Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

9737133185

CO-ORDINATED SCIENCES **0654/33**

Paper 3 (Extended) **May/June 2014**

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

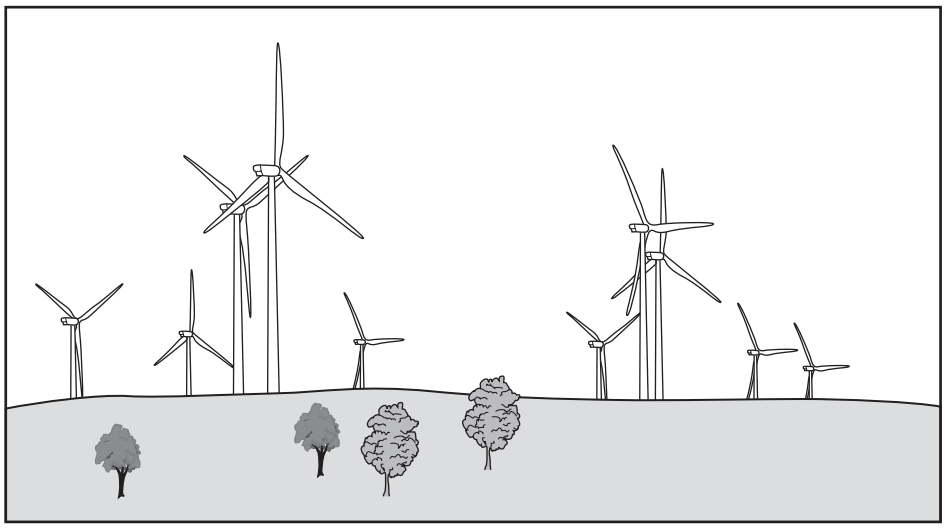
Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
A copy of the Periodic Table is printed on page 32.

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 **32** printed pages.

CAMBRIDGE International Examinations

1 **(a)** Wind farms are areas of land containing many wind turbines. Four thousand wind turbines can produce the same power as one coal-fired power station.



(i) State **one** advantage and **one** disadvantage of using wind, rather than coal, to generate electrical power.

advantage .....

.....

disadvantage .....

..... [1]

(ii) On a particular day, the power input to a wind turbine is 1500 kW. The turbine produces 900 kW of electrical power.

Calculate the efficiency of the wind turbine.

State any formula that you use and show your working. State your answer as a percentage.

formula

working

..... % [2]

(b) Nuclear power stations generate electricity using energy released by the nuclear fission of atoms.

(i) Describe the process that transforms this energy into electrical energy.

.....

.....

.....

..... [3]

(ii) Energy is released in the Sun by a different nuclear process.

Name this process.

..... [1]

(c) A wind farm generates 33 MW of electrical power. The wind farm is connected to a transmission line at a potential difference of 132 kV.

Calculate the current produced by the wind farm.

State the formula that you use and show your working.

formula

working

..... A [2]

(d) Fig. 1.1 shows how the electricity cables carrying electricity from a wind farm are attached to pylons.

The cables hang loosely in hot weather.

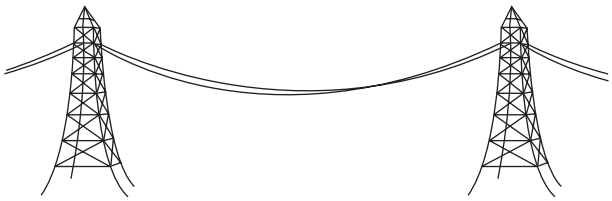


Fig. 1.1

Explain why the cables must hang loosely in hot weather.

.....

.....

..... [2]

(e) A scientist investigates six different wires used in making these cables. He wants to determine the resistance of each piece of wire.

wire	metal composition	length / m	cross-sectional area / cm^2
A	copper	10	0.1
B	nichrome	10	0.1
C	copper	20	0.1
D	nichrome	20	0.1
E	copper	10	0.2
F	nichrome	20	0.2

(i) Which wire, **A** or **E**, will have the greater resistance?

Explain your answer.

wire ..... because .....

..... [1]

(ii) Wire **B** has a greater resistance than wire **A**.

Which wire, **B**, **C**, **D**, **E** or **F**, has the greatest resistance?

Explain your answer.

wire .....

explanation .....

..... [2]

(iii) The resistance of wire **B** is 0.15 Ω.

Calculate the current passing through the wire when a voltage of 12 V is applied across it.

State the formula that you use and show your working.

formula

working

..... A [2]

2 **(a)** Fig. 2.1 shows some of the cells that line the trachea.

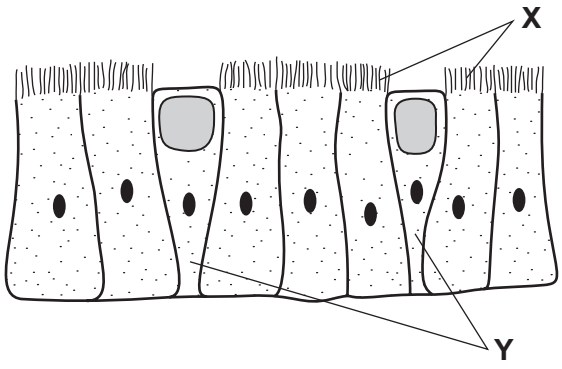


Fig. 2.1

(i) Name the structures labelled **X**.

.....

[1]

(ii) Explain how these structures, and the cells labelled **Y**, protect the gas exchange system from pathogens.

.....

.....

.....

.....

[3]

(b) Tobacco smoke can have a damaging effect on the working of the cells in Fig. 2.1.

(i) Name a component of tobacco smoke that damages these cells.

.....

[1]

(ii) Describe how this component of tobacco smoke affects the structures labelled **X** and the cells labelled **Y**.

structures labelled **X**

.....

.....

cells labelled **Y**

.....

.....

[2]

Please turn over for Question 3.

3 **(a)** Dutch metal is an alloy of copper and zinc that has been formed into very thin sheets.

When a small piece of Dutch metal is dropped into a container filled with chlorine, it bursts into flame and two compounds are produced as shown in Fig. 3.1.

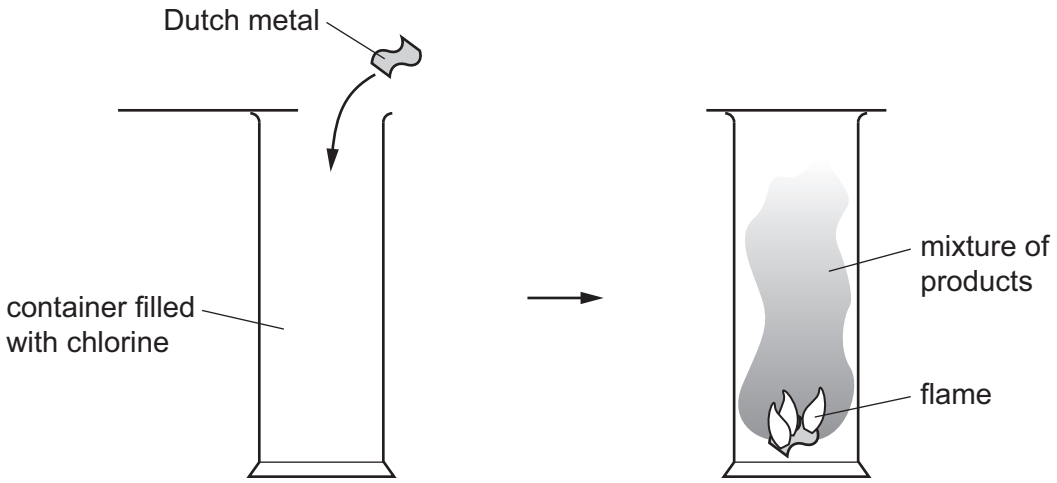


Fig. 3.1

(i) State the meaning of the term *alloy*.

.....

..... [1]

(ii) State the physical property of metals that allows them to be formed into very thin sheets.

..... [1]

(iii) Suggest the names of the **two** compounds formed when Dutch metal reacts with chlorine.

1 .....

2 ..... [1]

(b) Sodium burns in oxygen gas to produce a white solid that contains the ionic compound, sodium oxide.

Fig. 3.2 shows a sodium atom and an oxygen atom.

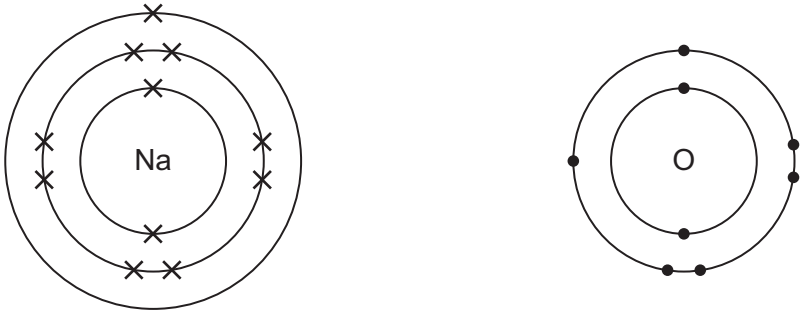


Fig. 3.2

Predict and explain, in terms of changes in electronic structure, the chemical formula of sodium oxide. You may wish to draw diagrams to help you to answer this question.

.....

..... [3]

(c) Phosphorus is a non-metallic element containing molecules that have the formula P_4.

The chemical formula of phosphorus oxide shows four phosphorus atoms bonded with ten oxygen atoms.

Construct a balanced symbolic equation for the reaction between phosphorus and oxygen gas to form phosphorus oxide.

..... [3]

4 Fig. 4.1 shows a river with nearby agricultural land. Large amounts of artificial fertiliser have been sprayed onto the agricultural land.

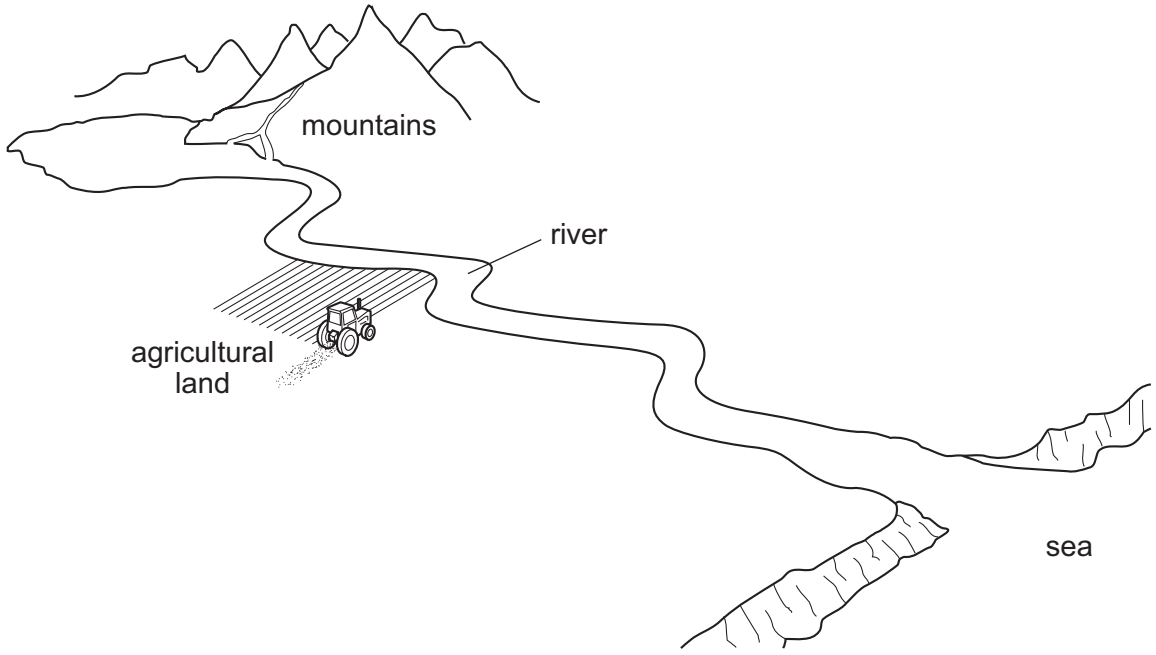


Fig. 4.1

(a) Name a mineral ion that would be present in the fertiliser.

.....[1]

(b) Describe how mineral ions in the fertiliser might reach the river.

.....

.....[1]

(c) When large amounts of mineral ions are added to a river a sequence of effects on the living organisms can take place.

Explain the effects on the following organisms

(i) algae (photosynthesising microorganisms),

.....

.....[1]

(ii) submerged aquatic plants,

.....

.....

.....[2]

(iii) bacteria,

.....

.....

..... [2]

(iv) fish.

.....

..... [1]

(d) If the farmer uses artificial fertiliser, suggest **two** ways in which the effect of the fertiliser on the river could be reduced.

1 .....

.....

2 .....

..... [2]

5 **(a)** Two bar magnets **A** and **B** are shown in Fig. 5.1. Magnet **A** is moved towards magnet **B**.

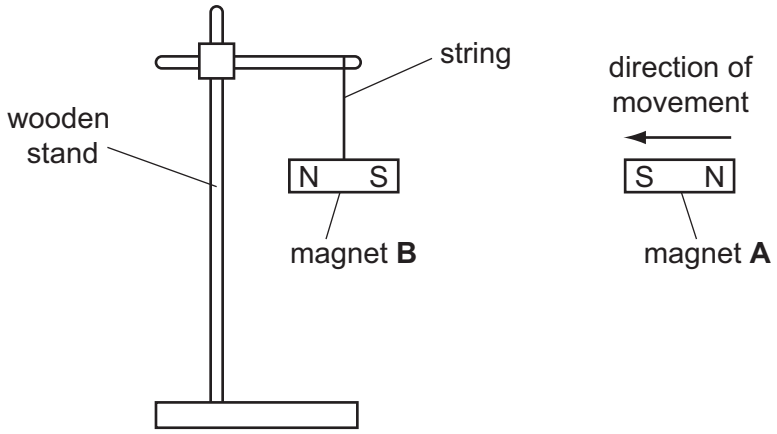


Fig. 5.1

(i) Describe and explain what happens to magnet **B** as magnet **A** is moved towards it.

.....

..... [1]

(ii) Magnet **A** is replaced by a piece of unmagnetised iron **C**.

Predict what happens as the unmagnetised iron **C** is moved towards **B**.

Explain your prediction.

.....

.....

..... [2]

(b) Fig. 5.2 shows two plastic balls hanging from threads. Both balls are electrically charged.

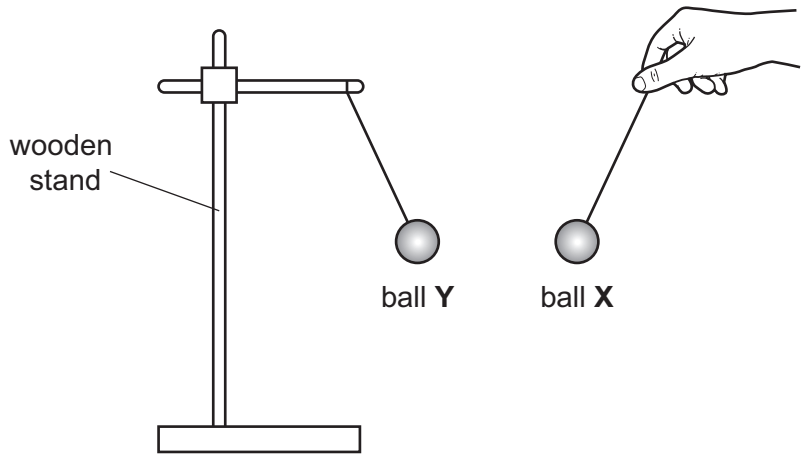


Fig. 5.2

Ball **Y** is negatively charged.

(i) State the charge on ball **X**. Give a reason for your answer.

.....

..... [1]

(ii) Describe and explain how ball **Y** has been given a negative charge.

.....

..... [2]

(iii) There is an electric field between ball **X** and ball **Y**.

State what happens to an electrical charge placed in this field.

.....

..... [1]

(c) The mass of ball **X** is 3.97 g (3.97×10^{-3} kg). The volume of ball **X** is 4.17 cm^3 (4.17×10^{-6} m^3).

Calculate the density of the plastic used to make ball **X**.

State the formula that you use and show your working. State the units of your answer.

formula

working

density = ... unit = ... [3]

Please turn over for Question 6.

6 **(a)** Fig. 6.1 shows diagrams **P**, **Q** and **R**, of three molecules containing carbon atoms.

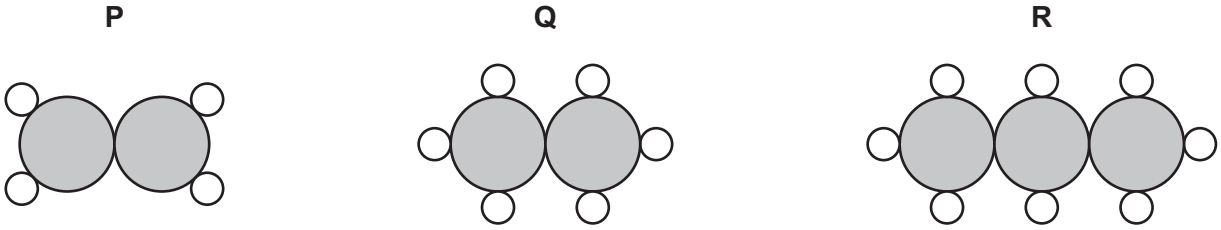


Fig. 6.1

(i) Using the Periodic Table on page 32, state the number of electrons in one atom of carbon.

Explain how you obtained your answer.

number of electrons .....

explanation .....

..... [2]

(ii) State and explain which diagram, **P**, **Q** or **R**, represents one molecule of ethane.

diagram .....

explanation .....

.....

..... [2]

(iii) Name the type of chemical bonding found in all of the compounds shown in Fig. 6.1.

Give a reason for your answer.

type of bonding .....

reason .....

..... [2]

(b) Methane hydrate is a solid mixture in which methane molecules are contained inside ice crystals.

Large amounts of methane hydrate exist under the oceans and in the cold polar regions of the Earth.

Table 6.1 shows the relative numbers of moles of methane and water in a typical sample of methane hydrate.

Table 6.1

substance	chemical formula	relative number of moles
methane	CH_4	1.00
water (ice)	H_2O	5.75

(i) The mass of 1.00 moles of methane is 16.0 g.

Calculate the mass of 5.75 moles of water.

Show your working.

..... [2]

(ii) Calculate the mass of methane hydrate that contains 1.00 moles of methane.

..... [1]

(iii) When the temperature of methane hydrate increases, the ice melts and releases the methane.

Some scientists think that methane hydrate might have a serious effect on global warming.

Suggest how the breakdown of methane hydrate might affect global warming.

.....

.....

.....

..... [2]

7 An electric motor inflates a car tyre by pumping air into it.

(a) Explain, in terms of particles, how the air causes the tyre to inflate.

.....

.....

.....

..... [3]

(b) Fig. 7.1 shows a simple electric motor.

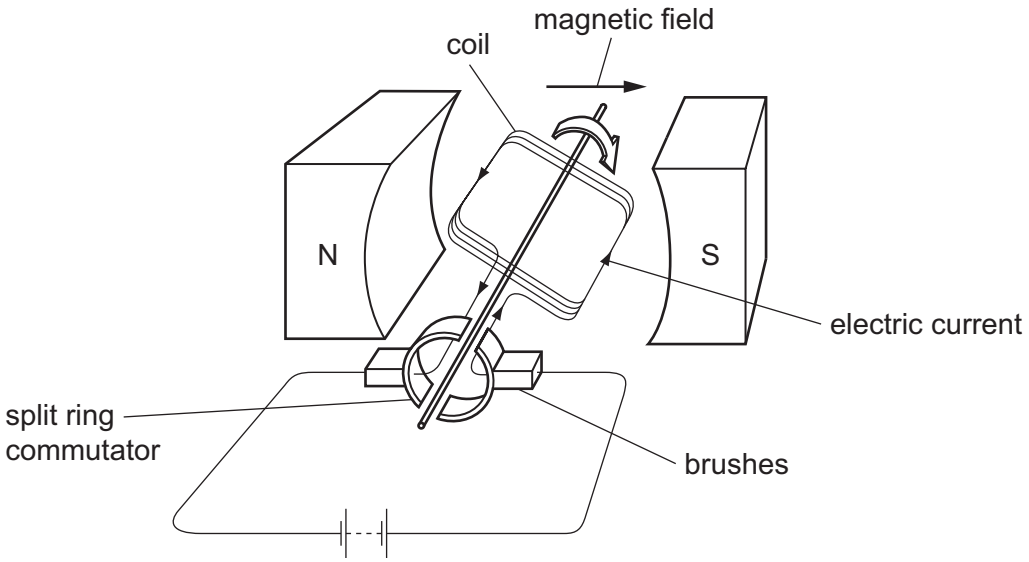


Fig. 7.1

Explain why the coil turns when an electric current passes through it.

.....

.....

.....

.....

..... [4]

Please turn over for Question 8.

8 After its flowers have been pollinated, a sweetcorn (maize) plant produces a corncob as shown in Fig. 8.1.

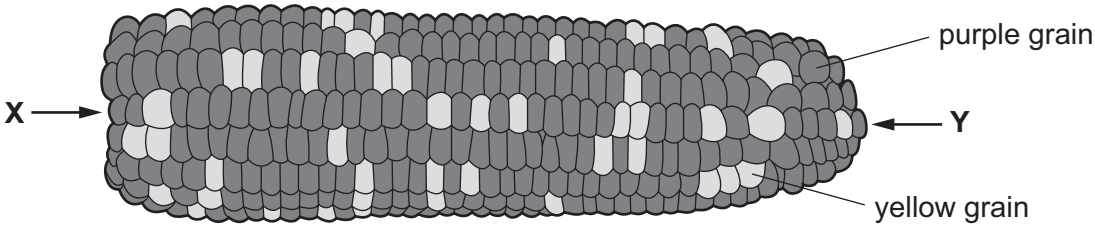


Fig. 8.1

Each of the individual grains on the corncob results from the fertilisation of a different egg cell in the female parent. The pollen all came from the same (male) parent.

Some of the grains are purple (dark) in colour and others yellow (light) in colour.

(a) The variation in grain colour is an example of discontinuous variation.

Explain why this variation is described as *discontinuous*.

.....

.....

..... [2]

(b) (i) In the row of grains labelled **X** to **Y**, count the number of purple (dark) grains and the number of yellow (light) grains.

number of purple (dark) grains .....

number of yellow (light) grains ..... [1]

(ii) State, to the nearest whole number, the ratio of purple grains to yellow grains.

..... [1]

(c) The allele for purple colour (**G**) is dominant and the allele for yellow colour (**g**) is recessive.

(i) What would be the colour of a sweetcorn grain with the genotype **Gg**?

..... [1]

(ii) Use the ratio of purple grains and yellow grains in **(b)(ii)** to state the genotypes of the parents.

genotypes ..... and ..... [2]

(d) Complete the genetic diagram below to show the result of crossing a heterozygous sweetcorn plant with a yellow-grained sweetcorn plant.

parents	purple	yellow
genotype	.....	.....
gametes	◯ ◯	◯ ◯

offspring

genotype	.....	.....
grain colour	.....	.....

ratio .....

[5]

9 **(a)** Fig. 9.1 shows air passing into the engine of a car, and a mixture of exhaust (waste) gases being released.

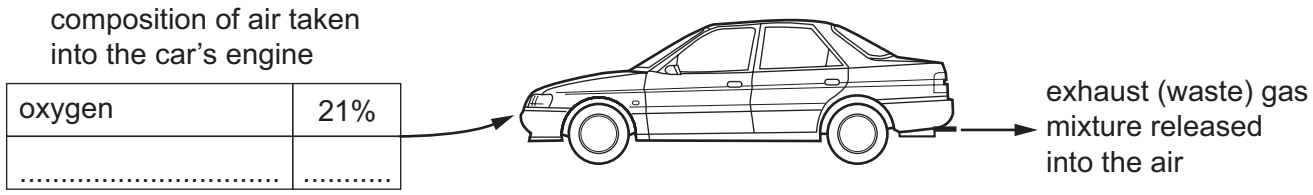


Fig. 9.1

(i) Complete the table in Fig. 9.1 to show the name and percentage of the main gas in air. [2]

(ii) Name **one** gas, other than carbon dioxide, in the mixture of exhaust gases which causes air pollution.

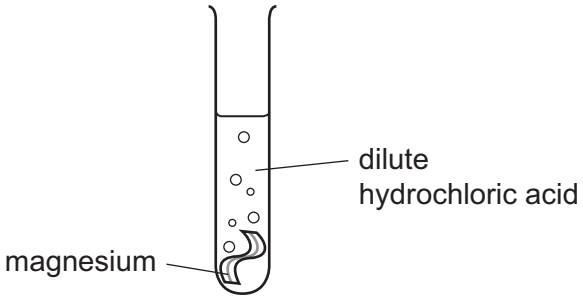
State **one** harmful effect that this gas has in the environment.

gas .....

harmful effect .....

..... [2]

(b) Hydrogen gas is released when magnesium reacts with dilute hydrochloric acid.



(i) Describe the test for hydrogen gas.

.....

..... [2]

(ii) State the **word** equation for the reaction between magnesium and dilute hydrochloric acid.

..... [1]

(c) Fig. 9.2 shows the apparatus a student used to measure the temperature change when magnesium powder reacted with dilute hydrochloric acid.

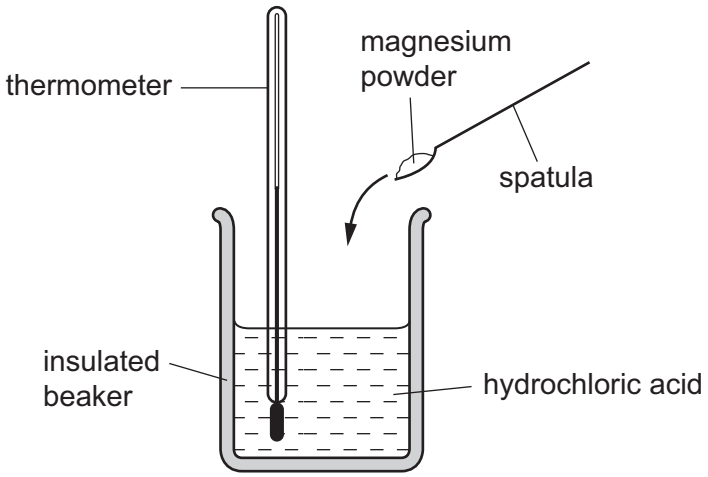


Fig. 9.2

The student repeated the experiment using different masses of magnesium powder.

After each experiment he rinsed out the insulated beaker and then refilled it using the same volume of 1.0 mol / dm^3 hydrochloric acid. His results are shown in Fig. 9.3.

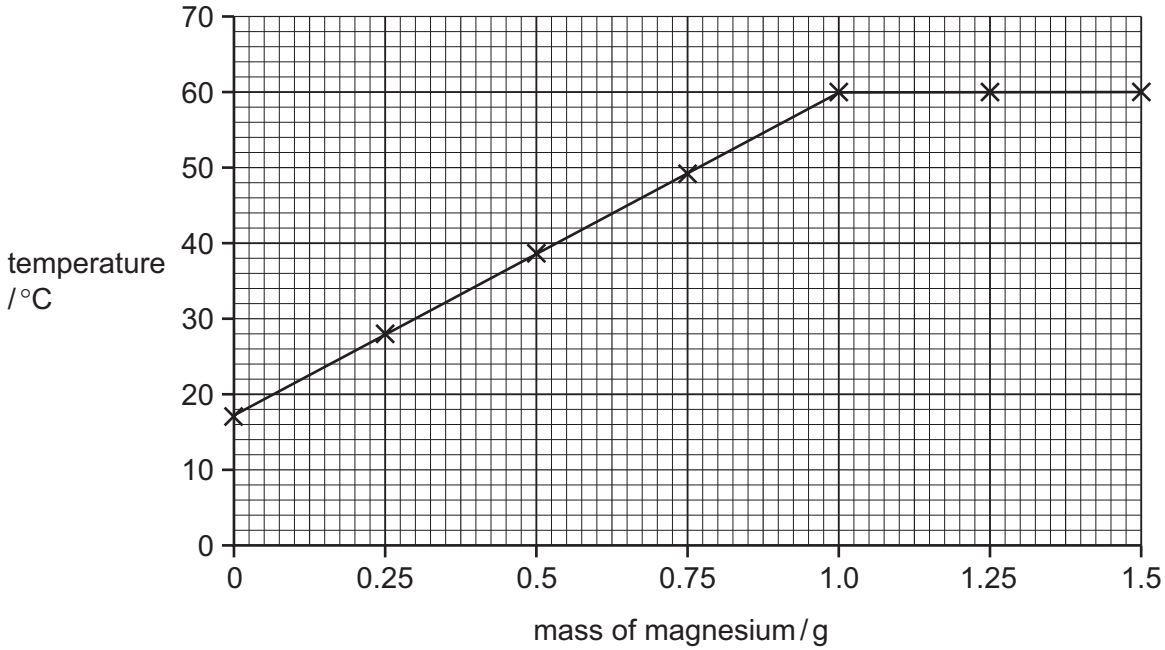


Fig. 9.3

(i) Explain, in terms of energy, why the temperature of the reaction mixture increases when magnesium powder is added to dilute hydrochloric acid.

.....

.....

.....

..... [2]

(ii) Suggest why in this experiment the graph eventually became horizontal.

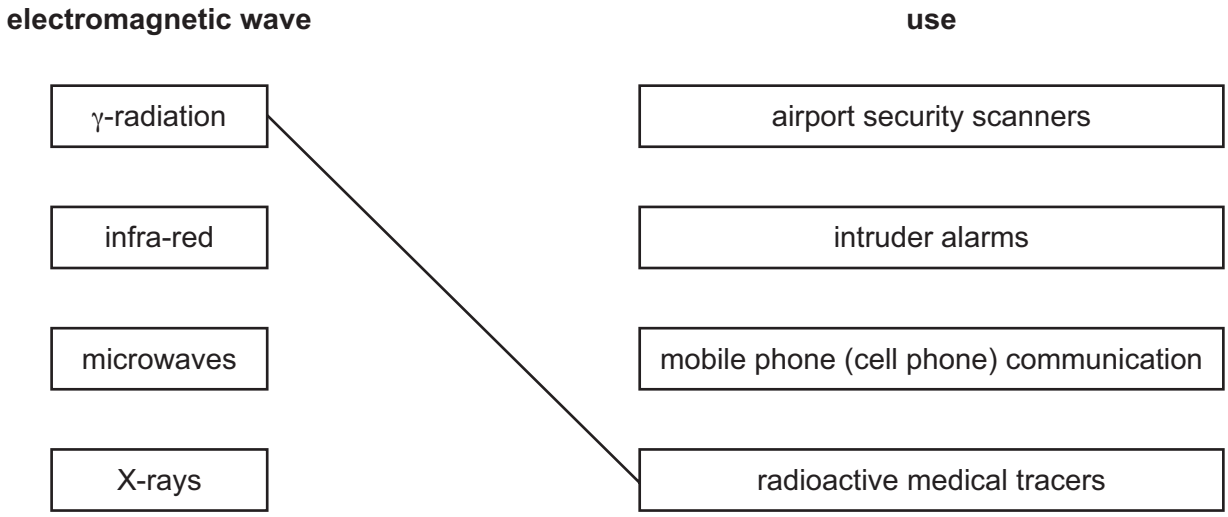
.....

.....

..... [2]

Please turn over for Question 10.

10 (a) Draw lines to link the waves in the electromagnetic spectrum to their uses. One line has been drawn for you.



[1]

(b) Different waves in the electromagnetic spectrum have different wavelengths and frequencies.

State the meaning of the terms *frequency* and *wavelength*.

You may use diagrams to help your explanation.

frequency

.....

.....

.....

wavelength

.....

.....

.....

[2]

(c) α-radiation, β-radiation and γ-radiation are three radioactive emissions.

(i) Place the three radiations in order of their ionising ability, placing the most ionising first.

most ionising .....

.....

least ionising ..... [1]

(ii) Fig. 10.1 shows α, β, and γ radiations passing through a magnetic field.

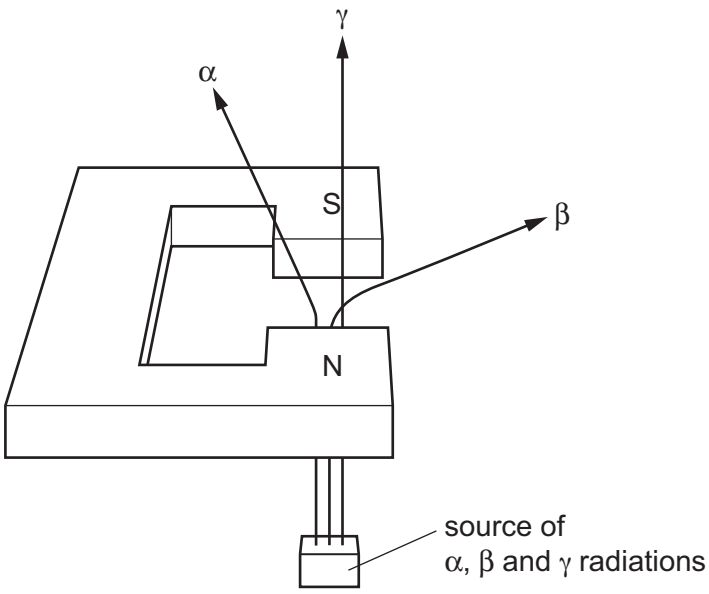


Fig. 10.1

Explain the results.

.....

.....

.....

.....

..... [3]

11 (a) Define *osmosis*.

.....

.....

.....

..... [3]

(b) A piece of plant tissue was placed in a concentrated sugar solution on a microscope slide. Fig. 11.1 shows the appearance of three of the cells from this tissue after they had been in the sugar solution for one hour.

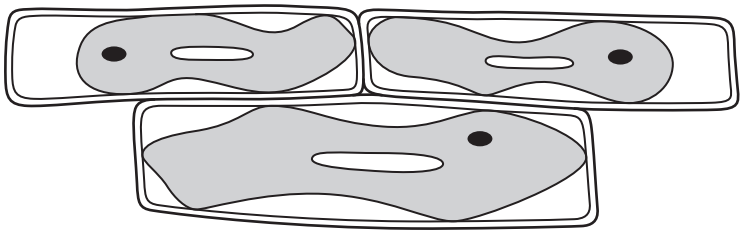


Fig. 11.1

(i) Describe the effect, as shown in Fig. 11.1, that the sugar solution has had on the cells.

.....

..... [1]

(ii) Explain this effect in terms of osmosis.

.....

.....

..... [2]

(iii) Complete Fig. 11.2, to show how the cells would appear if they had been placed in water, instead of in a concentrated sugar solution.

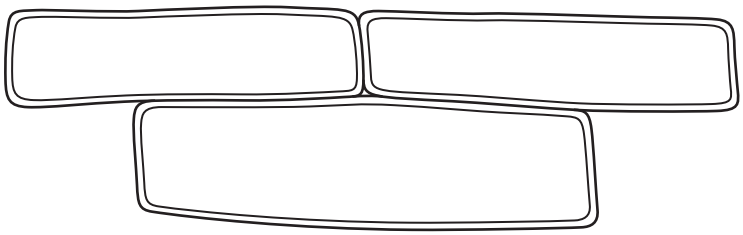


Fig. 11.2

[2]

(c) Plants absorb water by osmosis into their root hair cells.

(i) Explain how the structure of the root hair cells is related to this function.

.....

.....

..... [2]

(ii) State **one** other function of root hair cells.

..... [1]

12 **(a)** Fig. 12.1 shows some of the particles present in a mixture of gases.

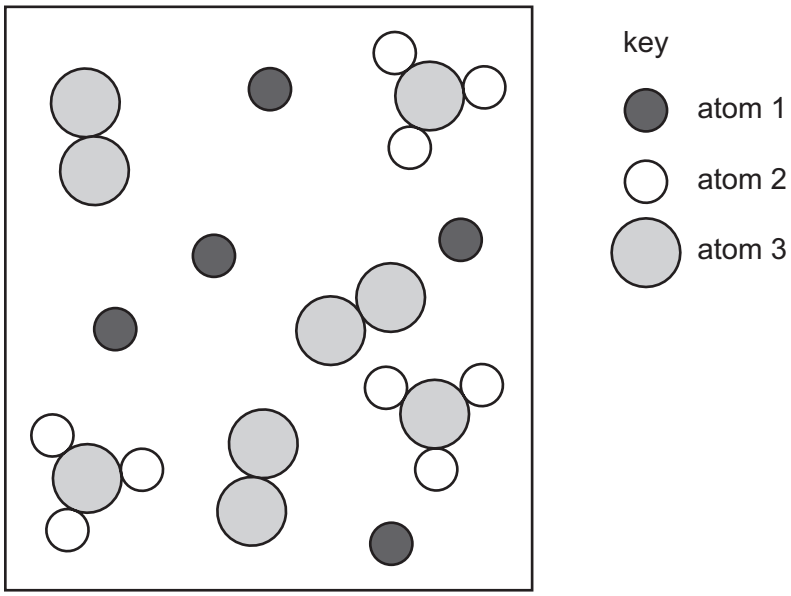


Fig. 12.1

(i) State the number of different gases that are contained in the mixture shown in Fig. 12.1.

..... [1]

(ii) On Fig. 12.1 draw a label line to a molecule of a **compound**. Label this molecule **C**. [1]

(iii) Explain your answer to **(ii)**.

.....

..... [1]

(b) Name the family of metals that includes cobalt (proton number 27) and nickel (proton number 28).

..... [1]

(c) Fig. 12.2 shows a simplified diagram of the industrial process used to produce aluminium.

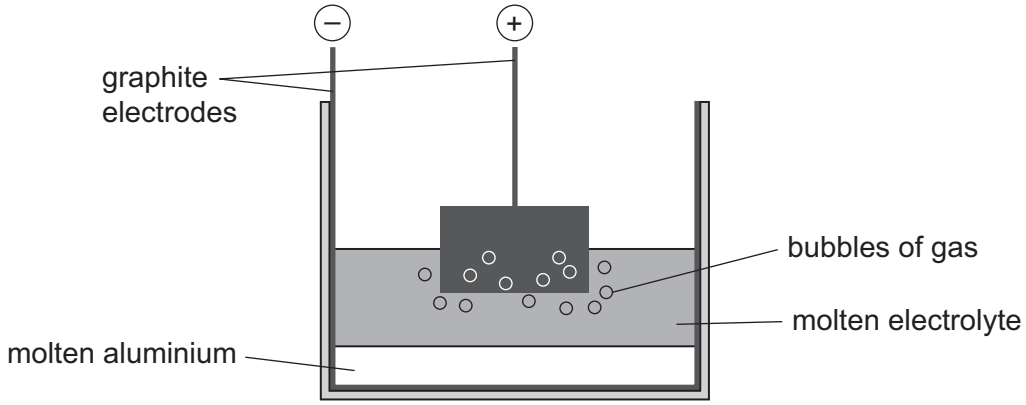


Fig. 12.2

(i) Name the **two** substances that are melted together to form the electrolyte.

1 .....

2 ..... [2]

(ii) Name **one** gas that bubbles from the surface of the anode.

..... [1]

(iii) Describe what happens on the surface of the cathode to convert aluminium ions, Al^{3+}, to aluminium atoms.

.....

.....

..... [2]

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 †															

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
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.).