Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

4402344455

COMBINED SCIENCE **0653/21**

Paper 2 (Core) **October/November 2014**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

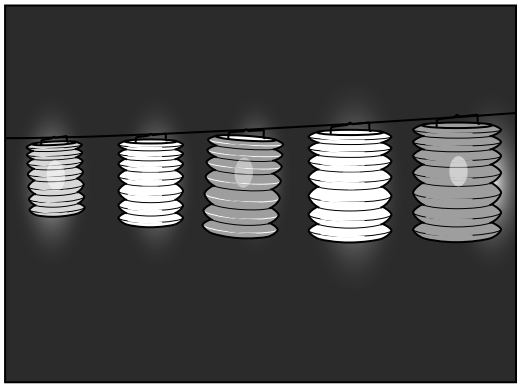
Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

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 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.

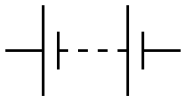
This document consists of **20** printed pages.

1 Party lights add light and colour to festive occasions.



A set of party lights has five lamps connected in series with a switch and a battery.

(a) Complete the circuit diagram using standard circuit symbols for this set of party lights.



[2]

(b) Each lamp in the set is labelled 1.2V, 0.1A.

(i) The term '1.2V' gives important information about the lamp.

Explain why this information is important for the use of the lamp in a circuit.

.....

.....

.....[2]

(ii) Use the formula

$$\text{resistance} = \frac{\text{potential difference}}{\text{current}}$$

to calculate the resistance of one lamp.

resistance = ... Ω [1]

(iii) Calculate the total resistance of the set of five lamps.

total resistance = ...Ω [1]

(iv) State the name of the unit of resistance whose symbol is Ω.

..... [1]

2 Gasoline is a product obtained from petroleum (crude oil) following fractional distillation.

(a) Statements **A** to **D** below describe the processes which occur during fractional distillation to produce gasoline.

The processes have been written in the wrong order.

A	gasoline vapour condenses into a liquid at its boiling point
B	petroleum mixture is heated in a furnace
C	vapour mixture enters the fractionating column
D	vapour mixture rises and cools

In the boxes in Fig. 2.1 write the letters **A** to **D** to show the order in which the processes occur.

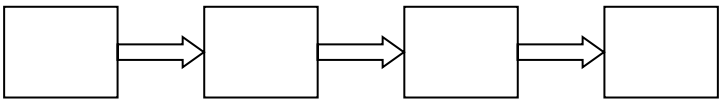


Fig. 2.1

[2]

(b) Gasoline and diesel oil are different *mixtures* of *compounds* called hydrocarbons.

A hydrocarbon is a *compound* of the *elements* hydrogen and carbon.

Table 2.1 gives four descriptions of materials.
Use the words *compound*, *element* and *mixture* to complete Table 2.1.
You can use each of the words once, more than once or not at all.

Table 2.1

material	description
	can be found in the Periodic Table
	cannot be broken down into simpler substances
	contains different types of molecules
	only contains molecules which are identical but each molecule contains more than one type of atom

[4]

(c) The hydrocarbons present in gasoline and diesel oil are alkanes.

(i) State a use that gasoline and diesel oil have in common.

.....[1]

(ii) State the chemical property of alkanes that make them suitable for this use.

.....[1]

(d) Refinery gas is another product obtained from petroleum.

Refinery gas contains methane and propane.

(i) The chemical formula of methane is CH_4.

State the products of the complete combustion of methane.

.....[2]

(ii) Propane contains molecules in which carbon atoms and hydrogen atoms are bonded in the ratio 3:8.

Deduce the chemical formula for propane.

chemical formula for propane = ... [1]

3 **(a)** A balanced diet for a person contains all the food groups in the correct amounts.

Fig. 3.1 shows some food substances needed in a balanced diet.

(i) Using straight lines connect the food substance with their correct functions. One has been done for you.

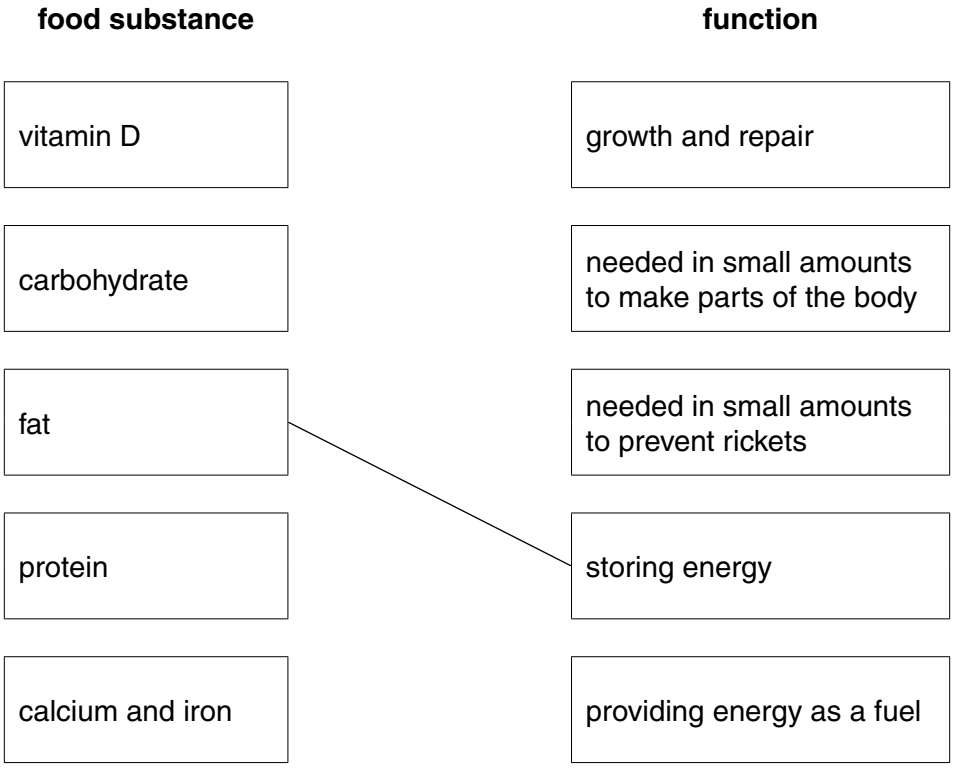


Fig. 3.1

[3]

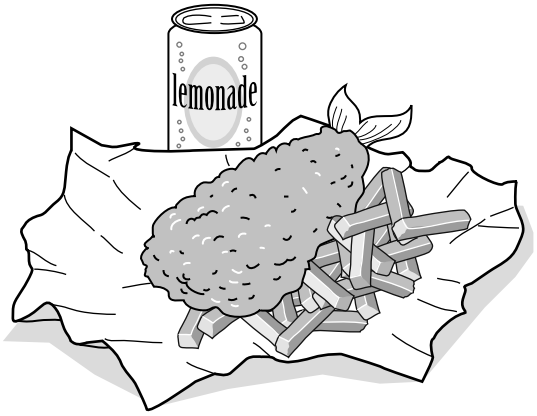
(ii) All diets should contain fibre.

Describe the role of fibre in the body.

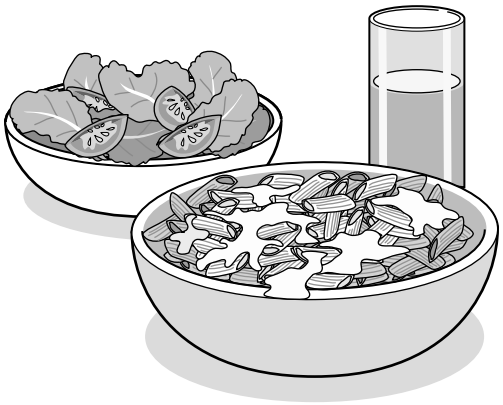
.....

.....[1]

(b) Fig. 3.2 shows two meals. Jill works in an office all day and is 15 kg overweight compared to the average weight for her height. In the evenings Jill sits and reads books and watches television.



meal **1** fried fish and fried potato,
can of lemonade



meal **2** pasta with cheese sauce,
lettuce and tomato,
milk

Fig. 3.2

(i) Give **two** reasons why meal **2** would be more suitable than meal **1** for Jill to eat on a regular basis.

reason 1

.....

.....

reason 2

.....

.....
[2]

(ii) Suggest **one** other food that Jill could add to meal **1** that would make it more healthy. Explain your choice.

.....

.....

.....[1]

4 **(a)** A student investigates the neutralisation reaction between hydrochloric acid and potassium hydroxide.

Fig. 4.1 shows the apparatus she uses.

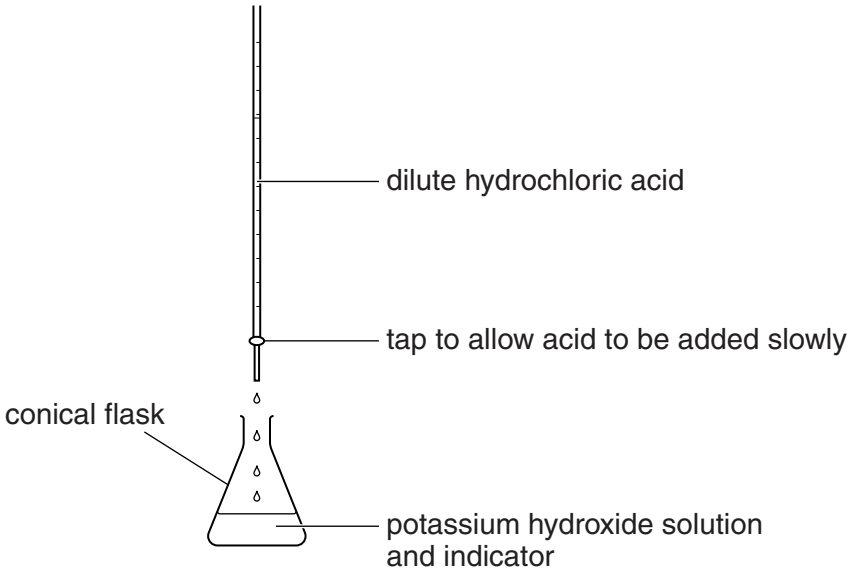


Fig. 4.1

She adds full range indicator (Universal Indicator) solution to the potassium hydroxide solution. Potassium hydroxide solution is alkaline.

She slowly adds some dilute hydrochloric acid to the potassium hydroxide solution until the solution in the flask is neutral.

The colour of the indicator changes as she adds the acid.

Fig. 4.2 shows how the colour of the indicator changes with pH.

pH	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
colour	RED			ORANGE				GREEN			BLUE			PURPLE	

Fig. 4.2

(i) State the initial and final values of the pH of the solution in the flask.

initial .....

final ..... [1]

(ii) State the initial and final colour of the indicator in the solution in the flask.

initial .....

final ..... [1]

(iii) Explain why a neutral solution is formed when she adds the acid to the alkali.

.....

.....

.....[2]

(b) (i) The student repeats part **(a)** in order to prepare a colourless neutral solution of potassium chloride.

She changes the method from that described in part **(a)** slightly, using information obtained from the first time she carried out the experiment.

Describe the change in method and explain how she uses the results of her first experiment.

.....

.....

.....[2]

(ii) Describe how a sample of crystals of potassium chloride could be produced from the solution obtained in **(b)(i)**.

.....

.....[1]

5 **(a)** Fig. 5.1 shows two cells **X** and **Y** which were taken from different areas of the same leaf.

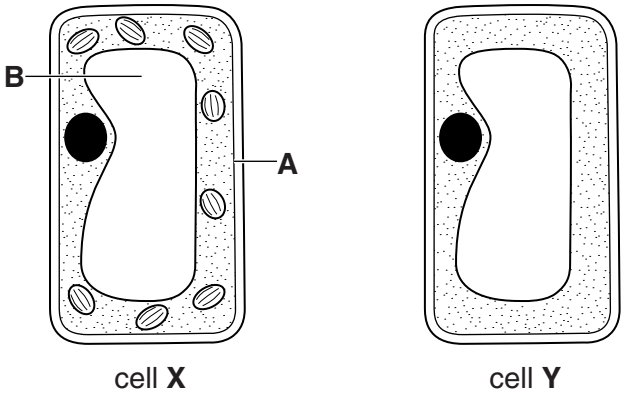


Fig. 5.1

(i) State the names of cell parts **A** and **B**.

A .....

B ..... [2]

(ii) Fig. 5.2 shows a leaf similar to the one from which these cells were taken.

Fig. 5.2

On Fig. 5.2, use label lines and the letters **X** and **Y** to show where these cells came from.

Explain your answer below.

.....

.....

.....[3]

(iii) The leaf was then tested with iodine solution for the presence of starch.

On Fig. 5.3 draw the result of the starch test on this leaf.

Label the leaf with the colours that are observed in different areas. [1]

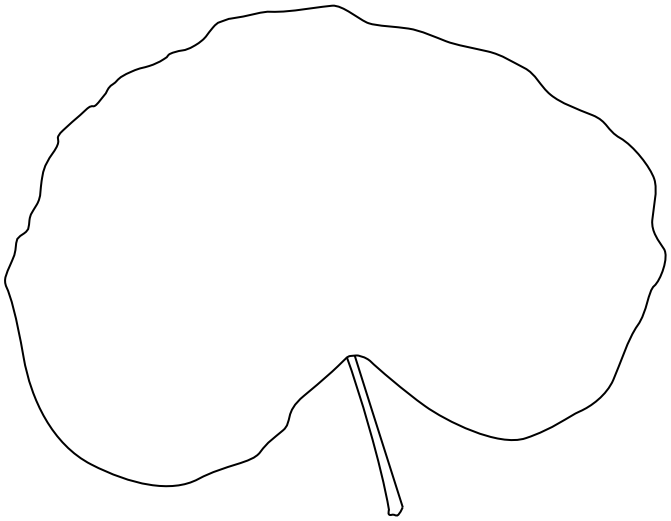


Fig. 5.3

(iv) Explain why only parts of the leaf show the presence of starch.

.....

.....[1]

(b) In humans, starch in food is digested by the enzyme amylase. The action of amylase starts when food is present in the mouth cavity.

(i) Explain why amylase stops working after the food is swallowed and it reaches the acidic conditions of the stomach.

.....

.....

.....[2]

(ii) Name **one** organ in the body which produces digestive enzymes.

.....[1]

6 **(a)** Fig. 6.1 shows an aircraft at rest on an airport runway waiting to take off.

The engines are running, but the pilot is using the brakes to prevent it moving.

The diagram shows four forces, labelled **P**, **Q**, **R** and **S**, acting on the aircraft as it waits to take-off.

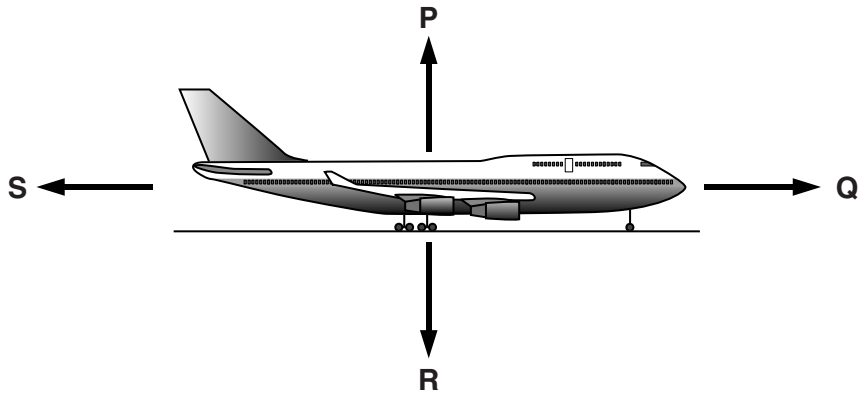


Fig. 6.1

(i) State which force from **P**, **Q**, **R** and **S** is

the weight of the aircraft .....

the thrust of the engines .....

the force of the brakes .....

[2]

(ii) Explain, in terms of balanced forces, why the aircraft remains at rest.

.....

.....

.....[2]

(b) **(i)** State the form of energy carried by the aircraft in its fuel tanks.

.....[1]

(ii) The aircraft takes off and climbs.

The energy in the aircraft's fuel is transferred to the aircraft as it takes off and climbs.

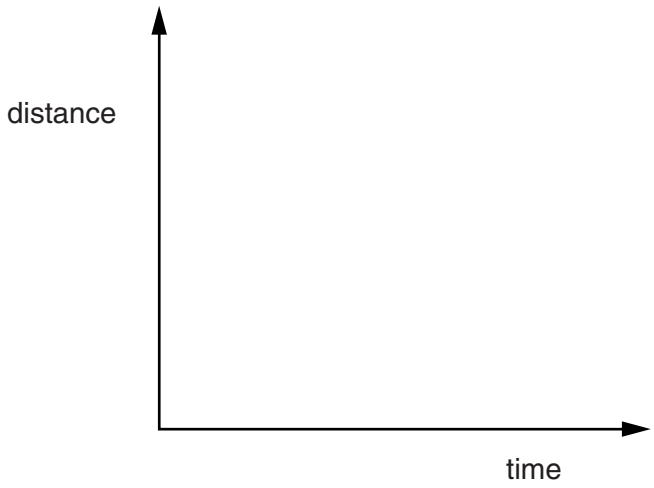
Identify the **two** useful forms of energy that the aircraft has gained.

..... and .....[2]

(iii) Identify **one** form of energy produced by the aircraft that is not useful.

.....[1]

(c) On the axes below, sketch a distance / time graph for the aircraft as it cruises at a constant speed.



[1]

7 **(a)** Fig. 7.1 shows the carbon cycle.

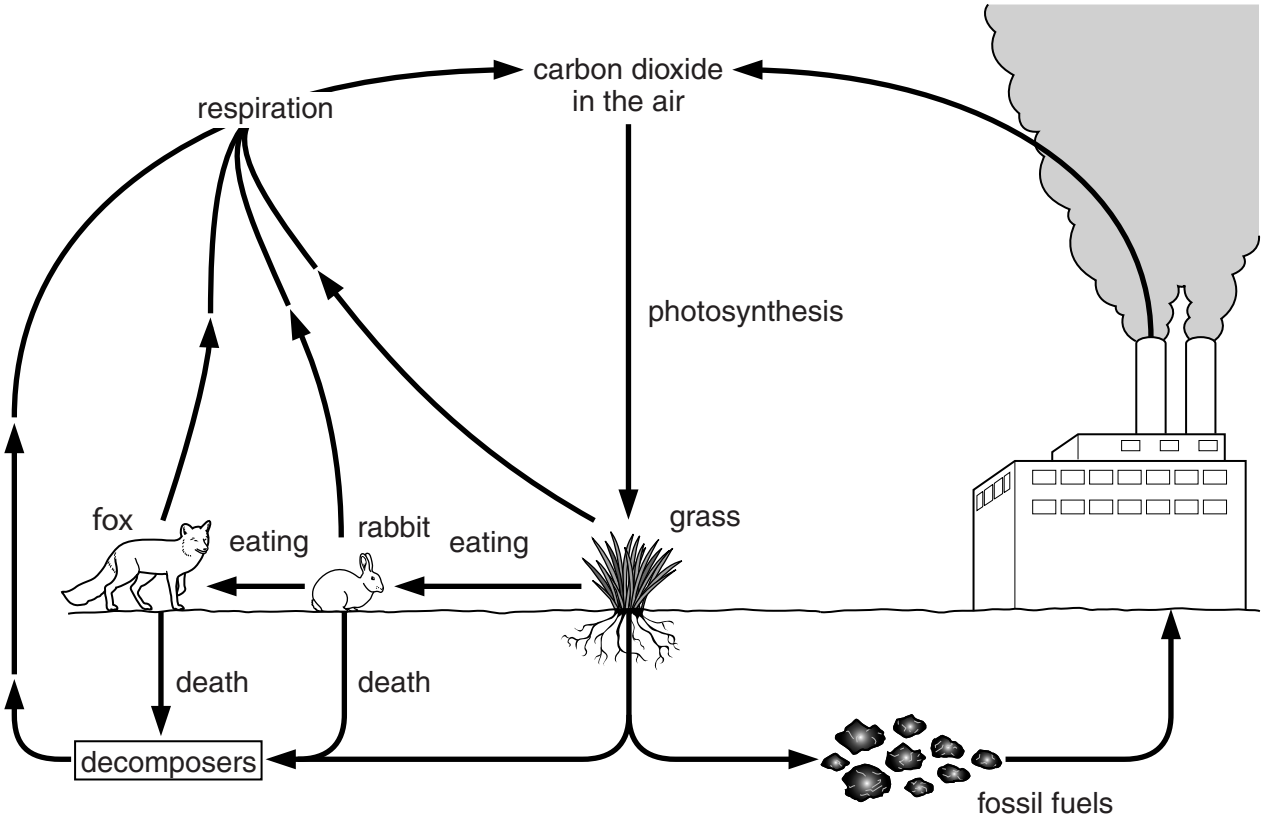


Fig. 7.1

(i) Describe the importance of respiration in the carbon cycle.

.....

.....[1]

(ii) Give the word equation for respiration.

[ ] + [ ] ⟶ [ ] + [ ]

[2]

(iii) In Fig. 7.1 find a food chain containing three organisms and write the food chain in the space below.

[2]

(iv) Decomposers are organisms found in the soil. Suggest the role of the decomposers in the carbon cycle shown in Fig. 7.1.

.....

.....

.....[2]

(b) (i) With reference to Fig. 7.1 explain why the amount of carbon dioxide in the air is increased by

coal-fired factories,

.....

.....

the removal of large amounts of grass.

.....

.....[2]

(ii) Describe how increased carbon dioxide levels could affect the environment.

.....

.....[1]

8 **(a)** Complete the sentences below using words from this list:

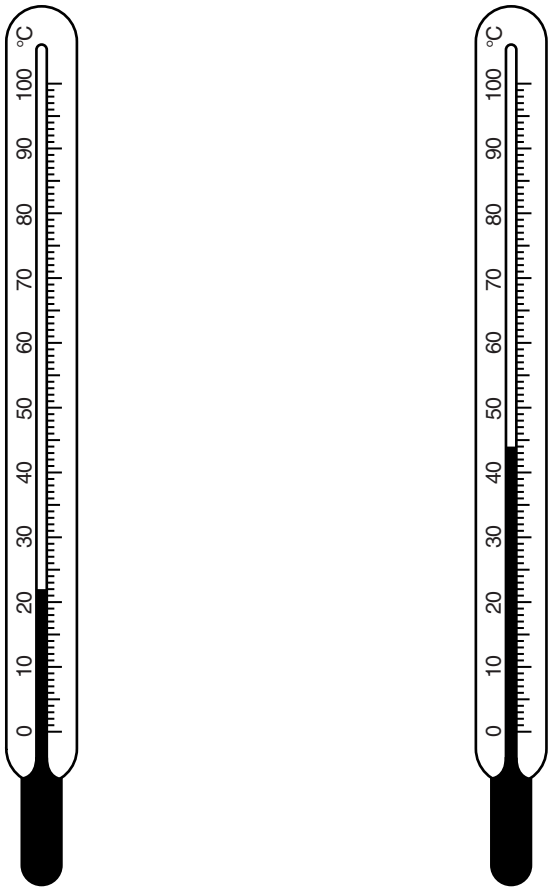
You may use each word once, more than once or not at all.

drops **boils** **energy** **evaporates**

infra-red **molecules** **ultraviolet**

The Earth is warmed by ..... radiation from the Sun. After it has rained, the Sun's heat ..... water on the ground, and the ground dries as water ..... escape from the water surface. [3]

(b) Fig. 8.1 shows a thermometer containing mercury which is taken from a dark room into bright sunlight.



in dark room in bright sunlight

Fig. 8.1

Explain, in terms of particles, why the level of mercury in the thermometer goes up.

.....

.....

.....[2]

(c) The Sun emits many different frequencies of electromagnetic radiation including visible light, infra-red, ultra-violet and X-rays.

Complete Table 8.1 to show the types of electromagnetic radiation emitted by the Sun.

Table 8.1

highest frequency						lowest frequency
gamma radiation					microwaves	radio waves

[3]

(d) The Sun produces sound waves as well as electromagnetic radiation.

Explain why we cannot hear any sound from the Sun.

.....

.....

.....[2]

9 A student performs an experiment to extract copper by heating copper oxide on a carbon block.

Fig. 9.1 shows the apparatus he uses.

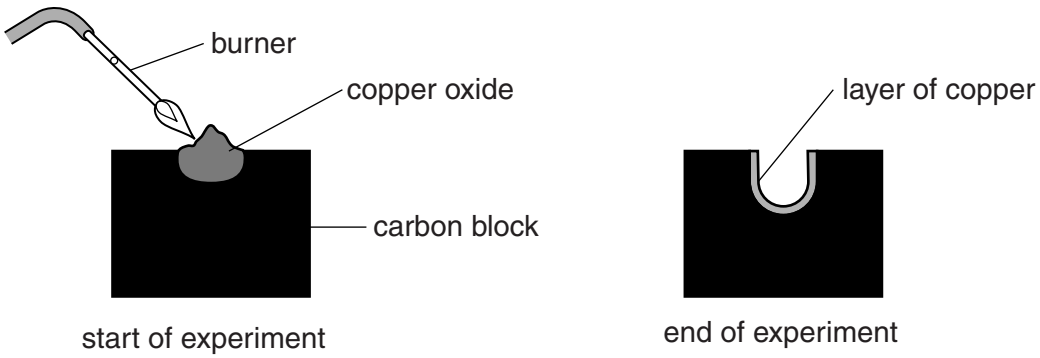
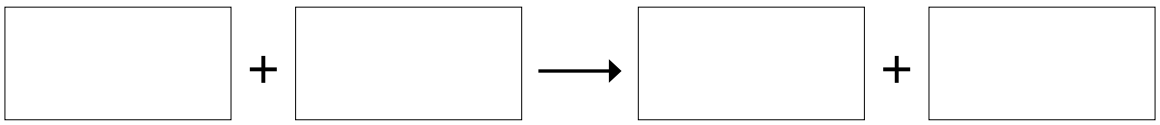


Fig. 9.1

(a) The copper oxide reacts with the carbon.

(i) Write a chemical **word** equation for the reaction between copper oxide and carbon.



[2]

(ii) Explain why this reaction is an example of a redox reaction.

.....

.....

.....[2]

(b) After the experiment the student tries to remove the copper from the block.
He pours dilute hydrochloric acid into the hole in the block.

Predict whether or not the hydrochloric acid will remove the copper. Explain your answer by referring to the reactivity series.

.....

.....

.....[2]

(c) Impurities in the copper oxide can produce sulfur dioxide gas when it is heated.
Sulfur dioxide forms a strongly acidic solution when it dissolves in water.

Describe how the environment is damaged by sulfur dioxide gas.

.....

.....

.....

.....[3]

DATA SHEET
The Periodic Table of the Elements

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.).