrogen tetroxide?

6 [1]

(iii) Suggest and explain how lightning could affect the pH of rain in a thunderstorm.

N_2O_4 dissolves in the rain

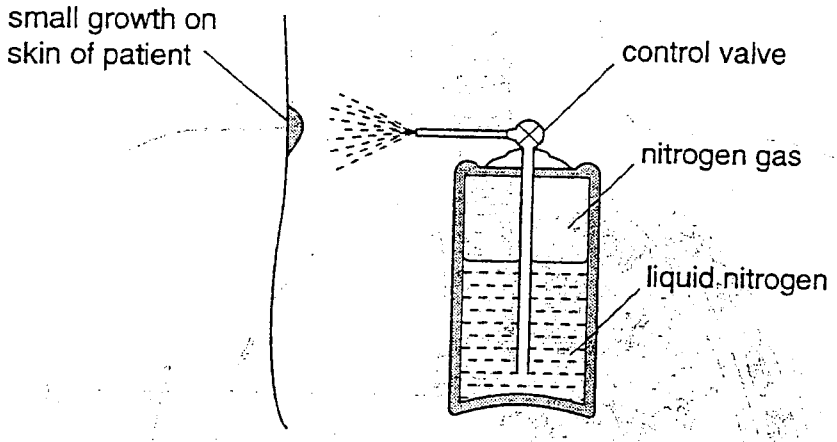
non-metal oxides make acidic solutions, therefore

pH of rain will decrease [2]

For Examiner's Use

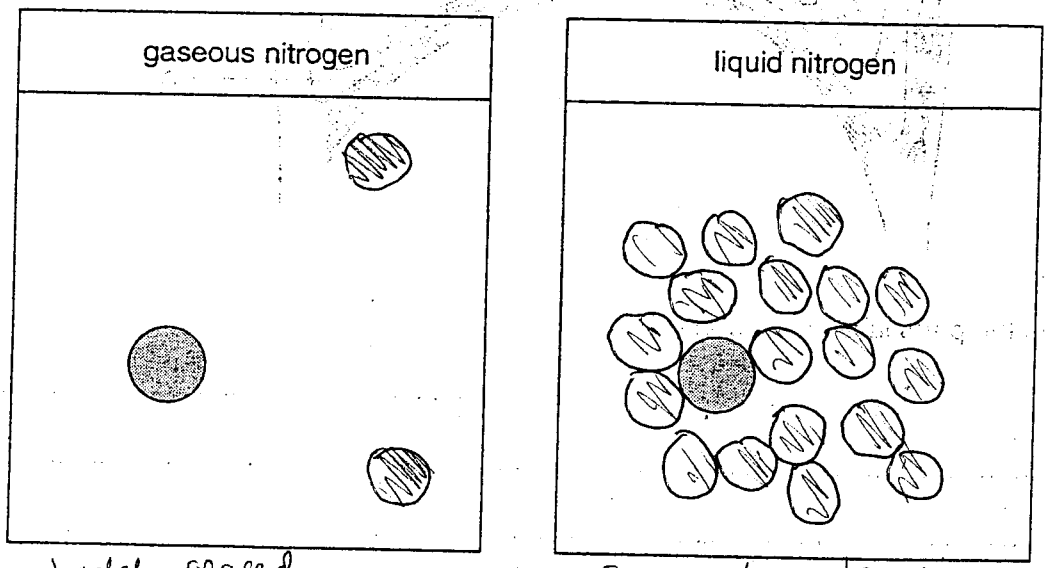
(c) Gaseous nitrogen turns into liquid nitrogen at very low temperature (–196 °C).

Liquid nitrogen is used by doctors to remove small skin growths. The simplified diagram below shows how this is done.



(i) Complete the boxes below to show the difference in the way the molecules are arranged in gaseous and liquid nitrogen.

Each box already contains a symbol to show one nitrogen molecule.



widely spaced

some particles touching (random arrangement)

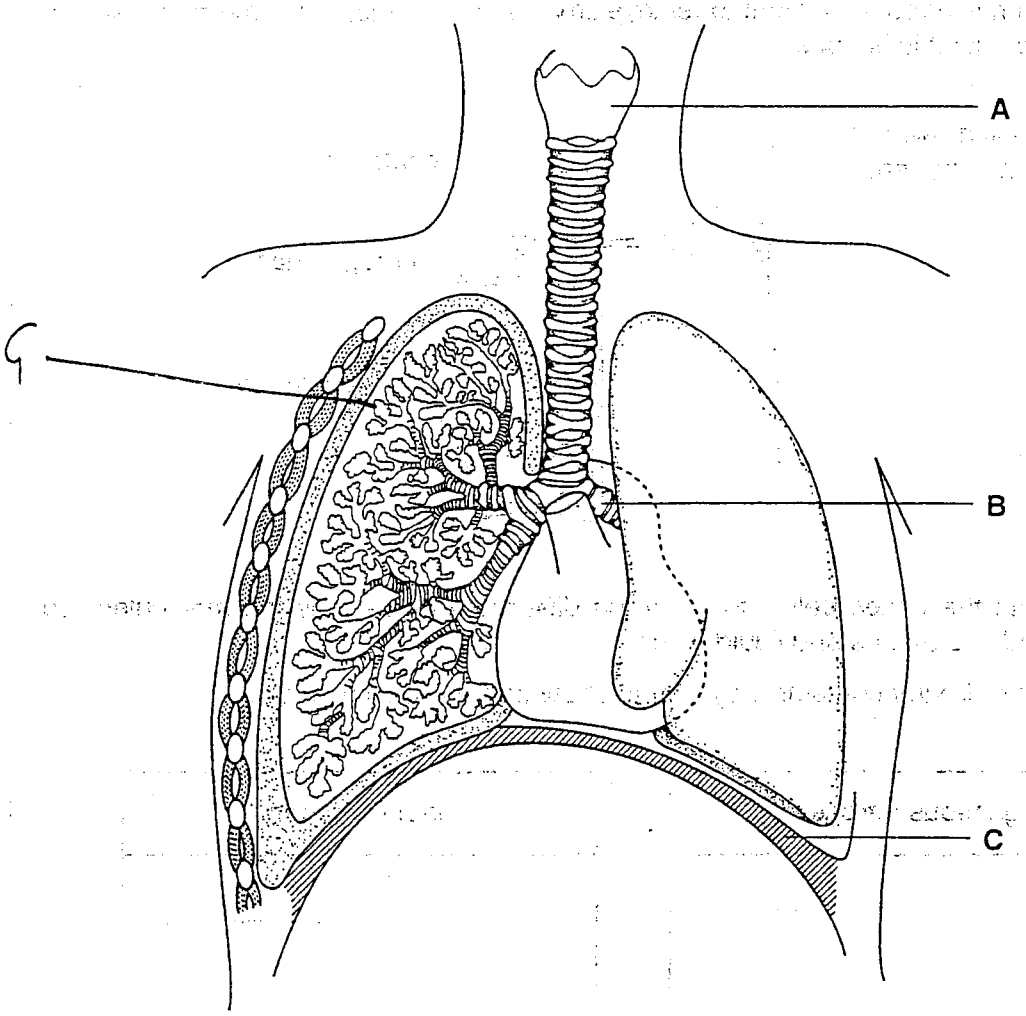
[2]

(ii) Suggest why liquid nitrogen destroys the cells in the skin growth.

water in cells freeze & break down cell structure

.....[1]

3 The diagram below shows the human breathing system.



(a) Name the parts labelled **A**, **B** and **C**.

A Larynx

B Bronchus

C Diaphragm

[3]

(b) (i) On the diagram, draw a labelling line to a part where gas exchange occurs, and label it **G**. Any Alveolus [1]

(ii) Name the process by which gas exchange takes place.

Diffusion [1]

(iii) Describe **one** way in which the part you have labelled **G** is adapted to help gas exchange to take place quickly.

Thin walled; Large S.A.;

In contact with many blood capillaries; [1]

Moist inner walls;

For Examiner's Use

(c) A carbon atom in a carbon dioxide molecule leaving a person's lungs could become part of a glucose molecule in the blood of a sheep.

Write the numbers **1** to **5** next to each of the following statements to show the sequence by which this could happen.

The first stage in the sequence has been numbered for you.

...3... Sheep eats grass containing starch.

...2... Carbon dioxide molecule combines with water inside a chloroplast to form glucose.

...5... Glucose molecule is absorbed through villi in the small intestine.

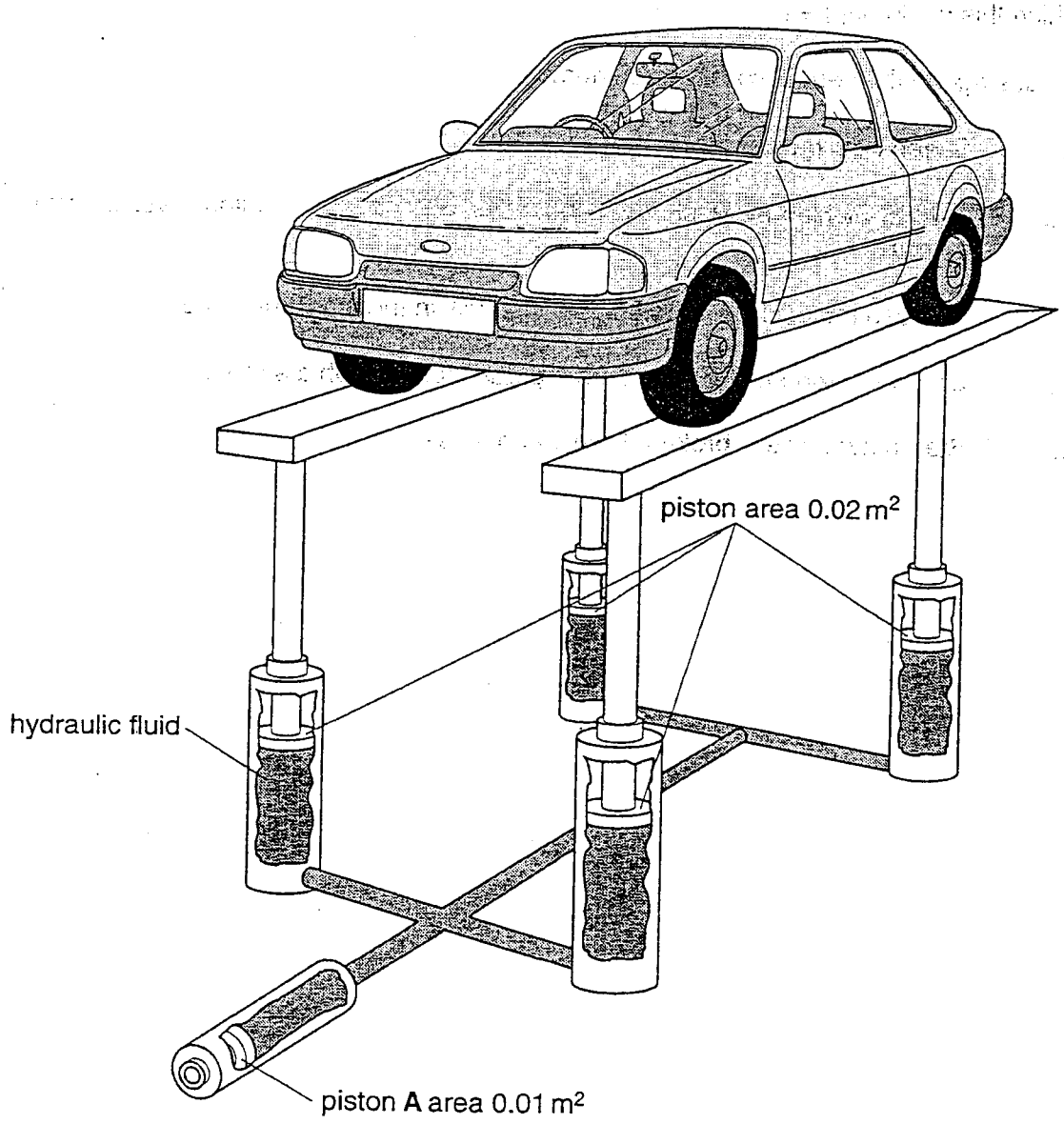
....1... Carbon dioxide molecule enters a grass leaf through a stoma.

...4... Starch molecule is broken down by amylase.

[3]

For Examiner's Use

4 A car is on a hydraulic lift in a garage. The total weight being lifted is 16 000 N.
The lift uses four large pistons each of which has an area of 0.02 m^2 and a smaller piston **A** which has an area of 0.01 m^2.



Use the equation 'pressure = force/area' to help you answer parts **(a)** and **(b)**.

(a) **(i)** Calculate the total area of the four large pistons.

4 x 0.02

0.08 ..... m^2 [1]

For Examiner's Use

(ii) Calculate the pressure in the hydraulic fluid used in the lift.

$P = \frac{F}{A} = \frac{16000}{0.08} =$

200 000 ..... N/m^2 [1]

(b) This pressure is caused by piston **A**. Calculate the force which piston **A** exerts, showing your working.

$F = P \times A = 200\,000 \times 0.01$

2000 ..... N [2]

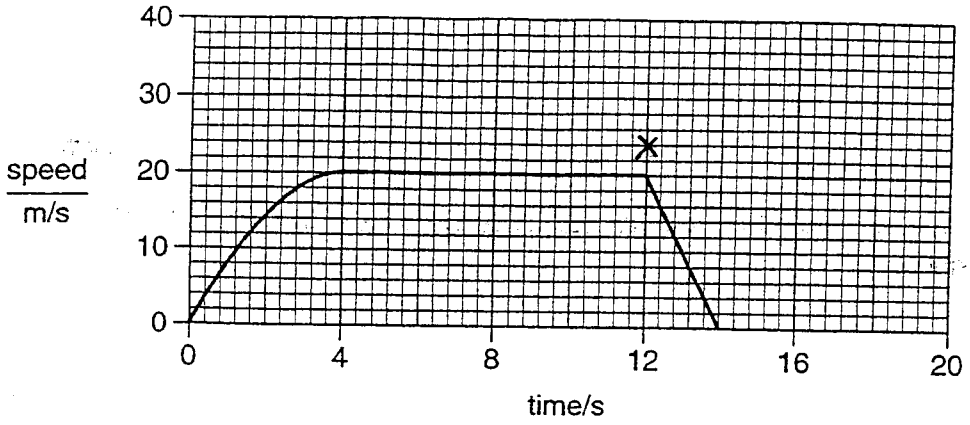
(c) Calculate how much work is done when the car and lift are raised 2 m.
Show your working and state any formula which you use.

$W = F \times d = 16000 \times 2$

32 000 ..... J [2]

For Examiner's Use

The brakes of the car were tested. The car was accelerated to 20 m/s and the brakes suddenly applied. The graph shows the motion of the car.



(d) (i) On the graph, write **X** to show when the brakes were applied. [1]

(ii) From this time, how many seconds did it take for the car to stop?

2 seconds [1]

(iii) Calculate the deceleration of the car, showing your working.

$a = \frac{\Delta v}{t} = \frac{20}{2}$

10 m/s^2 [2]

For Examiner's Use

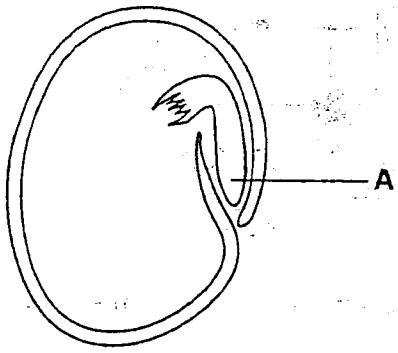
5 (a) (i) Name the part of a flower from which a seed develops.

Ovule [1]

(ii) What happens to this part to cause it to develop into a seed?

Male nucleus fuses with egg cell nucleus [1]

(b) The diagram below shows a section through a bean seed.



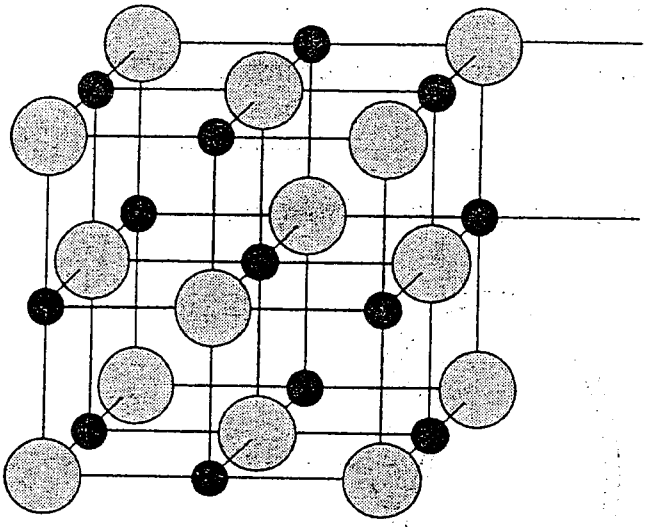
Describe what happens to part **A** when the seed germinates.

Young root pushes out through the seed coat;
Grows downwards into the soil;
Becomes the root. [2]

(c) State **two** conditions which are needed to make the seed germinate.

1. Warmth / Suitable temp.
2. Water
Oxygen [2]

6 The diagram below shows how the ions in sodium chloride crystals are arranged.



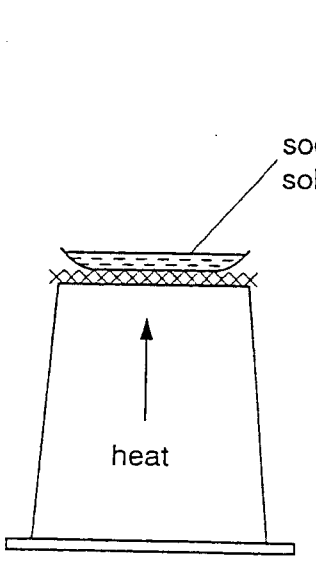
(a) Name the **type of structure** shown in the diagram above.

giant ionic [1]

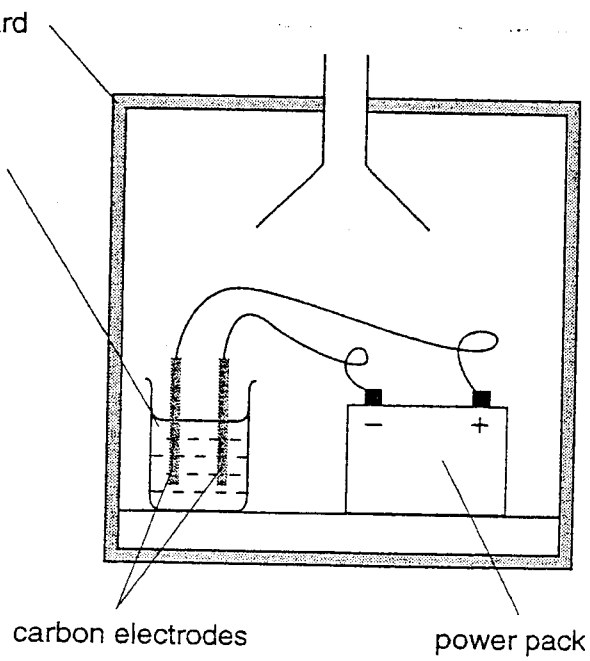
(b) Explain why the sodium and chloride ions are held together in sodium chloride crystals.

oppositely charged sodium and chloride ions attract each other [2]

(c) A student makes a concentrated solution of sodium chloride in water. She then uses some of this solution in two different experiments, as shown in the diagrams below.



experiment 1



experiment 2

For Examiner's Use

(i) Name the process in **experiment 2**.

electrolysis [1]

(ii) Explain why **experiment 2** needs to be carried out in a fume cupboard but **experiment 1** does not.

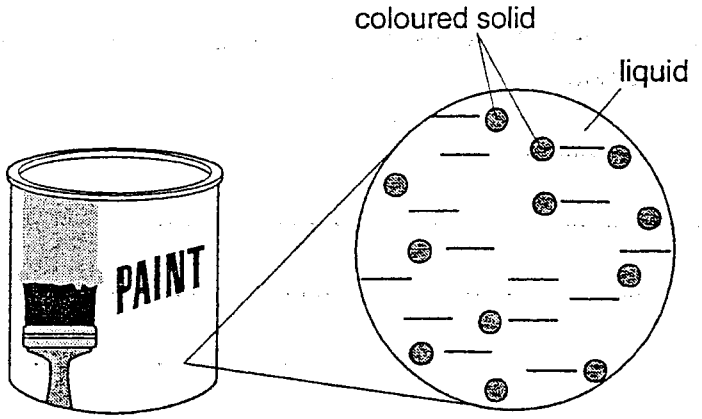
electrolysis of sodium chloride solution produces chlorine which is toxic. heating the solution only evaporates water which is not harmful (salt does not decompose) [3]

(iii) The reaction shown in **experiment 2** is important in the chemical industry.
Name **two** materials which are produced industrially by using this reaction.

1. chlorine, hydrogen
2. or sodium hydroxide

[2]

7 Some types of paint are mixtures consisting of tiny pieces of coloured **solid** dispersed in a **liquid**. Mixtures like this are called *colloids*.



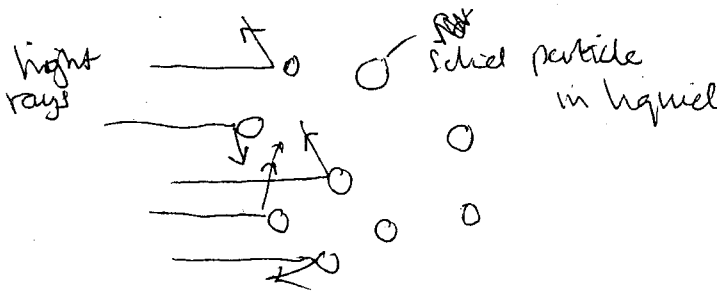
magnified view of paint

(a) (i) What name is given to the type of colloid shown in the diagram above?

Sol [1]

(ii) If the coloured solid had *dissolved* in the liquid, the resulting *solution* would be transparent.

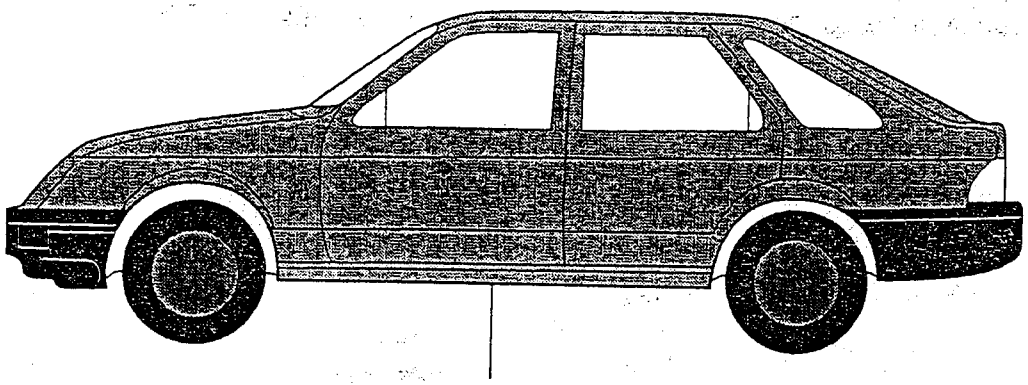
Explain, in terms of what happens to rays of light, why solutions are transparent but mixtures like paint are not. You may draw diagrams if it helps you to answer this question.



solid particles scatter the light and do not allow it to pass through. Dissolved particles do not affect light in this way. [2]

For Examiner's Use

(b) Car bodies are made from steel. Most of the car body is covered by layers of paint. In some countries, the steel on the underside of the car is galvanised by covering it with zinc.



galvanised steel on underside

(i) State and explain what would happen to the steel in a damp climate if the car body was **not** painted.

oxygen from air and water in atmosphere would react with the steel to form rust

[3]

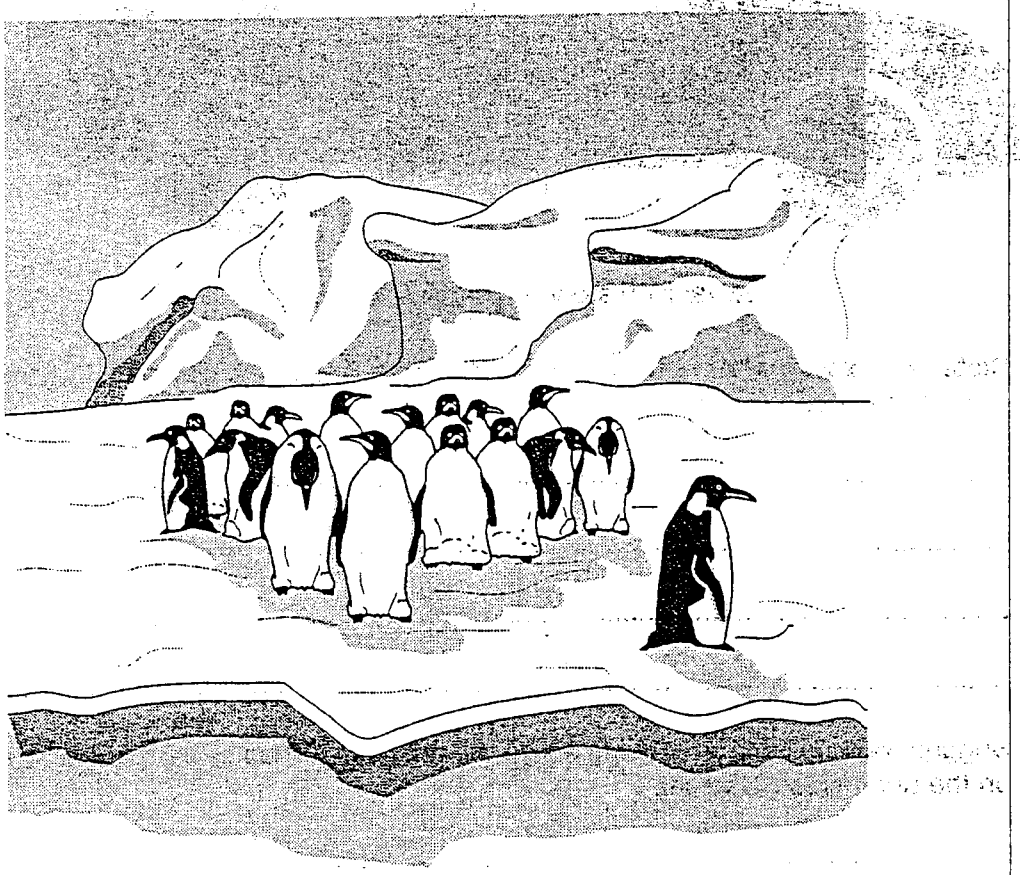
(ii) Suggest **one** advantage of using a layer of zinc, rather than paint, to cover the steel on the underside of the car.

if the zinc layer is scratched down to the ~~iron~~ steel, the steel will still not rust (because of sacrificial protection) unlike paint

[2]

8 Read the information below, and then answer the questions which follow.

Emperor penguins live in the Antarctic. Females lay eggs in autumn, and the males incubate the eggs all through the winter, when the average temperature is −16 °C.



During this time, the male penguins do not feed. They produce heat inside their bodies by using up stores of fat, which they break down by respiration.

$$\text{fat} + \text{oxygen} \longrightarrow \text{carbon dioxide} + \text{water}$$

The male penguins usually huddle together in groups while they are incubating the eggs. The eggs must be incubated for 110 days. If the male penguins lose too much body mass before then, they will abandon the eggs and go into the sea to feed. Research has found that huddled emperor penguins lose, on average, 137 g of body mass per day during the Antarctic winter, while penguins which stand on their own lose 171 g per day.

For Examiner's Use

(a) Describe **one** way by which a male penguin loses heat from its body to the environment.

Blood takes heat; Water evaporates from lungs;
Blood flows close to the surface; Evaporation of water needs heat energy;
Heat is lost to outside by radiation; Heat energy comes from Blood;

.....[3]

(b) Fat molecules contain atoms of hydrogen, carbon and oxygen.

When fat molecules are broken down by respiration, new substances are formed.

(i) Name the substance with molecules which now contain the hydrogen atoms.

Water [1]

(ii) Name the substance with molecules which now contain the carbon atoms.

Carbon Dioxide [1]

(iii) Underline **two** of the following terms which can be used to describe the reaction in which fat is broken down in respiration.

digestion	**exothermic**	neutralisation
oxidation	polymerisation	reduction

[2]

(c) Suggest and explain why huddled penguins lose less body mass per day than penguins that stand on their own.

Heat from Penguins;
Warms up air between penguins;
less surface exposed to outside;

.....[3]

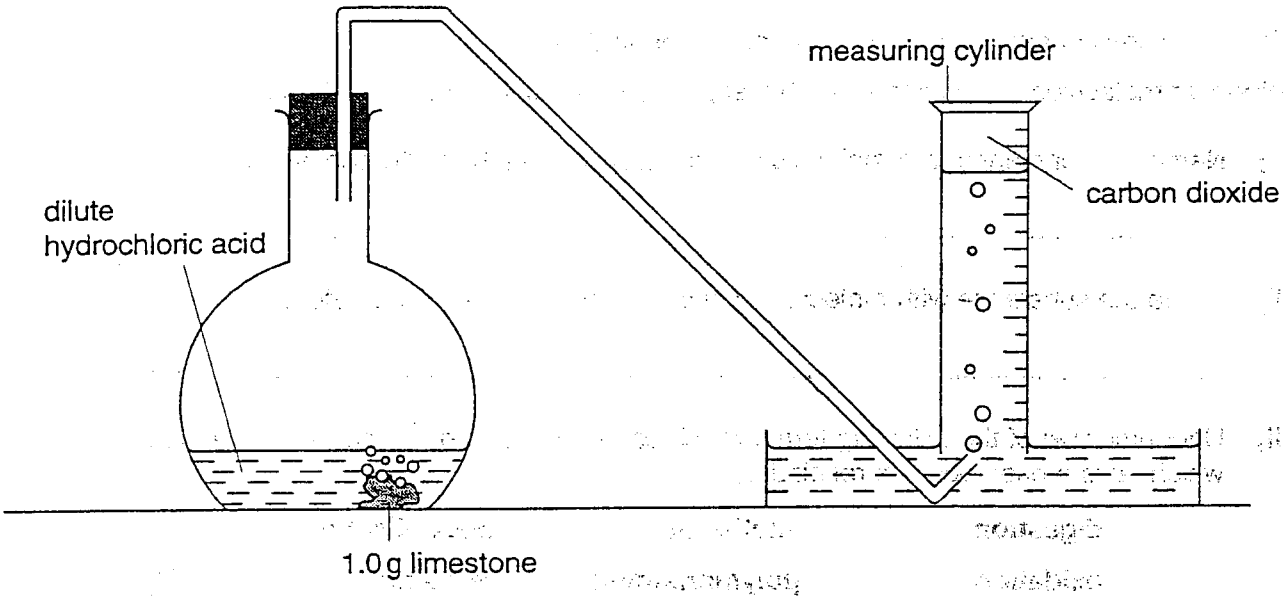
9 Limestone is impure calcium carbonate.

A student investigated two samples of limestone, **A** and **B**, to compare the amounts of calcium carbonate in the samples.

A single piece of limestone **A**, weighing 1.0 g, was added to an excess of dilute hydrochloric acid at room temperature (20 °C). The experiment was repeated using a single piece of limestone **B**, also weighing 1.0 g.

In each case, the total volume of carbon dioxide produced during the reaction was measured.

The apparatus used is shown in the diagram below.



(a) Complete the **word** chemical equation below.

hydrochloric acid	+	calcium carbonate	→	calcium chloride	+	carbon dioxide	+	water

[2]

(b) The results obtained in the experiments are shown in the table below.

sample	volume of carbon dioxide/cm^3
A	205
B	190

State and explain which sample, **A** or **B**, contained the greater amount of calcium carbonate.

A more carbon dioxide is produced

.....[1]

For Examiner's Use

(c) The student wanted to reduce experimental errors by **slowing down** the reaction.

State **two** changes he could make to his method to **slow down** the reaction.

1. reduce temperature of acid

2. add water to acid (reduce concentration) [2]

(d) In different experiments using the limestone samples, the student heated 1.0 g of each to 1000 °C. Both samples lost some mass.

Suggest and explain which sample, **A** or **B**, would lose more mass.

A contains more calcium carbonate. Calcium carbonate decomposes when heated losing mass, therefore the more present, the greater the loss of mass. [3]

(e) Describe briefly how the student could test a limestone sample to show that it contained a **calcium** compound.

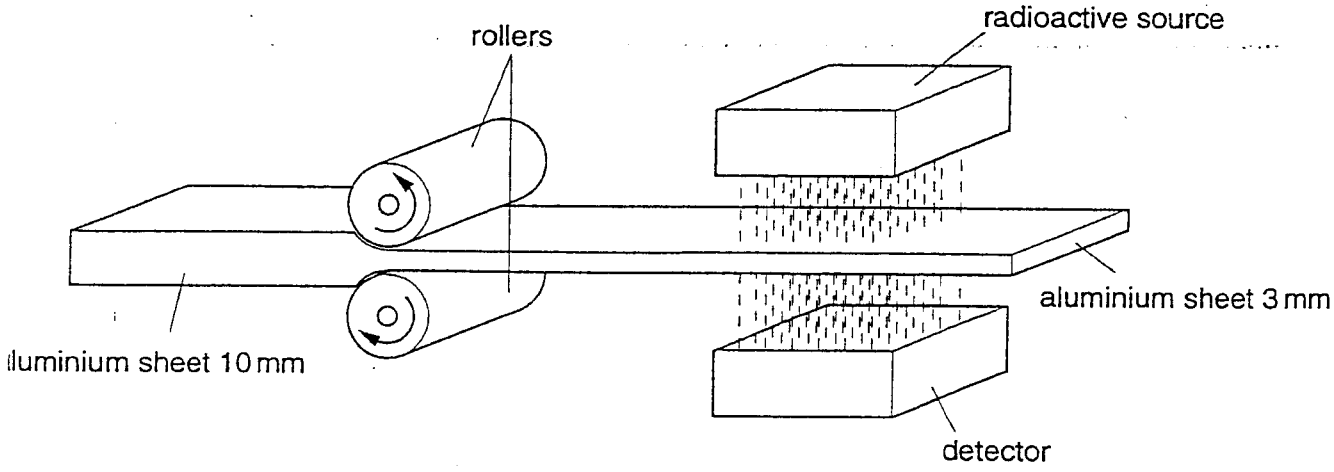
carry out flame test on a sample of the compound, brick red colour should be observed if calcium is present [2]

10 The table below shows information about three types of radiation. Use this information to help you answer the questions.

radiation	nature	ionising power	penetrating power
alpha	helium nucleus	strong	stopped by paper or smoke
beta	electron	medium	partly stopped by 3 mm of aluminium, completely stopped by 6 mm of aluminium
gamma	electromagnetic wave	weak	stopped by thick lead

(a) The following diagrams show radioactive sources being used. State which of these three types of radiation would be most suitable for each use and give a reason for your answer.

(i) Checking the thickness of a thin metal sheet



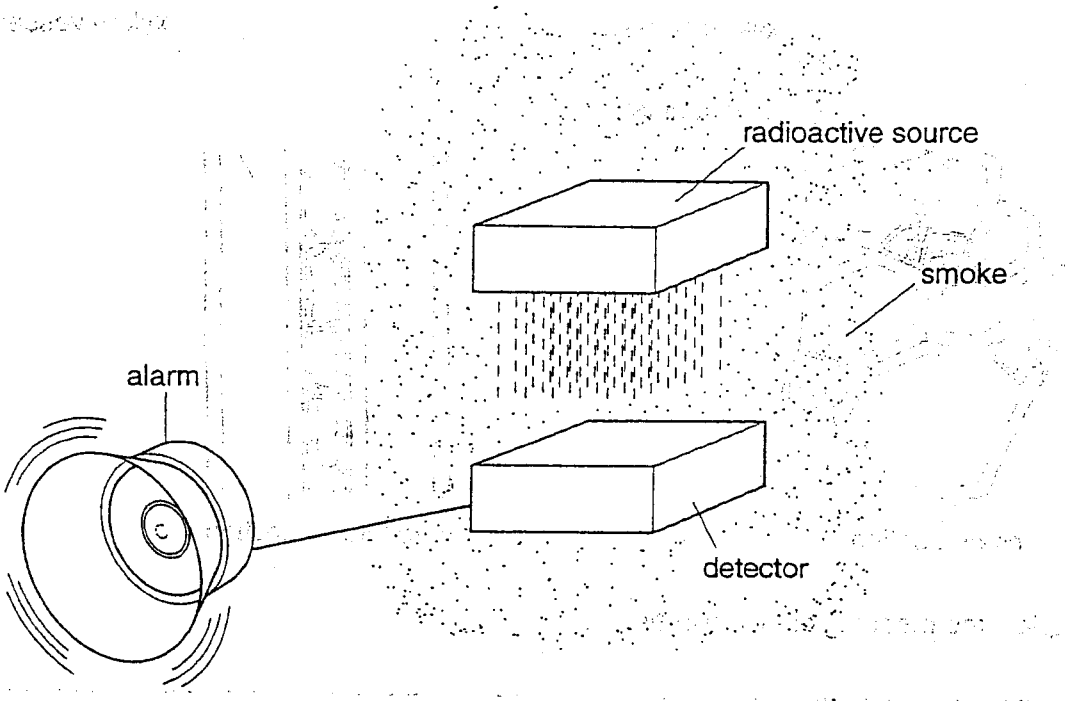
type of radiation used Beta

reason Alpha would not get through at all
Gamma would get through too easily

[2]

For Examiner's Use

(ii) A smoke alarm



type of radiation used Alpha

reason Alpha can be stopped by smoke.

[2]

(b) Explain why alpha radiation is harmful to living organisms even though it can be easily stopped.

• It causes heavy ionisation

• which can mutate cells / cause cancer

[2]

(c) (i) Which form of radiation is the same as the particle responsible for carrying charge around an electrical circuit?

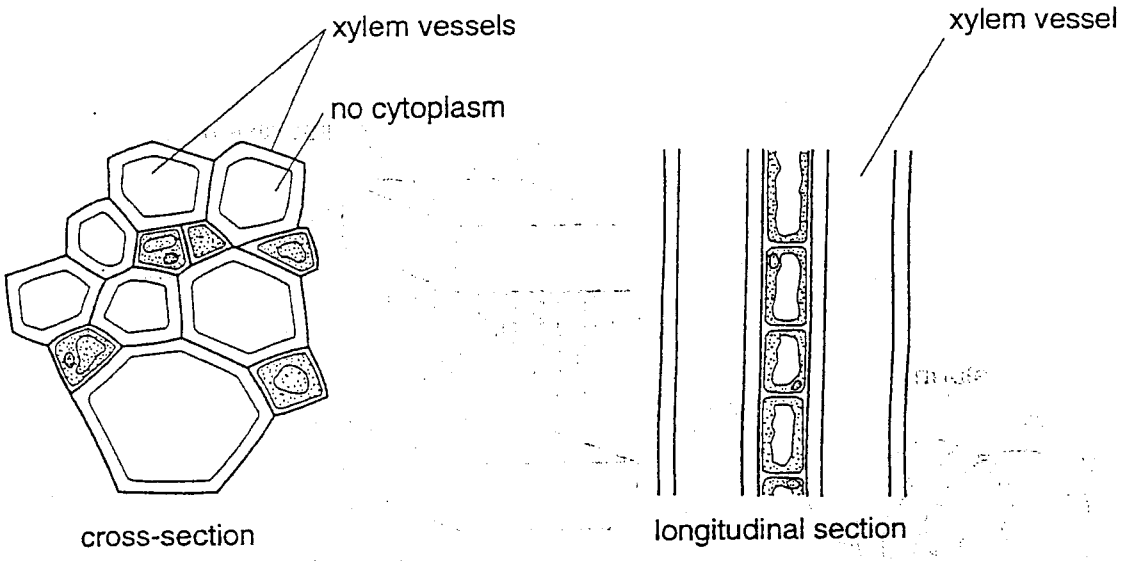
Beta [1]

(ii) What charge does this particle have?

-ve [1]

For Examiner's Use

11 The diagrams below show xylem tissue from a plant.



(a) Explain the meaning of the term *tissue*.

Group(1) of similar cells performing a particular function(1)

[2]

(b) Name the substance which forms the cell walls of the xylem vessels.

Lignin [1]

(c) Xylem tissue helps to support the plant.

(i) Describe how the non-woody parts of a plant, which do **not** contain xylem, are supported.

Vacuoles/ cells full of water
Water pushes against cell walls

[2]

(ii) Describe how xylem tissue in the leaf of a plant helps with photosynthesis.

Xylem transports water + Minerals;
from the roots;
To the leaves/ cells in leaf;
Where photosynthesis takes place;

[3]

DATA SHEET
The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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.)