Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

0829094613

COMBINED SCIENCE **0653/31**

Paper 3 (Extended) **October/November 2015**

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, graphs, tables or rough working.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

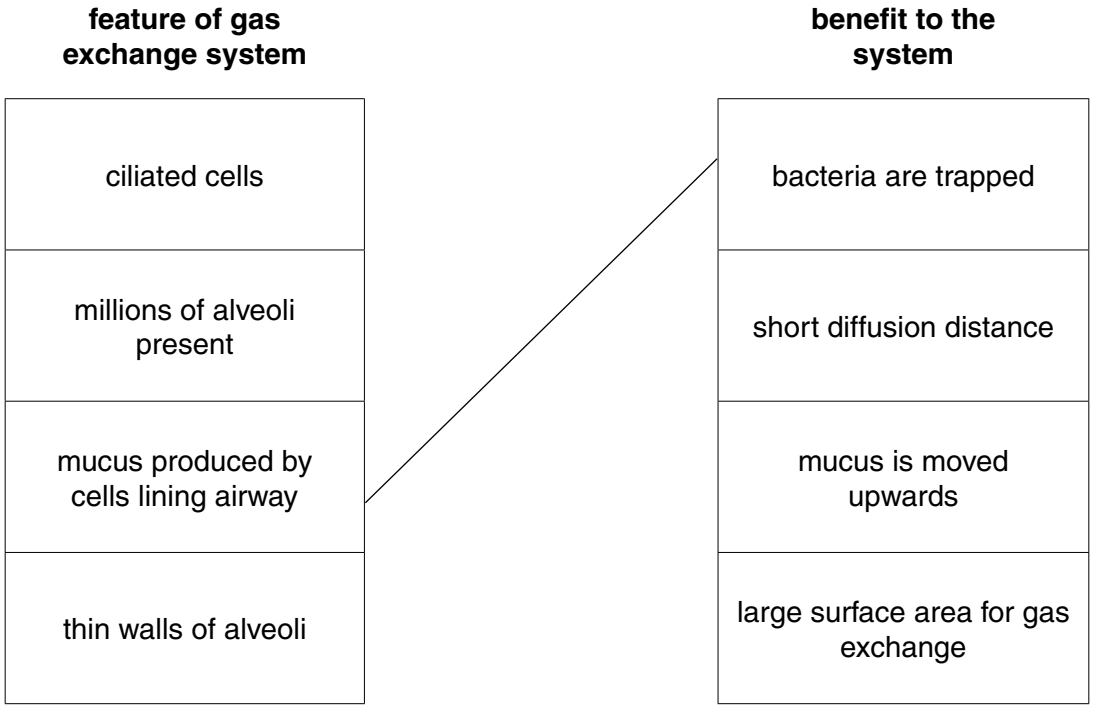
Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
A copy of the Periodic Table is printed on page 24.

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 **22** printed pages and **2** blank pages.

CAMBRIDGE International Examinations

1 **(a)** Fig. 1.1 shows some features of the human gas exchange system. Use lines to connect each feature with its benefit to the system. One line is drawn for you.



[2]

Fig. 1.1

(b) **(i)** Describe how each of these features is affected by cigarette smoking.

mucus production

.....

.....

ciliated cells

.....

.....[2]

(ii) Explain how the effects you described in **(b)(i)** make lung infections more likely.

.....

.....

.....[1]

(c) One of the products of smoking is the gas carbon monoxide. This gas reduces the ability of the blood to carry oxygen. Oxygen is needed by all cells to carry out aerobic respiration.

(i) Write the balanced symbol equation for aerobic respiration.

.....[2]

(ii) Describe how the blood transports oxygen around the body.

.....

.....[1]

(d) Smoking a cigarette causes the level of carbon monoxide in the blood to increase. This level gradually falls if no more cigarettes are smoked.

A group of people were trying to give up smoking. The level of carbon monoxide in their blood was tested four times during the day and the results compared with those of a non-smoker.

The results are shown in Table 1.1.

Table 1.1

person	units of carbon monoxide in the blood			
	08.00 hours	11.00 hours	14.00 hours	17.00 hours
A	1.9	1.5	1.3	1.0
B	3.4	2.2	4.8	3.6
C	3.7	2.6	2.0	1.6
D (non-smoker)	0.6	0.5	0.5	0.5

Use the information in Table 1.1 to

(i) suggest which person had most recently smoked **before** any readings were taken. Explain your answer.

person .....

explanation .....

.....[1]

(ii) state which person may have smoked a cigarette **during** the day and explain your answer.

.....

.....

.....[2]

2 **(a)** Fig. 2.1 shows samples of elements in Group VII of the Periodic Table. The elements are shown at room temperature.

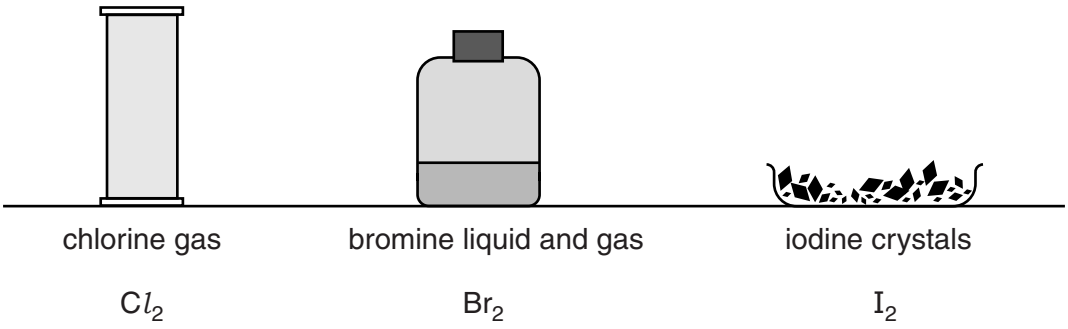


Fig. 2.1

Describe the trend in melting point down Group VII.

.....

.....[1]

(b) Fig. 2.2 shows what happens when a student adds colourless chlorine solution to a colourless solution of sodium bromide, NaBr.

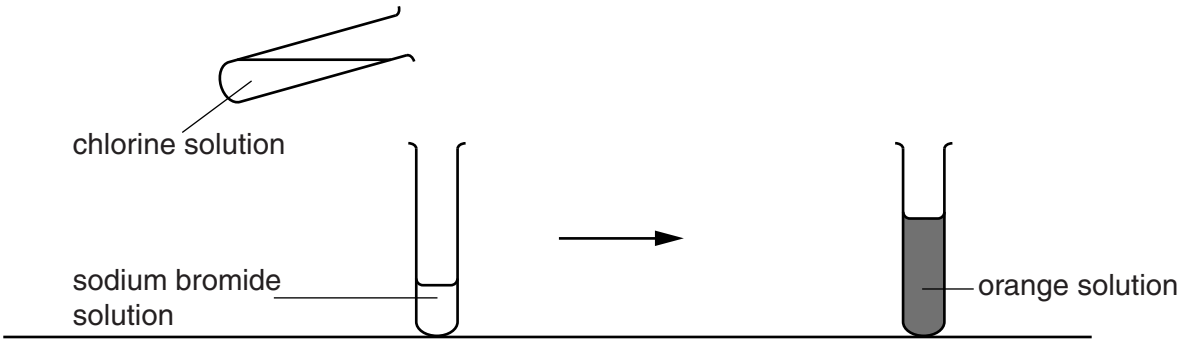


Fig. 2.2

The resulting mixture is orange.

(i) State the name of the substance formed which gives the final mixture this colour.

.....[1]

(ii) Write a balanced chemical equation for the reaction that occurs.

.....[2]

(iii) Write in order of reactivity the halogens bromine, chlorine and iodine.

most reactive ……..

……

least reactive ……. [1]

(iv) Use this trend in reactivity to explain why fluorine **cannot** be displaced from sodium fluoride by another halogen.

.....

.....

.....

.....[2]

(c) Fluorine gas is extracted by electrolysis.

Fig. 2.3 shows the electrolysis cell that is used.

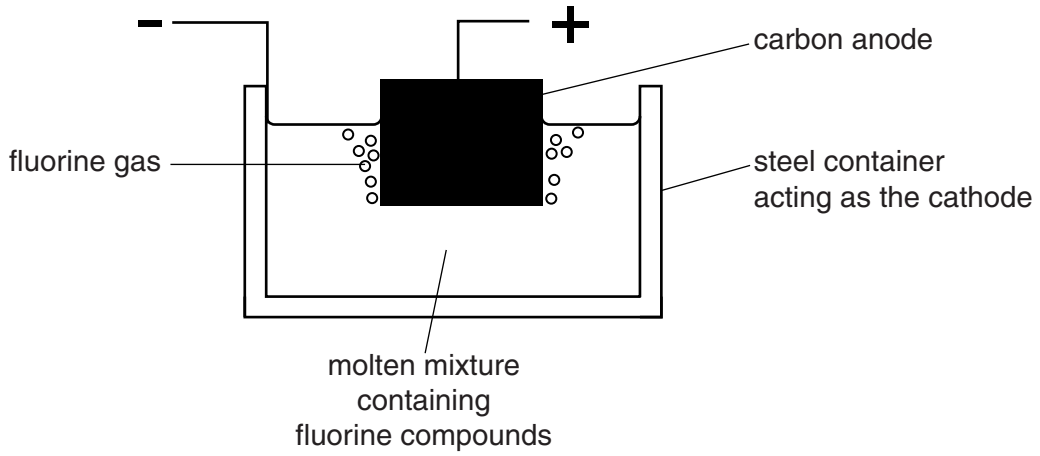


Fig. 2.3

The fluorine compounds which are used contain fluoride ions, F^- .

Describe how fluoride ions become fluorine atoms at the anode of the cell.

.....

.....

.....[2]

3 Fig. 3.1 shows a man bungee jumping. He is attached to a long elastic rope as he jumps off a bridge.

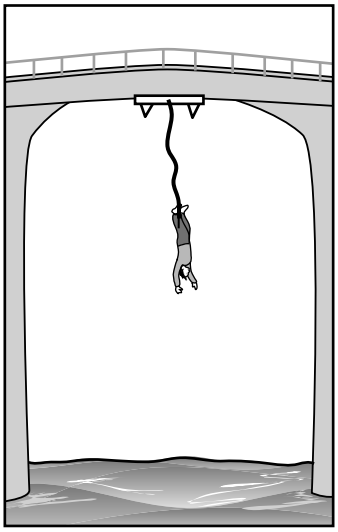


Fig. 3.1

Fig. 3.2 shows the jump at several stages from the time the man jumps off the bridge.

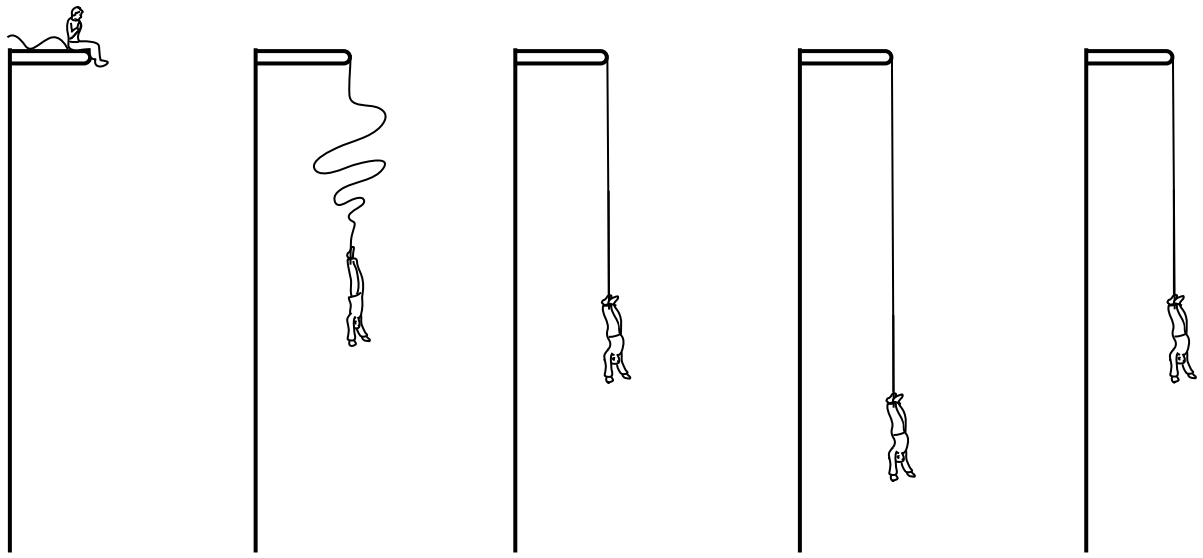


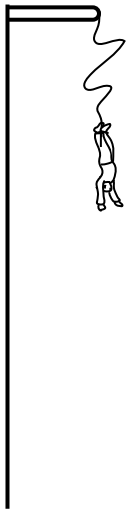
Fig. 3.2

(a) (i) Identify the main force acting on the man just after he jumps off the bridge.

.....[1]

(ii) As the man falls, another force, air resistance, acts on him to reduce his acceleration.

On Fig. 3.3, draw an arrow to show the direction in which air resistance is acting on the man.



[1]

Fig. 3.3

(b) (i) Tick the box or boxes beside the correct statement or statements in the list below.

When the man reaches his lowest point

the speed of the man becomes zero, ☐

the acceleration of the man becomes zero, ☐

the tension in the rope becomes zero. ☐ [1]

(ii) As the man falls, the rope begins to stretch.

On the axes below, sketch a speed/time graph to show how his speed changes as the rope stretches until he reaches the lowest point.

[2]

(c) (i) Identify the energy transformations occurring from the time the man jumps until he reaches his lowest point.

from gravitational potential energy

to ..... energy

to ..... energy.

[1]

(ii) At the lowest point, the length of the rope is 40 m. The man has a mass of 80 kg.

Calculate the gravitational potential energy loss that occurs during the fall to the lowest point.

State the formula used and show your working.

(g = 10 N/kg)

formula

working

gravitational potential energy loss = ... J [2]

Please turn over for Question 4.

4 **(a)** Fig. 4.1 shows two plant cells as seen under the light microscope. They are not drawn to scale.

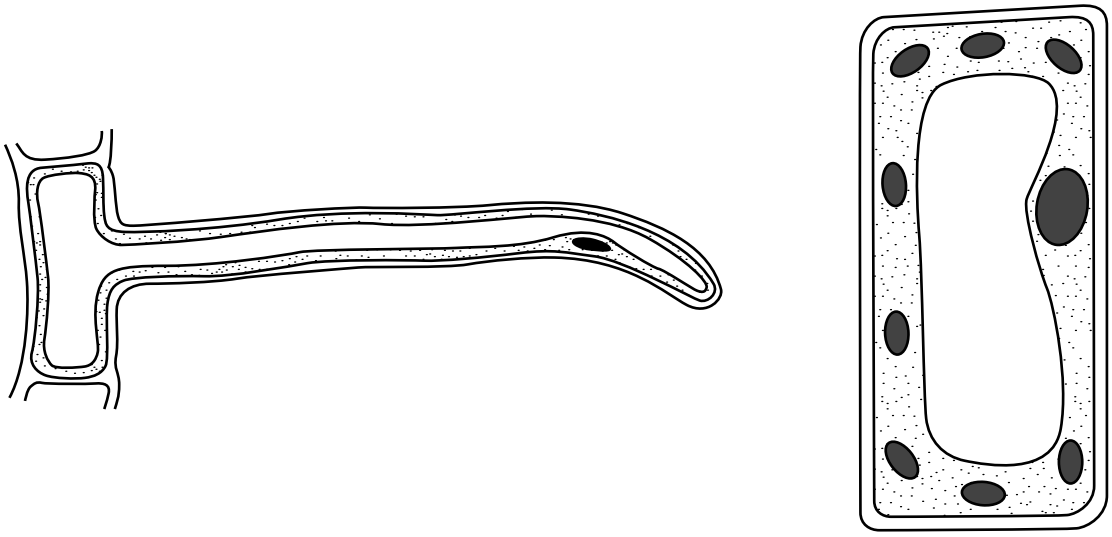


Fig. 4.1

(i) On one of the plant cells in Fig. 4.1 label **two** cell parts that are present in **both** of these plant cells but are absent from animal cells. Use label lines and the correct names for your answer. [2]

(ii) Describe the functions of the two cell parts you have labelled in **(a)(i)**.

cell part ……..……

function .....

.....

cell part ……..……

function .....

.....[2]

(b) Fig. 4.2 shows two leaves of approximately the same length. They were both taken from different regions of the same oak tree.

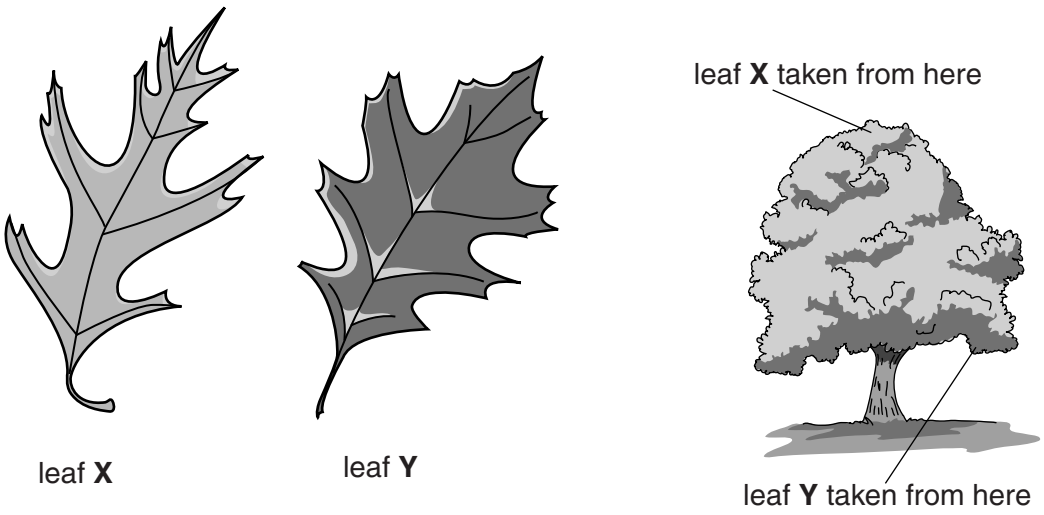


Fig. 4.2

Leaf **X** gets full sun. Leaf **Y** is in a shaded location.

(i) Describe one difference in structure between leaf **X** and leaf **Y**.

.....

.....[1]

(ii) Suggest one advantage to the tree of having leaves of shape **X** at the top of the tree.

.....

.....

.....

.....[2]

(iii) Suggest one advantage to the tree of having leaves of shape **Y** at the bottom of the tree.

.....

.....

.....

.....[2]

5 Methane is a hydrocarbon which is used as a fuel.

(a) State one source of methane.

……..…… [1]

(b) Fig. 5.1 shows a demonstration of an explosion caused when methane burns.

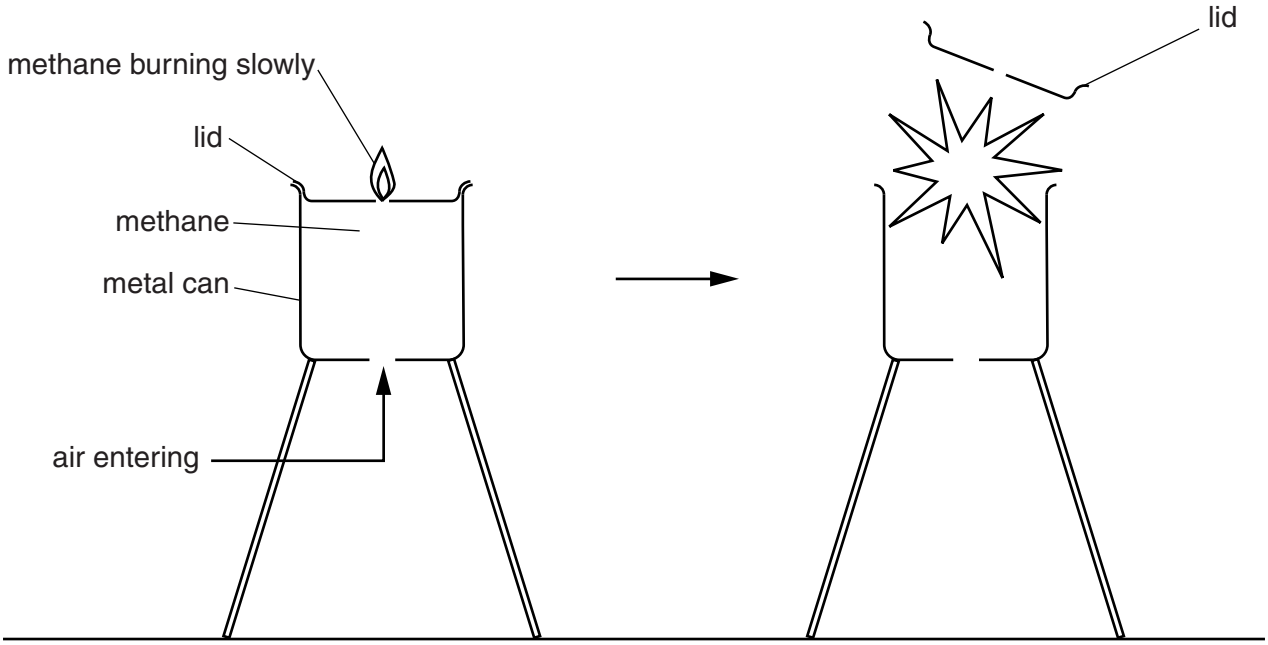


Fig. 5.1

- At first, methane escapes through the hole in the lid and burns slowly.
- As methane leaves the can, air enters through the hole in the base.
- When enough air has entered, an explosion occurs.

(i) Table 5.1 compares the three main gases in the can just before and just after the explosion.

Table 5.1

gases present **just before** the explosion	→	gases present **just after** the explosion
methane		
oxygen		

Complete Table 5.1 to show the main gases present just before and just after the explosion.

[2]

(ii) The explosion occurs when the rate of combustion of methane suddenly increases. This causes a rapid increase in temperature of the gases in the can.

Describe an energy transformation which occurs during this reaction.

.....

.....[1]

(iii) State the term used to describe a chemical reaction which causes an increase in temperature.

……..…… [1]

(c) Methane reacts with oxygen when it burns.

(i) Use the Periodic Table on page 24 to deduce and explain

the number of electron shells in an oxygen atom,

number .....

explanation .....

.....

the number of electrons in the outer shell of an oxygen atom.

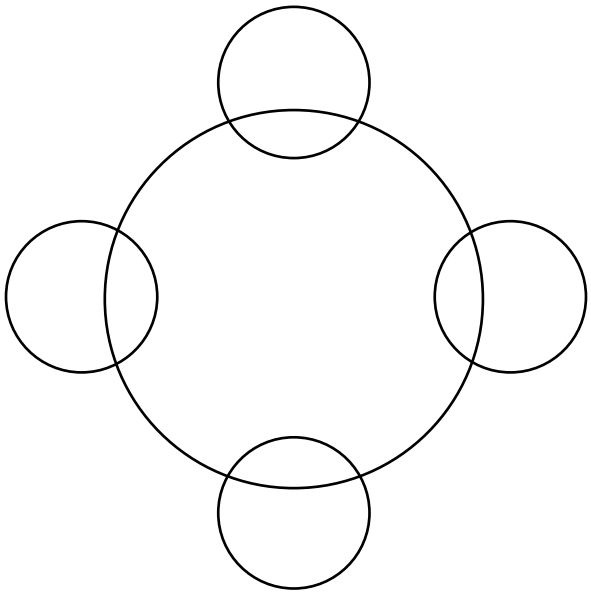
number .....

explanation .....

.....[2]

(ii) Complete the covalent bonding diagram of one molecule of methane to show

- the chemical symbols of each atom,
- how the outer electrons of each atom are arranged.



[2]

(d) (i) State the group in the Periodic Table that contains **only** unreactive gaseous elements.

……..…… [1]

(ii) Explain why these elements are unreactive.

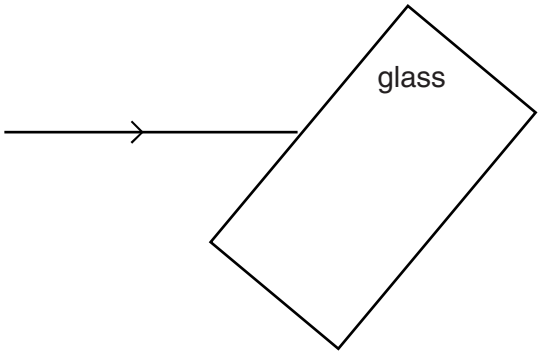
.....

.....[1]

6 (a) (i) Fig. 6.1 shows a glass block and a ray of light entering a glass block.

On Fig. 6.1 complete the path of the ray of light as it enters and passes through the block, and out into the air on the other side.

On your diagram, indicate clearly the angle of incidence *i* and the angle of refraction *r* as the ray passes into the block.



[3]

Fig. 6.1

(ii) The Sun is visible to a person at point **X**, as shown in Fig. 6.2. The dotted line shows the outer limit of the Earth's atmosphere.

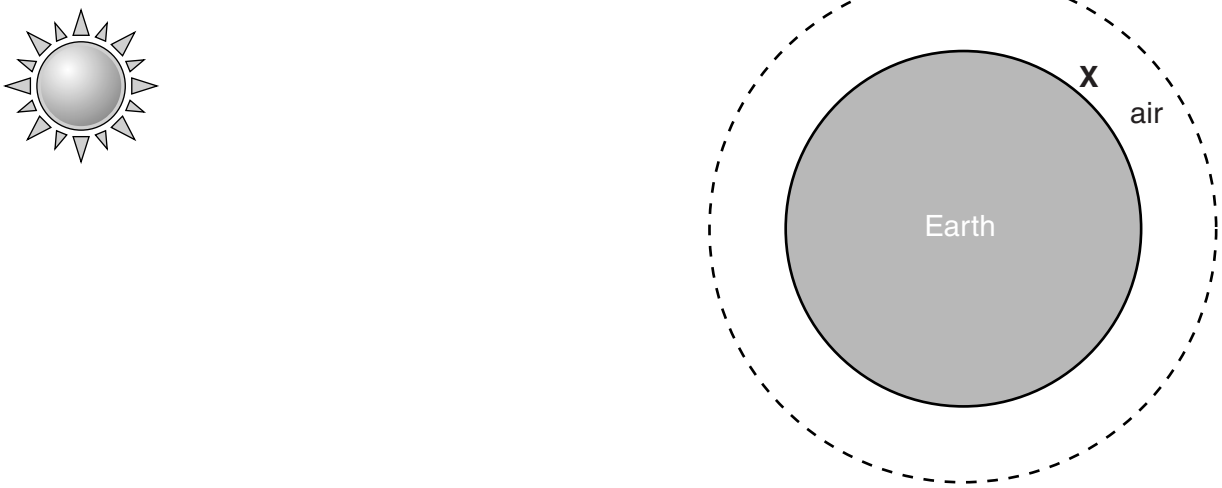


Fig. 6.2

The Earth is between the person at **X** and the Sun.

On Fig. 6.2 draw the path of a ray from the Sun that reaches point **X** to show how the person at **X** can still see the Sun.

Explain why the person at **X** can still see the Sun.

.....

.....

.....[2]

(b) Electromagnetic radiation from the Sun warms the Earth.

(i) State the form of electromagnetic radiation mainly responsible for this energy transfer from the Sun.

.....[1]

(ii) Suggest why, on a sunny day, the temperature of the sand on a beach next to the sea is higher than the temperature of the sea-water.

.....

.....[1]

(c) When electromagnetic waves move from a vacuum to the atmosphere, they slow down, but their frequency remains the same.

Explain why the wavelength of light changes as light from the Sun enters the Earth's atmosphere.

.....

.....

.....

.....[2]

7 The tree shown in Fig. 7.1 was blown over during a storm. Shortly afterwards, fungi began to grow on the tree trunk.

Fig. 7.1

(a) The fungi are decomposers.

Define the term *decomposers*.

.....

.....

.....

.....[2]

(b) The fungi secrete their digestive enzymes into the wood of the tree trunk.

(i) Suggest why the fungi secrete these enzymes into the tree trunk.

.....

.....

.....

.....[2]

(ii) The rate of digestion of the wood by the fungi is affected by the pH of the wood.

Suggest how the rate of digestion of the wood by the fungi is changed if acid rain has been falling on the tree trunk for some time.

Explain your answer.

.....

.....

.....

.....[2]

8 A student investigates the speed of reaction between metals and dilute hydrochloric acid.
He knows that adding dilute hydrochloric acid to iron wire will produce hydrogen gas.
Fig. 8.1 shows the apparatus he uses.

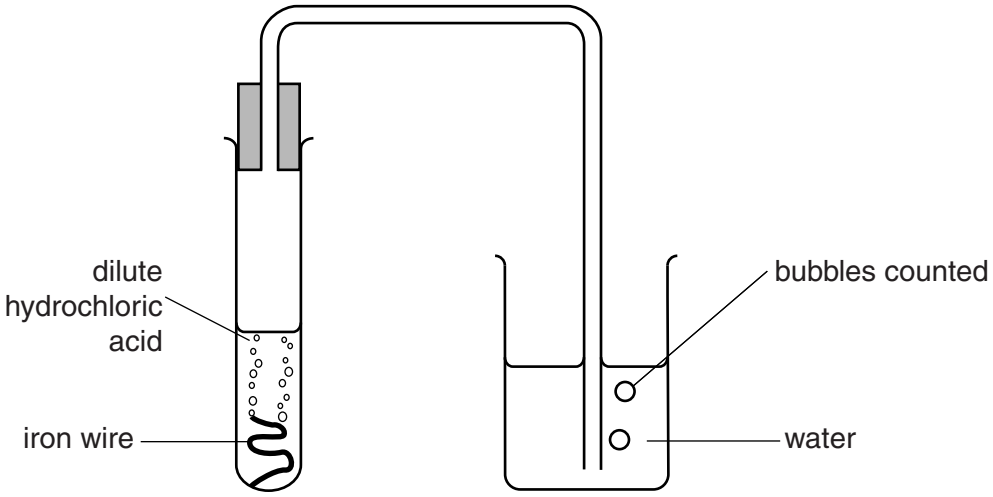


Fig. 8.1

He measures the speed of the reaction by counting the number of bubbles of hydrogen produced each minute for 10 minutes.

Some wire is left when the reaction stops.

Fig. 8. 2 shows his results as a graph of number of bubbles per minute against time.

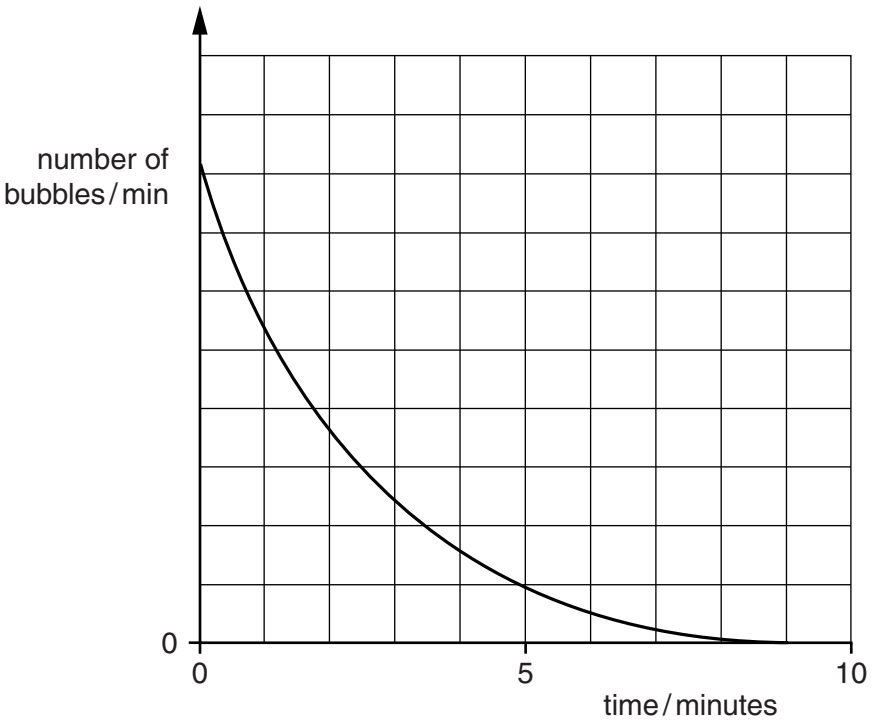


Fig. 8.2

(a) **(i)** Explain, in terms of acid concentration, why the number of bubbles per minute decreases with time.

.....

.....

.....[1]

(ii) On Fig. 8. 2, mark with an **X** the time when the reaction stops. [1]

(iii) Explain why the reaction stops.

.....

.....[1]

(b) He repeats the experiment using an identical piece of iron wire and the same volume of acid, but at a **higher** temperature.

(i) Sketch the graph for his new results on Fig. 8.2. [2]

(ii) The initial rate of reaction is different at a higher temperature.

Explain this difference in terms of the collision of particles.

.....

.....

.....

.....[2]

9 Fig. 9.1 shows a circuit being used to investigate the resistance of pieces of wire. The pieces of resistance wire are connected to the circuit between **X** and **Y**.

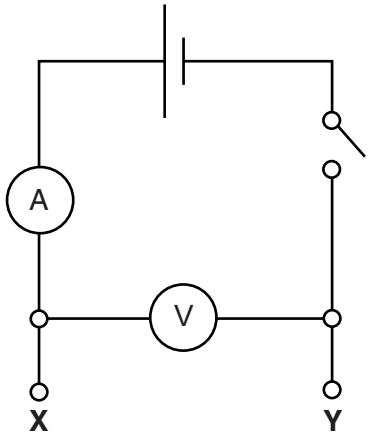


Fig. 9.1

A piece of resistance wire of length 100 cm is connected between **X** and **Y**.

The ammeter reading is 0.5 A.

The voltmeter reading is 1.2 V.

(a) (i) Calculate the resistance of the piece of wire.

State the formula used and show your working.

formula

working

resistance = ... Ω [2]

(ii) The piece of wire is cut into two shorter pieces of length 50 cm.

Predict the resistance of one of the shorter pieces of wire.

.....Ω [1]

(b) The energy stored in the cell in the circuit is used to drive the current round the circuit.

(i) State the equation for finding electrical power in a circuit.

.....[1]

(ii) Name the unit of power and give its symbol.

name ……..……

symbol ……..……. [1]

(iii) The circuit is left switched on for 2 minutes. The current during this time is 0.5 A, and the voltage remains at 1.2 V.

Calculate the energy output from the cell in this time.

State the formula used and show your working.

formula

working

energy = ... J [2]

(c) Most of the stored chemical energy taken from the cell is changed to thermal energy in the wire.

(i) Some of this thermal energy is then transferred to the air in contact with the wire before being transferred to the surroundings.

Name the method of thermal energy transfer by the heated air to the surroundings.

.....[1]

(ii) The rest of the thermal energy is transferred from the resistance wire to the connecting wires in the circuit.

Describe how this transfer happens in terms of molecular motion.

.....

.....

.....

.....

.....[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 †															
				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

* 58–71 Lanthanoid series
† 90–103 Actinoid series

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.).