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0654/02

**May/June 2009**

**2 hours**

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, highlighters, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

A copy of the Periodic Table is printed on page 28.

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.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
<b>Total</b>	

This document consists of **25** printed pages and **3** blank pages.

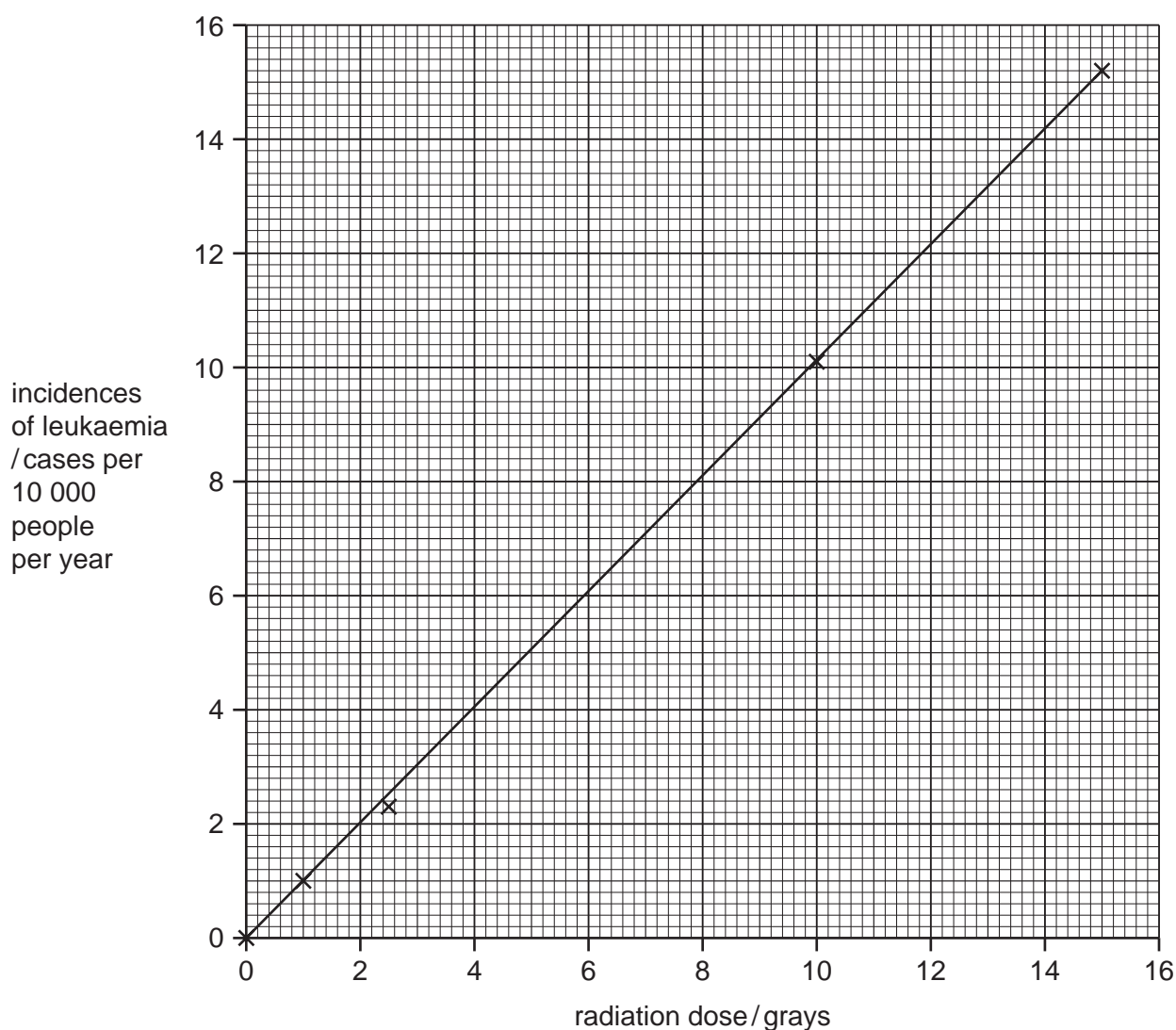
- 1 (a) Many people have survived accidents where they have been exposed to ionising radiation from radioactive materials. Such exposure can have serious effects on their health.

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The table and graph show how the dose (amount) of radiation received is linked to a type of cancer called leukaemia. The radiation dose is measured in units called grays.

**Table 1.1**

radiation dose / grays	incidences of leukaemia / cases per 10 000 people per year
1.0	1.0
2.5	2.3
5.0	
10.0	10.1
15.0	15.2



**Fig. 1.1**

- (i) The result for 5.0 grays has been missed out of the table.

Use the graph to help you fill in the missing result in the table. [1]

- (ii) What is the relationship between the ionising radiation and the incidence of leukaemia?

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

- (iii) Name **one** other health hazard, apart from leukaemia and other cancers, caused by ionising radiation.

..... [1]

- (b) The three types of nuclear radiation from naturally occurring sources are alpha, beta and gamma. They can be identified by their different penetrating powers.

Gamma radiation can pass through a thick layer of lead. Explain how you could identify alpha and beta radiation by their penetrating powers.

alpha radiation .....

.....

beta radiation .....

..... [2]

- (c) Radon-222 has a half-life of four days.

- (i) What is meant by the term *half-life*?

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

- (ii) 1 milligram of radon-222 is allowed to decay.

Calculate after how many days there would be 0.125 milligrams of radon-222 remaining.

Show your working.

..... [2]

2 Fig. 2.1 shows the water cycle.

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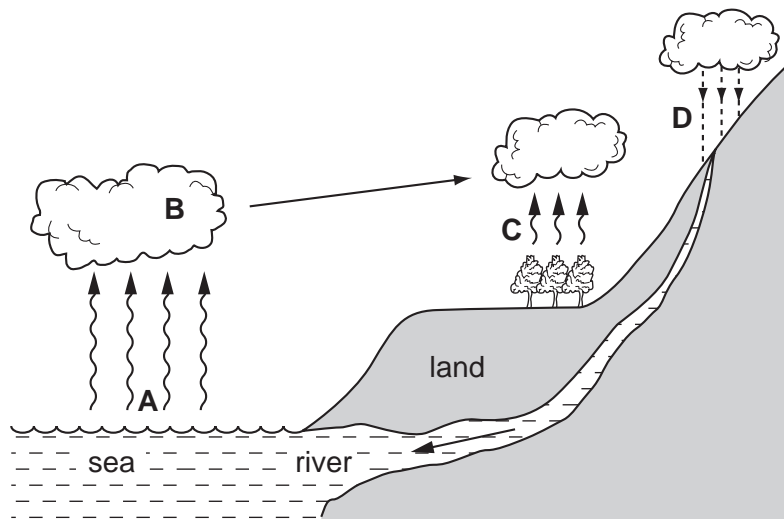


Fig. 2.1

(a) Choose the word from the list below that describes each of the stages **A**, **B**, **C** and **D**.

**condensation**

**evaporation**

**melting**

**osmosis**

**precipitation**

**transpiration**

**A** .....

**B** .....

**C** .....

**D** .....

[4]

(b) Describe **two** ways in which deforestation may affect the water cycle.

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

(c) Water is an essential part of the diet. Water is absorbed from the alimentary canal into the blood. It is transported around the body to every cell.

(i) Name the part of the blood that transports water around the body.

..... [1]

(ii) Describe how water moves from the blood into a body cell.

.....  
.....  
.....  
..... [3]

(d) Water that is to be used for drinking is often treated with chlorine.

Explain why this is done.

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

3 Food colourings contain molecules which make food appear coloured.

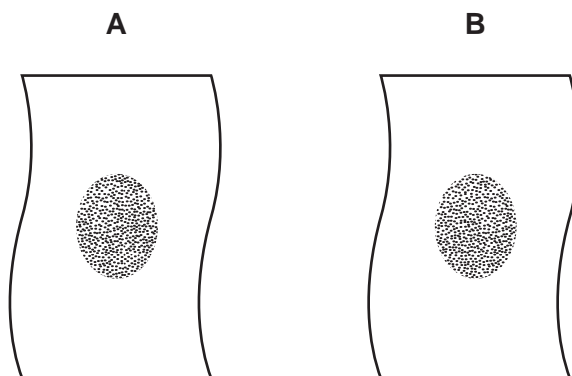
(a) Explain the meaning of the term *molecule*.

.....

.....

..... [2]

(b) Fig. 3.1 shows two pieces of cloth, **A** and **B**, stained with the same food colouring.

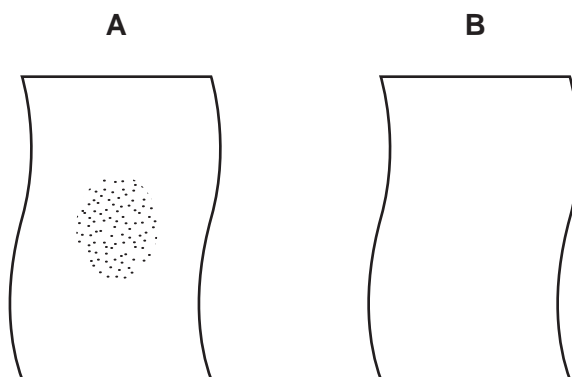


**Fig. 3.1**

Cloth **A** was washed with soap in hard water.

Cloth **B** was washed in the same way with the same amount of soap in soft water.

Fig. 3.2 shows the pieces of cloth after washing.



**Fig. 3.2**

Explain briefly, in terms of water hardness, why more of the food colouring was removed from cloth **B** than from cloth **A**.

.....

.....

.....

..... [3]

- (c) One compound which causes hardness in water is calcium hydrogencarbonate,  $\text{Ca}(\text{HCO}_3)_2$ .

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- (i) State the total number of atoms which are shown combined in the formula of calcium hydrogencarbonate.

..... [1]

- (ii) State the number of electrons in the outer energy level (shell) of a calcium atom.

Explain your answer briefly.

number of outer electrons .....

explanation .....

.....

..... [2]

- 4 (a) A student investigated how a change in potential difference across a lamp affected the current flowing through it.

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She used wires to connect the components shown in Fig. 4.1 to make a circuit.

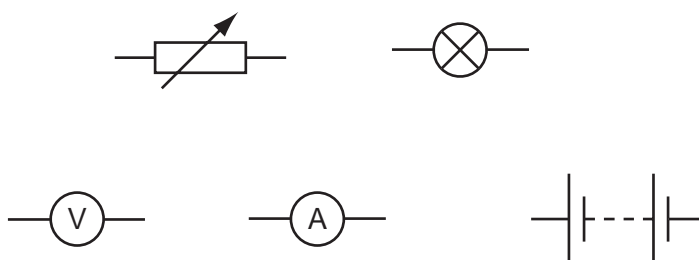


Fig. 4.1

- (i) Using the correct symbols from Fig. 4.1, draw a diagram to show the circuit she used.

[3]

- (ii) Explain why the variable resistor is included in the circuit.

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



- (iii) Her results are shown in Table 4.1.

**Table 4.1**

potential difference across lamp / V	current through lamp / A	resistance of lamp filament / $\Omega$
4	1.2	3.3
8	1.5	
12	1.7	7.1

Complete the table by calculating the missing resistance and writing your answer in the empty box.

State the formula that you use and show your working.

formula

working

[2]

- (iv) The student concluded that the relationship between potential difference and current did not correspond to Ohm's law.

Explain why the relationship between potential difference and current for the lamp did not correspond to Ohm's law.

.....

.....

..... [2]

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(b) Electricity can kill.

Identify and explain the electrical hazard shown in Fig. 4.2.

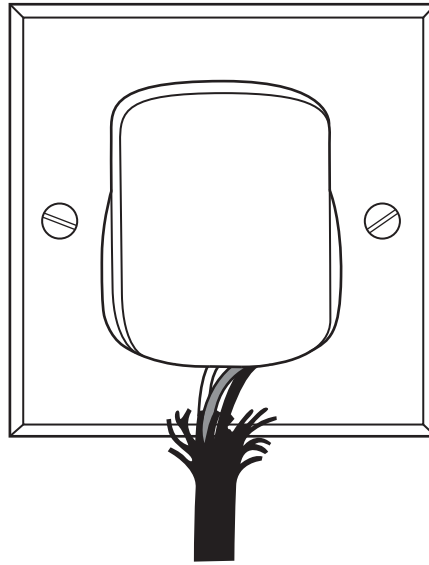


Fig. 4.2

.....

.....

.....

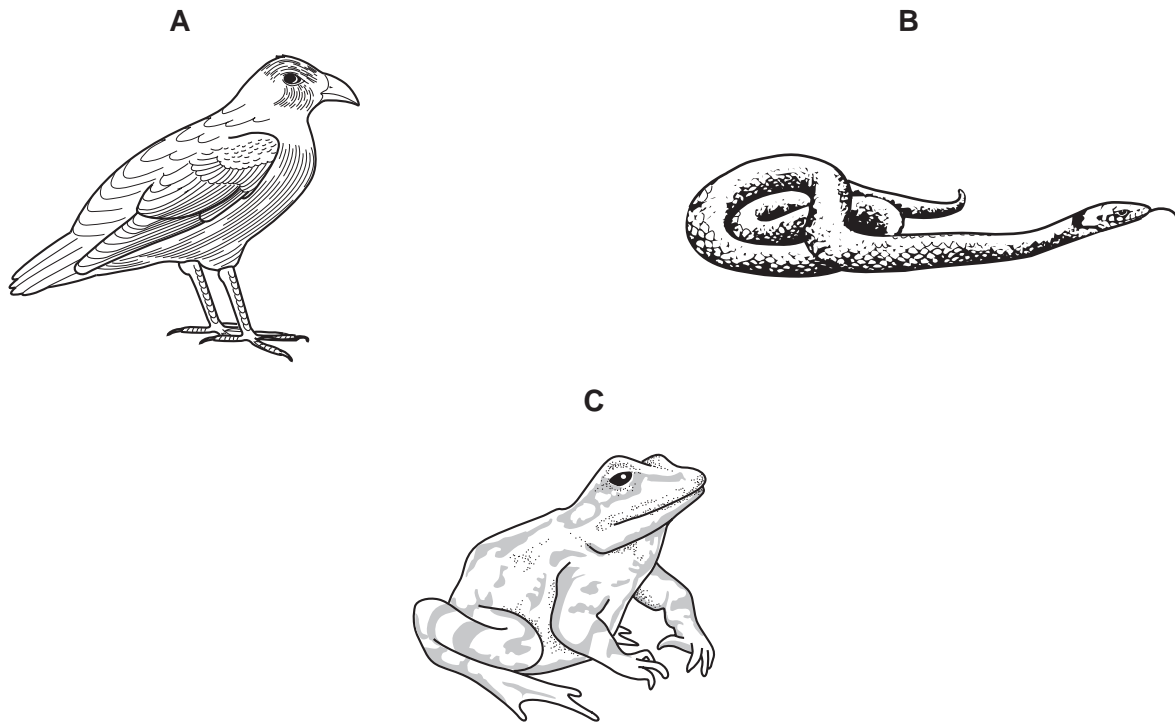
..... [2]

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**Please turn over for Question 5.**

5 Fig. 5.1 shows three vertebrates.



**Fig. 5.1**

- (a) (i) Animal **A** is a bird. State two features, visible on Fig. 5.1, that are characteristic of birds.

1 .....  
2 ..... [2]

- (ii) Name the classes to which animals **B** and **C** belong.

**B** .....  
**C** ..... [2]

- (iii) Animal **C** belongs to the genus *Rana* and the species *temporaria*.

Write the binomial for animal **C**.

..... [1]

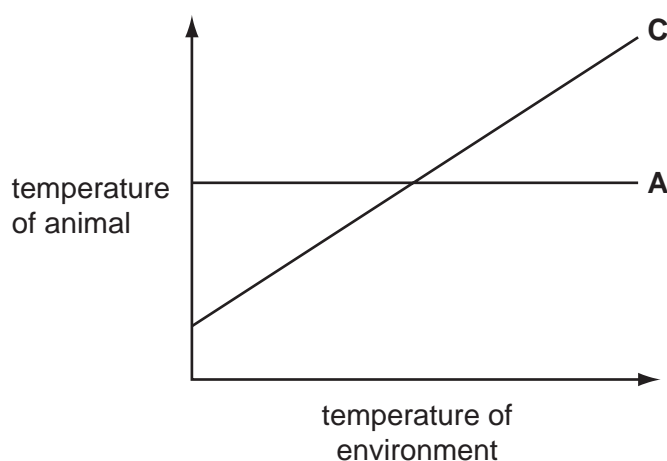
- (iv) Animal **C** spends part of its time in water.

Describe **one** way, visible in Fig. 5.1, in which animal **C** is adapted for life in water.

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

- (b) Fig. 5.2 shows how the temperatures of animal **A** and animal **C** change when the temperature of their environment changes.

For  
Examiner's  
Use



**Fig. 5.2**

- (i) Explain how Fig. 5.2 shows that animal **A** regulates its temperature but animal **C** does not.

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

- (ii) Name **one** group of vertebrates, other than birds, that regulates body temperature.

..... [1]

- (iii) Explain why it is useful to regulate body temperature.

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

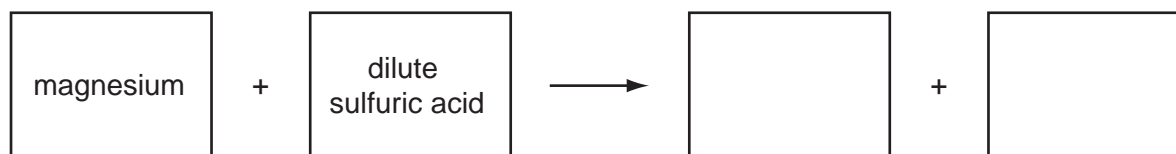
- (iv) Animals that regulate their body temperature need to eat much more food than animals that do not.

Suggest an explanation for this.

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

- 6 (a) Many metals react with dilute acids.

Complete the word equation for the reaction of magnesium with dilute sulfuric acid.



[2]

- (b) A student used the apparatus shown in Fig. 6.1 to investigate the rate of reaction between sulfuric acid and magnesium.

To start the reaction, she tilted the flask to mix the reactants.

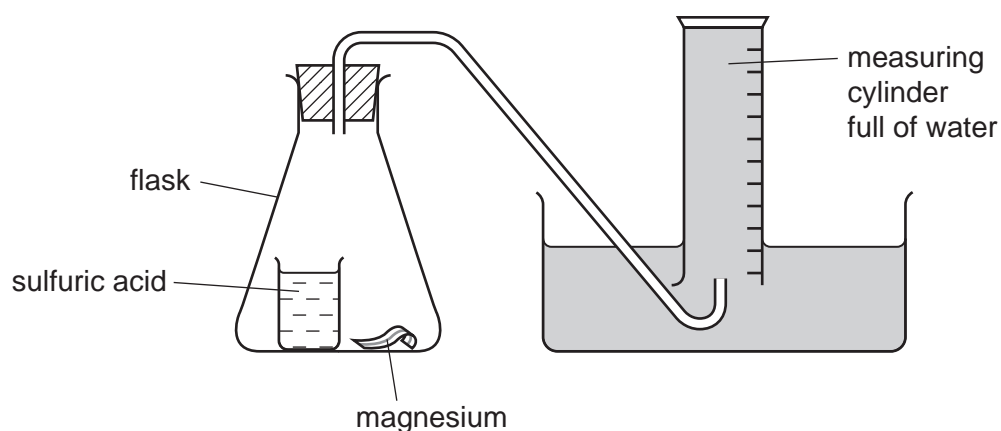


Fig. 6.1

She timed how long it took for 30.0 cm<sup>3</sup> of gas to collect in the measuring cylinder.

Some of her results are shown in Table 6.1.

Table 6.1

experiment number	time to collect 30 cm <sup>3</sup> gas / seconds
1	73
2	41
3	119

- (i) Explain in which experiment, 1, 2 or 3, the rate of reaction was highest.

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

For  
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Use

- (ii) Suggest two changes to the reaction conditions in experiment 1 that would cause the rate of reaction to decrease.

*For  
Examiner's  
Use*

1 .....

.....

2 .....

.....

[2]

- (iii) During experiment 1, the student noticed that the flask became warm.

Explain this observation.

.....

.....

.....

[2]

7 A diver is working under water, wearing a diving suit and helmet.

(a) The diving helmet has a plastic window of area  $100 \text{ cm}^2$ . The air pressure inside the helmet is the same as the water pressure outside.

(i) At a depth of 40 m, the diver breathes air at a pressure of  $50 \text{ N/cm}^2$ .

Calculate the force exerted by the air on the helmet window at this depth.

Use the formula

$$\text{pressure} = \text{force} / \text{area}$$

Show your working.

..... N [2]

(ii) At the surface of the sea, the pressure of the atmosphere is  $10 \text{ N/cm}^2$ .

Suggest a value for the pressure at a depth of 10 m. Explain your answer.

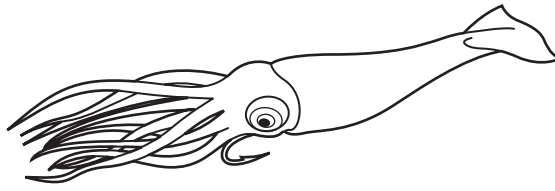
.....  $\text{N/cm}^2$

.....

..... [2]



- (b) The diver sees a squid. A squid moves by forcing out a jet of water.



This moving water has momentum.

The mass of water forced out is 1.2 kg and has a velocity of 10 m/s.

Calculate the momentum of the moving water.

State the formula that you use and show your working.

formula

working

..... kg m/s [2]

- (c) Water waves on the surface of the sea are transverse waves.

- (i) Give **one** other example of a transverse wave.

..... [1]

- (ii) How does a transverse wave differ from a longitudinal wave?

..... [1]

For  
Examiner's  
Use

8 A student carried out an investigation into the response of plant shoots to light.

He grew four maize seedlings and treated them as follows.

- He did nothing to seedlings **A** and **B**.
- He cut the tip off seedling **C**.
- He covered the tips of seedling **D** with black paper.

He placed seedling **A** where it received light from all directions.

He placed seedlings **B**, **C** and **D** in a container where they received light from one side only.

Fig. 8.1 shows the appearance of the four seedlings when the experiment was first set up, and after one day.

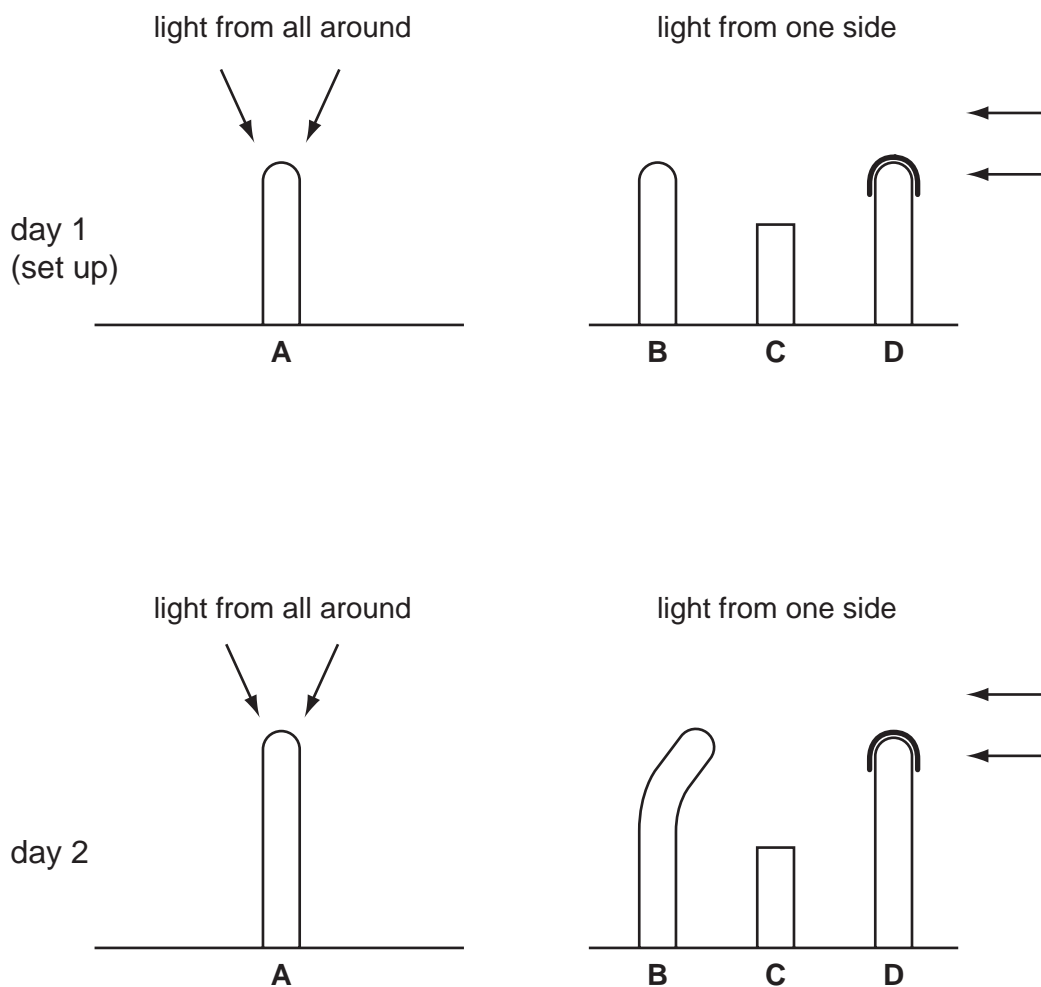


Fig. 8.1

- (a) The student concluded that the tip of a shoot is needed for growth.

Describe the evidence in Fig. 8.1 that supports his conclusion.

.....

.....

..... [2]

- (b) Compare the appearance of shoots **A** and **B** on day 2.

.....

.....

..... [2]

- (c) Explain how the results of this experiment show that the receptor that is sensitive to light is at the tip of the shoot.

.....

.....

..... [2]

- (d) Explain why it is useful for a plant to grow towards the light.

.....

.....

..... [2]

- 9 (a) Fig. 9.1 shows apparatus that a student used to investigate the electrolysis of sodium chloride solution.

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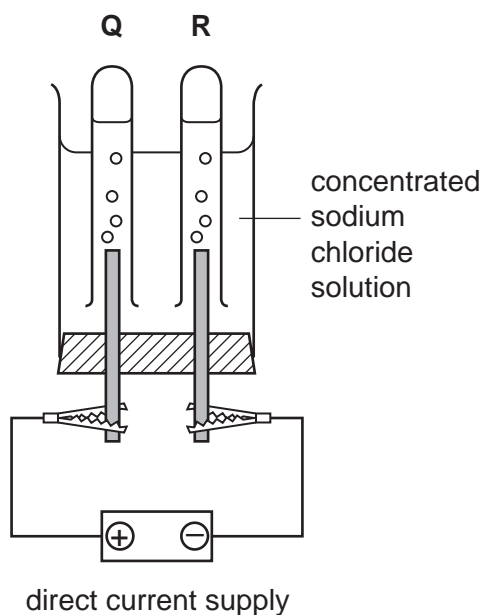


Fig. 9.1

When an electric current flowed through the circuit, gases collected in tubes **Q** and **R**.

- (i) Label the cathode in Fig. 9.1. [1]

- (ii) The gas in tube **Q** bleached damp litmus paper.

Name the gas which collected in tube **Q**. ..... [1]

- (iii) Name the gas which collected in tube **R**. ..... [1]

- (iv) During this electrolysis, the pH of the solution increased.

Explain why this occurred.

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

(b) When chlorine gas is bubbled through a colourless solution of potassium iodide, the solution turns dark brown because the element iodine is formed.

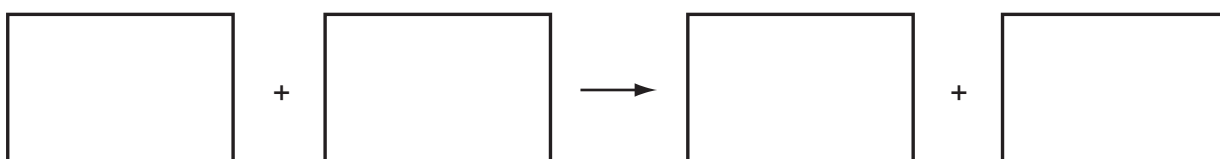
(i) Name this type of chemical reaction and explain briefly why it has occurred.

name of chemical reaction .....

why the reaction occurred .....

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

(ii) Write a **word** equation for the reaction.



[1]

- 10 (a) A plate on the back of an electric cooker gives this information.

power	5000 W
voltage	250 V
a.c. frequency	50 Hz

Fig. 10.1

- (i) Explain what is meant by an *a.c. frequency of 50 Hz*.

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

- (ii) Calculate the current which would flow when the cooker was using 5000 W of power.

Use the formula

$$\text{power} = \text{voltage} \times \text{current}$$

Show your working.

..... A [1]

- (b) The manufacturers of the cooker claim that it has *an efficiency of 50%*.

Explain what this means.

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

- (c) Explain, in terms of heat transfer, why saucepans used on the cooker  
are made of aluminium,

.....

.....

have wooden handles.

.....

.....

[2]

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11 Soybeans (soya beans) provide amino acids, which humans need for growth and repair.

- (a) (i) Name the type of compound that is formed when amino acids link together into polymer molecules.

..... [1]

- (ii) Write the chemical symbol of the element that is found in all amino acids, but which is **not** found in carbohydrates.

..... [1]

- (b) Soybeans contain soybean oil. This is extracted by crushing the beans and then adding the hydrocarbon solvent, hexane. The oil dissolves in hexane which is then separated from the solution by heating.

- (i) Suggest why it is possible to remove hexane from the soybean oil by heating the solution.

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

- (ii) Hexane is a saturated hydrocarbon.

Explain the meaning of the term *saturated hydrocarbon*.

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

- (iii) Hexane molecules contain covalent bonds.

Describe briefly, in terms of electrons, what happens when a covalent bond forms between two atoms.

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



- (c) Increasing amounts of soybean oil are being used to produce biodiesel. Biodiesel is an alternative fuel to diesel, obtained from petroleum (crude oil).

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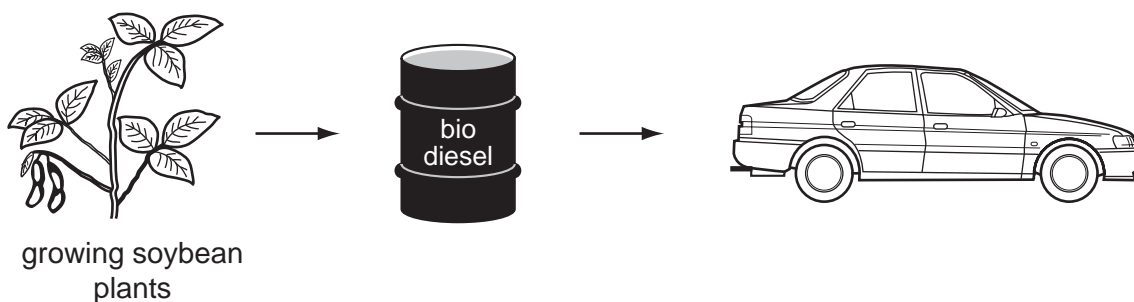


Fig. 11.1

Burning diesel and biodiesel produces similar amounts of carbon dioxide.

However, it is believed that burning biodiesel will cause less increase in the carbon dioxide concentration in the atmosphere.

Suggest the reason for this.

.....

.....

..... [2]

- (d) Biodiesel contains hardly any sulfur compounds.

Explain why this is an advantage of biodiesel when compared to diesel.

.....

.....

.....

..... [2]

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**DATA SHEET**  
**The Periodic Table of the Elements**

Group																	
I	II											III	IV	V	VI	VII	0

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

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

\*58-71 Lanthanoid series  
†90-103 Actinoid series

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