



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.

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

(i) Fig. 1.1 shows his first experiment.

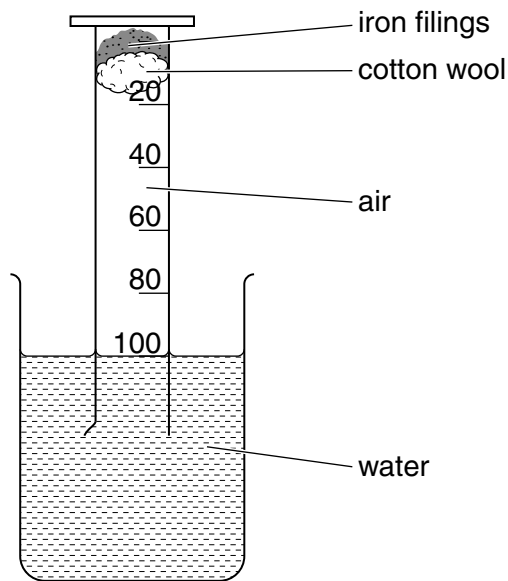


Fig. 1.1

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

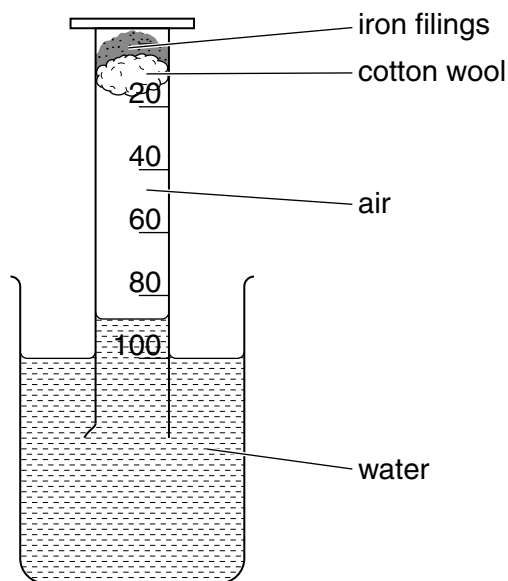


Fig. 1.2

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.

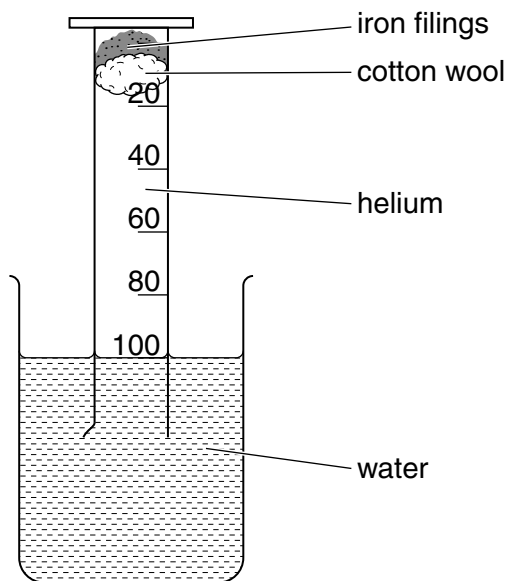


Fig. 1.3

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.

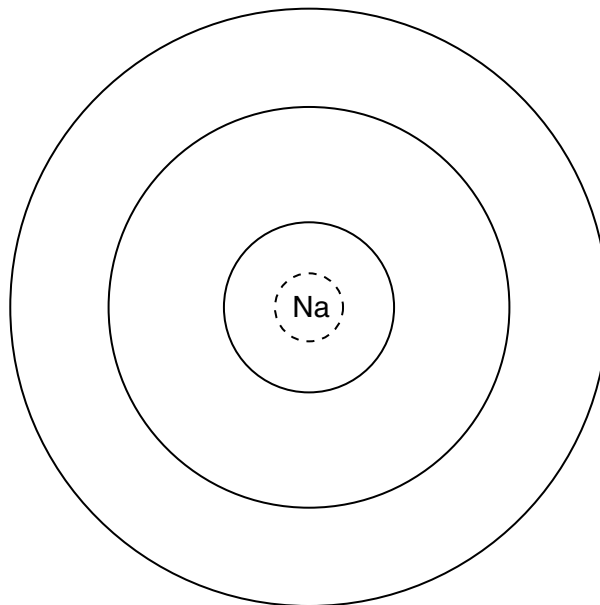
1

.....

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.

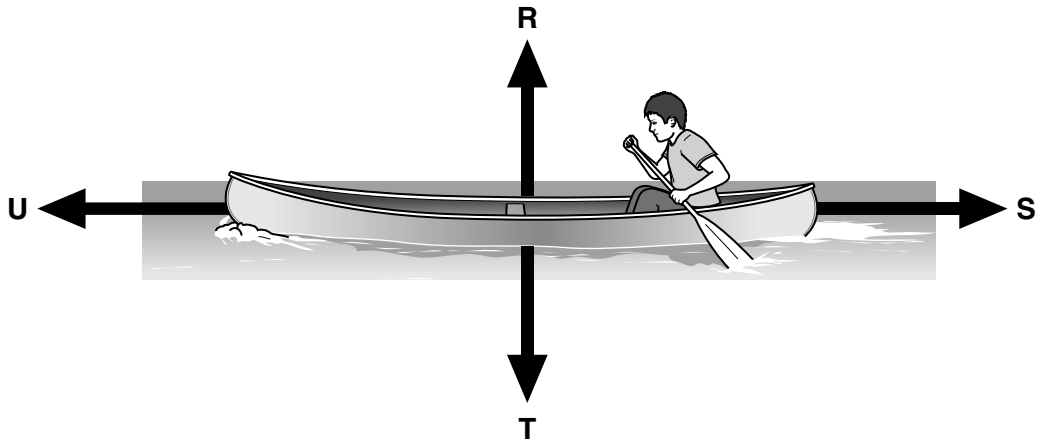


Fig. 2.1

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

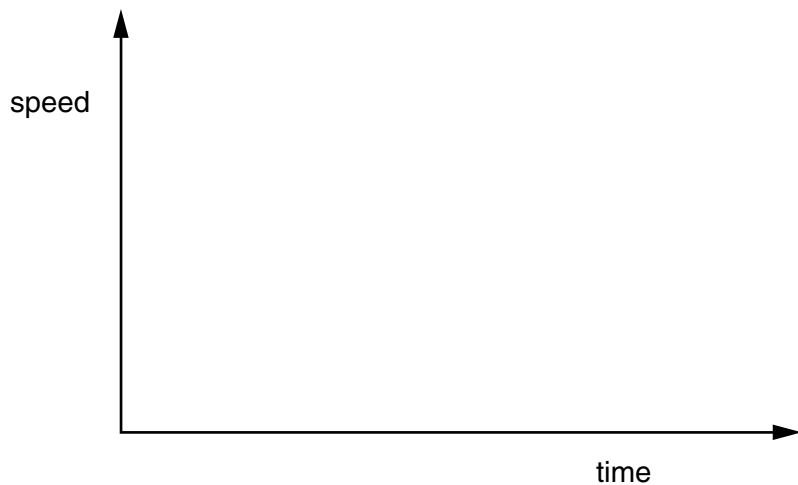
..... and [1]

(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.

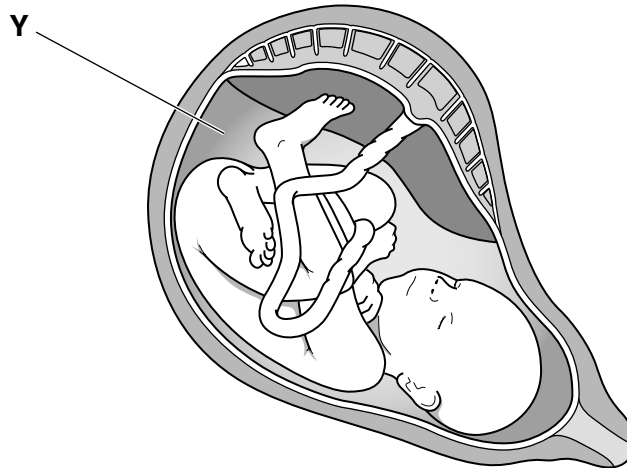


Fig. 3.1

(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 | | |

| |
|---------------------------------------------------------------------------------------------------|
| <p>key ✓ = enzyme active ✗ = enzyme inactive</p> |
|---------------------------------------------------------------------------------------------------|

[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]

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.

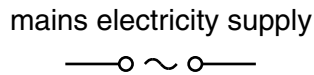
- (a) The hairdryer contains a switch, a heater to warm the air and an electric motor to drive the fan. The heater and the motor are connected in parallel.

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



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.

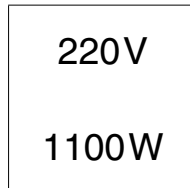


Fig. 4.3

- (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).

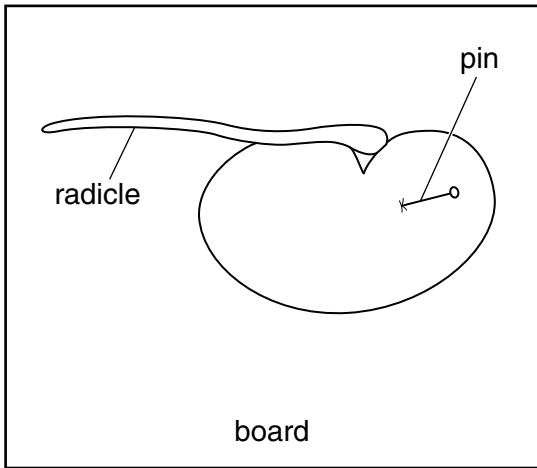


Fig. 5.1 (a)

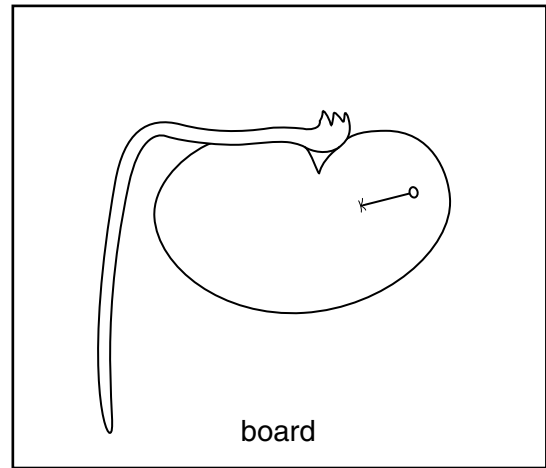


Fig. 5.1 (b)

- (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).

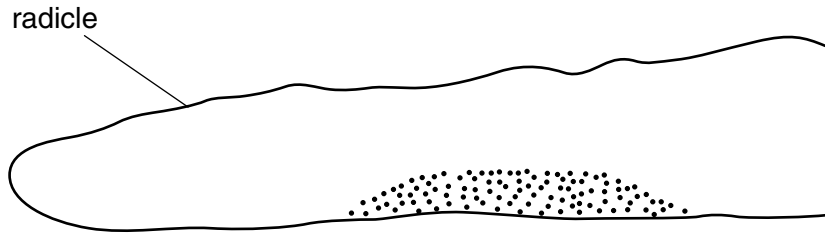


Fig. 5.2

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]

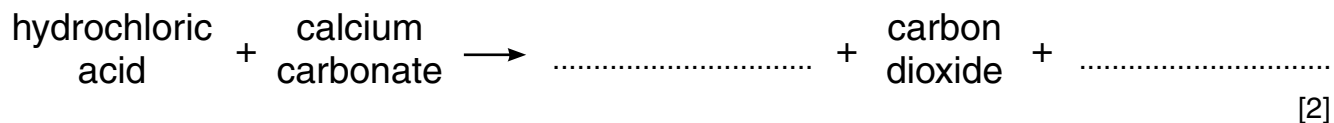
(ii) Predict and explain the effect this will have on the rate of growth of the seedling.

.....
.....[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.



(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.

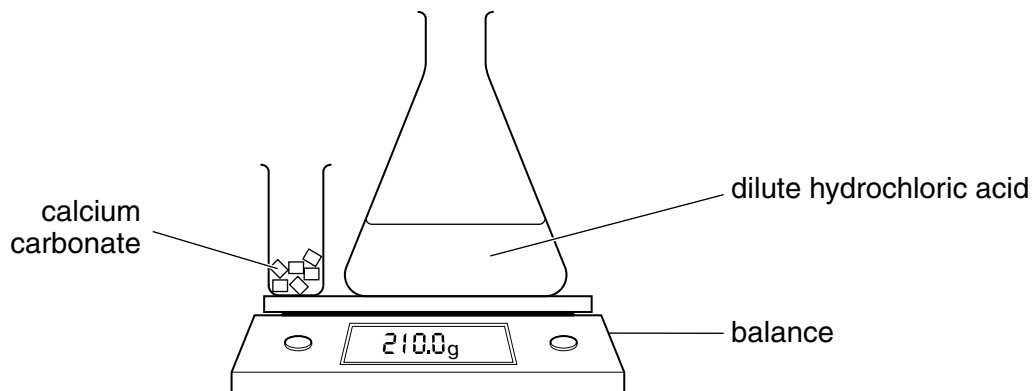


Fig. 6.1

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.

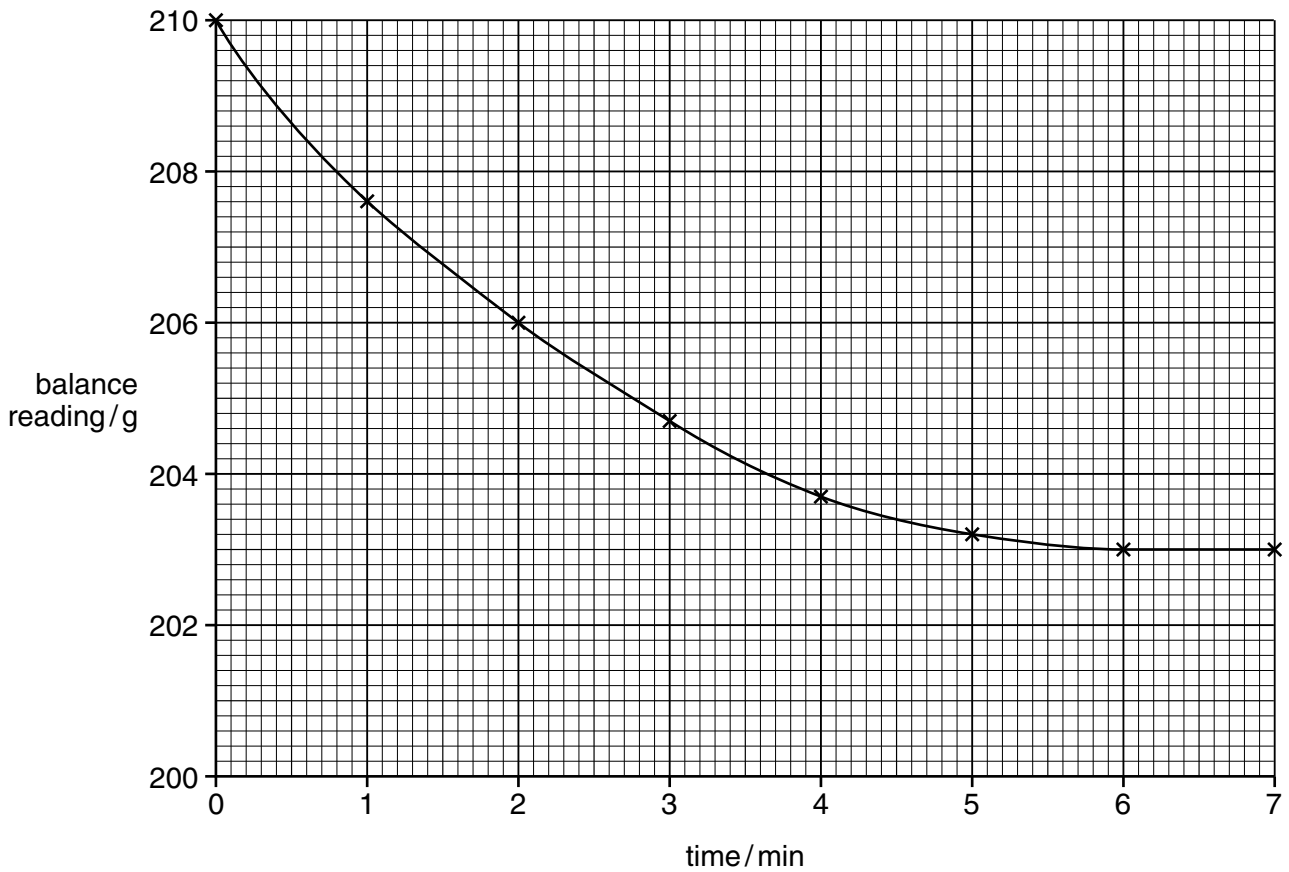


Fig. 6.2

(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.



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*.

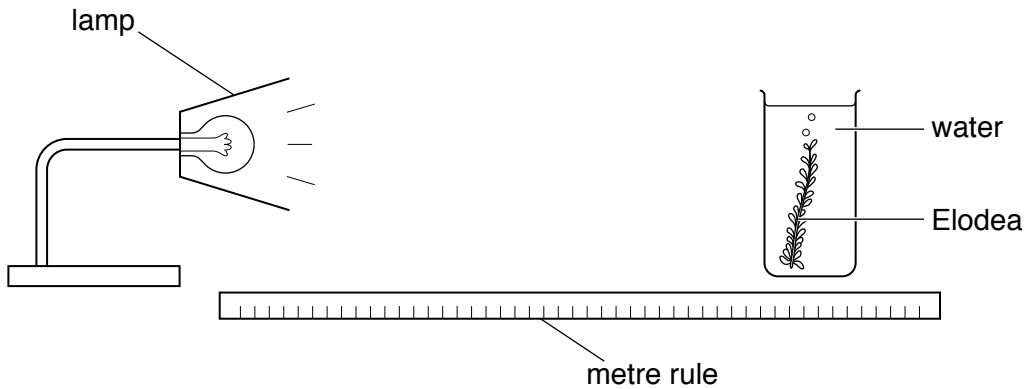


Fig. 8.1

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.

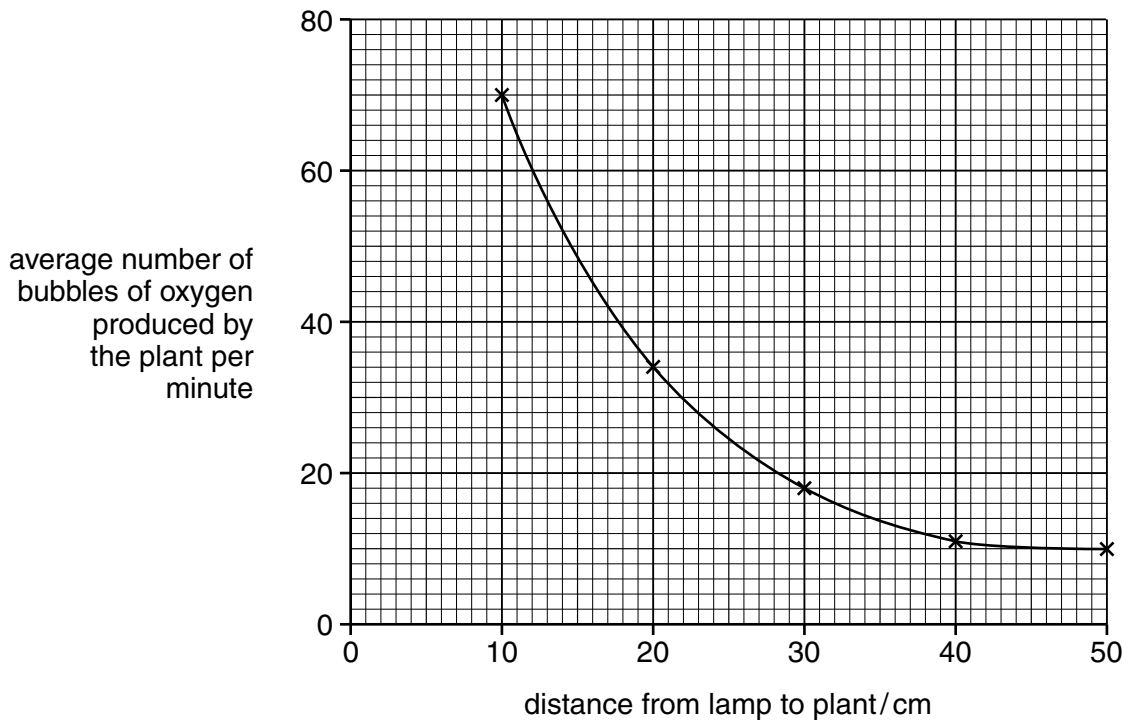


Fig. 8.2

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.

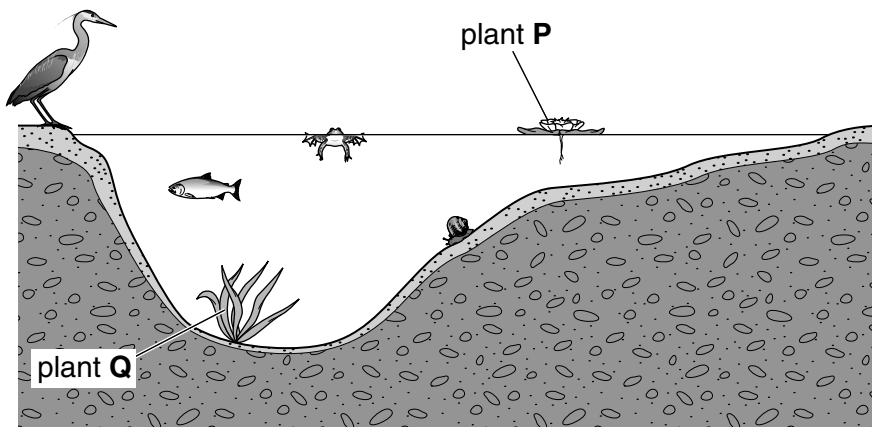


Fig. 8.3

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.

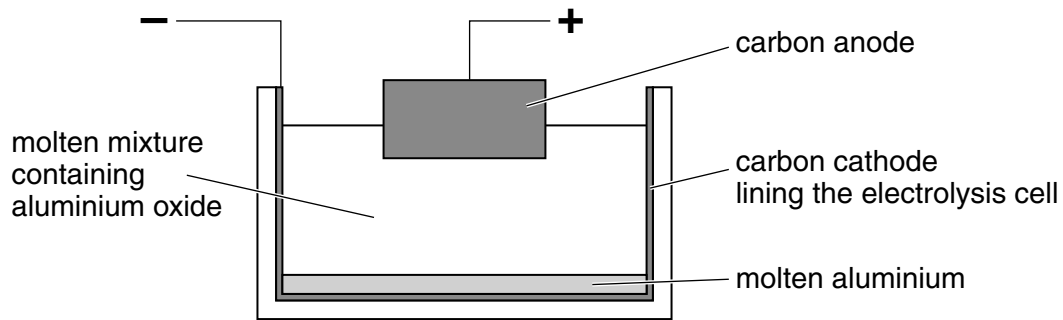


Fig. 9.1

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 | | | | | | |
| 7 Li Lithium 3 | 9 Be Beryllium 4 | 1 H Hydrogen 1 | 11 B Boron 5 | 12 C Carbon 6 | 13 Al Aluminium 13 | 14 Si Silicon 14 | 15 P Phosphorus 15 | 16 S Sulfur 16 | 17 Cl Chlorine 17 | 18 Ar Argon 18 | 19 F Fluorine 9 | 20 Ne Neon 10 | 4 He Helium 2 |
| 23 Na Sodium 11 | 24 Mg Magnesium 12 | 25 Mn Manganese 25 | 26 Fe Iron 26 | 27 Co Cobalt 27 | 28 Ni Nickel 28 | 29 Cu Copper 29 | 30 Zn Zinc 30 | 31 Ga Gallium 31 | 32 Ge Germanium 32 | 33 As Arsenic 33 | 34 Se Selenium 34 | 35 Br Bromine 35 | 36 Kr Krypton 36 |
| 39 K Potassium 19 | 40 Ca Calcium 20 | 41 Nb Niobium 41 | 42 Mo Molybdenum 42 | 43 Tc Technetium 43 | 44 Ru Ruthenium 44 | 45 Rh Rhodium 45 | 46 Pd Palladium 46 | 47 Ag Silver 47 | 48 Cd Cadmium 48 | 49 In Indium 49 | 50 Sn Tin 50 | 51 Sb Antimony 51 | 52 Te Tellurium 52 |
| 85 Rb Rubidium 37 | 88 Sr Strontium 38 | 91 Zr Zirconium 40 | 93 Nb Niobium 41 | 94 Mo Molybdenum 42 | 96 Cr Chromium 24 | 99 Y Yttrium 39 | 101 Ru Ruthenium 44 | 103 Rh Rhodium 45 | 106 Pd Palladium 46 | 108 Ag Silver 47 | 110 Cd Cadmium 48 | 112 Zn Zinc 30 | 115 In Indium 49 |
| 133 Cs Caesium 55 | 137 Ba Barium 56 | 141 Pr Praseodymium 59 | 142 Nd Neodymium 60 | 143 Pm Promethium 61 | 144 Sm Samarium 62 | 145 Eu Europium 63 | 146 Gd Gadolinium 64 | 147 Tb Terbium 65 | 148 Dy Dysprosium 66 | 149 Ho Holmium 67 | 150 Er Erbium 68 | 151 Tm Thulium 69 | 152 Yb Ytterbium 70 |
| 223 Fr Francium 87 | 226 Ra Radium 88 | 231 Pa Protactinium 91 | 232 Th Thorium 90 | 233 U Uranium 92 | 234 Np Neptunium 93 | 235 Pu Plutonium 94 | 236 Am Americium 95 | 237 Cm Curium 96 | 238 Bk Berkelium 97 | 239 Cf Californium 98 | 240 Es Einsteinium 99 | 241 Fm Fermium 100 | 242 Md Mendelevium 101 |
| 287 Uu Ununseptium 117 | 288 Uub Ununbium 118 | 289 Uuq Ununquadium 119 | 290 Uuq Ununquadium 119 | 291 Uuq Ununquadium 119 | 292 Uuq Ununquadium 119 | 293 Uuq Ununquadium 119 | 294 Uuq Ununquadium 119 | 295 Uuq Ununquadium 119 | 296 Uuq Ununquadium 119 | 297 Uuq Ununquadium 119 | 298 Uuq Ununquadium 119 | 299 Uuq Ununquadium 119 | 300 Uuq Ununquadium 119 |

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

Key

| | | |
|---|----------|----------------------------|
| a | X | a = relative atomic mass |
| | X | X = atomic symbol |
| b | | b = atomic (proton) number |

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

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