Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

8523783015

CO-ORDINATED SCIENCES **0654/23**

Paper 2 (Core) **October/November 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 soft pencil for any diagrams, graphs, tables or rough working.
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 **31** printed pages and **1** blank page.

CAMBRIDGE International Examinations

1 Fig. 1.1 shows what happens when a small piece of potassium metal reacts with chlorine gas inside a container.

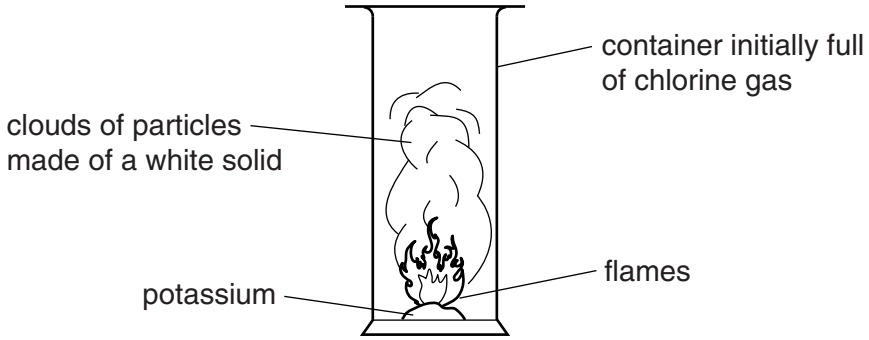


Fig. 1.1

When the reaction has finished, particles of a white solid compound are left in the container.

(a) (i) Suggest the name of the white solid compound.

.....[1]

(ii) Fig. 1.2 shows diagrams of a potassium atom and a chlorine atom.

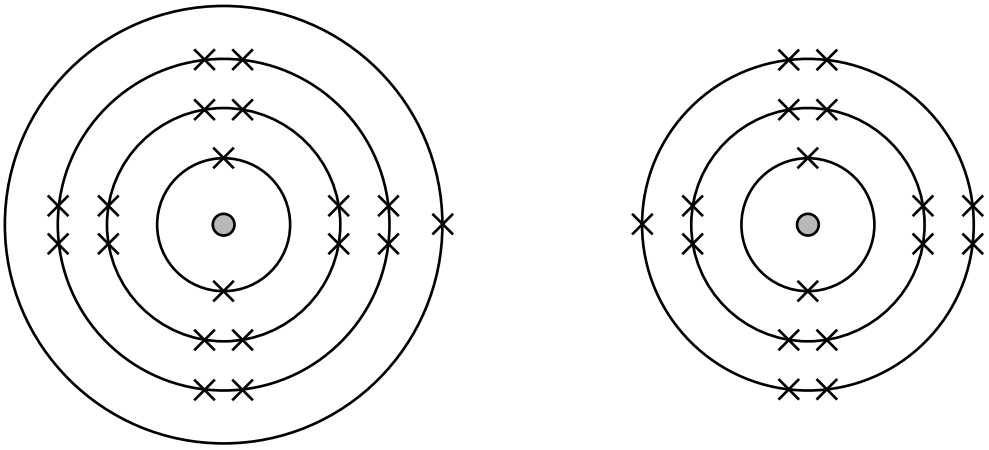


Fig. 1.2

Describe what happens to these atoms when they change into ions.

.....

.....

.....[2]

(b) A chemical change occurs when an electrical current passes through a solution of the compound copper chloride.

Fig. 1.3 shows apparatus that can be used to investigate this chemical change.

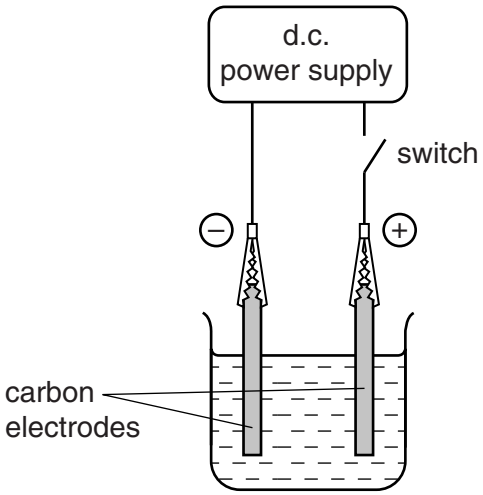


Fig. 1.3

(i) Name the process which occurs in the apparatus shown in Fig. 1.3 when the switch is closed.

.....[1]

(ii) On Fig. 1.3 use label lines to label the cathode and the electrolyte. [2]

(iii) When the switch is closed, bubbles of chlorine appear on the surface of the anode.

Describe a safe chemical test for chlorine.

.....

.....[2]

(c) A student investigates whether there is any change in the mass of the electrodes during the process shown in Fig. 1.3.

She uses the apparatus shown in Fig. 1.3 and her results are shown in Table 1.1.

Table 1.1

electrode	mass before the switch is closed /g	mass after the switch has been closed for some time /g
anode	48.3	48.3
cathode	47.6	47.9

(i) State the changes in mass of the electrodes during the experiment.

.....

.....[1]

(ii) Explain the results obtained for the cathode.

.....

.....[1]

2 Fig. 2.1 shows the chromosomes from the nucleus of a single cell of a human male.

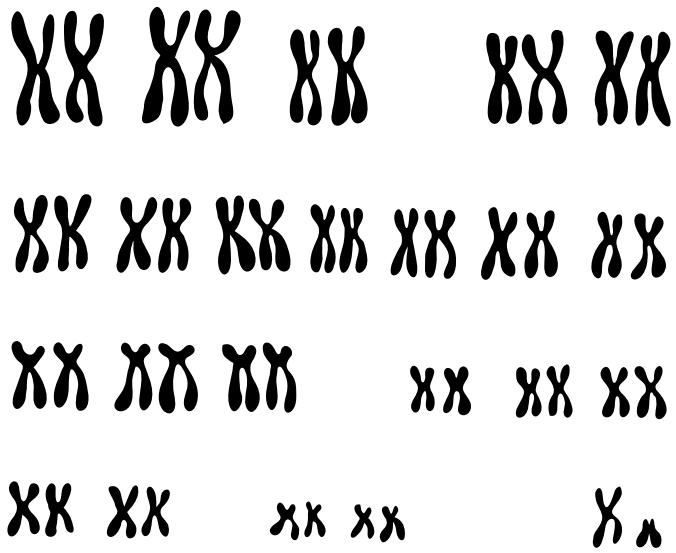


Fig. 2.1

(a) (i) State the number of chromosomes that can be seen in Fig. 2.1.

.....[1]

(ii) On Fig. 2.1, draw a circle around the Y chromosome.

[1]

(b) Chromosomes carry genes. Define a *gene*.

.....

.....

.....[2]

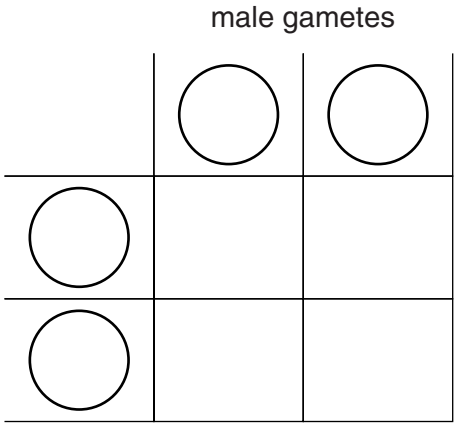
[Turn over

(c) Complete the genetic diagram below to explain why, in a human population, equal numbers of male and female babies should be expected.

parents

phenotypes	female	male
sex chromosomes	XX	XY
gametes	○ and ○	○ and ○

chromosomes and phenotypes of offspring



ratio of male to female .....

[4]

(d) In sea turtles, the sexes of the offspring are not determined by chromosomes. Instead, sex depends on the temperature at which the eggs are incubated. Fig. 2.2 shows this effect.

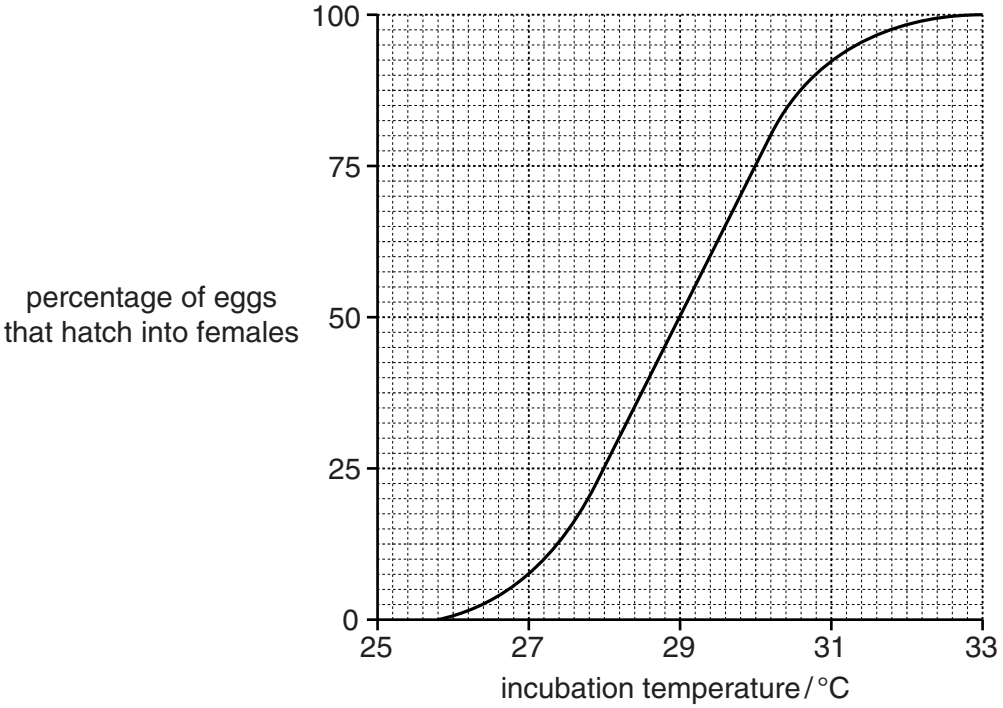


Fig. 2.2

(i) Describe the effect of temperature on the percentage of eggs that hatch into females.

.....

.....[1]

(ii) State the temperature at which equal numbers of male and female offspring are produced.

.....°C [1]

(iii) Use the information in Fig. 2.2 to predict how global warming will affect the sea turtle population. Explain your answer.

.....

.....

.....[2]

3 **(a)** A motorcycle is driven along a straight road. Fig. 3.1 shows a speed/time graph for the motion of the motorcycle from the time the rider sees a car approaching and gradually slows down.

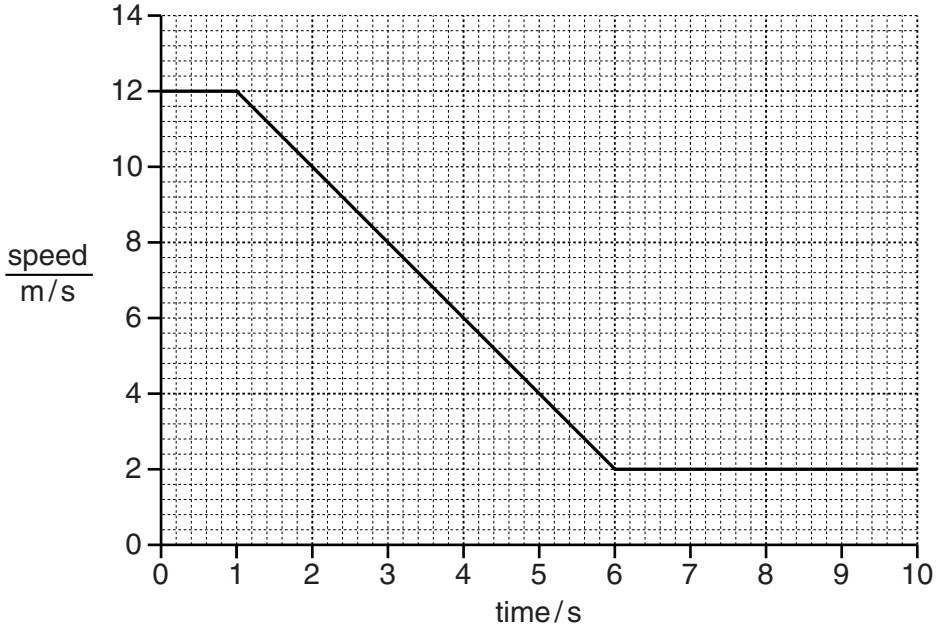


Fig. 3.1

(i) State the speed at which the driver was travelling before he slowed down.

.....m/s [1]

(ii) State whether the motorcycle stopped during the period of ten seconds shown in Fig. 3.1.

Explain your answer.

.....

.....[1]

(b) The motorcycle rider notices that the sound from a car's engine becomes louder as the car approaches and drops in pitch as the car passes.

Describe these changes in terms of the frequency and amplitude of sound waves released.

becomes louder .....

.....

has a lower pitch .....

.....[2]

(c) The motorcycle has one headlamp, connected to a 12V battery.

The headlamp takes a current of 4 A.

Calculate the resistance of the headlamp.

State the formula that you use, show your working and state the unit of your answer.

formula

working

resistance = ... unit ..... [3]

(d) As the motorcycle drives along, the temperature of the air in the tyres increases.

By referring to the motion of molecules in air, explain why this results in an increased tyre pressure.

.....

.....

.....

.....[3]

(e) The metal bodywork of the motorcycle can be painted using electrostatic paint spraying. In electrostatic paint spraying, the surface being painted is given a negative electric charge.

The paint particles emerge from the paint sprayer carrying a positive charge.

Fig. 3.2 shows part of a motorcycle frame being painted.

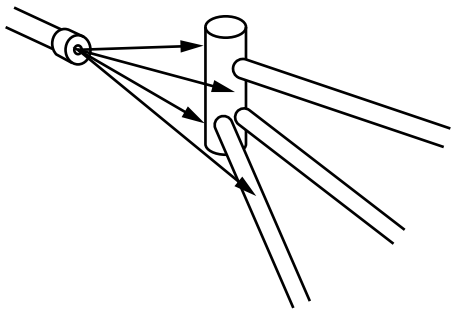


Fig. 3.2

(i) Suggest why more paint sticks to the charged frame than to an uncharged frame.

.....

.....[1]

(ii) The motorcycle is painted evenly. An even coat of paint is achieved because the paint particles repel each other.

Explain why the particles repel each other.

.....

.....[1]

Please turn over for Question 4.

4 **(a)** Define the term *transpiration*.

.....

.....

.....[2]

(b) Fig. 4.1 shows xylem vessels from the stem of a plant as seen in longitudinal section.

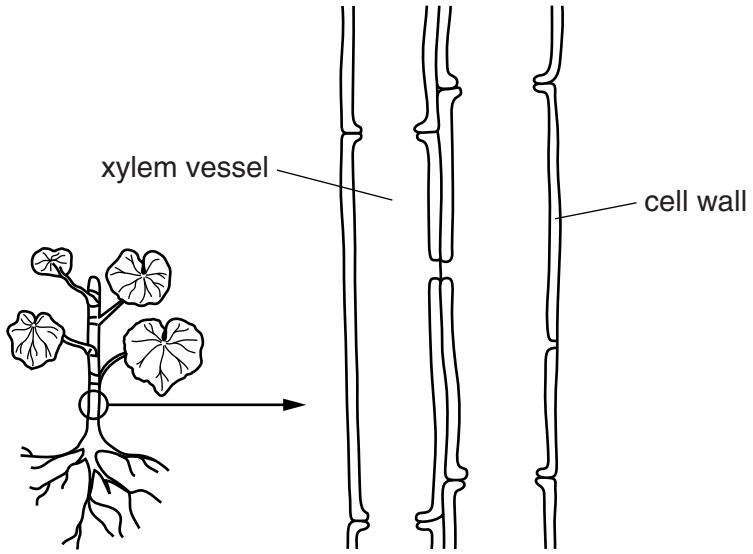


Fig. 4.1

(i) On Fig. 4.1 draw an arrow to show the direction in which water flows through the xylem vessel. [1]

(ii) Name **one** other substance, apart from water, that is transported through xylem vessels.

.....[1]

(c) Fig. 4.2 shows a stem and a root in transverse section.

On the stem, the positions of the xylem and the phloem tissues have been labelled.

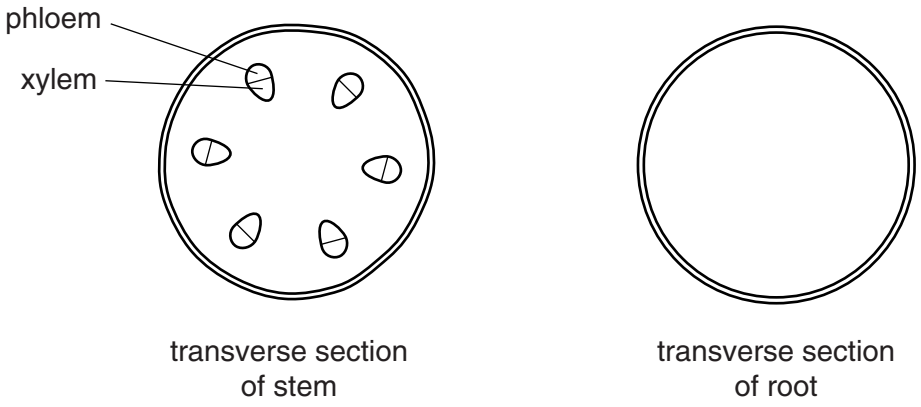


Fig. 4.2

(i) Complete the diagram of the root by drawing in the positions of the xylem and the phloem tissues and labelling them. [3]

(ii) State the function of the phloem.

.....[1]

(d) Plants absorb water from the soil. Name the plant cells that take up most of this water.

..... [1]

5 A student investigates the reactions between dilute hydrochloric acid and five substances.

Fig. 5.1 shows the five substances contained in test-tubes **A** to **E**.

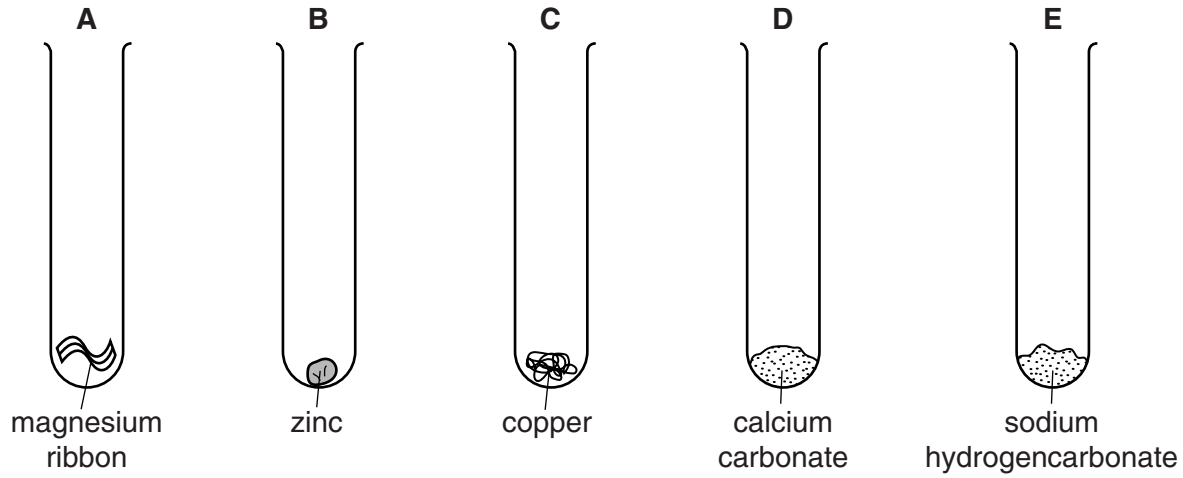


Fig. 5.1

She adds dilute hydrochloric acid to each tube.

Her observations and temperature measurements are shown in Table 5.1.

Table 5.1

test-tube	observations	temperature of the reactants before reaction/°C	temperature of the mixture in the test-tube after a short time/°C
A	gas given off quickly	18	45
B	gas given off slowly	18	19
C	no gas produced	18	
D	gas given off quickly	18	20
E	gas given off quickly	18	11

(a) (i) Name the gas given off when dilute hydrochloric acid is added to test-tubes **A** and **B**.

.....[1]

(ii) Describe a test and its result for the gas you have named in **(a)(i)**.

test .....

result .....[1]

(iii) The pH of the dilute hydrochloric acid before reacting is 2.

Predict the pH of the solution in test-tube **D** after reaction.

Explain your answer.

prediction .....

explanation .....

.....

.....[2]

(b) When substances are mixed together, a change in temperature is evidence that a chemical reaction occurs.

(i) Suggest the temperature of the mixture in test-tube **C** after a short time.

Write your answer in Table 5.1. [1]

(ii) Explain your answer to **(b)(i)**.

.....

.....[1]

(iii) State and explain in which test-tube, **A**, **B**, **C**, **D** or **E**, an endothermic reaction occurs.

test-tube .....

explanation .....

.....[1]

(c) Suggest **two** possible reasons why gas is given off more quickly in test-tube **A** than in **B**.

1 .....

.....

2 .....

.....[2]

6 **(a)** Infra-red waves can pass through optical fibres.

Fig. 6.1 shows a length of optical fibre.

An infra-red ray goes in at one end and emerges at the other end.

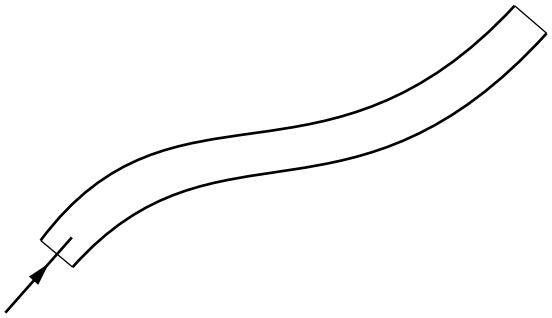


Fig. 6.1

On Fig. 6.1, use a ruler to draw its path along the optical fibre. [2]

(b) **(i)** State what is transferred by all electromagnetic waves.

.....[1]

(ii) γ-radiation is also part of the spectrum of electromagnetic waves.

State **one** difference between γ-radiation and infra-red radiation.

.....

.....[1]

(c) Fig. 6.2 shows an experiment to investigate infra-red radiation.

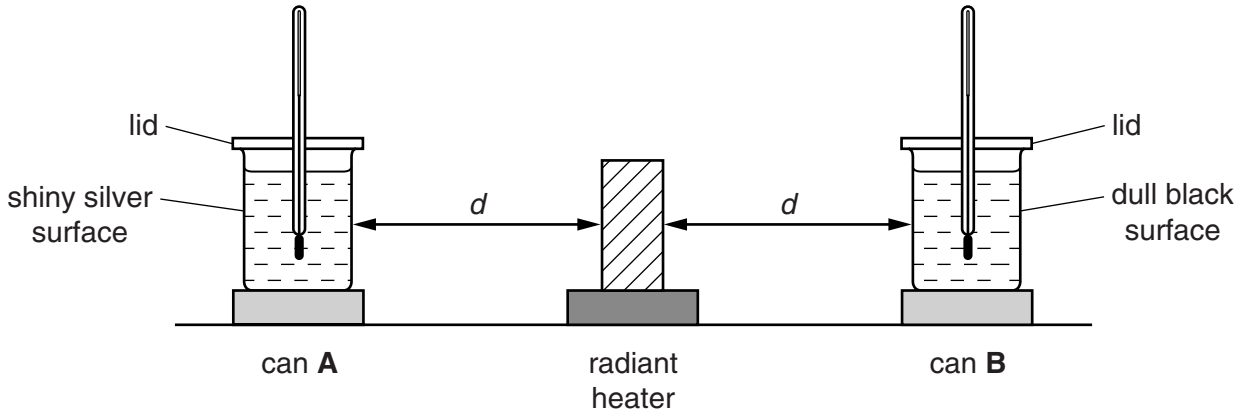


Fig. 6.2

Two similar cans **A** and **B** contain equal amounts of water which start off at the same temperature.

Can **A** has a shiny silver surface and can **B** has a dull black surface.

A thermometer is placed into each can. The cans stand on cork mats and are placed at the same distance *d* from a radiant heater emitting infra-red radiation.

The temperature of the water is measured every minute for twelve minutes.

Fig. 6.3 shows how the temperature of the water changes for the two cans.

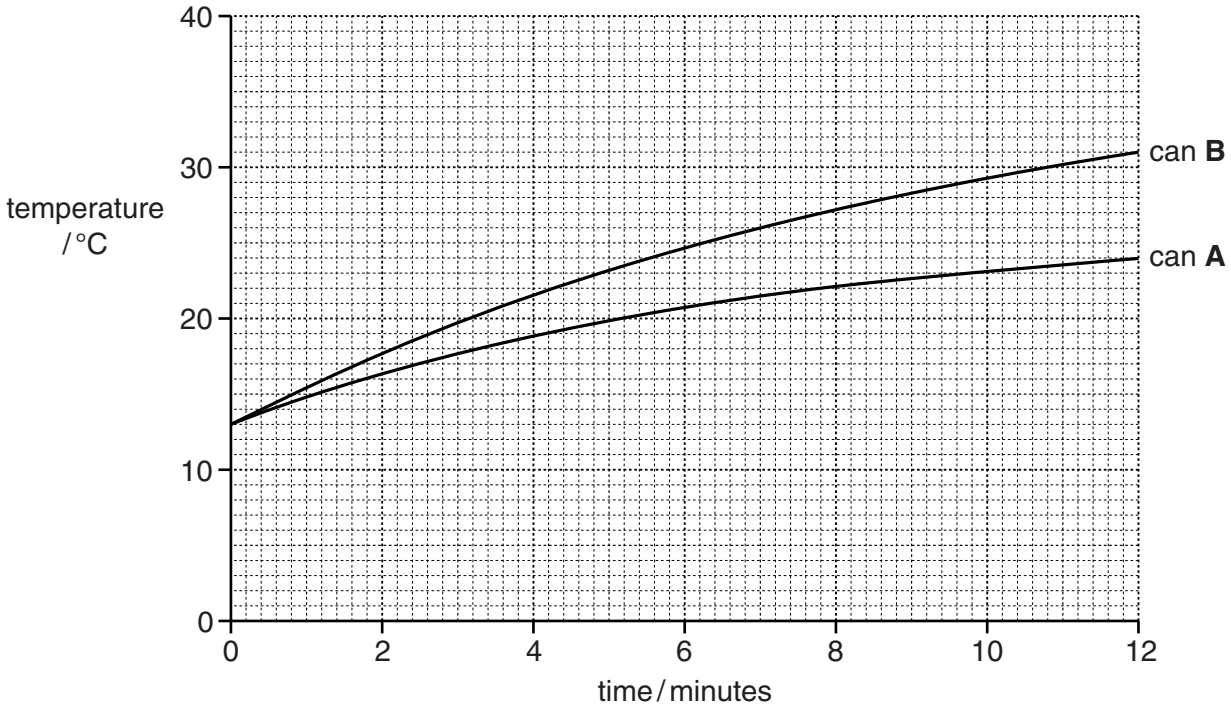


Fig. 6.3

(i) State the starting temperature of the water in both cans.

.....°C [1]

(ii) Explain why the two cans are placed on cork mats.

.....[1]

(iii) Describe how the temperature changes are different for the two cans.

.....

.....

.....[1]

(iv) Suggest reasons for your answer to **(c)(iii)**.

.....

.....

.....[2]

7 Fig. 7.1 shows the concentration of carbon dioxide in a muscle cell of an athlete before, during and after a period of exercise.

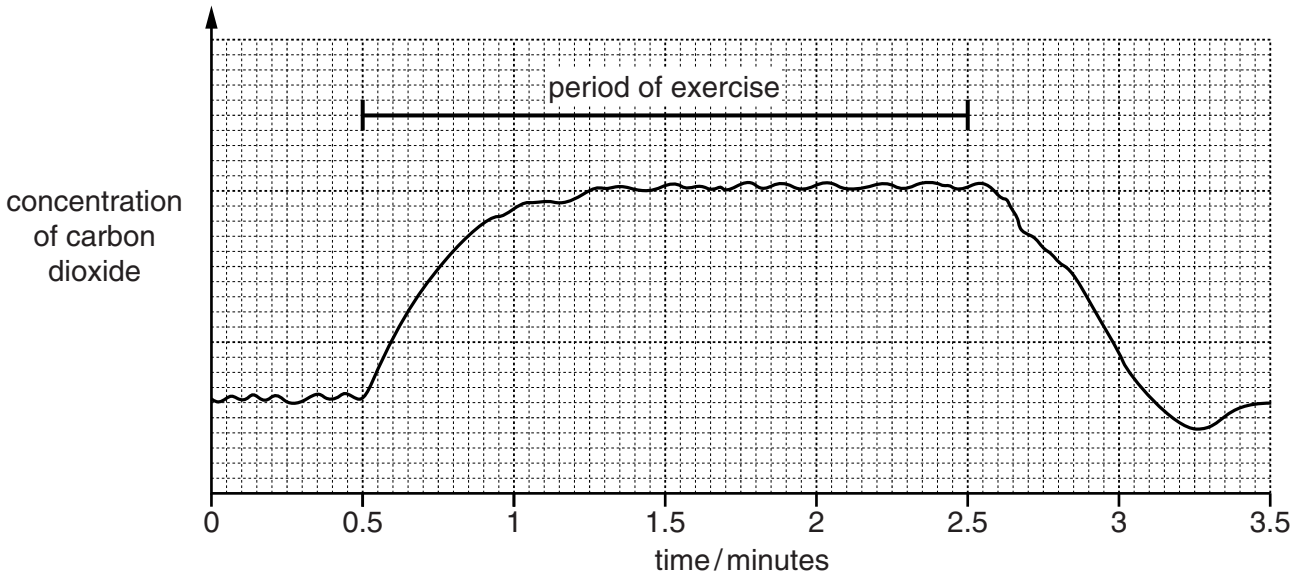


Fig. 7.1

(a) **(i)** Name the process that produces carbon dioxide in cells.

.....[1]

(ii) Complete the word equation for this process.

	+		→		+	carbon dioxide

[2]

(b) State the time in Fig. 7.1 at which the carbon dioxide concentration is lowest.

.....min [1]

(c) During exercise, the blood flow to the muscles increases. Explain why this increased blood flow is important during exercise.

.....

.....

.....

.....[2]

(d) Training increases the number of red blood cells in an athlete's body. Suggest how this affects the amount of lactic acid produced when an athlete is sprinting. Explain your answer.

.....

.....

.....[2]

8 **(a)** A spillage of a radioactive substance occurs in a store for radioactive materials.

The activity due to normal background radiation is 100 counts per minute.

After the spillage, the activity in the store rises to 900 counts per minute.

(i) State the meaning of the term *background radiation*.

.....

.....[1]

(ii) Write down the increase in activity produced by the spilled material.

..... counts per minute [1]

(iii) The pie chart in Fig. 8.1 shows the proportion of the average background radiation that comes from all sources in the United Kingdom.

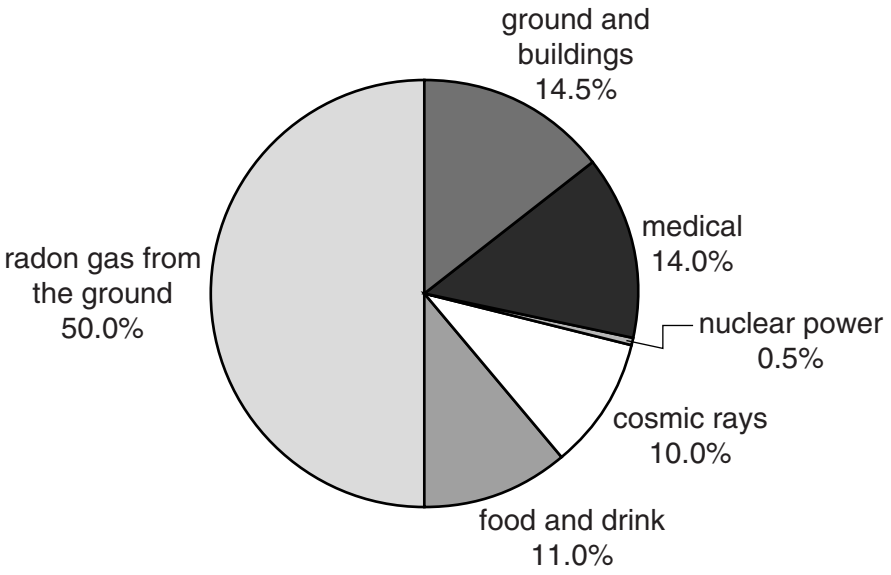


Fig. 8.1

Use the pie chart to explain why doubling the amount of power generated from nuclear sources would only produce a relatively small increase in background radiation.

.....

.....[1]

(b) Apart from cost, give **one** advantage and **one** disadvantage of an oil-fired power station compared to a nuclear power station.

advantage .....

.....

disadvantage .....

.....[2]

(c) Electricity supplied to a house is used to produce light.

The lighting circuits in a house are constructed so that the lamps are connected in a parallel circuit and not a series circuit.

(i) Draw simple circuit diagrams to show the difference between a series circuit and a parallel circuit.

Each circuit should include a power source (a cell).

[2]

(ii) State **two** advantages of connecting lamps in parallel in a lighting circuit.

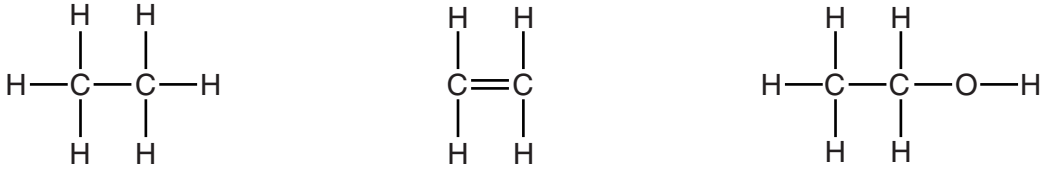
1 .....

.....

2 .....

.....[2]

9 Fig. 9.1 shows molecules of ethane, ethene and ethanol.



ethane ethene ethanol

Fig. 9.1

(a) (i) State and explain which of these compounds are hydrocarbons.

compounds .....

explanation .....

.....[2]

(ii) State and explain which **one** of the three compounds named above is an unsaturated compound.

compounds .....

explanation .....

.....[1]

(b) (i) State **one** use of ethanol.

.....[1]

(ii) In industry, ethanol is made in a chemical reaction involving ethene.

Name the substance that reacts with ethene to produce ethanol.

.....[1]

(iii) The reaction in **(b)(ii)** needs a catalyst.

State the meaning of the term *catalyst.*

.....

.....

.....[2]

(c) Ethene is a colourless gas that reacts to form poly(ethene) which is a white solid.

(i) Describe what happens when ethene molecules react to form poly(ethene) molecules.

Draw a diagram to help you answer this question.

Use the symbol —(E)— to show an ethene molecule.

.....

.....[2]

(ii) State the full name of the type of chemical reaction that occurs in **(c)(i)**.

.....[2]

10 (a) Fig. 10.1 represents some waves on water.

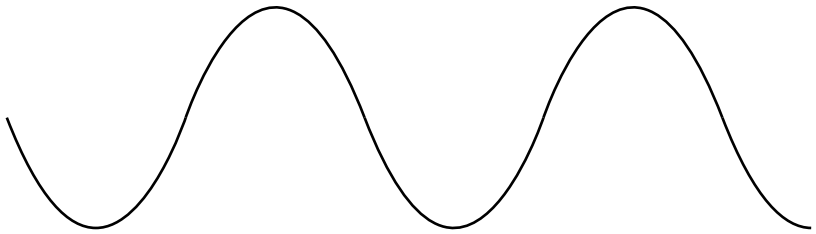


Fig. 10.1

(i) On Fig. 10.1 label with an arrow (◄——►) one wavelength.

[1]

(ii) The waves have a frequency of 0.2 Hz.

Explain what is meant by a *frequency of 0.2 Hz*.

.....

.....[1]

(iii) Water waves are transverse waves and sound waves are longitudinal waves.

Describe how a transverse wave is different from a longitudinal wave.

You may draw a labelled diagram if it helps your answer.

.....

.....

.....[2]

(b) A large meteorite falls into the sea.

(i) The meteorite produces a wave which travels at a speed of 5.6 m / s.

Calculate the time taken by the wave to travel 33 600 m.

State the formula that you use and show your working.

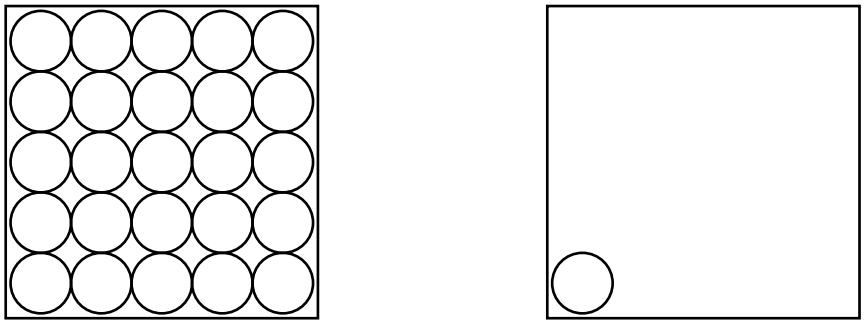
formula

working

time = ... s [2]

(ii) The meteorite is a solid and the sea water is a liquid.

Complete Fig. 10.2 to show the arrangement of particles in a liquid. The diagram for a solid has been done for you.



solid liquid

[2]

Fig. 10.2

(iii) The mass of the meteorite is 32 000 kg and its volume is 4 m^3.

Calculate the density of the meteorite in kg / m^3.

State the formula that you use and show your working.

formula

working

density = ... kg / m^3 [2]

11 Fig. 11.1 shows two liver cells, as seen under a light microscope.

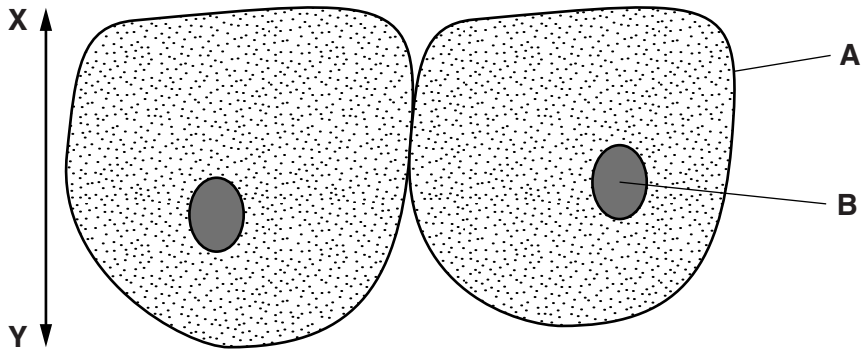


Fig. 11.1

(a) Name the structures labelled **A** and **B**.

A .....

B ..... [2]

(b) State **two** functions of liver cells.

1 .....

2 .....[2]

(c) Give **three** ways in which a plant palisade cell differs from a liver cell.

1 .....

2 .....

3 .....[3]

(d) In Fig. 11.1, the actual height of the cells along the line **X**–**Y** is 0.03 mm. Calculate the magnification of the drawing.

magnification = ...[2]

(e) Name **two** of the blood vessels that are associated with the liver, and outline their function.

vessel 1 .....

function .....

vessel 2 .....

function .....

[2]

12 (a) The Periodic Table lists the elements in order of their proton numbers.

Fig. 12.1 shows the positions of the first eighteen elements.

The letters are **not** the chemical symbols of the elements.

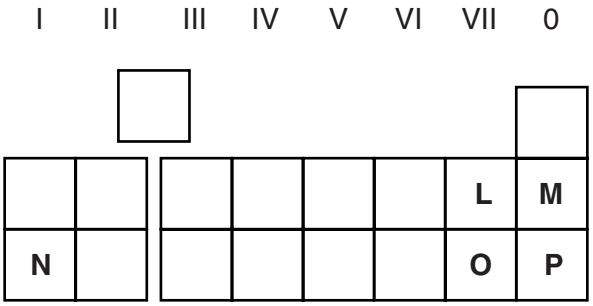


Fig. 12.1

(i) State the meaning of the terms *proton number* and *nucleon number (mass number)*.

proton number .....

.....

nucleon number .....

.....[2]

(ii) Predict and explain whether element **N** has a higher or lower melting point than element **P**.

.....

.....[1]

(iii) State and explain which other element in Fig. 12.1 has chemical properties that are very similar to those of element **O**.

element .....

explanation .....

.....[2]

(b) Carbon dioxide is a gas at room temperature and contains molecules that have the chemical formula CO_2.

State the type of chemical bonding that joins the atoms together in a molecule of carbon dioxide.

Give a reason for your choice.

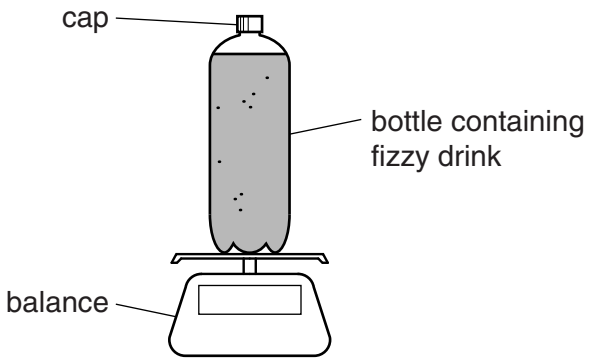
type of bonding .....

reason .....

.....[2]

(c) A student investigates how much carbon dioxide gas is contained in a carbonated (fizzy) drink.

He measures the mass of a full bottle of fizzy drink.



He shakes the bottle. He releases the carbon dioxide by carefully unscrewing the cap.

He measures the mass of the bottle and cap, and liquid without the carbon dioxide.

His results are shown in Table 12.1.

Table 12.1

mass of bottle filled with fizzy drink /g	mass of bottle and cap, and liquid without carbon dioxide /g	volume of the liquid /cm^3
526.2	524.0	500.0

(i) State the mass of carbon dioxide that was released from the fizzy drink.

Show your working.

mass = ...g [1]

(ii) Calculate the mass of carbon dioxide that is dissolved in 1.0 dm^3 of the fizzy drink.

Show your working.

mass = ...g [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	209 **Po** Polonium 84	210 **At** Astatine 85	222 **Rn** Radon 86
223 **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	147 **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	231 **Pa** Protactinium 91	238 **U** Uranium 92	237 **Np** Neptunium 93	244 **Pu** Plutonium 94	243 **Am** Americium 95	247 **Cm** Curium 96	247 **Bk** Berkelium 97	251 **Cf** Californium 98	252 **Es** Einsteinium 99	257 **Fm** Fermium 100	258 **Md** Mendelevium 101	259 **No** Nobelium 102	260 **Lr** Lawrencium 103

Key

a **X** b	a = relative atomic mass **X** = atomic symbol b = atomic (proton) number

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).