Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

COMBINED SCIENCE **0653/33**

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 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 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 **24** printed pages.

CAMBRIDGE International Examinations

1 **(a)** A student performs some experiments to find out what makes iron rust.

(i) Fig. 1.1 shows his first experiment.

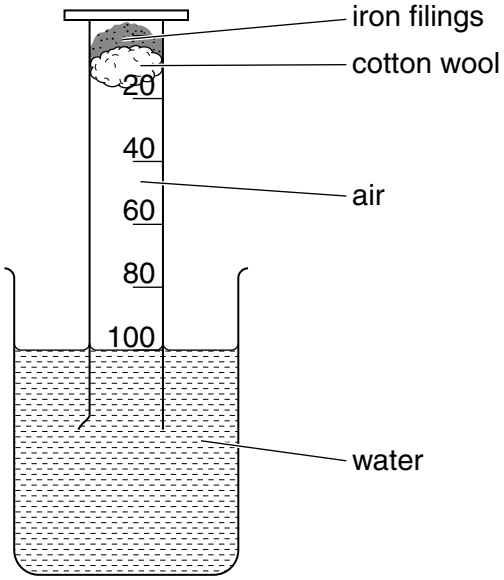


Fig. 1.1

Fig. 1.2 shows the apparatus after one week. The iron has rusted and the water has risen up the cylinder.

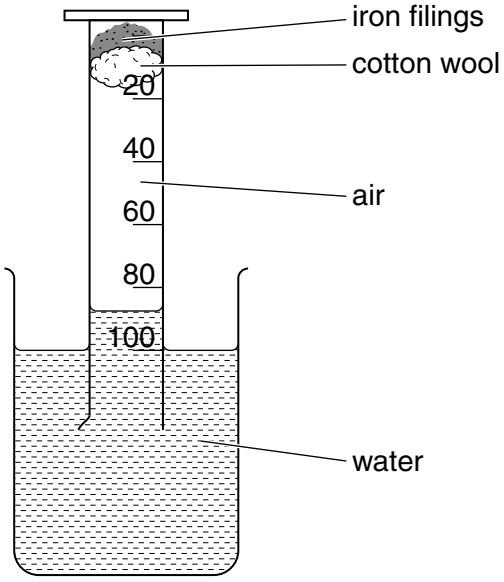


Fig. 1.2

Explain why the water has risen up the cylinder.

.....

.....[1]

(ii) The student repeats the experiment using helium in the cylinder instead of air.

Fig. 1.3 shows the results after one week.

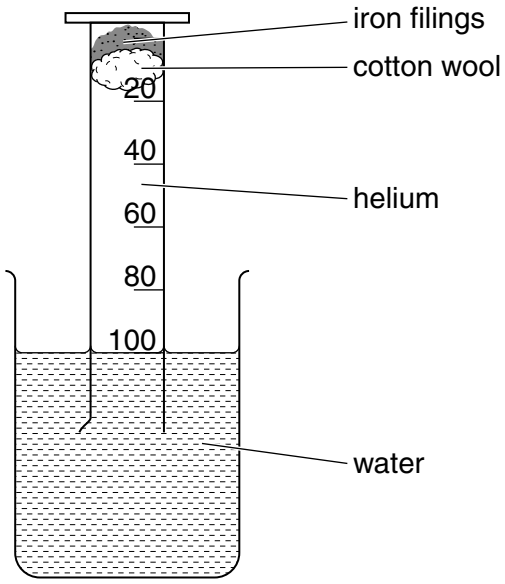


Fig. 1.3

The iron has not rusted and the water has not risen up the cylinder.

Explain why the water has not risen up the cylinder.

.....

.....[1]

(b) The student writes in his notebook:

*"When sodium burns in chlorine it forms **ions** that are like neon **atoms**."*

(i) State **two** similarities in the arrangement of electrons in a sodium **ion** and a neon **atom**.

The Periodic Table on page 24 may help you to answer this question.

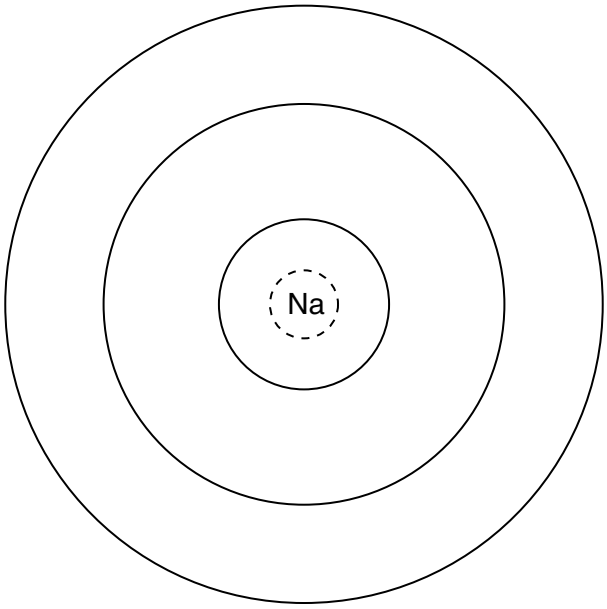
1 .....

.....

2 .....

.....[2]

(ii) Complete the diagram of the electronic structure of a sodium **atom.**



[1]

(iii) Describe what happens when a sodium **atom** becomes a sodium **ion**.

.....

.....[1]

(iv) Some sodium chloride is dropped into a container filled with chlorine.

Predict whether or not the sodium **ions** in sodium chloride would react with chlorine **atoms**.

Explain your answer.

.....

.....[1]

(c) Name a noble gas.

State and explain a use for this noble gas.

name .....

use .....

explanation .....

.....[2]

2 **(a)** Fig. 2.1 shows a man paddling a canoe across a lake.

The man is paddling hard to gain speed from rest.

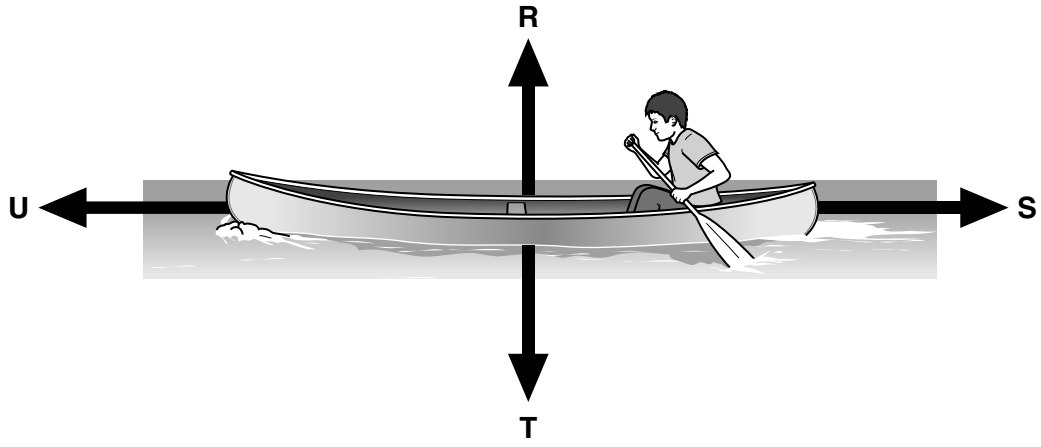


Fig. 2.1

(i) State **two** forces from **R**, **S**, **T** and **U** that are equal and opposite.

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

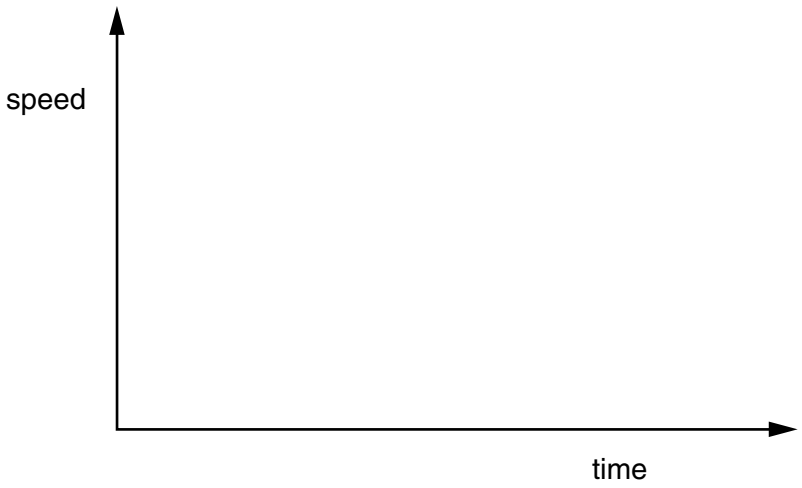
(ii) Explain which force from **R**, **S**, **T** and **U** is the result of a gravitational field acting on the combined mass of the canoe and man.

.....

.....[2]

(iii) The canoe moves across the lake from rest to maximum speed with decreasing acceleration, then continues across the lake at a constant speed.

Sketch a speed/time graph for this journey.



[3]

(b) The man's energy is transferred to the canoe as it gains speed.

The kinetic energy gained by the canoe is less than the energy transferred from the man.

The principle of energy conservation applies to these energy transfers.

State what happens to the man's energy that is **not** transferred into kinetic energy of the canoe.

.....[1]

(c) The man paddles the canoe at a steady speed of 2 m / s.

The canoe and man together have a mass of 250 kg.

Calculate the kinetic energy of the canoe.

State the formula you use and show your working.

formula

working

kinetic energy = ... J [2]

3 **(a)** Fig. 3.1 shows a diagram of the uterus in a pregnant female.

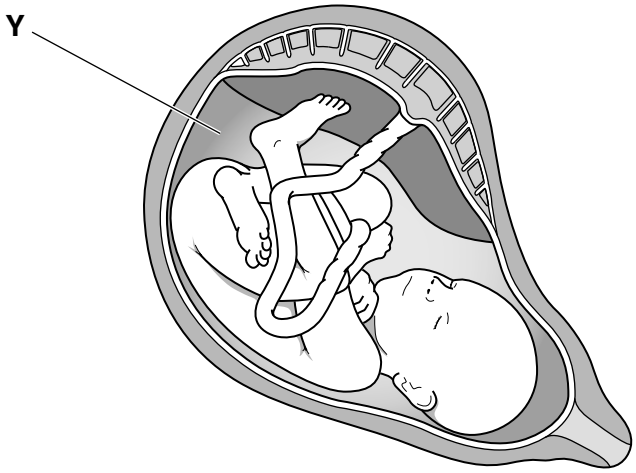


Fig. 3.1

(i) Using label lines, label the placenta and cervix on Fig. 3.1. [2]

(ii) Complete the sentences using words or phrases from the list.

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

bacteria **carbon dioxide** **cells** **glucose** **viruses**

The placenta allows dissolved nutrients such as ..... to pass through to the baby. Other small molecules such as ..... are also able to pass through the placenta. [2]

(iii) Name the liquid found at position **Y** and state its function.

name .....

function .....

.....[2]

(b) Some of the nutrients that pass through the placenta result from the chemical digestion of large food molecules in the digestive system of the mother.

(i) Complete Table 3.1 with ticks (✓) and crosses (✗) to predict whether the digesting enzymes amylase (starch-digesting enzyme) and protease (protein-digesting enzyme) are active in the parts of the digestive system shown.

Table 3.1

type of enzyme	in the small intestine	in the large intestine
amylase		
protease		

key
✓ = enzyme active
✗ = enzyme inactive

[2]

(ii) Explain your answers to part **(b)(i)**.

.....

.....

.....[2]

(c) The human immunodeficiency virus (HIV) can be transmitted through sexual intercourse.

Describe how HIV affects the immune system.

.....

.....

.....[2]

[Turn over

4 Fig. 4.1 shows an electric hairdryer that uses mains electricity.

Fig. 4.1

A heater inside the hairdryer warms the air. A fan blows the warm air out of the hairdryer.

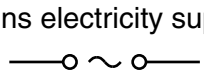
(a) The hairdryer contains a switch, a heater to warm the air and an electric motor to drive the fan. The heater and the motor are connected in parallel.

Fig. 4.2 shows the circuit symbols for a heater and an electric motor.

electric heater electric motor

Fig. 4.2

Complete the circuit diagram for the hairdryer. The circuit has been started for you.



[2]

(b) The flow of warm air dries the wet hair by evaporation.

Describe in terms of molecules how the flow of warm air speeds up the drying of wet hair.

.....

.....

.....

.....[3]

(c) If the heated air was not blown out sideways by a fan, it would simply move upwards.

Explain why heated air rises.

.....

.....

.....[2]

(d) Fig. 4.3 shows information on a label fixed to the hairdryer.

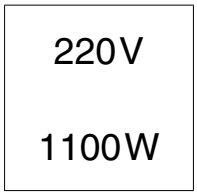


Fig. 4.3

(i) State the name of the unit whose symbol is W.

.....[1]

(ii) Use the formula $P = IV$ to show that the current in the hairdryer when in use is 5 A.

Show your working.

[1]

(e) The plug on the lead of the hairdryer is fitted with a fuse. One day, the fuse blows while the hairdryer is being used.

(i) Give **one** possible cause for the fuse blowing.

.....

.....[1]

(ii) The fuse has to be replaced.

The current through the hairdryer when in use is 5 A. Several new fuses with different current ratings are available.

2 A 5 A 10 A 15 A

Explain which of these four fuses should be used.

Fuse ..... because .....

.....

.....

.....[2]

5 **(a)** A student investigates the effect of gravity on the growth of a seedling.

The student germinates a seed. When the radicle is clearly visible, he pins the seedling to a board, as shown in Fig. 5.1 (a). He positions the board on its side so that the radical is horizontal.

The radicle continues to grow and curves downwards, as shown in Fig. 5.1 (b).

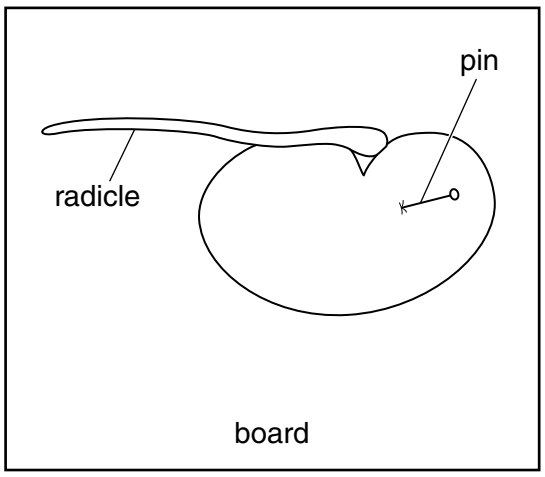


Fig. 5.1 (a)

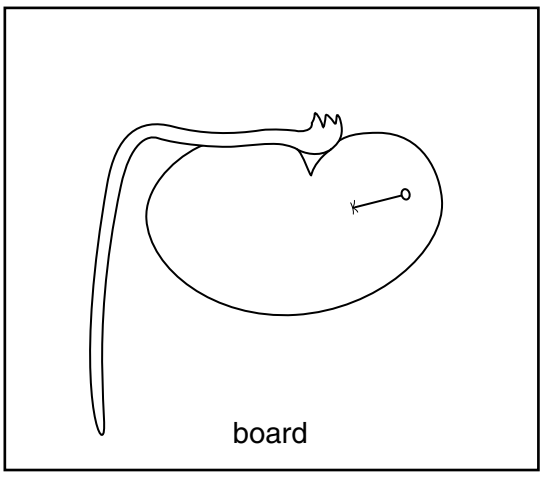


Fig. 5.1 (b)

(i) Name the growth response shown by the seedling.

.....[1]

(ii) Explain why this growth response is an advantage to the seedling.

.....

.....

.....[2]

(b) Fig. 5.2 shows a diagram of a radicle similar to the one in Fig. 5.1 (a). The shaded area shows the location of hormones that cause the response in **(a)(i)**.

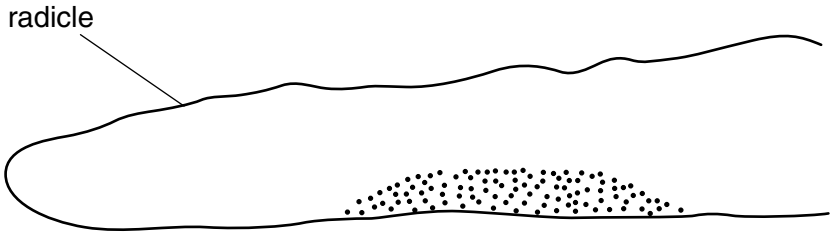


Fig. 5.2

Describe fully how the hormones act to cause the response shown by the radicle.

.....

.....

.....[2]

(c) Roots usually get their energy from aerobic respiration.

The soil around a seedling becomes waterlogged so there are no air spaces.

(i) Suggest how this affects the rate of aerobic respiration.

Explain your answer.

.....

.....[1]

(ii) Predict and explain the effect this will have on the rate of growth of the seedling.

.....

.....[1]

Question 6 begins on page 16

6 Dilute hydrochloric acid reacts with calcium carbonate to produce carbon dioxide gas.

(a) Complete the word equation for the reaction.

hydrochloric acid + calcium carbonate → ..... + carbon dioxide + ...

[2]

(b) Fig. 6.1 shows the apparatus a student uses to investigate the effect of changing the initial temperature of the acid on the rate of reaction.

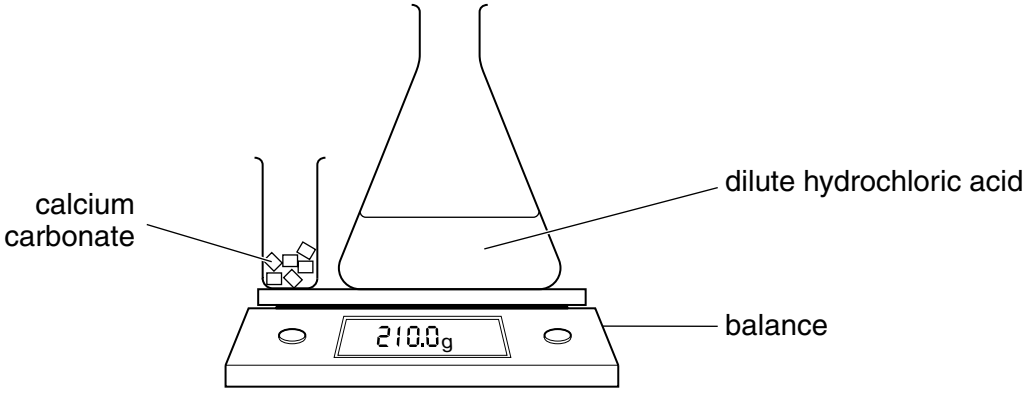


Fig. 6.1

The student adds the calcium carbonate to excess acid at a temperature of 20 °C.

She records the reading of the balance every minute for 7 minutes.

Fig. 6.2 shows the results obtained in the first experiment.

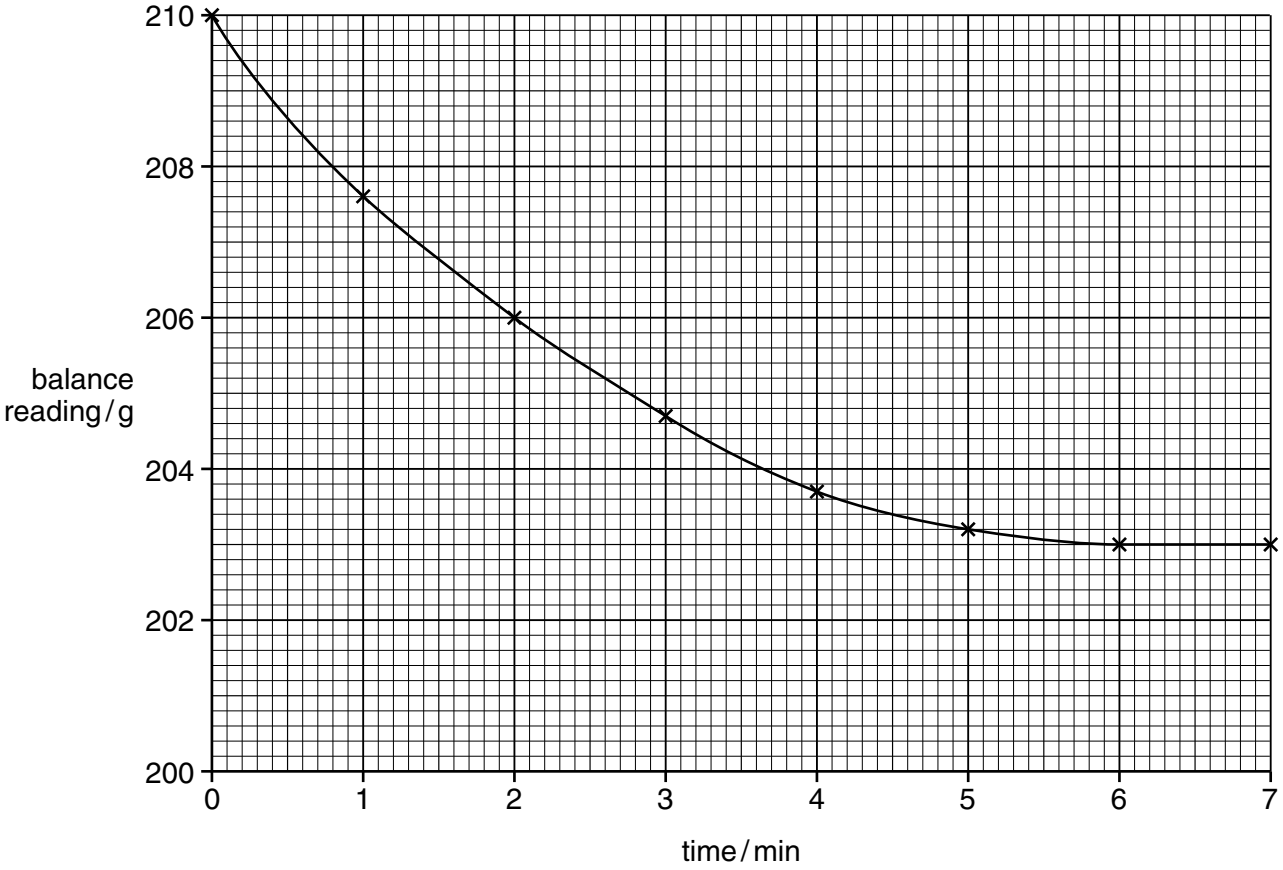


Fig. 6.2

(i) Explain why the mass of the apparatus decreases during the experiment.

.....

.....[1]

(ii) Describe and explain how the rate of reaction changes during the experiment.

.....

.....

.....

.....[3]

(c) The experiment is repeated with the same mass of calcium carbonate and excess acid at a temperature of 30 °C.

(i) Use the information from Fig. 6.2 to predict the **final mass** of the apparatus when the acid has an initial temperature of 30 °C.

.....[1]

(ii) The student finds that the rate of reaction increases as the temperature of the acid increases.

Use the idea of particle collision to explain the effect of temperature on the rate of reaction.

.....

.....

.....[2]

7 Astronomers use telescopes to study the electromagnetic radiation that reaches the Earth from the stars.

(a) (i) Complete the sentences below using words or phrases from the list. You may use each term once, more than once or not at all.

radio waves **sound waves** **ultra-violet** **visible light** **water waves**

People can see stars with their eyes because the stars emit ..... .

Astronomers need special telescopes to see other types of electromagnetic radiation from stars. Examples of such types of radiation are ..... and ..... . [2]

(ii) We are able to see the Moon, even though the Moon itself does not emit electromagnetic radiation.

State a characteristic behaviour of electromagnetic radiation that enables us to see the Moon.

.....[1]

(b) Some stars emit electromagnetic radiation with a very high frequency, such as X-rays.

(i) Fig. 7.1 shows an incomplete diagram of the electromagnetic spectrum.

gamma radiation					microwaves	

Fig. 7.1

Mark with an **X** on Fig. 7.1 the part of the spectrum where X-rays are situated. [1]

(ii) A binary consists of two stars close together. In one particular binary, one star emits mainly light, while the other emits mainly X-rays.

The light and X-rays leave this binary at the same time.

Tick the box next to the correct statement in the list below and give a reason for your answer.

X-rays will reach the Earth first. ☐

Light will reach the Earth first. ☐

X-rays and light will reach the Earth at the same time. ☐

reason .....

.....

.....[2]

8 **(a)** Fig. 8.1 shows an experiment to investigate the effect of changing light intensity on the rate of photosynthesis of a water plant called *Elodea*.

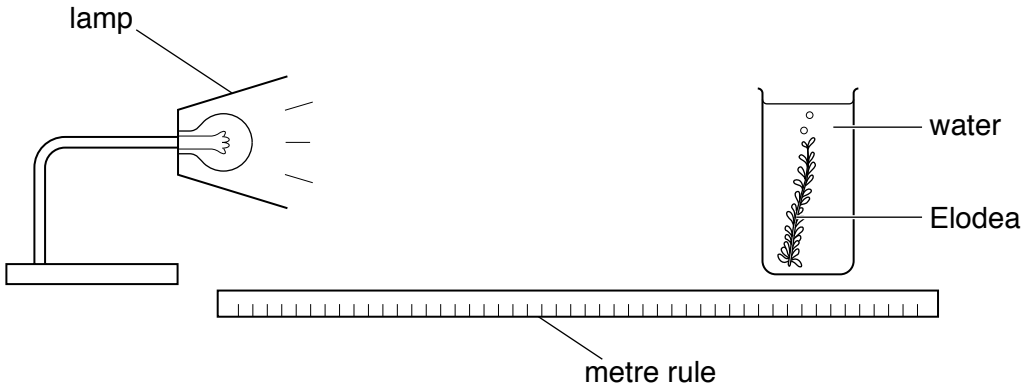


Fig. 8.1

The light intensity is altered by changing the distance between the lamp and the plant.

The number of bubbles of oxygen produced by the plant per minute is used to find the rate of photosynthesis.

The results are shown in Fig. 8.2.

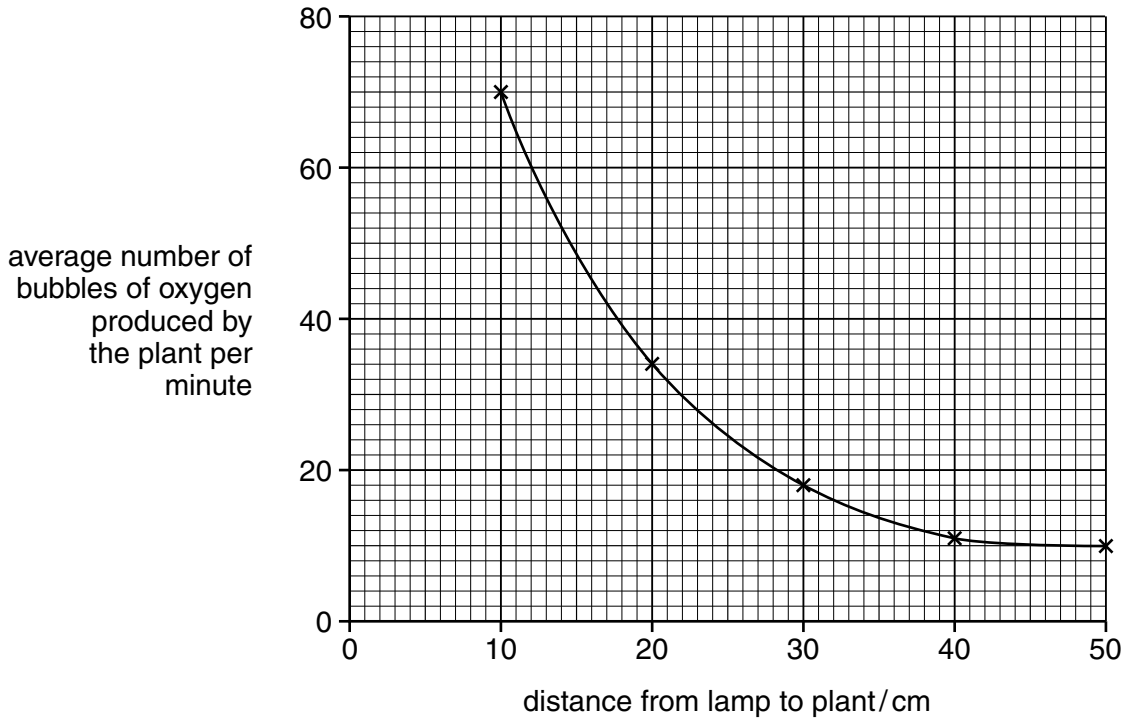


Fig. 8.2

Use Fig. 8.2 to describe how the rate of photosynthesis of the plant changes as the light intensity is varied.

.....

.....

.....[2]

(b) Fig. 8.3 shows some of the living organisms in a pond.

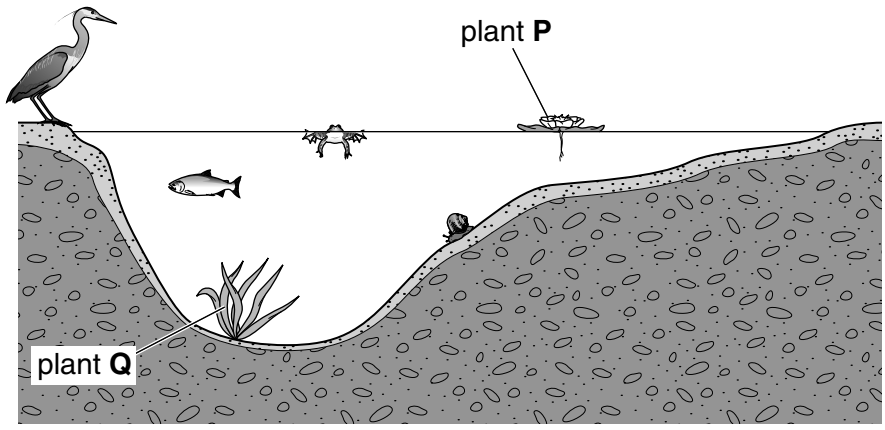


Fig. 8.3

Suggest how the rate of photosynthesis of plant **P** compares with plant **Q**. Explain your answer.

.....

.....

.....[2]

(c) The pollution of water by fertilisers can cause *eutrophication*.

(i) Some fertiliser is added to a pond. Describe the effect this will have on the plants that live on the surface of the pond.

.....

.....[1]

(ii) Use your answer to **(b)(i)** to predict how eutrophication will affect plant **Q** in Fig. 8.3.

.....

.....

.....[2]

9 Aluminium is extracted from an ore called bauxite.

Bauxite is a mixture of aluminium oxide and other compounds.

The element aluminium is extracted from molten aluminium oxide by electrolysis.

The element oxygen is also formed during the electrolysis.

(a) Using examples taken from the sentences above, explain

(i) **one** difference between an element and a compound,

.....

.....[1]

(ii) **one** difference between a compound and a mixture.

.....

.....[1]

(b) Aluminium oxide consists of Al^{3+} ions and O^{2-} ions.

Deduce the formula of aluminium oxide. Explain your answer.

.....[2]

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

Fig. 9.1 shows the apparatus used.

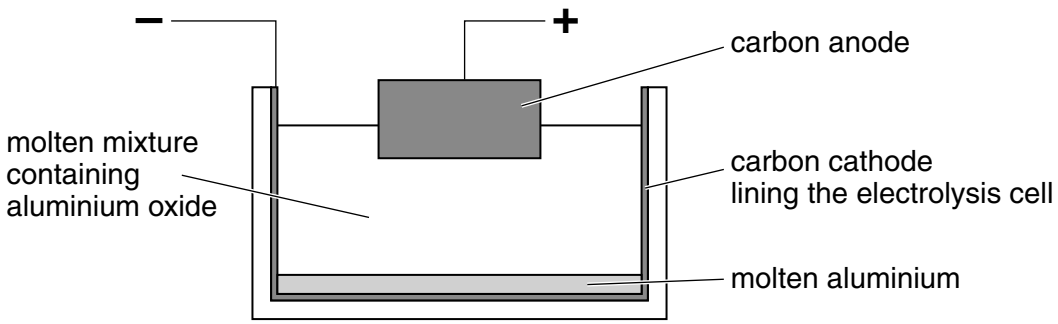


Fig. 9.1

Explain, in terms of the ions present, how aluminium is formed at one of the electrodes.

.....

.....

.....

.....[3]

(d) Copper can be extracted from an ore containing copper oxide by heating it with carbon.

Explain why aluminium cannot be obtained from aluminium oxide in the same way.

.....

.....

.....[2]

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	a = relative atomic mass
Key	**X**	**X** = atomic symbol
	b	b = atomic (proton) number

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