Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

CO-ORDINATED SCIENCES **0654/23**

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 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 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

[Turn over

1 Table 1.1 shows some information about three elements **A**, **B** and **C**.

Table 1.1

element	group in Periodic Table	group name	reactive or unreactive	electrical conductor or insulator
A	1	alkali metals	reactive	
B	7	halogens		
C	0			insulator

(a) Add the five missing pieces of information to complete Table 1.1. [3]

(b) Describe how the structure of the nucleus is used to place the elements in the order found in the Periodic Table.

.....[1]

(c) Table 1.2 shows information about two different atoms, **X** and **Y**, of the element boron.

Table 1.2

atom	proton number	nucleon number
X	5	10
Y	5	11

(i) State and explain which of the atoms, **X** or **Y**, contains the same number of neutrons as protons.

atom .....

explanation .....

.....[1]

(ii) State the word used to describe forms of an element that have atoms with different nucleon numbers.

.....[1]

(d) Fig. 1.1 shows sodium reacting in water that contains a solution of full range indicator (Universal Indicator).

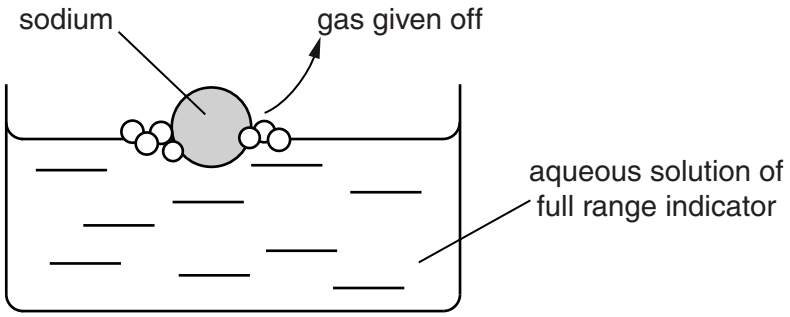


Fig. 1.1

(i) Name the gas that is given off in the reaction.

.....[1]

(ii) State and explain how the pH of the solution changes during the reaction.

.....

.....

.....[2]

(iii) State and explain **one** observation that would be different if the reaction is repeated using lithium instead of sodium.

.....

.....

.....[2]

[Turn over

2 (a) (i) A torch (flashlight) contains three cells, a lamp and a switch connected in series. Using the correct circuit symbols, draw the electrical circuit for the torch.

[2]

(ii) The voltage across the lamp is 4.5 V.
The resistance of the lamp is 5 Ω.

Calculate the current through the lamp.

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

formula

working

current = ... unit .....[3]

(iii) The lamp from the torch has a resistance of 5 Ω when lit. Two identical lamps are connected together in a series circuit.

State the combined resistance of the two lamps when lit and connected in series.

..... Ω [1]

(b) Fig. 2.1 shows a ray of light from the torch that is reflected by a plane mirror.

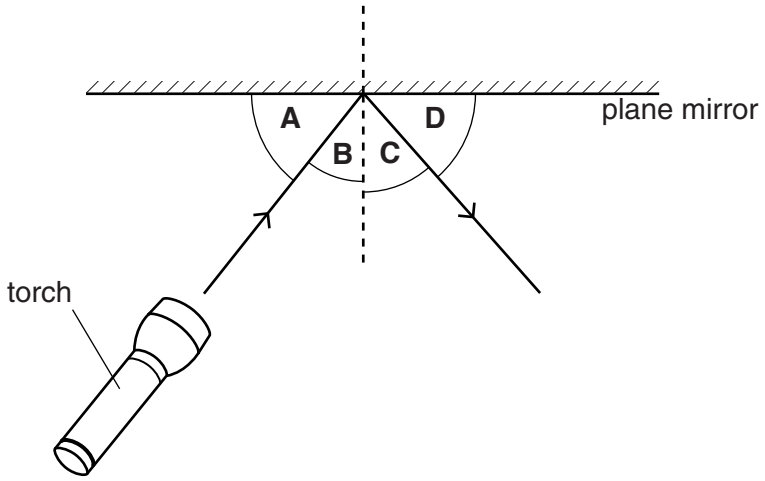


Fig. 2.1

(i) Name angle **B**.

..... [1]

(ii) Name angle **C**.

..... [1]

(iii) State what happens to the value of angle **C** when the value of angle **B** is doubled.

.....[1]

3 Fig. 3.1 shows, for one country, the number of people recorded as newly infected with HIV each year from 1985 to 2010.

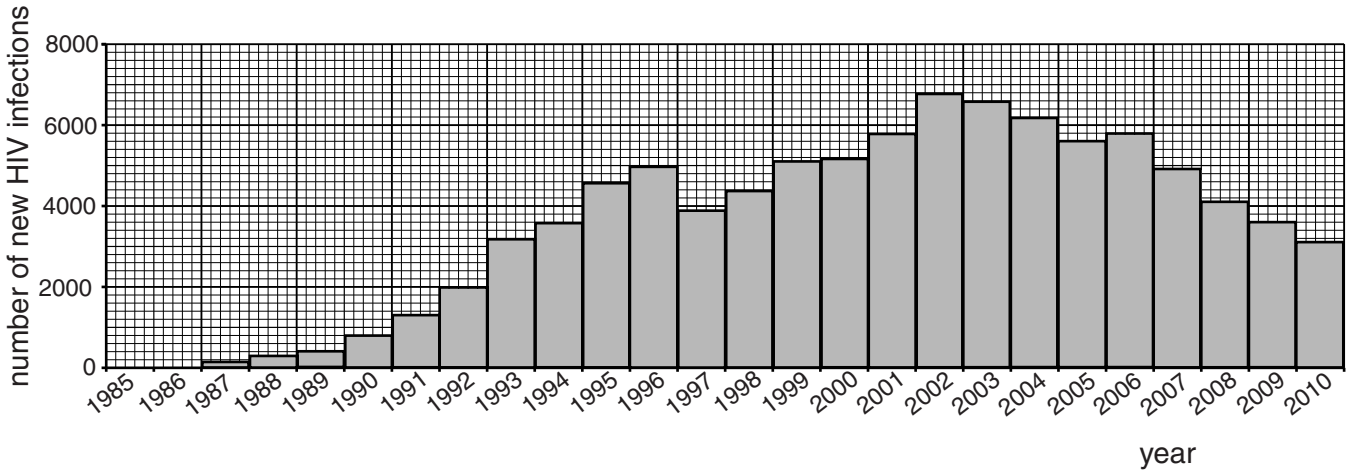


Fig. 3.1

(a) (i) State in which year the number of new HIV infections was greatest.

.....[1]

(ii) Suggest **one** reason why the actual number of new HIV infections may have been greater than this.

.....

.....[1]

(b) State **two** ways in which HIV can be transmitted within a population.

1 .....

2 .....[2]

(c) (i) Use Fig. 3.1 to describe how the number of new HIV infections changed between 2006 and 2010.

.....

.....

.....[2]

(ii) Suggest **two** possible reasons for this change.

1 .....

2 .....[2]

4 **(a)** A student rubs a balloon on his sweater. Charged particles move from the sweater to the balloon which becomes negatively charged.

(i) Name the charged particles.

..... [1]

(ii) The student charges a second balloon in the same way.

Fig. 4.1 shows the two charged balloons next to each other.

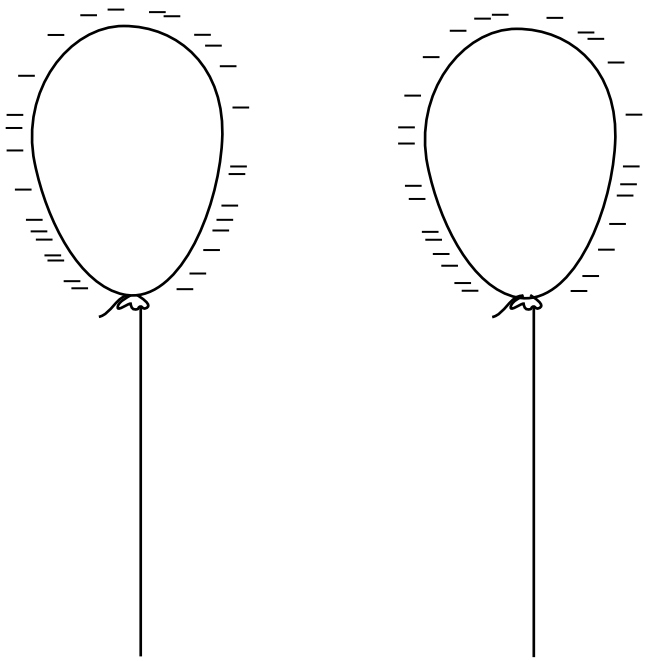


Fig. 4.1

State what happens to the balloons when the student brings the balloons very close together.

Explain your answer.

.....

.....

.....[2]

(b) The student then bursts one of the balloons 83 m from a brick wall. This is shown in Fig. 4.2.

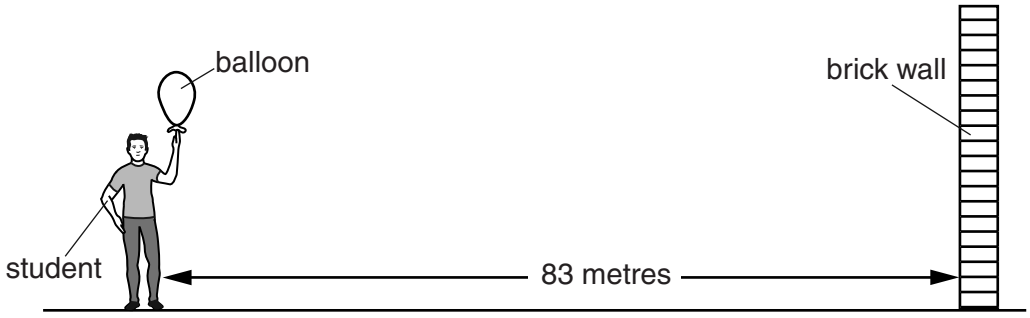


Fig. 4.2

The noise the balloon makes when it bursts travels through the air as a sound wave.

The student hears an echo.

(i) Explain why the student hears an echo.

.....

.....[1]

(ii) Between the balloon bursting and the student hearing the echo, there is a delay.

How far has the sound wave travelled in this time?

.....m [1]

(iii) The time delay for the echo is 0.5 s. Use your answer to **(ii)** to calculate the speed of sound in air.

State the formula that you use and show your working.

formula

working

speed of sound = ... m/s [2]

(c) The student places the second balloon in a refrigerator.

Explain in terms of particles why the balloon shrinks when placed in the refrigerator.

.....

.....

.....

.....[2]

(d) Fig. 4.3 shows a large hot air balloon moving upwards.

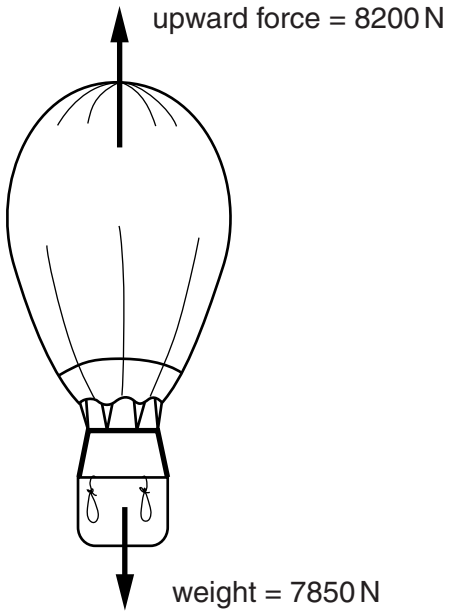


Fig. 4.3

(i) Explain why the balloon rises.

.....

.....[1]

(ii) The mass of the air in the hot air balloon is 2660 kg. The volume of the air in the hot air balloon is 2800 m^3.

Calculate the density of the air in the hot balloon in kg/m^3.

State the formula that you use and show your working.

formula

working

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

5 In some countries, sodium chloride is obtained from sea water or salt water lakes.

(a) Describe how sodium chloride crystals can be obtained from sea water.

.....

.....

.....[2]

(b) Sodium chloride is formed when sodium metal reacts in a container of chlorine gas.

In this reaction, sodium atoms and chlorine atoms are changed into sodium ions and chloride ions.

(i) Complete the explanations below in terms of protons and electrons.

A sodium **atom** has no overall electrical charge because .....

.....

.....

A sodium **ion** has a positive electrical charge because .....

.....

.....
[3]

(ii) Explain why strong bonds form between sodium ions and chloride ions.

.....

.....[1]

(c) Fig. 5.1 shows laboratory apparatus that can be used to obtain chlorine from sodium chloride solution.

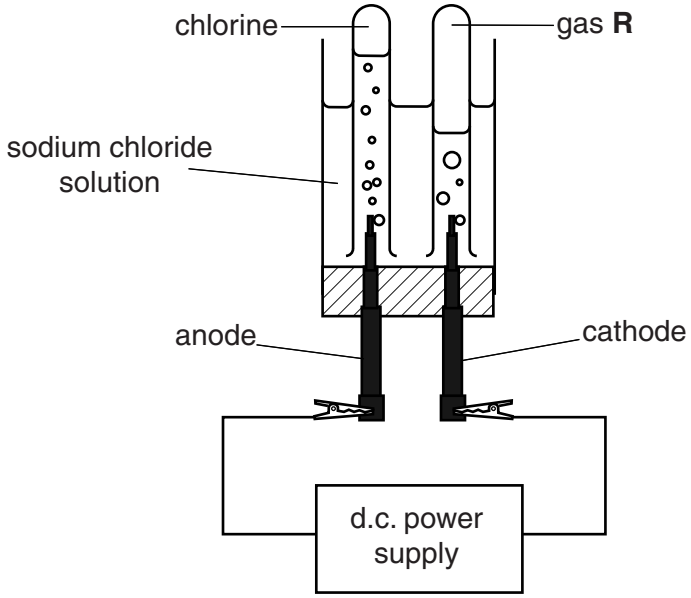


Fig. 5.1

(i) Name the process shown in Fig. 5.1.

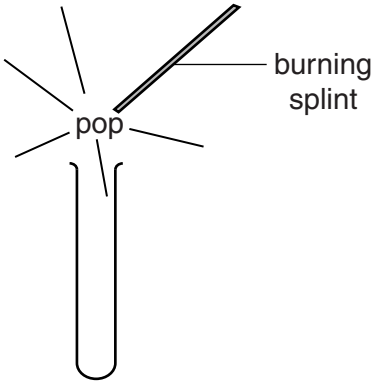
.....[1]

(ii) State the difference between the cathode and the anode.

.....

.....[1]

Gas **R** in Fig. 5.1 is tested as shown below.



(iii) Name gas **R**.

.....[1]

6 Fig. 6.1 shows part of a leaf in section, as it appears under a microscope.

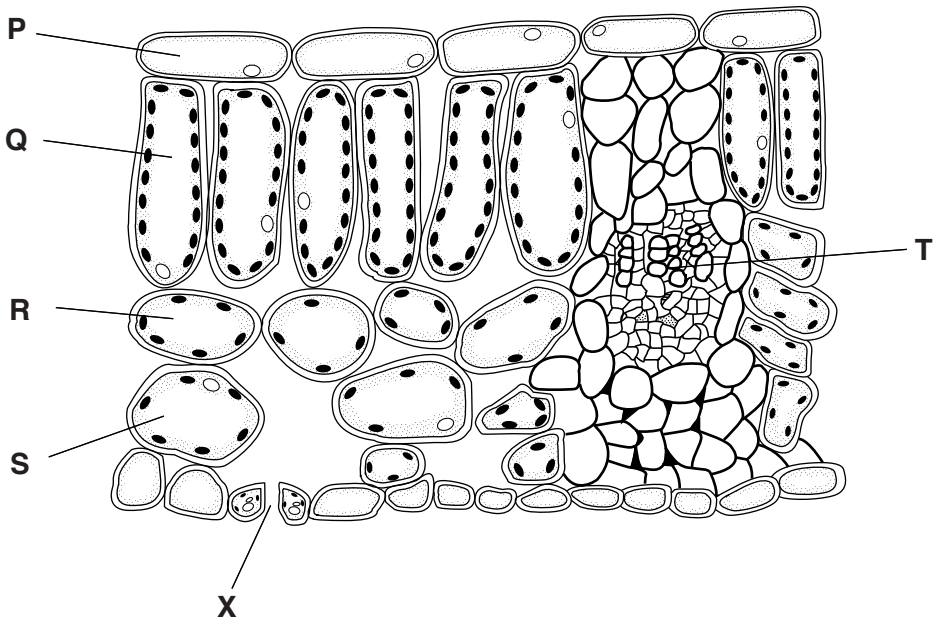


Fig. 6.1

(a) Plants lose water from their leaves in the form of water vapour.

(i) State the name for the loss of water from leaves.

.....[1]

(ii) Water inside the leaf evaporates and the water vapour then diffuses through pores in the leaf.

On Fig. 6.1, use a label line with the letter **E** to show a place inside the leaf where water evaporates. [1]

(iii) Name the pore in the leaf labelled **X**.

.....[1]

(iv) State **two** environmental conditions that would **increase** the rate of this water loss.

1 .....

2 .....[2]

(b) The main function of the leaf is photosynthesis.

(i) With reference to Fig. 6.1, identify the type of cells in which most photosynthesis occurs, and explain your answer.

cells .....

explanation .....

.....[2]

(ii) Explain why the pore at **X** is important for photosynthesis.

.....

.....[1]

7 Oxygen combines with many elements to form oxides.

(a) Fig. 7.1 shows two test-tubes, **J** and **K**, that a student set up to investigate the conditions needed for iron to rust.

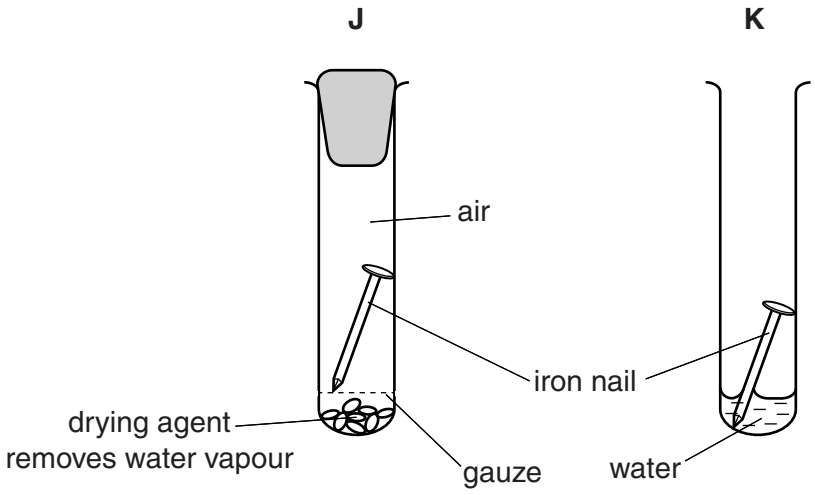


Fig. 7.1

(i) Predict and explain in which test-tube, **J** or **K**, the nail rusted.

Your explanation should include why the iron rusted in one of the tubes and not in the other.

test-tube in which rust forms .....

explanation .....

.....

.....

.....[2]

(ii) Mild steel is an alloy of iron that forms rust.

Describe how rust is prevented from forming on mild steel that is used to make large objects such as bicycle frames or car bodies.

.....

.....[1]

(iii) Explain why the method you have described in **(ii)** prevents rust formation.

.....

.....[1]

(b) Table 7.1 shows some of the physical and chemical properties of five oxides **L** to **P**.

Table 7.1

oxide	physical state at 20 °C	colour	pH after shaking with pure water
L	solid	white	7
M	solid	red	7
N	solid	white	13
O	solid	white	1
P	gas	colourless	2

(i) State and explain which of the oxides have **no** effect on the pH of pure water when shaken with it.

oxides .....

explanation .....

.....[2]

(ii) State and explain which of the oxides contains a transition metal.

oxide .....

explanation .....

.....[1]

(iii) The elements calcium and phosphorus both form white, solid oxides.

Use the information in Table 7.1 to deduce whether oxide **O** is calcium oxide or phosphorus oxide. Explain your answer.

.....

.....

.....[2]

(c) The burning of magnesium in air to form magnesium oxide is an exothermic reaction.

(i) Construct the **word** chemical equation for this reaction.

[1]

(ii) State the meaning of the term *exothermic*.

.....

.....[1]

(iii) Name the salt that is produced when dilute sulfuric acid is neutralised by magnesium oxide.

.....[1]

8 **(a)** Coal is burned in a power station to generate electricity.

Complete the sentences using suitable words to describe how this happens.

Coal is burned to heat ..... in a boiler to produce steam.

The steam drives a ....., which turns a generator. [2]

(b) Fig. 8.1 shows the energy transformations in a coal burning power station.

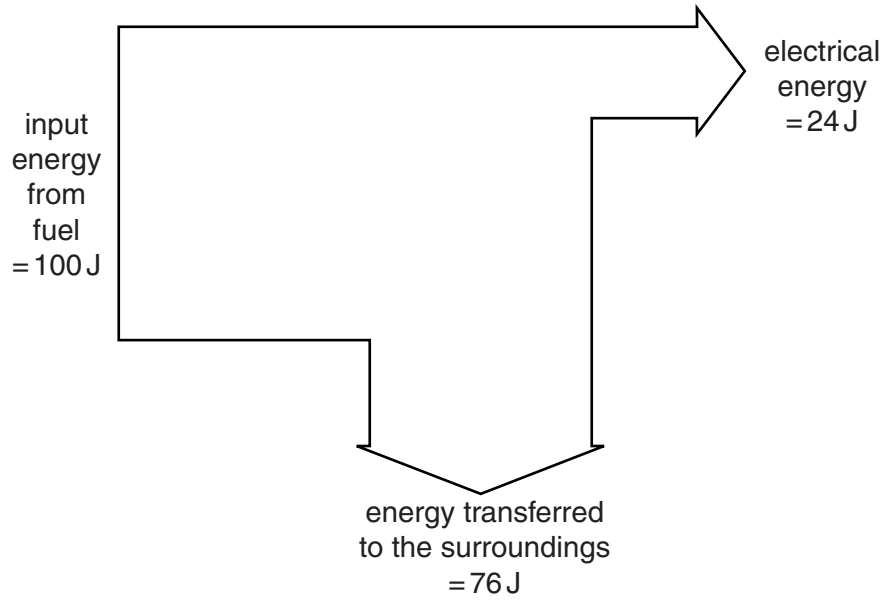


Fig. 8.1

(i) State the form of energy contained in a fuel such as coal.

..... [1]

(ii) State a form in which most energy is transferred to the surroundings.

..... [1]

(iii) Explain how the information in Fig. 8.1 shows that the energy transfer from the fuel to electrical energy is not 100% efficient.

.....

.....[1]

(c) Some energy resources are shown.

coal **geothermal** **hydroelectricity** **nuclear**

oil **solar energy** **wind energy**

Identify **two** resources that do **not** use the Sun as their source of energy.

1 .....

2 ..... [1]

(d) The workers in a nuclear power station must be protected from radioactive materials.

(i) Explain why workers need protection from radioactive materials.

.....

.....

.....[2]

(ii) Describe how enclosing the nuclear reactor in thick concrete protects the workers.

.....

.....[1]

The combustion of fossil fuels may lead to global warming.

(e) Name a gas produced by the combustion of fossil fuels that may lead to global warming.

.....[1]

(f) Describe how global warming may affect

(i) plants, ...

.....[1]

(ii) people living near the coast. .....

.....[1]

(g) Fossil fuels are non-renewable. Explain why it is important to conserve non-renewable resources.

.....

.....[1]

Please turn over for Question 9.

9 Frederick Hopkins, a scientist, investigated the effect of diet on the growth of mice.

He kept two groups of mice in a laboratory, feeding them on different diets.

- Group 1 had a **basic diet** of purified protein, carbohydrate, fat and mineral ions. They also had plenty of water.
- Group 2 had a **supplemented diet**. This was exactly the same as the basic diet, but with a small amount of milk added.

Hopkins measured the average mass of the mice in each group over a period of 18 days. After 18 days, he reversed the diets.

Fig. 9.1 shows his results.

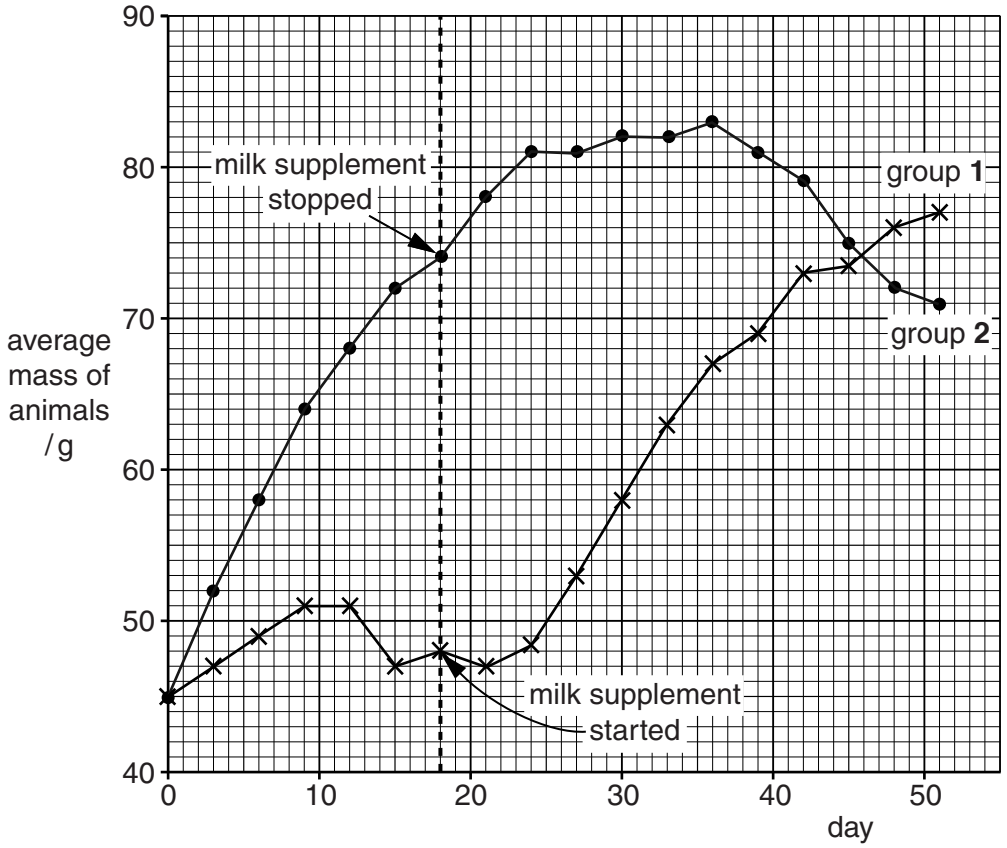


Fig. 9.1

(a) Compare the growth of the group **1** and group **2** animals between day 0 and day 9. Include in your answer how the growth of each group is alike and how the growth of each group is different.

.....

.....

.....[2]

(b) State **one** function, in the diets, of

(i) the protein, ...[1]

(ii) the carbohydrate. .....[1]

(c) Name **one** mineral ion that the mice would need in their diet, and state its function.

mineral ion .....

function .....

.....[2]

(d) The basic diet lacked vitamins, such as vitamin D, but the supplemented diet contained these vitamins.

Suggest how a lack of vitamin D would have affected the mice on the basic diet.

.....

.....[1]

(e) In Hopkins' experiment, the two groups of mice were treated in exactly the same way except for the food they were given. Explain why this was important.

.....

.....[1]

(f) In the experiment, the diets were swapped after 18 days.

Suggest what would have happened to the mice in group **1** if the diets had been swapped back again after 36 days. Give a reason for your answer.

.....

.....

.....[1]

(g) Hopkins' experiment was about nutrition, which is one of the seven characteristics of living organisms.

State **two** other characteristics of living organisms.

1 .....

2 .....[2]

10 Many useful products are obtained from the fossil fuel, petroleum (crude oil).

Before any useful products can be obtained, petroleum is first processed at an oil refinery.

(a) Gasoline and diesel oil are fuels obtained from petroleum.

Fig. 10.1 shows the industrial apparatus used to obtain gasoline and diesel oil from petroleum.

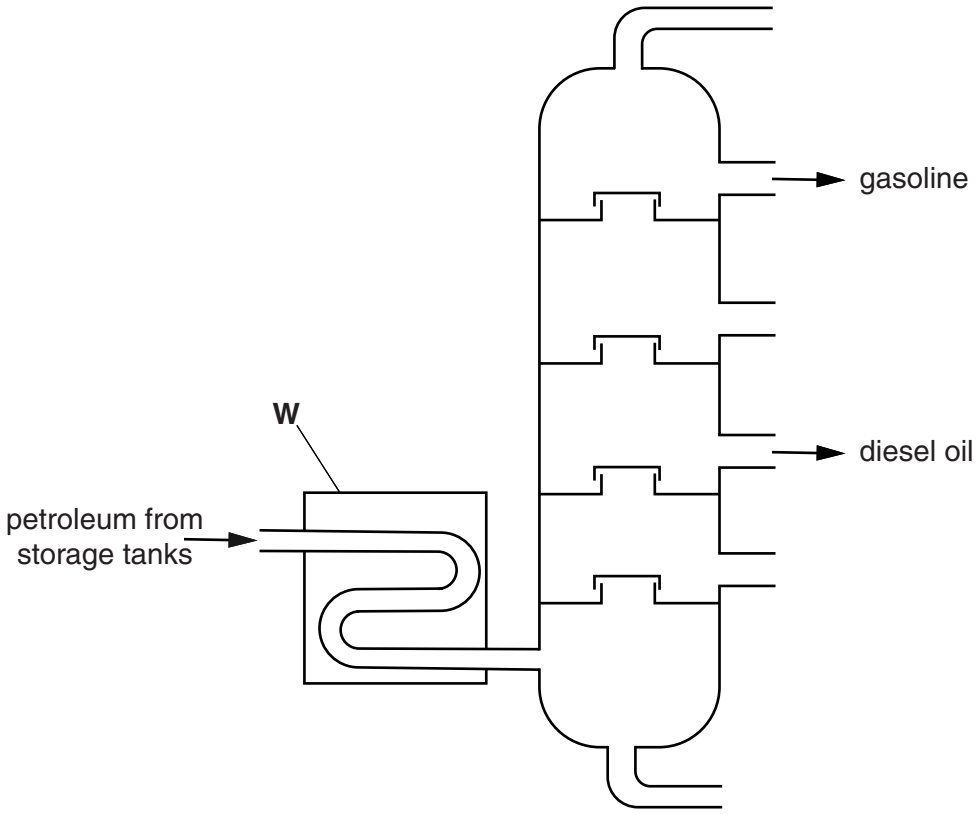


Fig. 10.1

(i) Name the process shown in Fig. 10.1.

.....[1]

(ii) State what happens to petroleum in the part of the apparatus labelled **W**.

.....[1]

(iii) Fig. 10.2 shows one molecule of a compound found in gasoline and diesel oil.

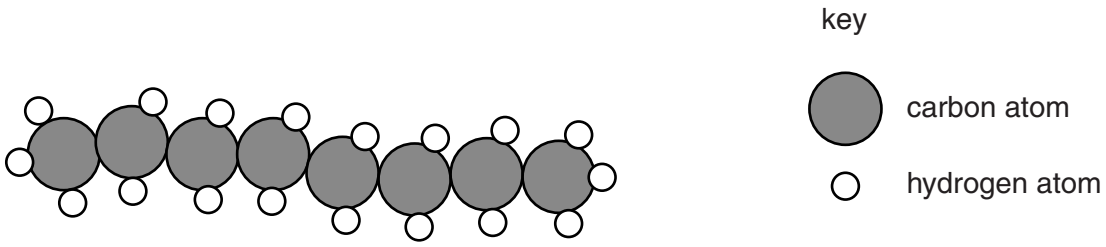


Fig. 10.2

Name the type of compound whose molecule is shown in Fig. 10.2.

.....[1]

(iv) State the chemical formula of the molecule shown in Fig. 10.2.

.....[1]

(b) Gasoline and diesel oil from the process in Fig. 10.1 contain dissolved sulfur compounds.

(i) Name the gas that will be released into the air from car engines if sulfur compounds are **not** removed from these fuels before they are used.

.....[1]

(ii) Describe some of the problems that the gas in **(i)** causes if it is released into the environment.

.....

.....

.....

.....[3]

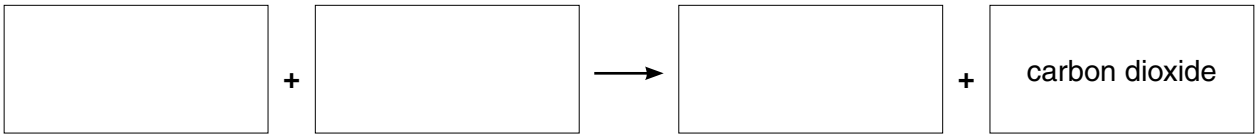
11 (a) Define *respiration*.

.....

.....

.....[2]

(b) Complete the word equation for aerobic respiration.



[2]

(c) Fig. 11.1 shows apparatus that is used to demonstrate carbon dioxide production in a small mammal.

Air is drawn through the apparatus by a pump.

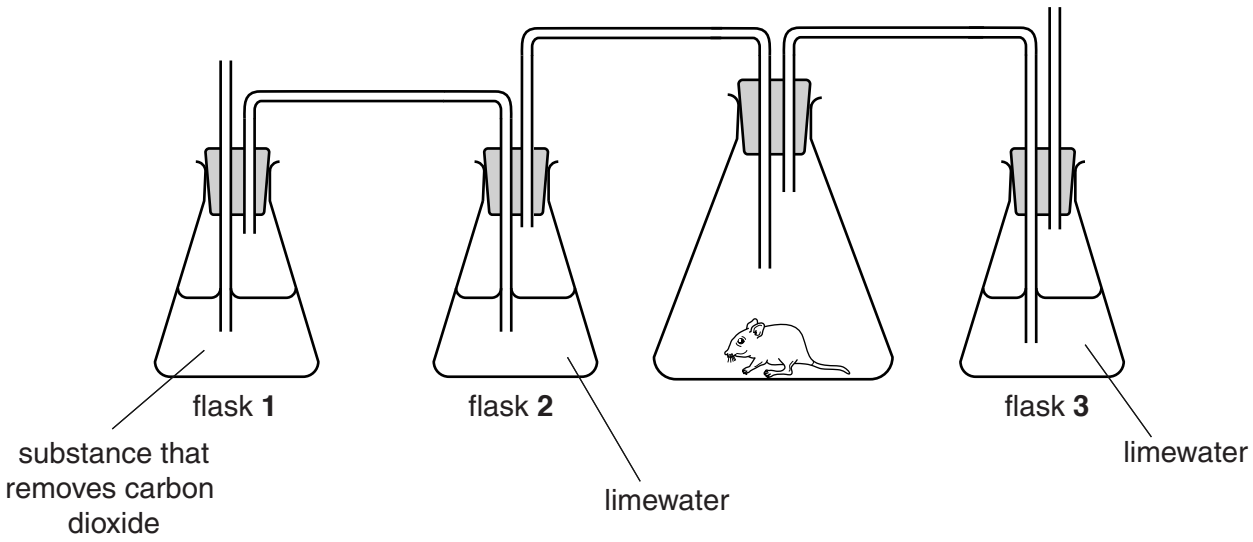


Fig. 11.1

(i) On Fig. 11.1, draw arrows to indicate

- where air enters the apparatus,
- where air leaves the apparatus. [1]

(ii) State the purpose of the limewater

in flask **2**, ...

.....

in flask **3**. .....

.....
[2]

(iii) Describe what will happen to the limewater in flasks **2** and **3** after air has been drawn through the apparatus for a few minutes.

flask **2** .....

flask **3** .....[2]

12 (a) Fig. 12.1 shows a speed/time graph over two minutes for a police car.

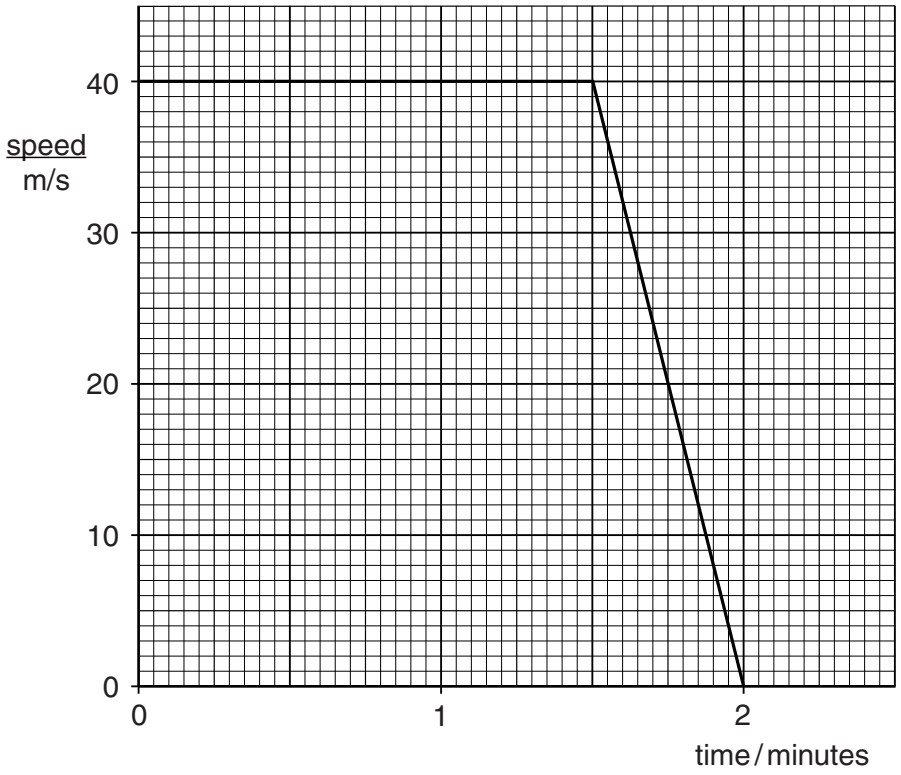


Fig. 12.1

(i) Label with the letter **X** a point on the graph when the police car is not moving. [1]

(ii) Label with the letter **A** a point on the graph where the car is accelerating. [1]

(iii) Label with the letter **K** a point on the graph where the car has the most kinetic energy. [1]

(b) The police car communicates with the police station using radio waves. The police car uses a flashing light to alert people.

(i) Radio waves and light waves are both parts of the electromagnetic spectrum.

Place radio waves and light waves in the correct boxes of the incomplete electromagnetic spectrum below.

	microwaves	infra-red			X-rays	

[2]

(ii) Microwaves are used for heating and cooking food.

State **one** other use for microwaves.

.....[1]

(iii) State **one** difference between the properties of radio waves and light waves.

.....

.....[1]

(iv) Fig. 12.2 shows a wave.

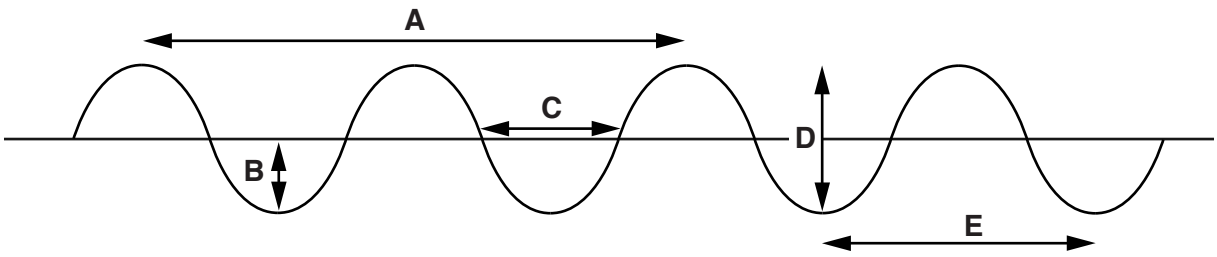


Fig. 12.2

State which measurement, **A**, **B**, **C**, **D** or **E**, is

the amplitude of the wave, ...

the wavelength of the wave. .....

[2]

(c) The bodywork of the police car is made from steel.

The bodywork of some vehicles is made from aluminium.

Suggest a simple way of deciding whether the bodywork of a vehicle is made from steel or aluminium.

.....

.....[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.).