Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

5058226223

CO-ORDINATED SCIENCES **0654/22**

Paper 2 (Core) **May/June 2015**

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, 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 28.

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 **28** printed pages.

CAMBRIDGE International Examinations

1 **(a)** Fig. 1.1 shows a passenger at an airport pulling a suitcase towards the check-in desk.

Fig. 1.1

The suitcase has a mass of 18.4 kg and a weight of 180 N.

Explain the difference between the terms *mass* and *weight*.

.....

.....

..... [2]

(b) Fig. 1.2 shows the suitcase being loaded onto an aircraft using a conveyor belt.

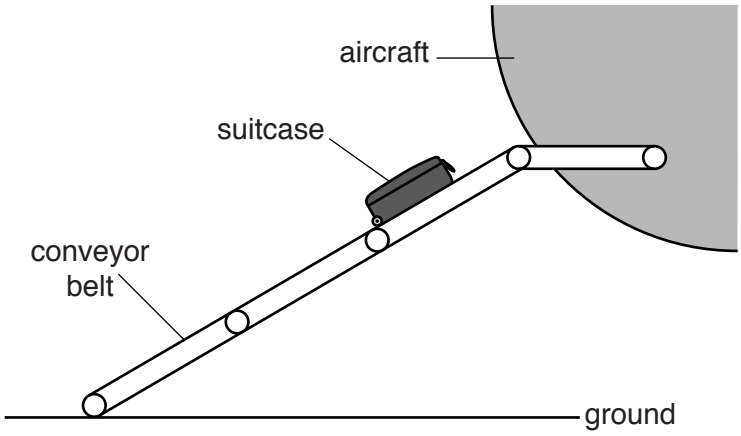


Fig. 1.2

(i) State the form of energy which the case has due to its movement.

..... [1]

(ii) State the form of energy gained by the case after it has been lifted up the conveyor belt.

..... [1]

(c) Fig. 1.3 shows four forces acting on an aircraft.

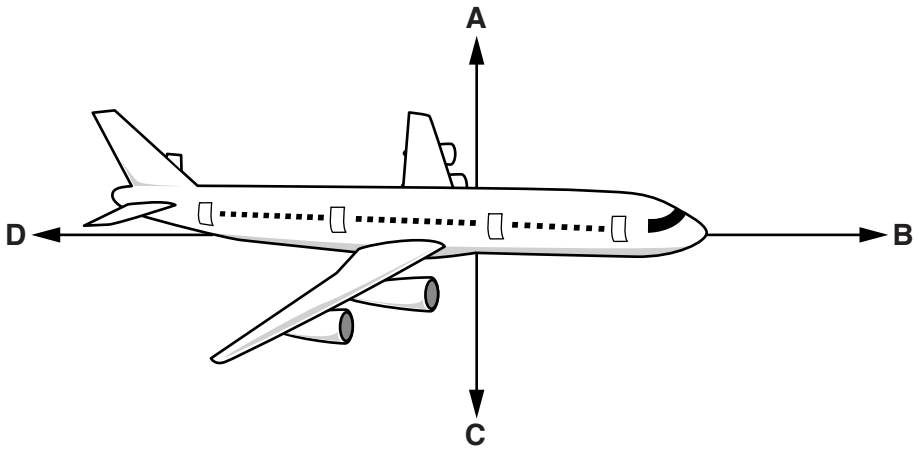


Fig. 1.3

(i) Complete the sentences using the letters **A**, **B**, **C** or **D**.

Each letter may be used once, more than once or not at all.

Initially the aircraft is at rest on the runway because forces ..... and

..... are balanced, and also forces ..... and

..... are balanced.

The aircraft begins to move forward along the runway when forces ..... and

..... are unbalanced. [2]

(ii) Compare the size and direction of forces **B** and **D** when the aircraft flies forward at a steady speed and altitude.

.....

.....

..... [2]

(d) Fig. 1.4 shows the speed/time graph for the aircraft, during part of its flight.

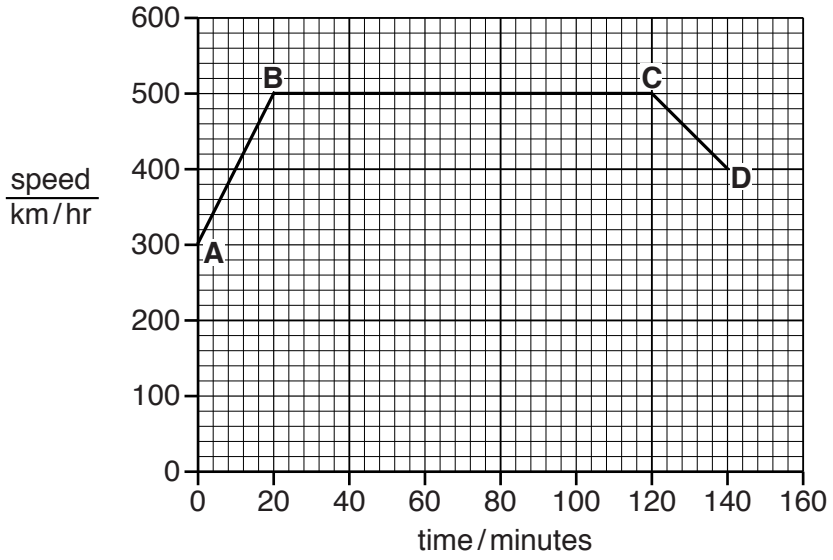


Fig. 1.4

(i) State which section **AB**, **BC** or **CD** of the graph shows the aircraft travelling at a constant speed.

Explain your answer.

section .....

explanation ..... [1]

(ii) State which section **AB**, **BC** or **CD** of the graph shows the aircraft accelerating.

Explain your answer.

section .....

explanation .....

..... [1]

2 **(a)** A student uses litmus paper to test three colourless aqueous solutions.

Complete Table 2.1 to show the colour of the litmus paper in each solution.

Table 2.1

solution	colour of litmus paper
dilute hydrochloric acid	
dilute sodium hydroxide (an alkali)	
dilute solution of chlorine	

[2]

(b) Fig. 2.1 shows the apparatus the student uses to measure the pH of dilute hydrochloric acid.

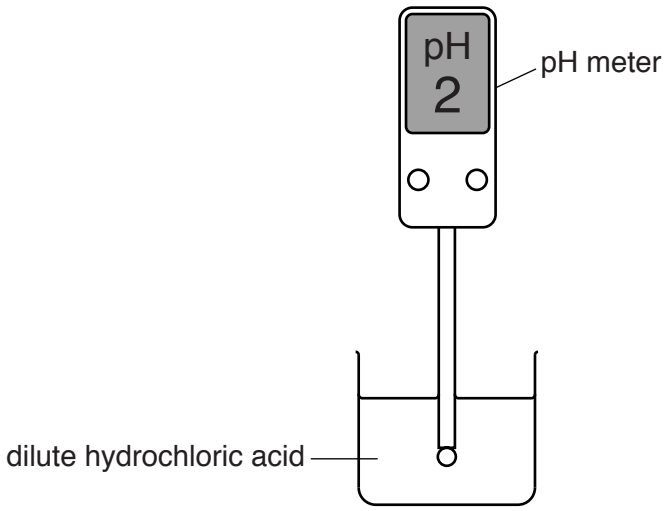


Fig. 2.1

(i) State what happens to the pH of the mixture when a small volume of dilute sodium hydroxide solution is added to the acid.

..... [1]

(ii) Predict the reading on the pH meter when the student has added just enough sodium hydroxide to react with all the acid.

Explain your answer.

pH meter reading .....

explanation .....

..... [2]

(c) Fig. 2.2 shows apparatus the student uses to investigate the reaction between calcium carbonate and dilute hydrochloric acid.

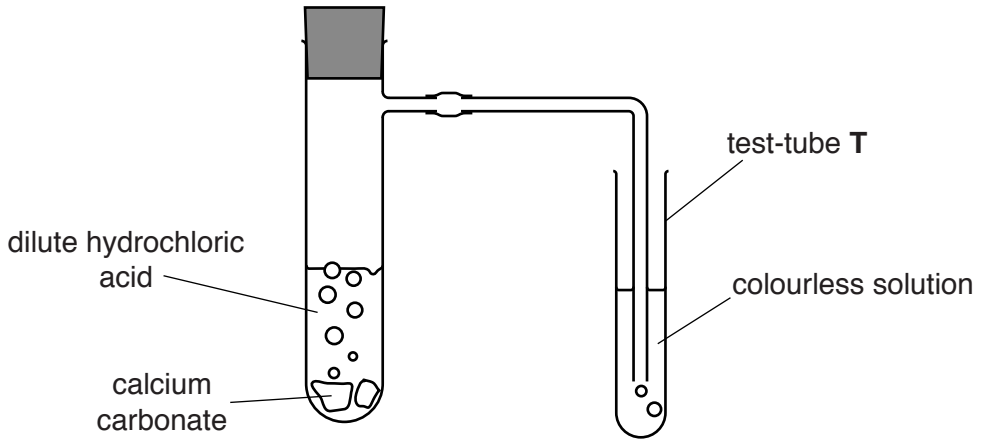


Fig. 2.2

The student has set up test-tube **T** to show that carbon dioxide gas is given off.

(i) Name the colourless solution in test-tube **T**.

..... [1]

(ii) State what happens to the solution in test-tube **T** when calcium carbonate reacts with dilute hydrochloric acid.

..... [1]

(iii) Complete the **word** chemical equation for the reaction between calcium carbonate and dilute hydrochloric acid.

calcium carbonate	+	dilute hydrochloric acid	→		+	carbon dioxide	+	

[2]

(iv) State **two** changes, other than using a catalyst, the student can make that will increase the reaction rate.

1 .....

.....

2 .....

.....[2]

Please turn over for Question 3.

3 Fig. 3.1 shows part of the carbon cycle.

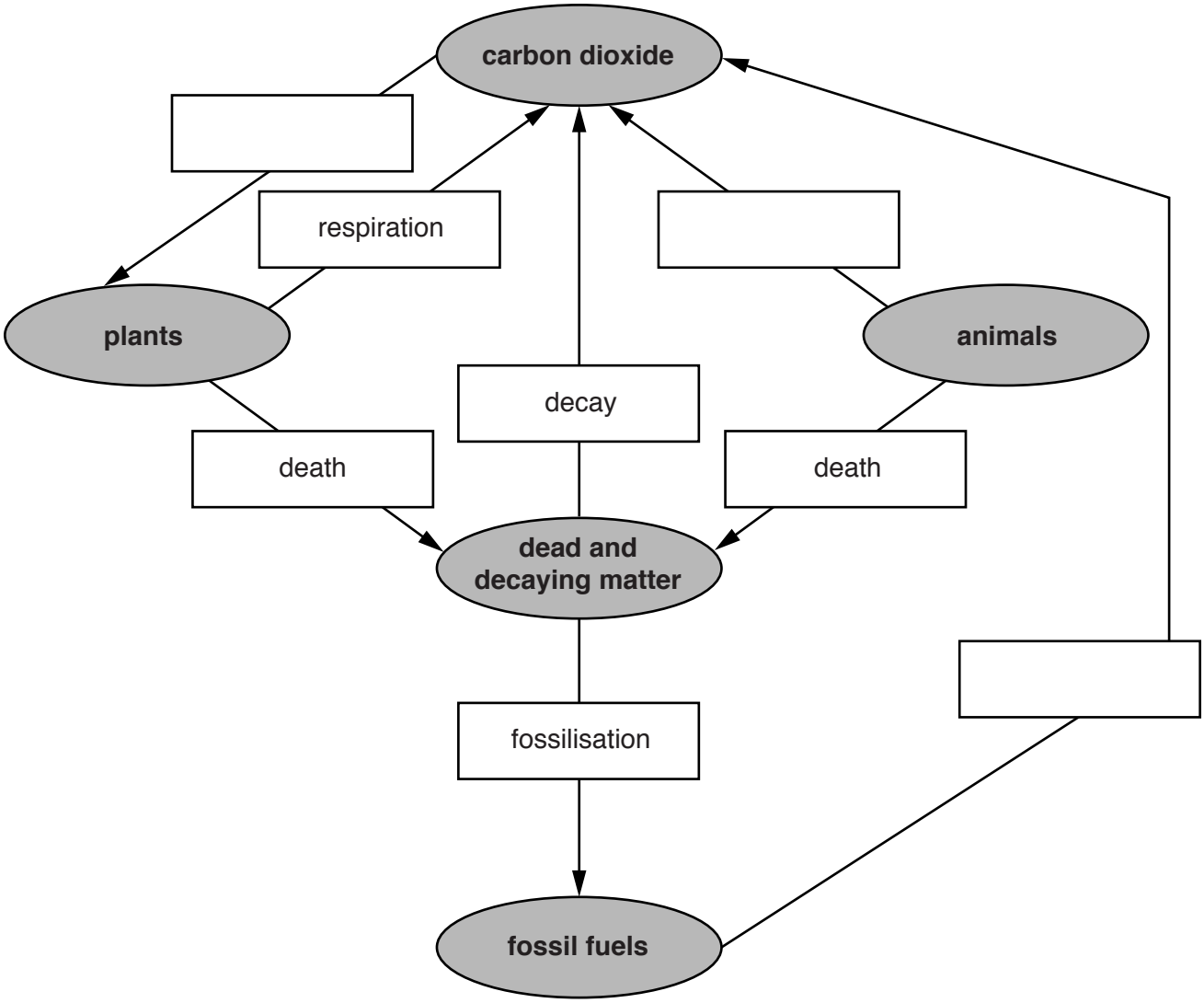


Fig. 3.1

(a) Fill in the empty boxes in Fig. 3.1, naming the processes involved in the carbon cycle. Choose words from this list.

You may use each word once, more than once, or not at all.

breathing **combustion** **decomposition**

photosynthesis **respiration** **transpiration**

[3]

(b) Add an arrow to Fig. 3.1 to show how animals obtain their carbon. [1]

(c) Use the ideas of the carbon cycle to explain why, in a deciduous (temperate) forest, the carbon dioxide concentration in the atmosphere

falls slightly in spring and summer,

.....

.....

rises again in the autumn.

.....

.....
[2]

(d) In many parts of the world, large areas of forest are being cut down. With reference to Fig. 3.1, explain why the carbon dioxide concentration of the atmosphere might be affected by this.

.....

.....

..... [2]

4 **(a)** Fig. 4.1 shows the chemical symbols of some elements in the first four periods of the Periodic Table.

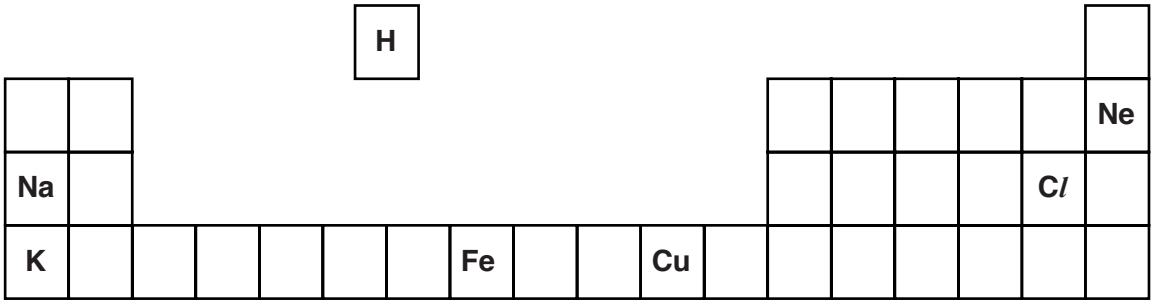


Fig. 4.1

Using only those **symbols** shown in Fig. 4.1, complete Table 4.1 with the **element or elements** that match the descriptions in the column on the left.

Each symbol may be used once, more than once or not at all.

Table 4.1

description	element symbol(s)
it is an unreactive gas	
it oxidises to form rust	
its atoms have the lowest proton number	
they are good electrical conductors	
they are transition metals	
they combine to form sodium chloride	

[6]

(b) Many of the rocks in the Earth's crust are made of compounds known as feldspars.

The chemical formula of one type of feldspar is shown below.

$$CaAl_2Si_2O_8$$

(i) State the total number of atoms shown in this chemical formula.

..... [1]

(ii) State the **name** of the element shown in the chemical formula that is found in

Group IV of the Periodic Table, ...

the 4th period of the Periodic Table. ..... [2]

(c) Fluorine is a non-metallic element.

Fluorine combines with hydrogen and potassium to form the compounds hydrogen fluoride, HF, and potassium fluoride, KF.

(i) Suggest and explain which of these two compounds contains **ionic** bonding between the elements.

compound .....

explanation .....

..... [1]

(ii) Suggest, in terms of electrons, what happens when a fluorine atom is converted into a fluoride ion.

.....

..... [1]

5 On a farm, the wheat yield from one field was recorded over a period of sixty years.

Fig. 5.1 shows the results.

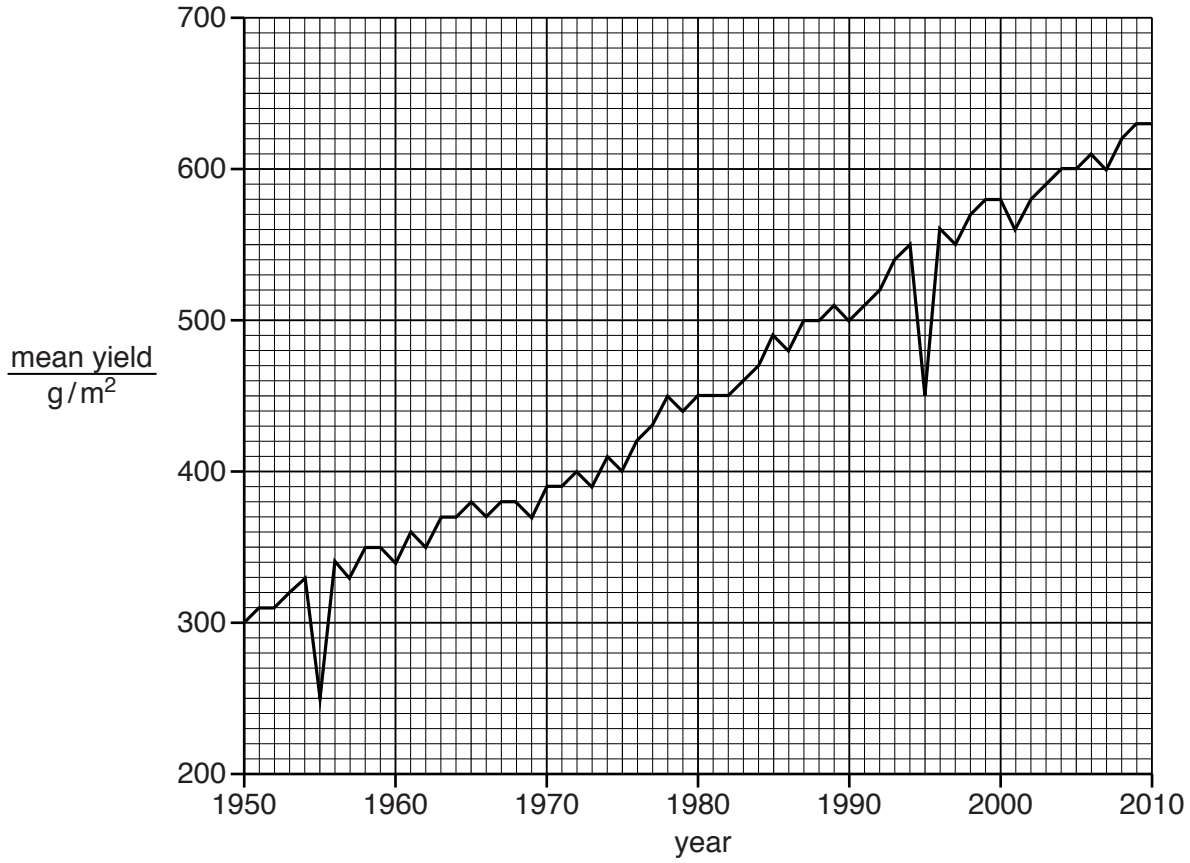


Fig. 5.1

(a) (i) State in which year the yield from this field was lowest.

..... [1]

(ii) Calculate how much the mean yield increased between 1950 and 2010.

yield increase ..... g/m^2 [1]

(b) (i) It is suggested that the increase in yield shown in Fig. 5.1 was caused by artificial selection.

Describe how artificial selection would have been carried out.

.....

.....

..... [2]

(ii) Suggest **two** other possible explanations of the increase in yield that do **not** involve artificial selection.

1 .....

2 ..... [2]

(c) Suggest a possible reason for the results that were obtained in 1955 and in 1995.

.....

..... [1]

(d) In addition to yield, give one other characteristic of wheat plants that farmers might try to improve through artificial selection.

..... [1]

6 **(a)** During car journeys, a car becomes electrostatically charged. This is more obvious on a dry day than on a damp, humid day.

Explain what happens to cause the car to become charged.

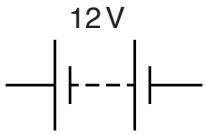
.....

.....

..... [2]

(b) A car has two headlamps connected in parallel with each other across a 12V battery.

(i) Complete the circuit diagram below to show how the two lamps are connected to the battery. Include one switch in the circuit which will control both lamps.



[3]

(ii) If one bulb fails, the other stays lit. Explain why this happens.

.....

..... [1]

(iii) Each lamp has a resistance of 2 Ω. Calculate the current passing through one of the lamps.

State the formula that you use and show your working.

formula

working

current = ... A [2]

(c) A police car uses a blue light and a loud sound from a siren to alert people.

(i) State how the sound from the siren changes when the amplitude of the sound waves emitted decreases.

..... [1]

(ii) Sound waves are longitudinal waves but light waves are transverse waves.

Describe the difference between a transverse wave and a longitudinal wave. You may draw diagrams if it helps your answer.

.....

.....

..... [2]

7 Fig. 7.1 shows the female reproductive system.

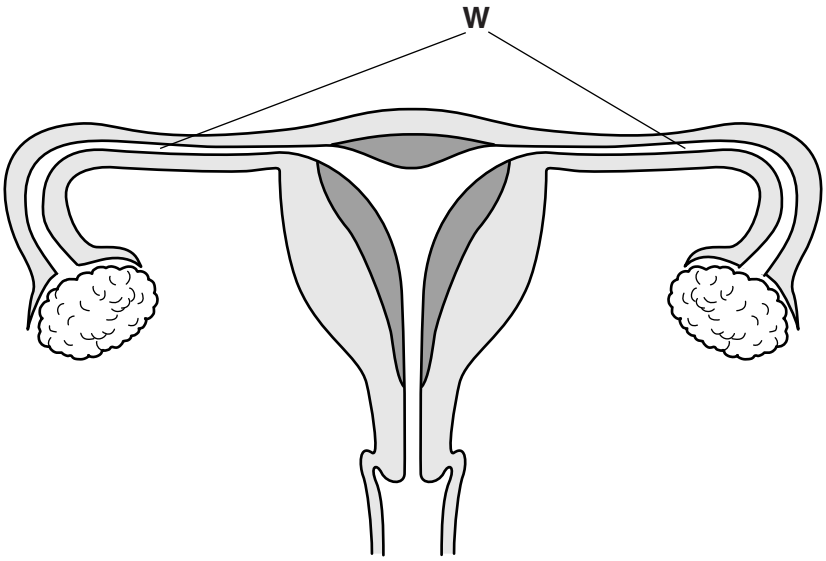


Fig. 7.1

(a) Name the part of the female reproductive system in which the female gametes are produced.

..... [1]

(b) **(i)** Name the tubes labelled **W**.

..... [1]

(ii) Infertility in women can sometimes be caused by the tubes **W** becoming blocked. Explain why this would lead to infertility.

.....

..... [1]

(c) The female reproductive system produces hormones.

(i) Define a *hormone*.

.....

.....

.....

..... [3]

(ii) On Fig. 7.1, use a label line to name and identify the part that produces hormones. [1]

8 The percentages of chemical elements found in the Earth's crust and in the Earth's atmosphere are shown in Fig. 8.1 and Fig. 8.2.

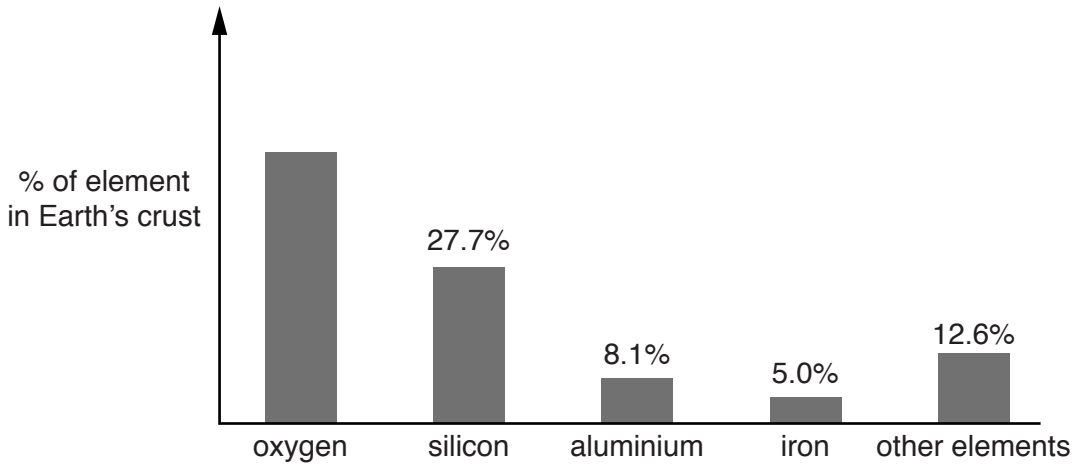


Fig. 8.1

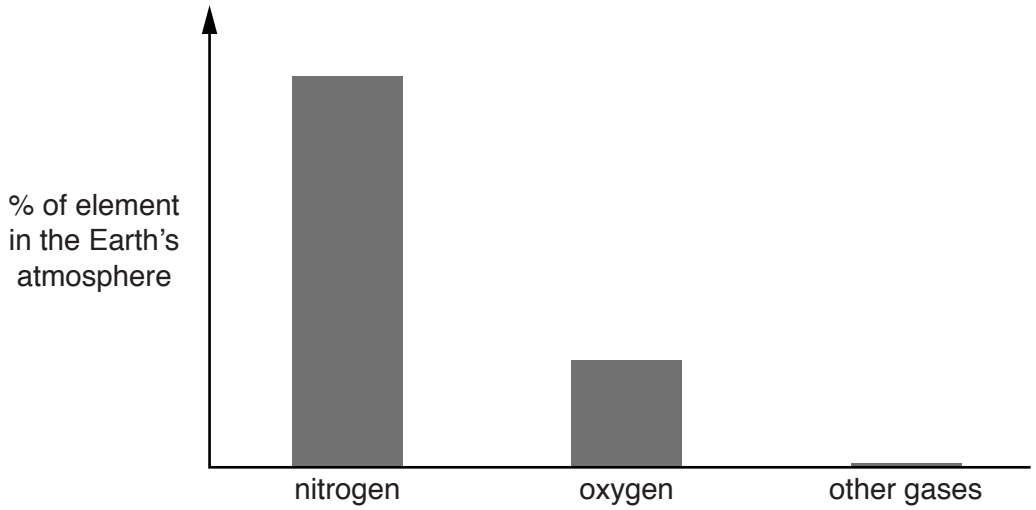


Fig. 8.2

(a) (i) Calculate the percentage of oxygen in the Earth's crust.

Write the value above the correct bar in Fig. 8.1. [1]

(ii) State the percentages of nitrogen and oxygen in the Earth's atmosphere.

Write the values above the correct bars in Fig. 8.2. [2]

[Turn over

(b) The Earth's crust contains useful metals such as iron and aluminium combined with oxygen.

(i) The word equation below shows a reaction that is used to extract iron from iron oxide.

iron oxide + carbon monoxide → iron + carbon dioxide

State the term used to describe a chemical reaction in which oxygen is removed from a compound.

..... [1]

(ii) Aluminium is obtained by the electrolysis of an electrolyte containing aluminium oxide. In this process both the anode and the cathode are made of graphite (carbon).

Complete the sentences.

Electrolysis is a chemical change in which.....

.....

.....

An electrolyte is a liquid that contains .....

.....

The cathode is .....
[3]

(c) Aluminium is used to make food containers and to wrap around food during cooking.

(i) State the physical property of aluminium that allows it to be formed into thin sheets.

..... [1]

(ii) Suggest **two** other properties of aluminium that make it a suitable material to wrap around food during cooking.

1 .....

.....

2 .....

..... [2]

9 **(a)** Fig. 9.1 shows two dolphins communicating with each other under water using sound waves.

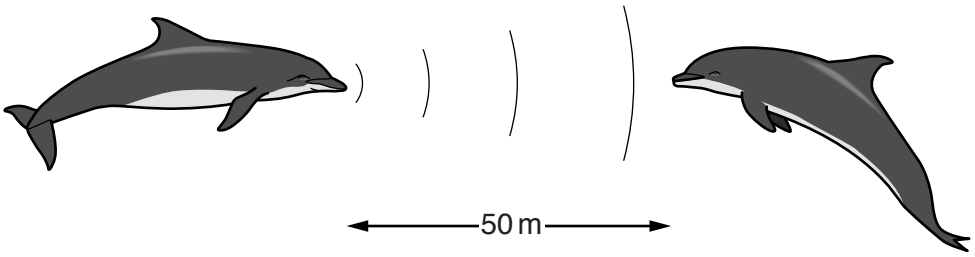


Fig. 9.1

(i) The dolphins are 50 m apart. The speed of sound in water is 1500 m/s.

Calculate how long it will take for a sound wave to travel from one dolphin to the other.

State the formula that you use and show your working.

formula

working

..... s [2]

(ii) Some of the sounds made by the dolphins have a frequency of 50 000 Hz.

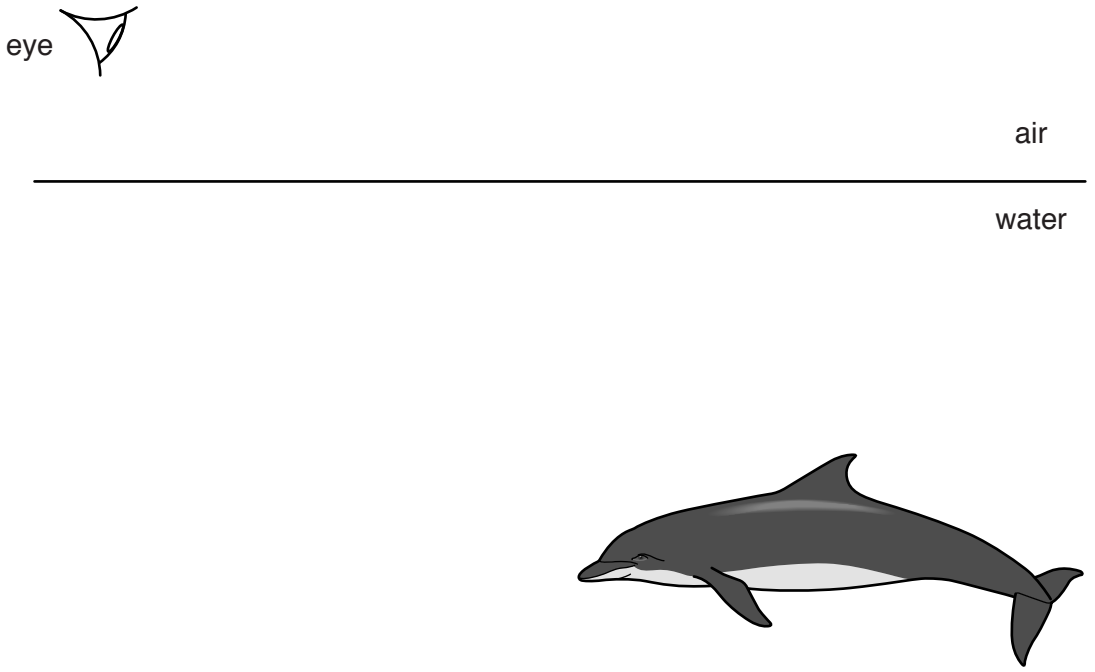
State whether or not humans can hear sounds with a frequency of 50 000 Hz.

Explain your answer.

.....

..... [1]

(b) A man on a boat sees a dolphin under the water. Draw a ray of light on Fig. 9.2 to show how light travels from the dolphin's head to the man's eye.



[2]

Fig. 9.2

(c) The water in the sea is heated by the Sun.

When the water is heated, the temperature of the water increases but never reaches the boiling point of water. Some water evaporates.

(i) State the meaning of the term *boiling point*.

.....

..... [1]

(ii) Describe the process of evaporation in terms of the movement of water molecules.

.....

.....

.....

..... [3]

(d) Fig. 9.3 shows three different ways in which particles may be arranged in substances.

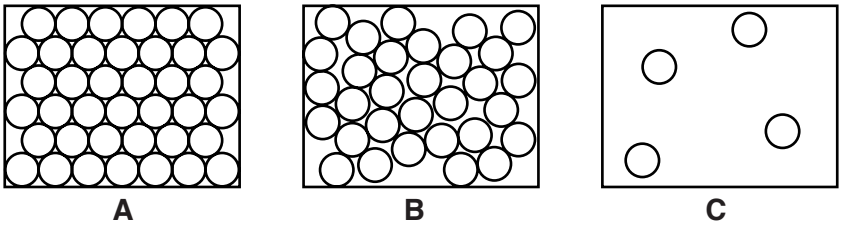


Fig. 9.3

Water in the sea is a liquid and water in the air is a gas.

(i) State which diagram best represents the way particles are arranged in liquid water.

Explain your answer.

diagram .....

explanation .....

..... [1]

(ii) State which diagram best represents the way particles are arranged in gaseous air.

Explain your answer.

diagram .....

explanation .....

..... [1]

10 Fig. 10.1 shows a cell from a plant. The cell absorbs water from the soil.

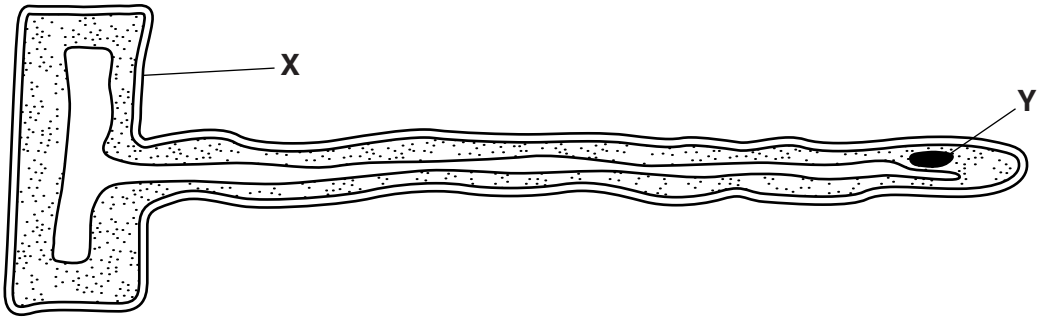


Fig. 10.1

(a) **(i)** Name this type of cell.

..... [1]

(ii) Name the structures labelled **X** and **Y**.

X .....

Y ..... [2]

(b) State **one** other function of the cell, apart from water absorption.

..... [1]

(c) Most of the water absorbed by this cell later evaporates from the plant.

(i) Name the process by which water evaporates from a plant.

..... [1]

(ii) State where most of this evaporation occurs.

..... [1]

(d) Not all of the water absorbed by a plant is lost by evaporation.

Suggest **one** way in which a plant might make use of the absorbed water.

.....

..... [1]

11 Alkanes and alkenes are general names given to two types of hydrocarbons.

Alkanes are found in petroleum (crude oil) and alkenes are produced in the chemical industry.

(a) (i) Name the type of reaction that is used to produce alkenes in the chemical industry.

..... [1]

(ii) Fig. 11.1 shows the structure of one molecule of a gaseous hydrocarbon, **G**.

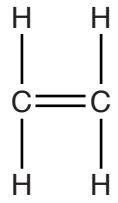


Fig. 11.1

State and explain whether hydrocarbon **G** is an alkane or an alkene.

hydrocarbon **G** is an .....

explanation .....

..... [1]

(iii) Describe the colour change that is observed when hydrocarbon **G** is shaken with a solution of bromine.

from ..... to ..... [2]

(b) Fig. 11.2 shows hydrocarbon **G** being passed through a reaction vessel to produce a white solid substance that has the appearance of plastic.

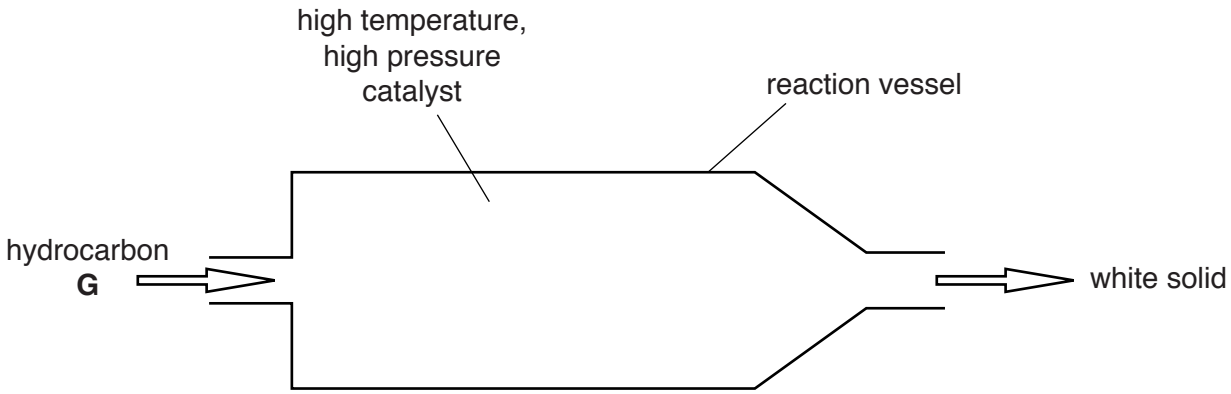


Fig. 11.2

(i) Name the type of chemical reaction that converts hydrocarbon **G** into the white solid substance.

..... [1]

(ii) Draw a simple diagram that shows the way a molecule of the white solid is formed from molecules of hydrocarbon **G**.

Use the symbol —(G)— to represent a molecule of hydrocarbon **G**.

[1]

(iii) State and explain whether or not the white solid compound is a hydrocarbon.

.....

.....

..... [2]

12 Fig. 12.1 shows the human skull, seen from the side.

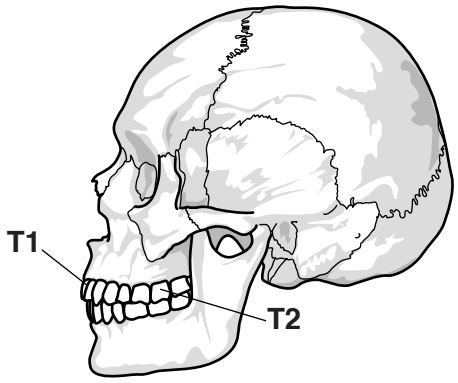


Fig. 12.1

(a) Name the type of tooth labelled **T1**.

..... [1]

(b) Describe how tooth **T2** is different from tooth **T1** in its structure and in its function.

structure .....

.....

.....

function .....

.....
[3]

(c) Explain why it is important to chew food that we eat.

.....

.....

..... [2]

(d) Explain how regular brushing of the teeth helps to prevent tooth decay.

.....

.....

..... [2]

(e) Apart from brushing the teeth, state **two** other ways in which tooth decay can be prevented.

1 .....

2 ..... [2]

[Turn over

13 (a) A doctor uses both X-rays and γ-(gamma) rays in a hospital.

(i) X-rays and γ-rays are both examples of ionising radiation.

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

.....

..... [1]

(ii) Before using an X-ray machine, the doctor moves and stands behind a metal screen. Suggest a reason why the doctor does this.

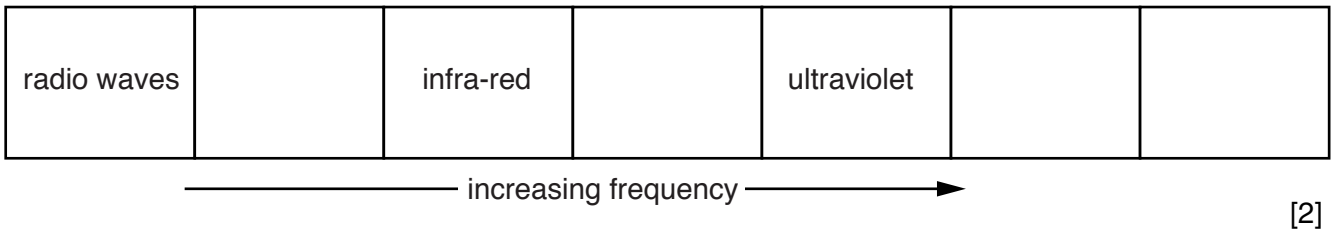
.....

.....

..... [2]

(iii) X-rays and γ-rays are both part of the electromagnetic spectrum.

Write each one in its correct box on the incomplete electromagnetic spectrum below.



[2]

(b) Optical fibres are used to see inside the human stomach. Light is sent along a bundle of fibres to enable the doctor to see what is in the stomach.

Fig. 13.1 shows an optical fibre with a ray of light travelling down part of it.

(i) Complete the path of the ray of light as it travels down the fibre.

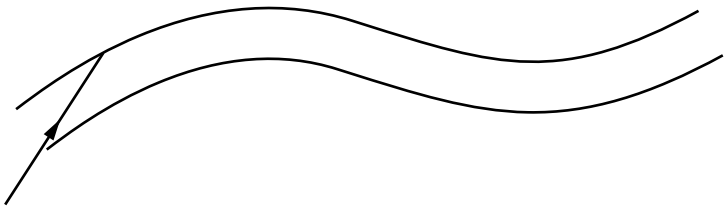


Fig. 13.1

[1]

(ii) Explain why the ray stays inside the fibre.

.....

..... [1]

(c) To study the blood flow in a patient's lungs, the patient is injected with a radioactive isotope, technetium-99.

The γ-radiation given out by the technetium-99 is detected using a gamma camera outside the patient's body.

Identify **two** statements that explain why γ-radiation is used for this investigation. Place a tick in each of the two correct boxes.

It can pass through the human body. ☐

It destroys cancer cells. ☐

It is safer than α- or β-radiation. ☐ [1]

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.).