Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

COMBINED SCIENCE **0653/31**

Paper 3 (Extended) **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 24.

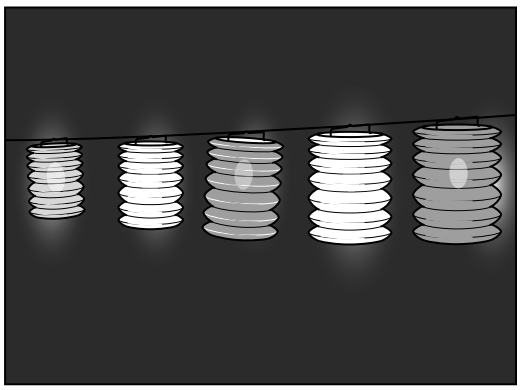
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **21** printed pages and **3** blank pages.

CAMBRIDGE International Examinations

[Turn over

1 Party lights add light and colour to festive occasions.



A set of party lights has a switch and a battery connected to five lamps in parallel.

The battery consists of four cells in series.

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

[2]

(b) The p.d. across the battery of four cells is 6 V.

(i) Each lamp in the set is labelled 6 V, 0.5 A.

Find the current from the source required to light this set of lamps.

current from source = ... A [1]

(ii) Use your answer to **(i)** to calculate the total resistance of the set of lights.

State the formula that you use and show your working.

formula

working

total resistance = ... Ω [2]

(c) Most sets of party lights have lamps that are connected in parallel but some sets are connected in series.

State what happens to the set of lights if one lamp breaks when the lamps are connected in

series,

.....

parallel.

.....[1]

2 Gasoline and petroleum jelly are products obtained from petroleum (crude oil) following fractional distillation at an oil refinery.

(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 correct order of the processes.

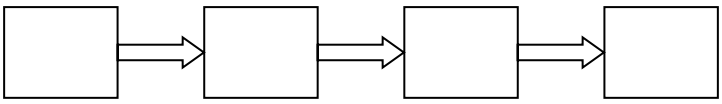


Fig. 2.1

[2]

(b) A process called *cracking* is also carried out at an oil refinery.

Fig. 2.2 shows the apparatus used to demonstrate the cracking of petroleum jelly.

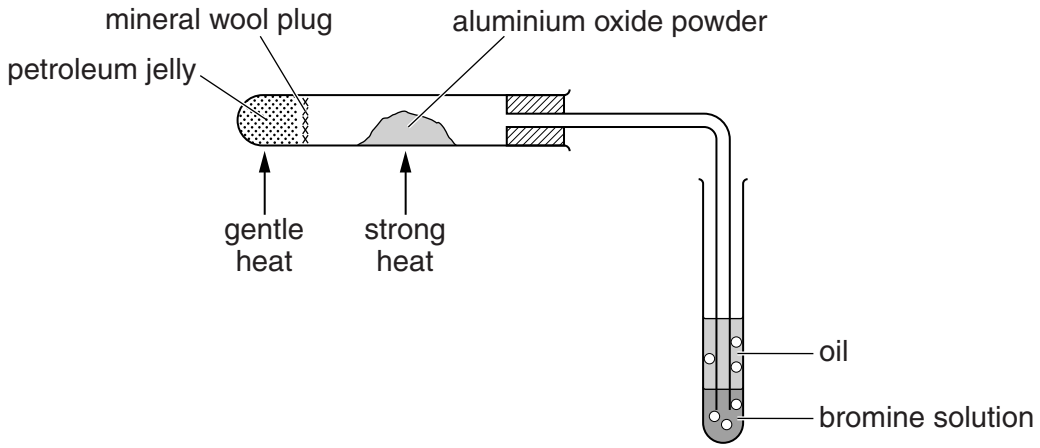


Fig. 2.2

Petroleum jelly is gently heated until it melts and then boils.

The vapour passes over aluminium oxide powder, which is strongly heated.

The gas formed reacts with bromine solution.

An oil forms on top of the bromine solution.

(i) State the function of the aluminium oxide.

.....[1]

(ii) Explain, in terms of collisions of reacting particles, why the aluminium oxide is powdered.

.....

.....

.....[2]

(iii) List petroleum jelly, diesel oil and refinery gas in order of their boiling points.

highest boiling point .....

.....

lowest boiling point .....

[1]

(iv) List petroleum jelly, diesel oil and refinery gas in order of the average length of their molecules.

longest molecules .....

.....

shortest molecules .....

[1]

(v) State the relationship between boiling point and length of molecules.

Explain your answer.

.....

.....

.....[2]

3 **(a)** If a person does not eat a balanced diet, they can suffer from malnutrition.

(i) Use straight lines to match the effects of malnutrition to their causes. One line is drawn for you.

effect of malnutrition	cause
obesity	not enough fibre in the diet
constipation	taking in much more energy than the body needs
coronary heart disease	taking in less energy than the body needs
starvation	taking in too much animal fat and salt

[2]

(ii) A person has constipation.

Suggest **one** food that may be missing from their diet and explain how this food prevents constipation.

food .....

explanation .....

.....[2]

(iii) Obese people are extremely overweight because they are taking in more energy than they need.

Suggest **one** food an obese person should avoid eating regularly and explain your answer.

food .....

explanation .....

.....[1]

(b) Taking exercise is recommended for people who are overweight.

A survey was carried out to compare the amounts of exercise taken by two groups of people. The first group was made up from people of normal weight and the second group was made up from overweight people. Each group contained 100 men and women.

The survey determined how many people took exercise at least twice a week. To count as exercise, an activity had to raise a person's heart rate for at least 20 minutes.

The results are shown in Fig. 3.1.

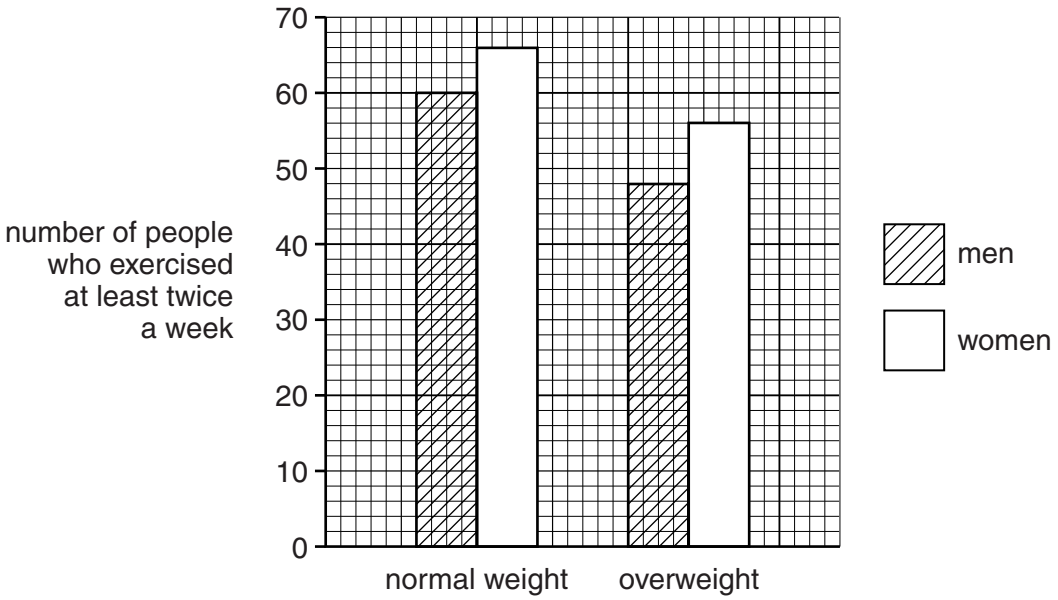


Fig. 3.1

(i) Use the information in Fig. 3.1 to compare the level of exercise people did in terms of

their sex,

.....

.....

their weight.

.....

.....[2]

(ii) Suggest why there is not enough evidence in the survey to conclude that exercise prevents people from being overweight.

.....

.....

.....[2]

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

Fig. 4.1 shows the apparatus she uses.

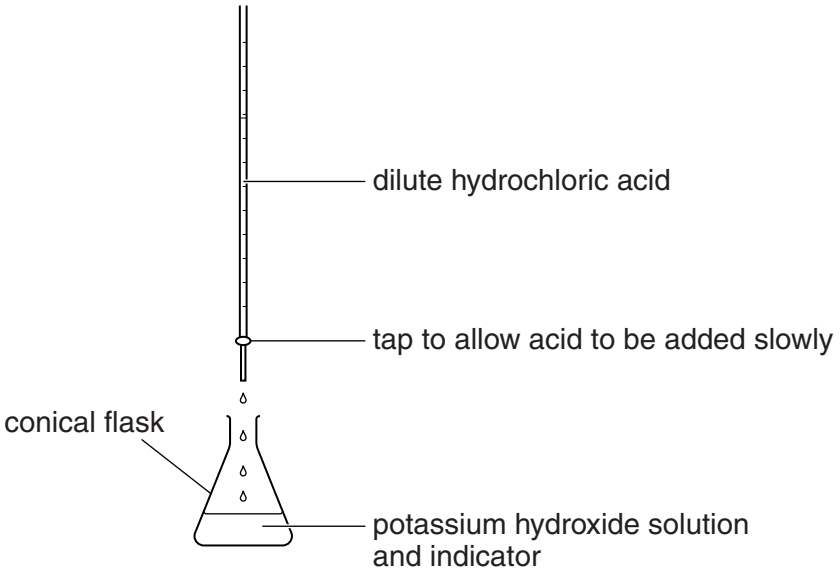


Fig. 4.1

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]

(b) The reaction between hydrochloric acid and potassium hydroxide forms potassium chloride.

(i) Complete the balanced chemical equation for the reaction.

$KOH + HCl \longrightarrow$ ..... [2]

(ii) The student repeats part **(a)** in order to prepare a colourless sample of crystals of potassium chloride.

She changes the method 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.

.....

.....

.....

.....[3]

(c) The melting point of crystals of potassium chloride is 770 °C.

Explain, in terms of the forces between particles, why potassium chloride forms crystals with a high melting point.

.....

.....

.....

.....[2]

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

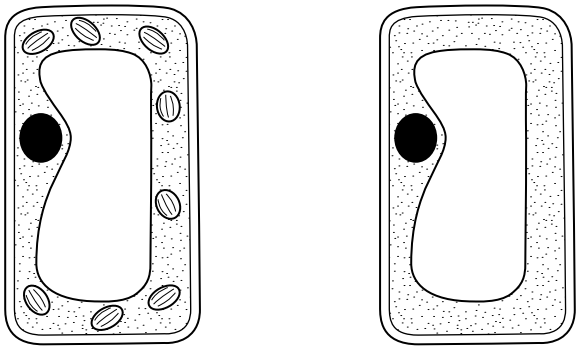


Fig. 5.1

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 leaf cells came from.

Explain your answer below.

.....

.....

.....[2]

(b) The leaf in Fig. 5.2 was then tested with iodine solution for the presence of starch.

(i) 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]

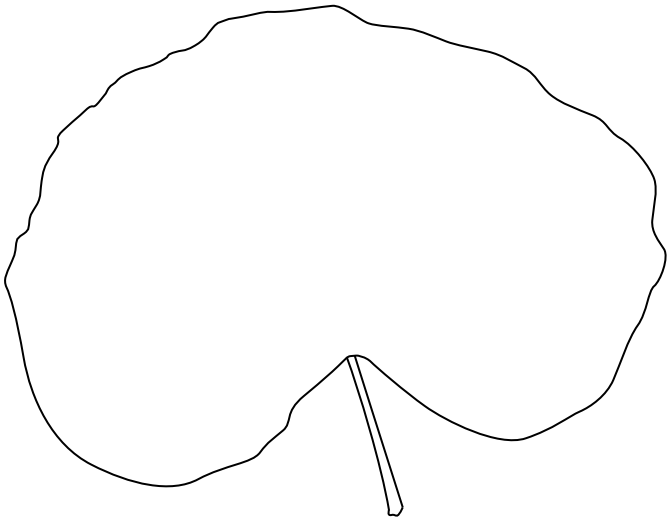


Fig. 5.3

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

.....

.....

.....

.....[3]

(c) In humans, starch is digested by the enzyme amylase which starts its action while food is in the mouth cavity.

Explain in detail why amylase stops working after the food is swallowed and reaches the acidic conditions in the stomach.

.....

.....

.....

.....[3]

6 **(a)** Fig. 6.1 shows an aircraft accelerating along the airport runway.

The aircraft, fully loaded, has a total mass of 205 000 kg.

The diagram shows four forces, labelled **P**, **Q**, **R** and **S**, acting on the aircraft as it moves along the runway before taking off.

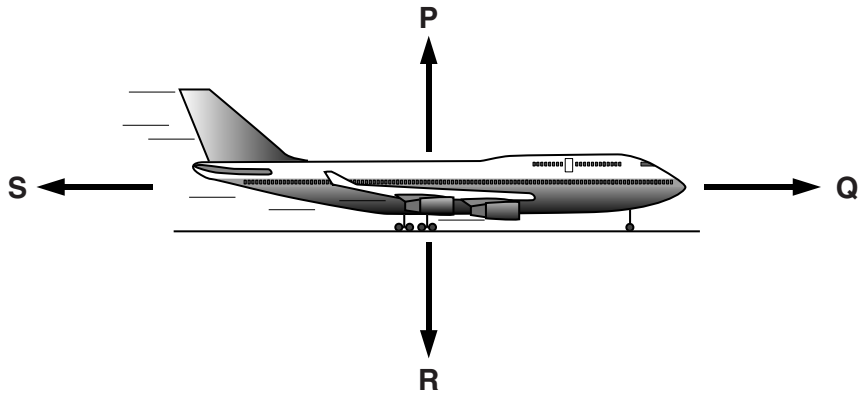


Fig. 6.1

(i) State **two** forces from **P**, **Q**, **R** and **S** that are equal and opposite while the aircraft accelerates along the airport runway.

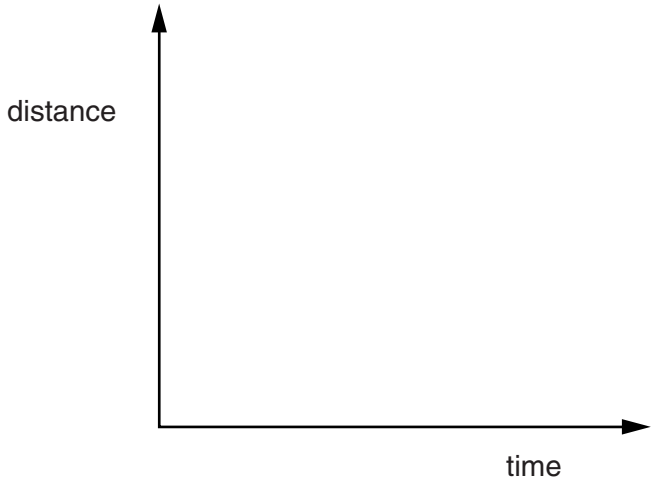
..... and ..... [1]

(ii) State which force from **P**, **Q**, **R** and **S** is the result of a gravitational field acting on the mass of the aircraft and give the name of this force.

.....

.....[2]

(iii) On the axes below, sketch a distance/time graph for the aircraft as it moves along the runway from rest to take-off.



[1]

(b) The aircraft takes off and climbs to a height of 5000 m.

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

(i) State **two** useful forms of energy gained by the aircraft as a result of this transfer.

..... and ..... [1]

(ii) The forms of energy in **(b)(i)** add up to less energy than the energy transferred from the fuel.

The principle of energy conservation applies to the energy transferred from the fuel.

State what happens to the remainder of the energy from the fuel.

.....[1]

(c) When the aircraft levels out at a height of 5000 m, it has burned some fuel and now has a reduced total mass of 200 000 kg.

The aircraft flies at constant speed of 720 km / hr.

(i) Calculate the speed of the aircraft in metres per second.

speed = ... m / s [1]

(ii) Use your answer from **(c)(i)** to calculate the kinetic energy of the aircraft.

State the formula you use and show your working.

formula

working

kinetic energy = ... J [2]

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

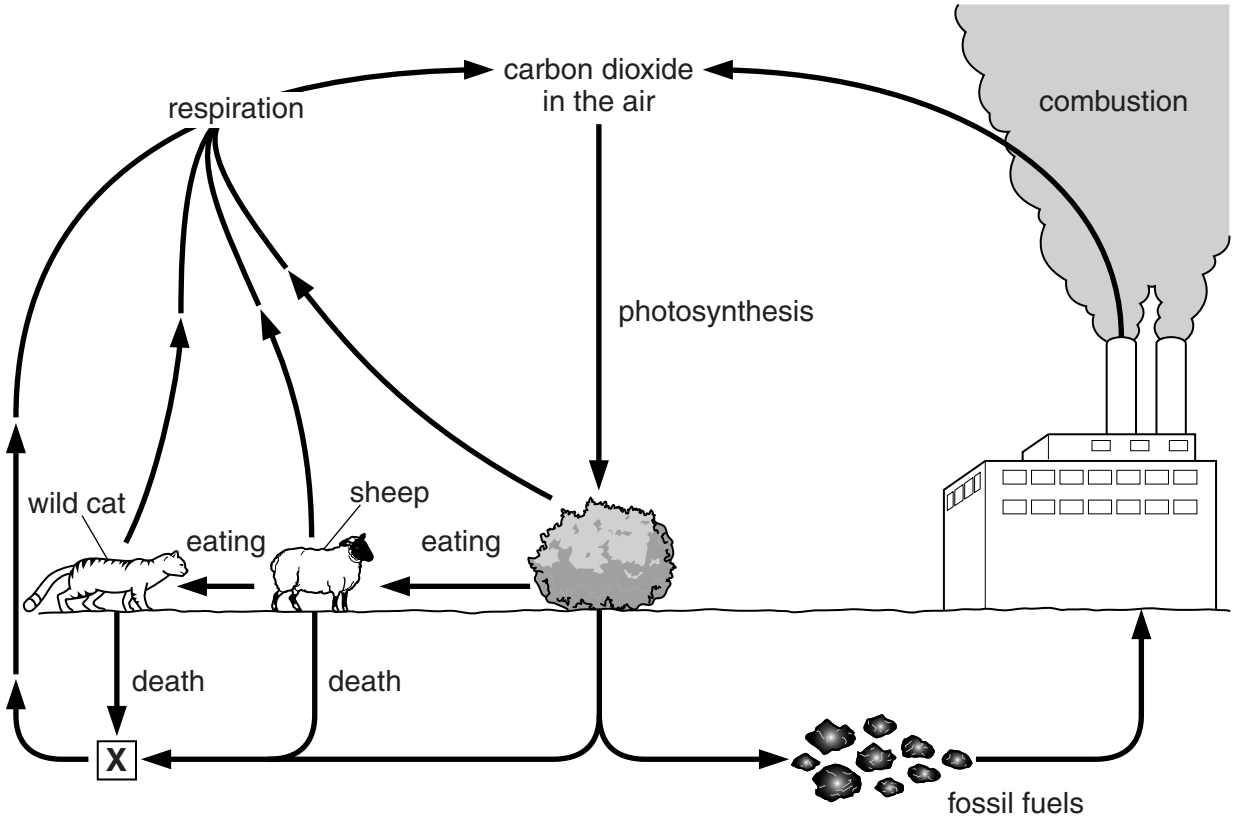


Fig. 7.1

(i) The sheep eats a plant leaf. A carbon atom from the starch in this leaf enters the air shortly after the leaf is eaten.

Describe a possible pathway taken by the carbon atom. Explain your answer fully.

.....

.....

.....

.....

.....[3]

(ii) The organisms labelled **X** are found in the soil.

Describe in detail the role these organisms play in the carbon cycle.

.....

.....

.....

.....[3]

(b) (i) With reference to Fig. 7.1 and your own knowledge, state **two** ways in which the burning of fossil fuels can change the composition of the gases in the atmosphere.

1 .....

2 .....[2]

(ii) Suggest **one** way in which the environment can be harmed by one of the changes you have stated in part **(b)(i).**

.....

.....[1]

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

(a) (i) State the meaning of the term *frequency*.

.....

.....[1]

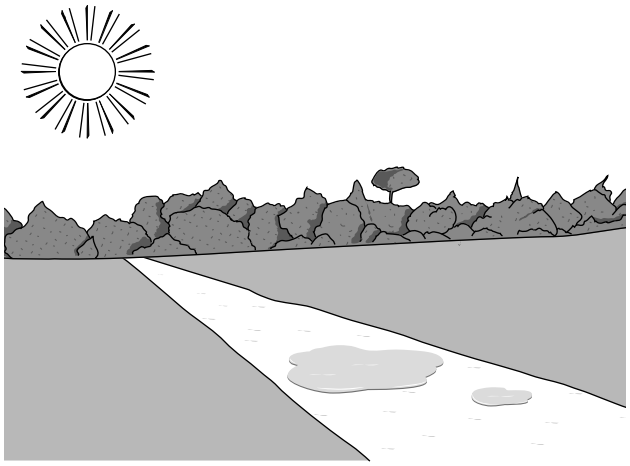
(ii) Complete Table 8.1 to show the types of electromagnetic radiation emitted by the Sun.

Table 8.1

highest frequency						lowest frequency
gamma radiation			visible light		microwaves	radio waves

[2]

(b) After rain has fallen, puddles of water are left on the ground. When the Sun shines, it warms the air and the water in the puddles and dries the ground.



(i) Complete the following sentences about the forces and distances between molecules, using words or phrases.

When the Sun warms the water in a puddle on the ground, the water expands because the water molecules ..... .

When the water expands, the forces between the molecules ..... .

As the air above the puddle gets warmer, the molecules in the air move ..... .

[3]

(ii) Use your answers to **(b)(i)** to explain why the Sun dries the ground.

.....

.....

.....[2]

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

(i) Explain why we cannot hear any sound from the Sun.

.....

.....[2]

(ii) It takes eight minutes for the visible light emitted from the Sun to travel to the Earth.

Suggest how long it would take for a burst of X-rays emitted by the Sun to travel to the Earth. Give a reason for your answer.

.....

.....[1]

9 **(a)** The Thermite reaction occurs between aluminium and iron oxide powders.

It is an example of a redox reaction.

Fig. 9.1 shows how a furnace in which the Thermite reaction is occurring can be used to repair a broken steel rail.

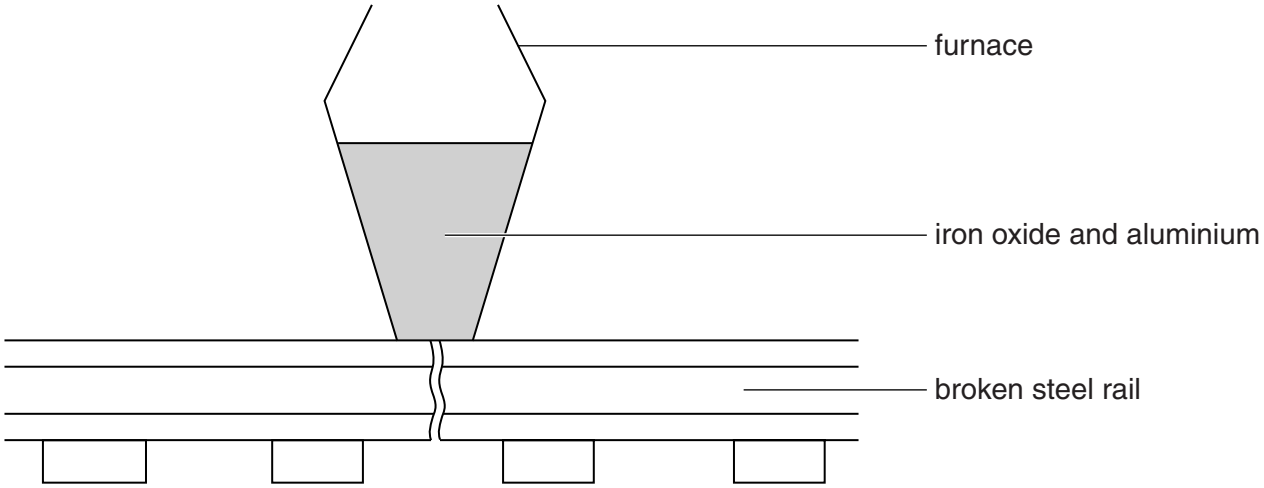


Fig. 9.1

The Thermite reaction produces molten iron that runs down into the broken rail and welds (joins) the ends together.

(i) State the type of chemical reaction that causes the temperature to increase.

.....[1]

(ii) State the energy transfer occurring during the reaction.

..... ⟶ ..... [1]

(iii) The word equation for the Thermite reaction is shown below.

aluminium + iron oxide ⟶ aluminium oxide + iron

Explain why the Thermite reaction is an example of a redox reaction.

.....

.....

.....[2]

(iv) Aluminium ore contains aluminium oxide.

A student suggests that metallic iron could be used to extract aluminium from its ore.

State whether or not this would work.

Explain your answer by referring to the information contained in part **(a)(iii)**.

.....

.....

.....[2]

(b) In industry, aluminium is extracted from aluminium oxide by electrolysis.

Fig. 9.2 shows the apparatus used.

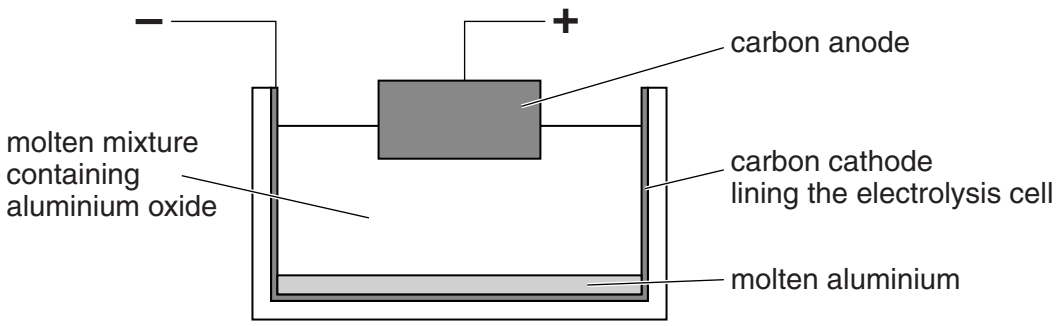


Fig. 9.2

(i) Aluminium is deposited on the cathode.

Describe, by referring to the movement of ions and electrons, how these aluminium atoms are formed.

.....

.....

.....[2]

(ii) Name the other substance formed by this electrolysis process.

.....[1]

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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 †															

* 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.).