Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

COMBINED SCIENCE **0653/21**

Paper 2 (Core) **May/June 2016**

1 hour 15 minutes

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 20.

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 **20** printed pages.

CAMBRIDGE International Examinations

[Turn over

1 **(a)** Complete the sentences below using words or phrases from the list.

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

downwards **phloem** **respiration** **root hairs** **transpiration**

upwards **upwards and downwards** **xylem**

In the plant, water travels upwards in the ..... .

Dissolved sugar travels in the ..... and moves

..... . The evaporation of water from the

surfaces of the mesophyll cells is called ..... . [4]

(b) Some plant cells were placed on a microscope slide and observed through the microscope. Fig. 1.1 shows one of these cells.

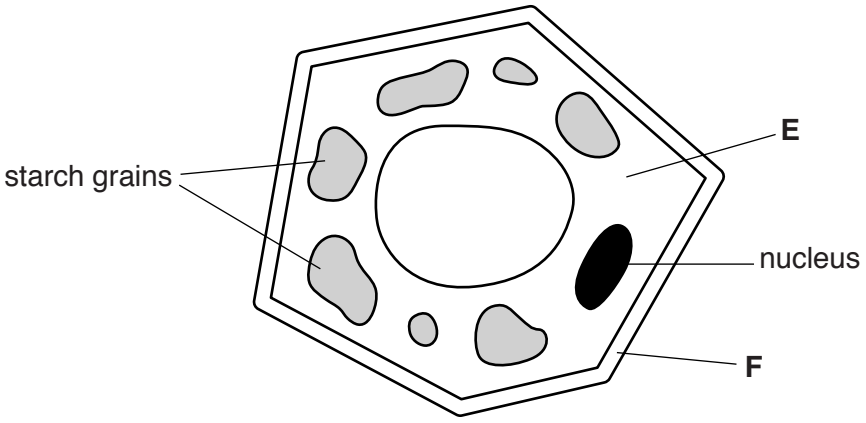


Fig. 1.1

(i) State the names of structures **E** and **F**.

E .....

F .....[2]

(ii) State **one** piece of evidence from the diagram in Fig. 1.1 that suggests that the plant cell came from under the ground.

.....

.....[1]

(iii) State the name of the chemical that can be added to the slide to confirm that the plant cell contains starch.

.....

Describe the result of the test.

.....

.....

[2]

(c) A starch test can also be used to investigate the conditions needed for photosynthesis.

- A variegated plant, with green and white areas of leaf, is put in the dark to remove the starch from its leaves.
- One leaf of the plant has some black paper put on it as shown in Fig. 1.2 (a), and the plant is left in the light.
- A few hours later small discs of leaf, **P**, **Q**, **R**, and **S** are removed from the leaf and tested for the presence of starch. Fig. 1.2 (b) shows the areas of the leaf that are tested.

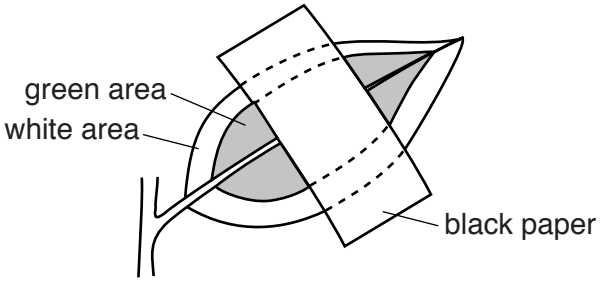


Fig. 1.2 (a) leaf at the start

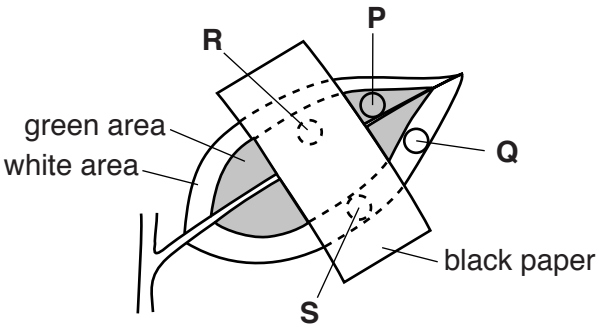


Fig. 1.2 (b) after a few hours

Complete Table 1.1 to predict the results of the starch tests.

Write an explanation for each prediction.

Table 1.1

disc	starch present yes (✓) or no (✗)	explanation
P		
Q		
R		
S		

[4]

2 A student investigates the speed of reaction between dilute hydrochloric acid and calcium carbonate.

The reaction produces carbon dioxide gas.

(a) Fig. 2.1 shows some of the apparatus the student uses.

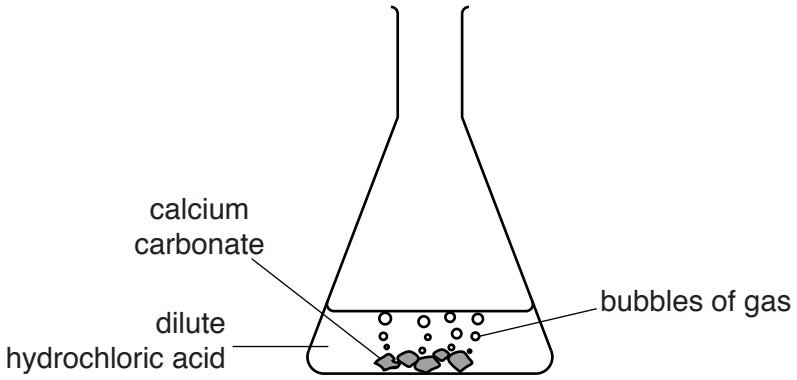


Fig. 2.1

(i) The student wants to measure the volume of gas produced in this reaction every minute for 10 minutes.

Complete Fig. 2.1 to show how the student collects and measures the volume of gas. [2]

(ii) Describe the test for carbon dioxide gas.

test .....

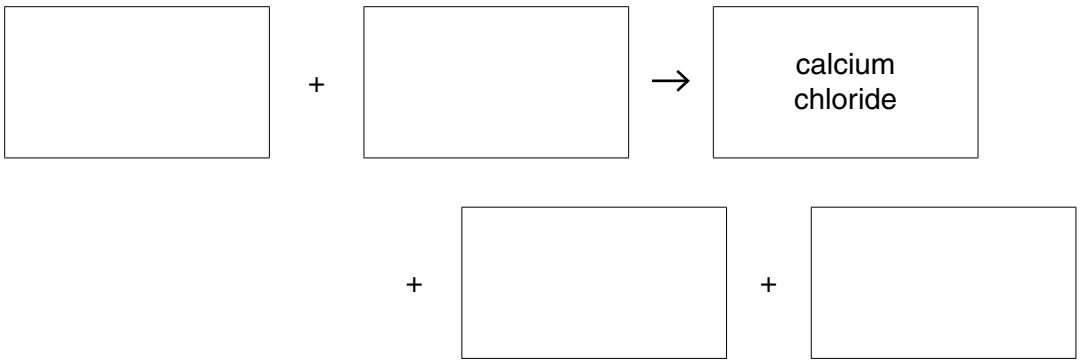
result .....[2]

(iii) As the reaction proceeds, the acid concentration decreases.

Describe what happens to the speed of the reaction.

.....[1]

(b) Complete the word equation for the reaction between hydrochloric acid and calcium carbonate.



[2]

(c) In a separate reaction, the student adds sodium carbonate to dilute nitric acid. Deduce the name of the salt that is made.

.....[1]

3 Fig. 3.1 shows a television camera that moves on rails alongside the athletes on an athletics track.

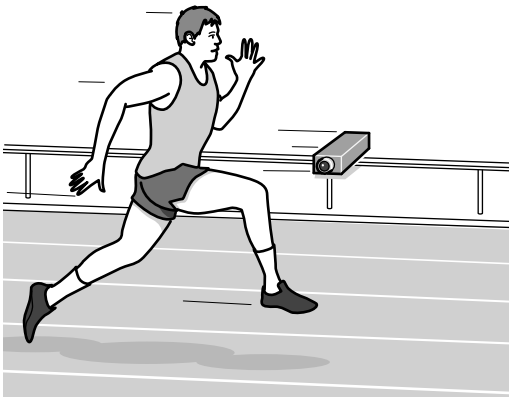


Fig. 3.1

The camera records a 100 metre race from start to finish.

At the start the camera begins to move alongside the athletes. They quickly reach their maximum speed and maintain this speed until they cross the finish line.

At the end of the race the athletes and the camera quickly stop moving.

(a) (i) On the axes in Fig. 3.2, sketch a speed/time graph for the camera from the start until it stops after the end of the race. (Scales and numbers are NOT required.)

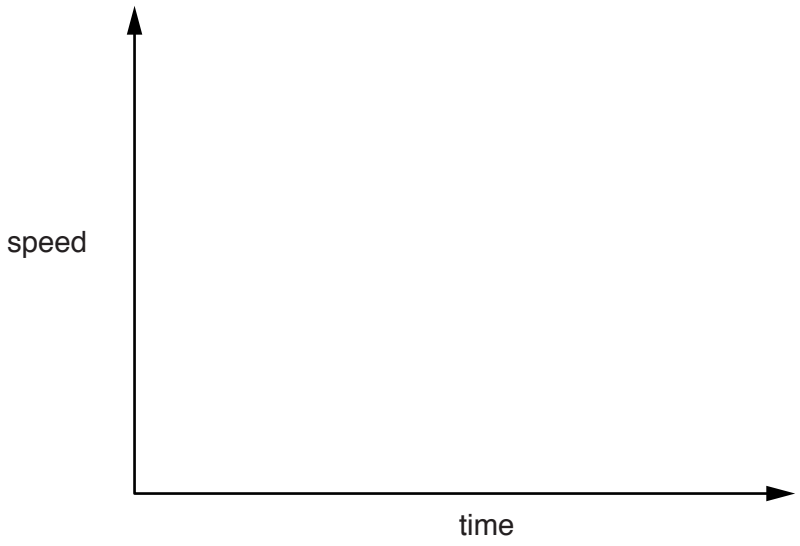


Fig. 3.2

[2]

(ii) On Fig. 3.2, use the letter **P** to label a point on the graph when the camera is moving at constant speed. [1]

(iii) On Fig. 3.2, use the letter **R** to label a point on the graph when the camera is accelerating. [1]

(b) The winning athlete recorded a time of 9.8 s.

Calculate the average speed of this athlete during the 100 m race.

Show your working.

average speed = ... m/s [1]

(c) The camera uses a thin converging lens to focus light rays coming from the athlete onto the light sensor inside the camera.

(i) Complete the ray diagram in Fig. 3.3 to show how this happens.

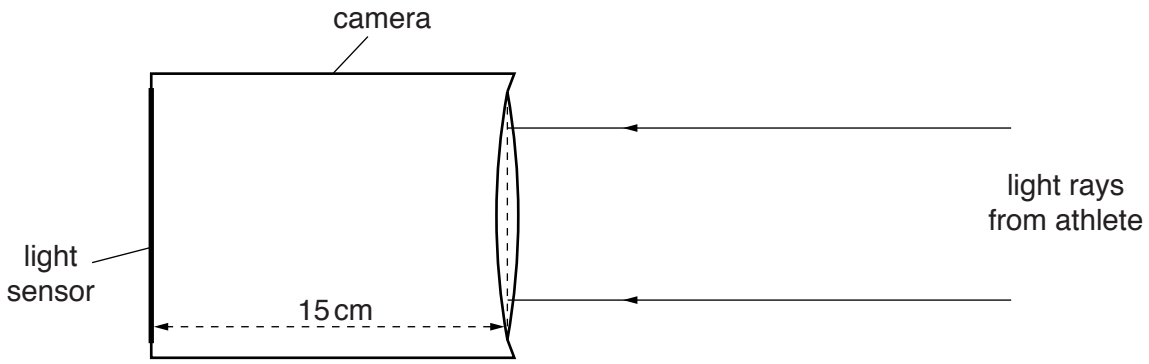


Fig. 3.3

[1]

(ii) The distance from the lens to the light sensor is 15 cm.

State the focal length of the lens.

.....[1]

(d) The camera is moved along the rails by an electric motor powered by a battery.

Complete the energy transfers that take place while the camera is moving.

From .....chemical..... energy stored in the battery

to ..... energy supplied to the motor

to ..... energy of the moving camera. [2]

4 **(a)** Fig. 4.1 is a diagram of the internal structure of the heart.

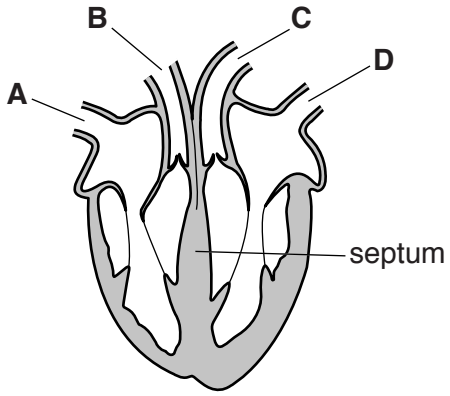


Fig. 4.1

(i) State which of the vessels labelled **A**, **B**, **C** and **D** are arteries.

.....[1]

(ii) On Fig. 4.1 label and name the chamber of the heart that receives blood from the lungs. [2]

(iii) State the function of the septum in the heart.

.....

.....

.....[1]

(b) Fig. 4.2 shows cross sections of an artery and a vein. The diagrams are not drawn to the same scale.

Fig. 4.2

State which diagram shows an artery.

Explain your answer.

diagram .....

explanation .....

.....[1]

(c) Table 4.1 shows the effect of exercise on an athlete's heart. The volume of blood pumped by the left ventricle in one minute is called the cardiac output.

Table 4.1

activity	volume of one heart beat / cm^3	pulse rate / beats per minute	cardiac output / cm^3 per minute
resting	65	70	4550
exercising	105		18690

(i) Calculate the pulse rate of the athlete during exercise.

Show your working.

answer = ... beats per minute [2]

(ii) The increased cardiac output means that the blood is travelling more quickly around the body. This carries more oxygen to the exercising muscles.

Describe other changes in the athlete's body that enable more oxygen to be taken in at the lungs.

.....

.....

.....[2]

5 **(a)** Five substances are to be separated from mixtures. Fig. 5.1 shows the five mixtures and five methods of separation.

Draw a straight line from each mixture to the method that is used to obtain the underlined substance from the mixture. One has been done for you.

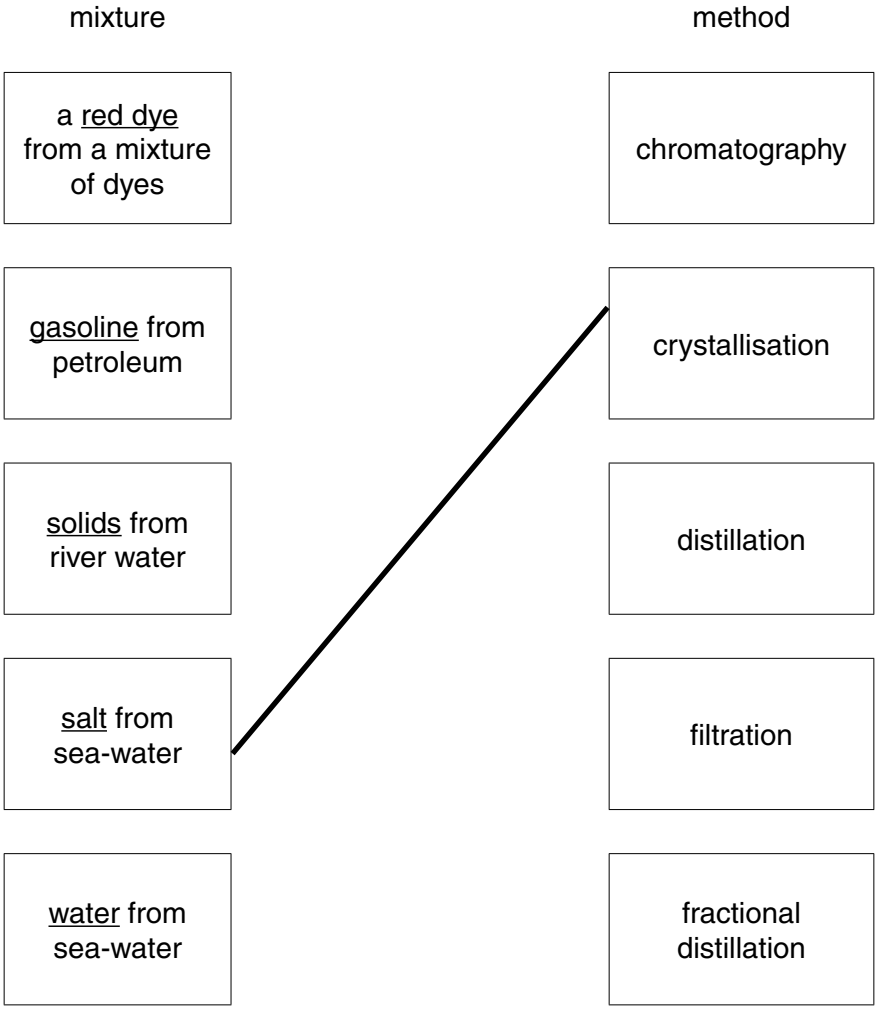


Fig. 5.1

[3]

(b) An atom of iron has proton number 26 and nucleon number 56.

Calculate the number of electrons and the number of neutrons in this atom.

number of electrons .....

number of neutrons ..... [2]

(c) (i) Predict the type of bonding that occurs when the following pairs of elements react to form compounds.

rubidium, a Group I metal	+	iodine, a Group VII non-metal	bonding type .....
sulfur, a Group VI non-metal	+	fluorine, a Group VII non-metal	bonding type .....

[2]

(ii) During the reaction between rubidium and oxygen the rubidium melts due to a change in the temperature.

State the type of chemical reaction that causes this temperature change.

.....[1]

(d) (i) Iron reacts with oxygen. The equation for this reaction is

iron + oxygen $\longrightarrow$ iron oxide.

State whether the iron is oxidised or reduced in this reaction.

Explain your answer.

iron is .....

explanation .....

.....[1]

(ii) Another substance is involved in the formation of rust.

Name this substance.

..... [1]

(iii) Describe **one** method of rust prevention. Explain how this method prevents rust from forming.

method .....

explanation .....

.....

.....[2]

6 Fig. 6.1 shows a thermometer containing a liquid at 20 °C and at 60 °C.

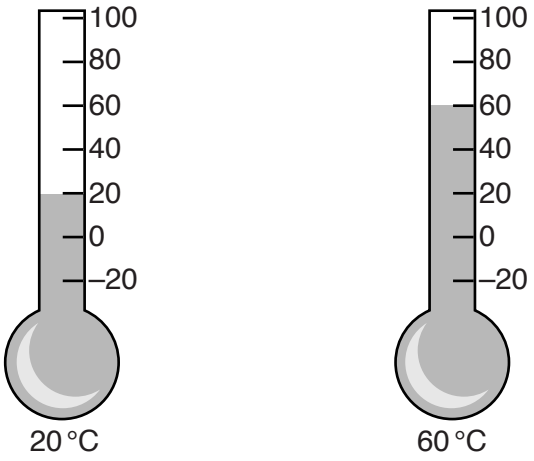


Fig. 6.1

(a) Complete the sentences below by choosing the correct words from this list:

density **force** **mass** **power** **volume** **work**

When the liquid is heated, the ..... of the liquid remains the same. The ..... of the liquid increases on heating, which means that the ..... of the liquid decreases. [3]

(b) Water freezes at 0 °C. Explain why the scale on the thermometer in Fig 6.1 shows that the liquid in the thermometer cannot be water.

.....

.....

.....[1]

(c) Fig. 6.2 shows the bulb of the thermometer placed in hot water at 80 °C.

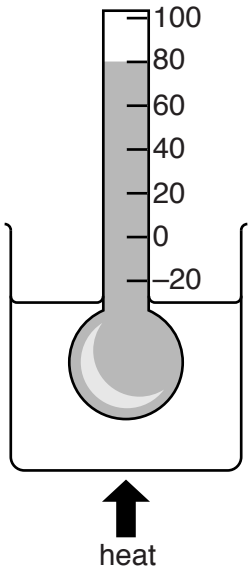


Fig. 6.2

The bulb and stem of the thermometer are made of glass.

When the thermometer is placed in the hot water, the top of the stem of the thermometer remains cold to touch, but the liquid level rises to the 80 °C mark.

(i) Name the method of thermal energy transfer that takes place in the liquid.

.....[1]

(ii) Suggest why the top of the thermometer stem remains cold to the touch.

.....

.....[1]

[Turn over

(d) Fig. 6.3 shows simple diagrams of the arrangements of molecules in a solid, a liquid and a gas.

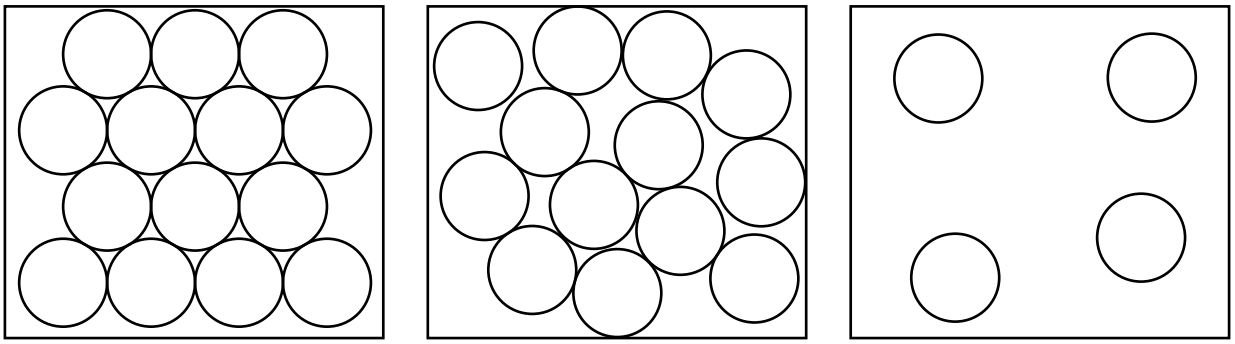


diagram 1 diagram 2 diagram 3

Fig. 6.3

Complete the statement.

Diagram 2 shows a liquid because .....

.....

.....

.....[2]

7 Sometimes humans add untreated sewage to rivers.

Fig. 7.1 shows how the concentration of dissolved oxygen and number of bacteria in the river is affected after some sewage is added at point **X** on the river.

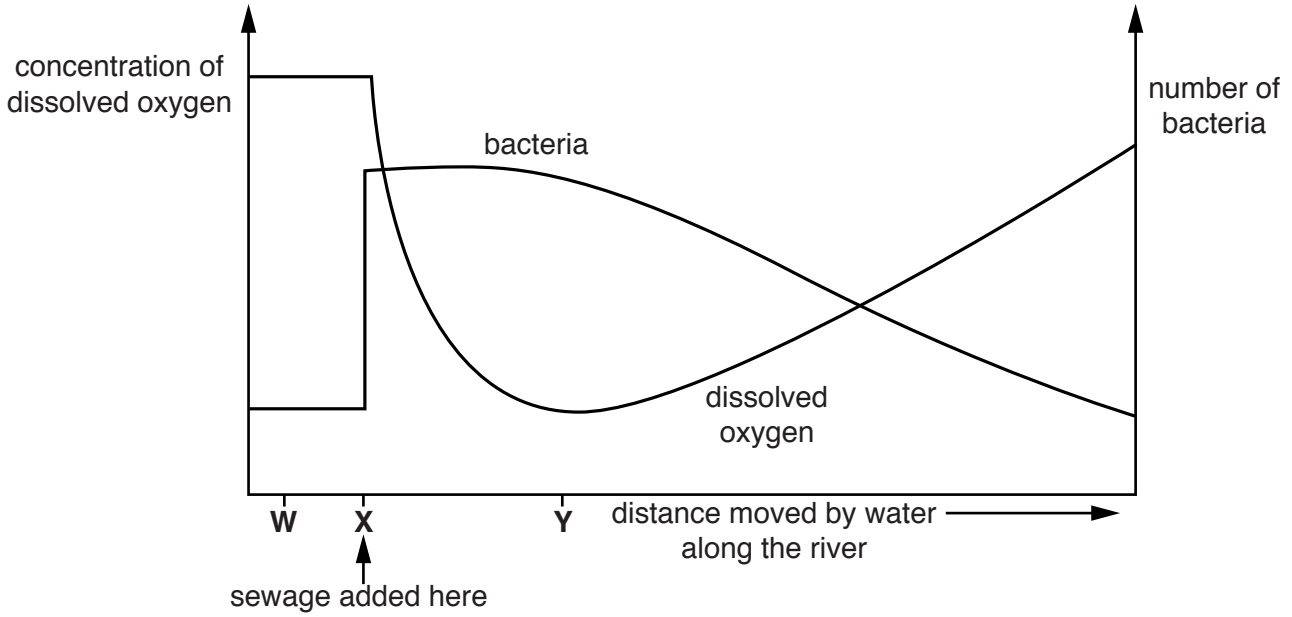


Fig. 7.1

After the sewage is added to the water at point **X**, the water continues to move along the river.

(a) Describe and explain how the concentration of dissolved oxygen changes immediately after the sewage is added to the water.

.....

.....

.....[2]

(b) The numbers of fish change after the sewage is added to the water.

Suggest why there are fewer fish when the water is at point **Y**, compared with point **W**.

.....

.....

.....[2]

(c) Explain why it is unsafe for humans to drink water containing untreated sewage.

.....

.....[1]

8 **(a)** Coal is a fuel that is used to heat homes. Fig. 8.1 shows a coal fire.

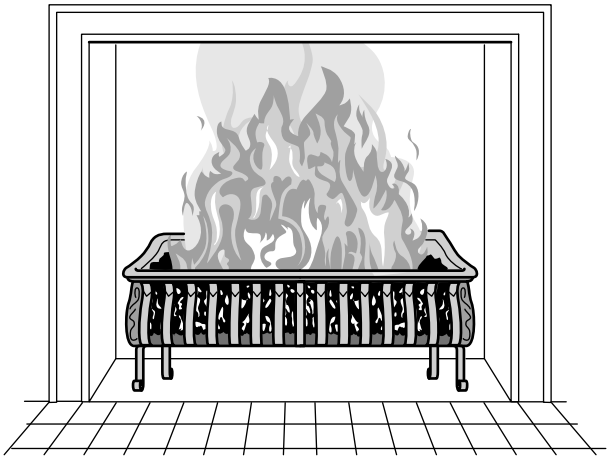


Fig. 8.1

Name the main substance produced during the complete combustion of coal.

.....[1]

(b) Natural gas and petroleum are two other fuels.

(i) Coal, natural gas and petroleum are all examples of one type of non-renewable fuel.

Name this type of fuel.

.....[1]

(ii) Name the main constituent of natural gas.

..... [1]

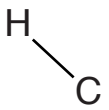
(c) Ethene is a hydrocarbon.

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

.....

.....[2]

(ii) Complete the structure of one molecule of ethene.



[2]

9 A student investigates the current through a lamp as she varies the potential difference (p.d.) across the lamp.
She designs the circuit in Fig. 9.1 to use in her investigation.

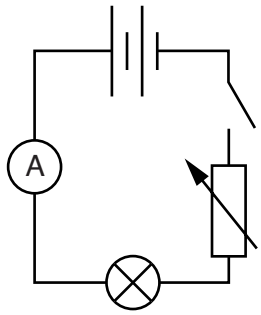
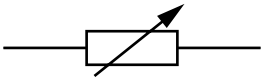


Fig. 9.1

(a) (i) Name the component represented by this symbol



.....[1]

(ii) The student has left out an important component from her design. This component is needed to make some of her measurements.

On Fig. 9.1 draw the symbol for this missing component in its correct place.

[2]

(b) The student uses the correct circuit to carry out her experiment.

Fig. 9.2 shows her results plotted as a graph.

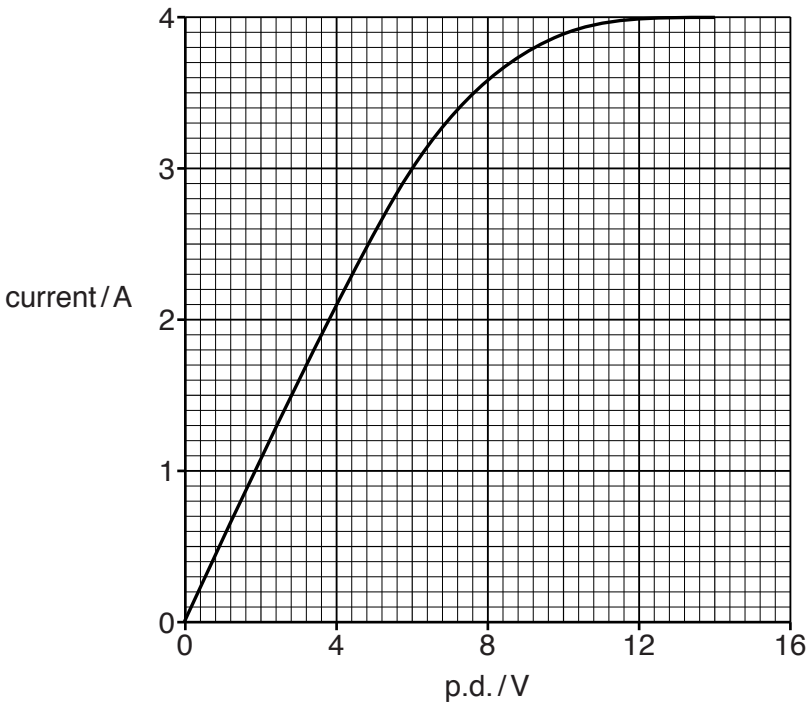


Fig. 9.2

The resistance of the lamp is given by the formula

$$\text{resistance} = \frac{\text{potential difference (p.d.)}}{\text{current}}$$

The student says that the resistance of the lamp is higher when the p.d. is 12V than when the p.d. is 6V. The resistance at 6V is 2Ω.

Use the graph in Fig. 9.2 to calculate the resistance at 12V to show that the student was correct.

resistance at 12V = ... Ω [2]

(c) The current through the metal filament in the lamp is a flow of electric charges.

Name the charged particles that carry these charges.

.....[1]

(d) The lamp, when lit, emits radiation in the form of visible light and infra-red radiation.

Infra-red radiation has a longer wavelength than visible light.

(i) In Fig 9.3 below, write visible light and infra-red in their correct positions in the electromagnetic spectrum.

gamma radiation		ultraviolet				radio waves

Fig. 9.3

[2]

(ii) State which type of radiation in the electromagnetic spectrum has the highest frequency.

.....[1]

The Periodic Table of Elements

Key

atomic number atomic symbol name relative atomic mass

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 A*l* aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 C*l* chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 117	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 T*l* thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cr copernicium –		114 F*l* flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

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