

Centre Number	Candidate Number	Name
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MINISTRY OF EDUCATION, BOTSWANA
 in collaboration with
 UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE
Botswana General Certificate of Secondary Education
SCIENCE : DOUBLE AWARD
Paper 3
0569/03
 October/November 2006
 Candidates answer on the Question Paper
 No Additional Materials are required.
2 hours

Read the following carefully before you start.

Write your centre number, candidate number and name in the spaces provided at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

Do not use staples, paper clips, highlighters, glue or correction fluid.

The number of marks is given in brackets [] at the end of each question or part question.

You may use a calculator.

A copy of the Periodic Table is printed on Page 20.

For Examiner's Use

1	
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TOTAL	

- 1 A boy drops a stone of mass 0.5 kg into a well. The stone takes 2 seconds to reach the bottom of the well. ($g = 10 \text{ N/kg}$).

(a) Calculate the depth of the well.

depth =[2]

(b) Calculate the kinetic energy of the stone **just** before it reaches the bottom of the well.

kinetic energy =[2]

(c) Calculate the velocity of the stone **just** before hitting the bottom of the well.

velocity =[2]

(d) What assumption did you make in answering (b)?

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

(e) If the boy now drops a 1.0 kg stone into the well, how would the value of the kinetic energy compare with your answer to (b)?

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

- 2 A student performs an experiment to determine the period of a simple pendulum. She uses a stopwatch to record the time taken for 20 oscillations. Fig. 2.1 shows the face of the stopwatch used.

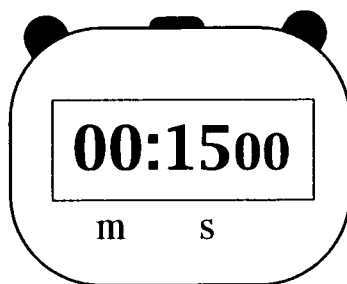


Fig. 2.1

- (a) What is the time recorded by the stopwatch?

time =[1]

- (b) Calculate the period of the pendulum.

period =[2]

- (c) State **one** factor that would affect the period of the pendulum.

.....[1]

- (d) After some time, the pendulum would stop oscillating. Give a reason for this observation.

.....
[1]

- 3 (a) A hot metal block is immersed in a beaker containing 500 g of water. The temperature of the water rises by 20°C . Calculate the amount of heat energy gained by the water (specific heat capacity of water = $4200 \text{ J/kg }^{\circ}\text{C}$).

heat energy =[2]

- (b) Explain why the energy lost by the metal block does not equal the energy gained by the water.

.....

[2]

- 4 Fig. 4.1 shows a slide projector.

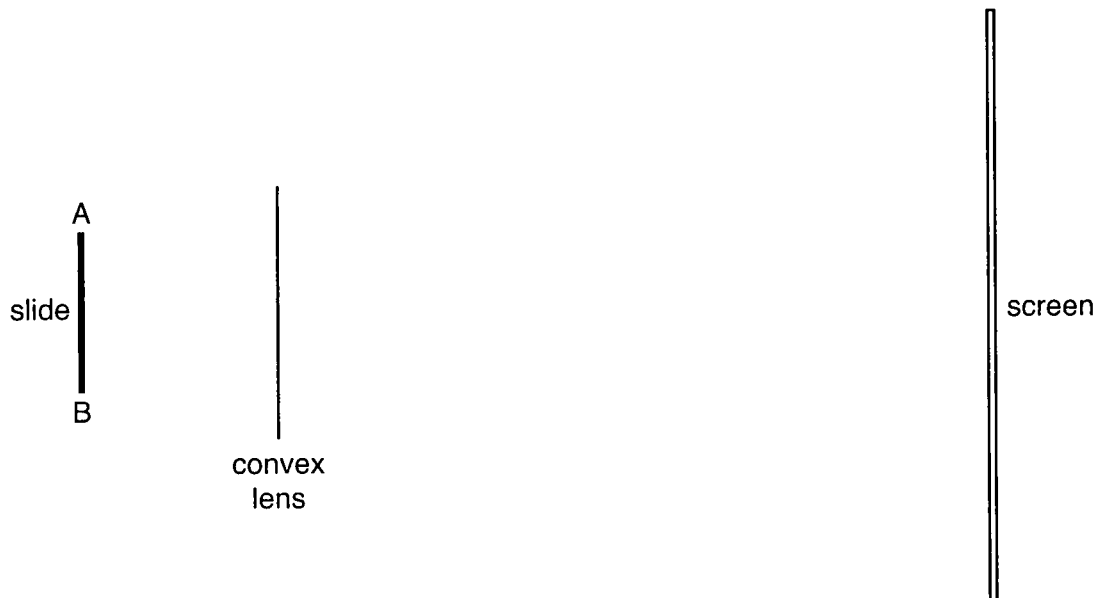


Fig. 4.1

- (a) On Fig. 4.1, draw two rays to show how an image of the slide is formed on the screen. [2]

- (b) Give **two** properties of the image formed.

1
 2[2]

(c) If the image is not clear, how can it be focused?

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

(d) Give **one** way in which the image formed by a projector is different from that formed by a camera.

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

- 5 (a) Fig. 5.1 shows the charge on a balloon after it has been rubbed with a woollen cloth.

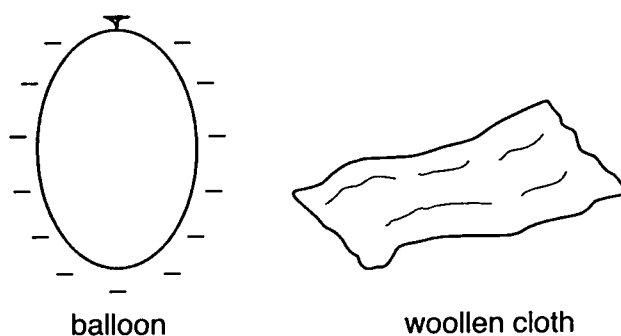


Fig. 5.1

- (i) Explain why the balloon becomes negatively charged.

.....
[1]

- (ii) Explain why the balloon is attracted to the woollen cloth.

.....
[1]

- (b) Fig. 5.2 shows a plastic rod brought near the metal cap of a positively charged gold-leaf electroscope. The divergence of the leaf increases.

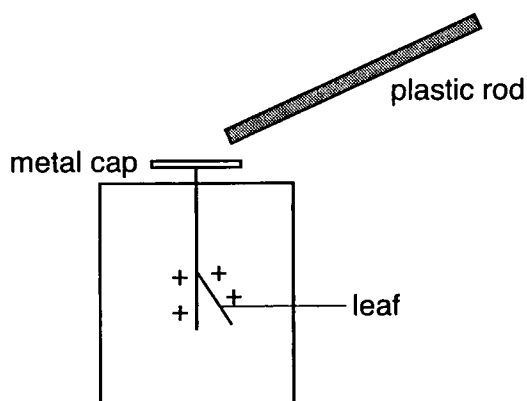


Fig. 5.2

- (i) What is the charge on the plastic rod?

.....[1]

- (ii) The plastic rod is taken away, and the cap of the electroscope is touched with a finger. What will be observed?

.....

Explain your answer.

.....

.....

.....[2]

- 6 Fig. 6.1 shows two bulbs connected in a circuit with a battery and two ammeters. Ammeter A reads 2 A and ammeter A_1 reads 0.5 A.

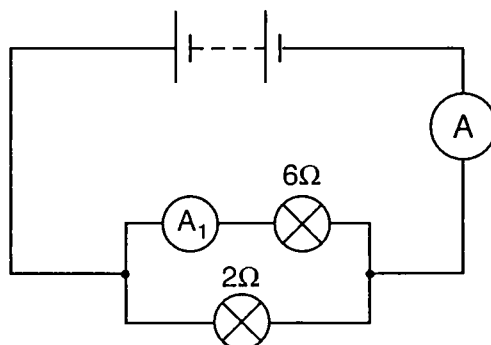


Fig. 6.1

Calculate:

- (a) The current through the $2\ \Omega$ bulb.

current = [2]

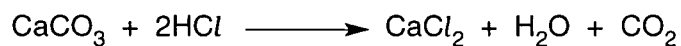
- (b) The potential difference across the $6\ \Omega$ bulb.

potential difference = [2]

- (c) What is the potential difference across the battery?

potential difference = [1]

- 7 The equation shows how calcium carbonate reacts with hydrochloric acid.



- (a) Calculate the relative molecular mass of calcium carbonate.
Use the Data Sheet on page 20 to help with your calculation.

RMM = [1]

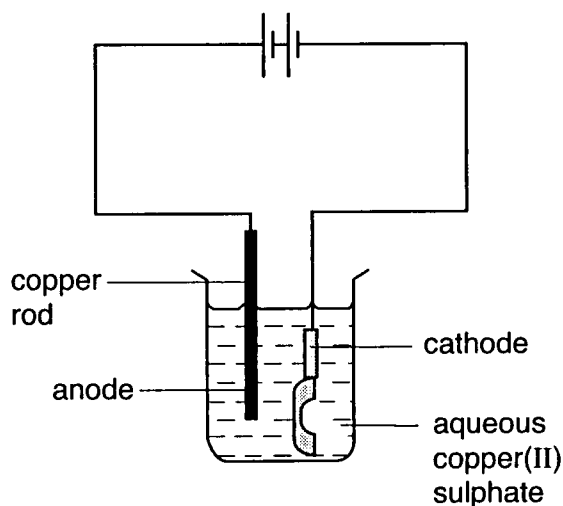
- (b) (i) Calculate the mass of carbon dioxide produced when 25.0 g of calcium carbonate reacts with excess hydrochloric acid.

mass = [2]

- (ii) Calculate the volume occupied by the mass of carbon dioxide in (b)(i) measured at room temperature and pressure.

volume = [2]

- 8 The diagram shows how a door handle was electroplated with copper.



- (a) Complete the statement below by using some words in the diagram.

In the electrolytic cell the door handle is connected as the and
the electrolyte is [2]

The process was carried out for 2 hours.

- (b) Describe the appearance of each of the following after 2 hours;

- (i) electrolyte;

.....

- (ii) copper rod;

.....[2]

- (c) Explain why the colour of the solution does not change.

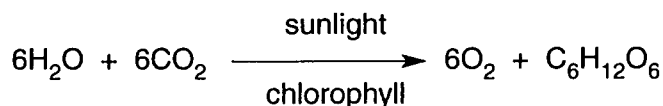
.....[1]

- (d) Write ionic equations for the anode and cathode reactions.

- (i) anode

- (ii) cathode[2]

- 9 The chemical equation represents the process of photosynthesis.



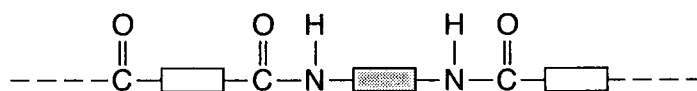
The reaction proceeds in stages. Bonds between atoms in reactant molecules have to be broken, and then new bonds formed between atoms in the product molecules.

Use this information to explain why the reaction is endothermic.

.....

[2]

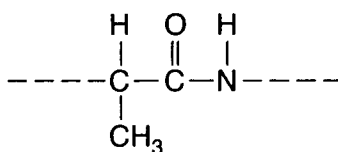
- 10 The structure of a macromolecule, nylon, is shown.



- (a) What is a macromolecule?

.....[1]

Proteins are also macromolecules. The structure of a protein is shown.



- (b) Write one similarity and one difference between the structures of nylon and the protein.

(i) similarity:
[1]

(ii) difference:
[1]

(iii) Name the type of compounds produced by the hydrolysis of proteins.
[1]

- (c) What are the products of the hydrolysis of fats?

..... and[2]

11 Nitrogen is used for making ammonia in the Haber process.

- (a) Suggest a reason why oxygen should be removed from nitrogen in air before the nitrogen is used.

.....[1]

- (b) (i) Name one acidic oxide of nitrogen formed in car engines.

.....[1]

- (ii) What is the purpose of a catalytic converter in a car exhaust system?

.....

.....[1]

12 Fig. 12.1 shows the laboratory preparation of chlorine.

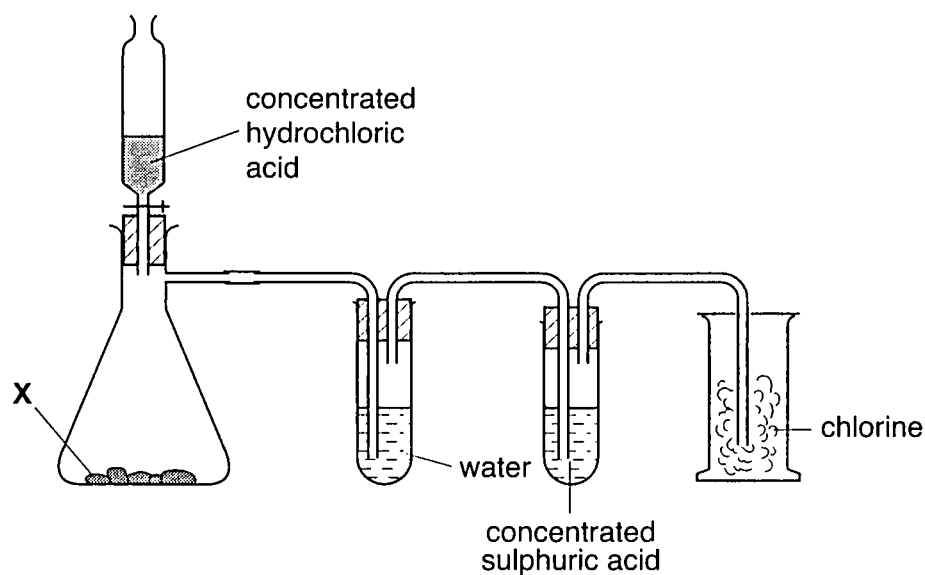


Fig. 12.1

- (a) (i) Name the solid labelled X.

.....[1]

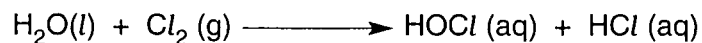
- (ii) What is the purpose of the water in the test tube?

.....[1]

- (b) What is the colour of chlorine gas?

.....[1]

(c) Chlorine reacts with water as shown by the equation.



(i) Name the **two** products for the reaction.

..... and[2]

(ii) One of the products is a bleaching agent. Write the formula of this product.

.....[1]

13 Describe a chemical test for the presence of aluminium ions, Al^{3+} , in an aqueous solution.

test

.....

positive results

.....[3]

- 14 An experiment was carried to investigate the activity of the enzyme amylase. Two test tubes, **P** and **Q**, were set up, each containing equal volumes of amylase, its substrate and either an acidic or alkaline solution, as shown in Fig. 14.1.

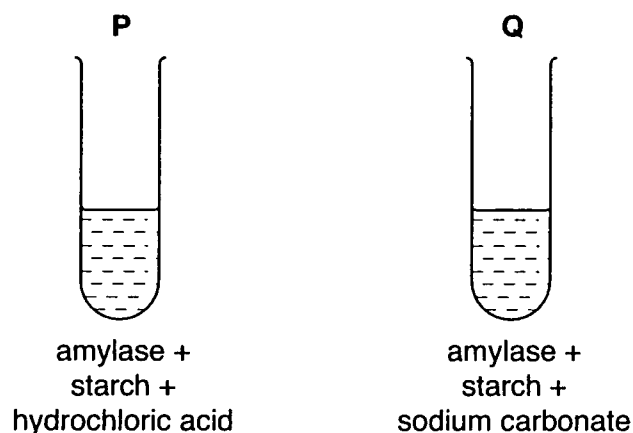


Fig. 14.1

Samples from the test tubes were tested for starch at the start of the experiment. The test tubes were then placed in a water bath kept at 35 °C for one hour. The contents were tested for starch again. The results are as shown in Table 14.1.

Table 14.1

tube	start of experiment	end of experiment
P	blue – black	blue – black
Q	blue – black	brown

- (a) Name the reagent that was used to test for starch.

.....[1]

- (b) (i) In which test tube would the contents test positive for reducing sugar at the end of the experiment?

.....[1]

- (ii) Explain your answer to (i).

.....
[2]

- (c) What factor was being investigated in the experiment?

.....[1]

- (d) Name a part of the alimentary canal where amylase acts.

.....[1]

- 15 Fig. 15.1 shows variation in oxygen concentration, number of bacteria and fish in a river a distance of 50 km from point P, which is up stream from a source of pollution.

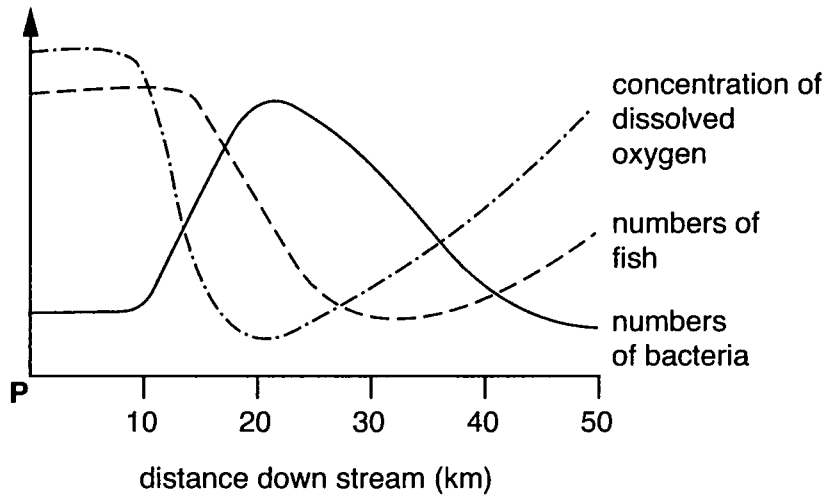


Fig. 15.1

- (a) At what distance from P did the river become polluted?

.....[1]

- (b) With reference to the three curves on Fig. 15.1, state the effect of the pollution on the following:

concentration of dissolved oxygen

numbers of fish

numbers of bacteria[3]

- (c) Explain why the numbers of bacteria started decreasing after a distance of 20 km from point P.

.....

[2]

- 16 Fig. 16.1 shows the changes in numbers of three organisms, X, Y and Z in a pond between January and August.

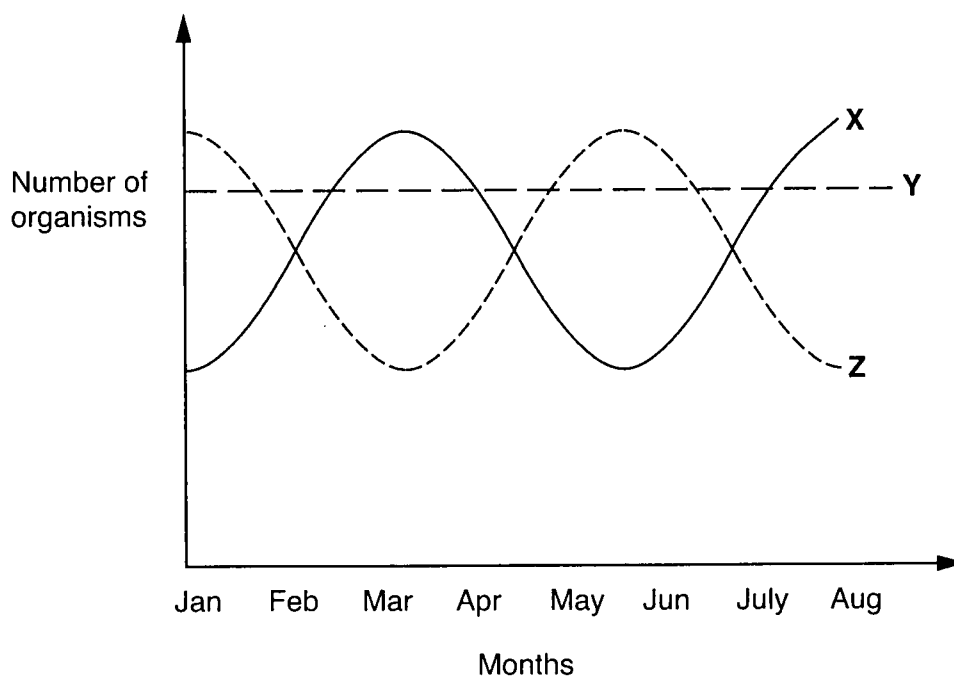


Fig. 16.1

- (a) Which organism has the largest numbers in June?

.....[1]

- (b) A pesticide was sprayed to kill organisms X.

- (i) Suggest in which month organism X was sprayed.

.....[1]

- (ii) Give a reason for your answer.

.....

.....[1]

- (c) Suggest why the population of organism Y remained constant.

.....

.....

.....[2]

- 17 Fig. 17.1 shows three cuttings from one plant placed in a tray of moist soil. The tray and cuttings were covered with a polythene bag. The cuttings developed into individual plants.

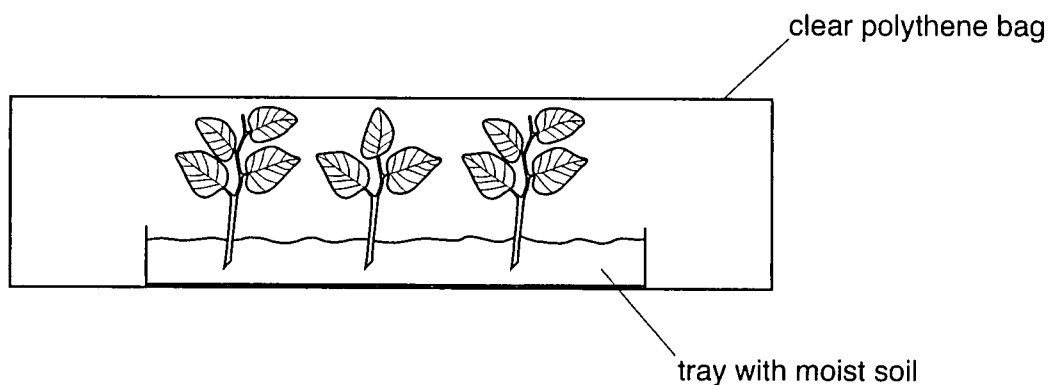


Fig. 17.1

- (a) What form of reproduction is represented in the diagram?
[1]
- (b) The clear polythene bag reduces water loss by evaporation.
- (i) Describe how the polythene bag helps to reduce water loss through leaves of stem cuttings.

[2]
- (ii) Why is it better to use a clear plastic bag rather than a dark coloured one?

[1]

18 Fig. 18.1 shows apparatus used to measure the rate at which a certain gas is used.

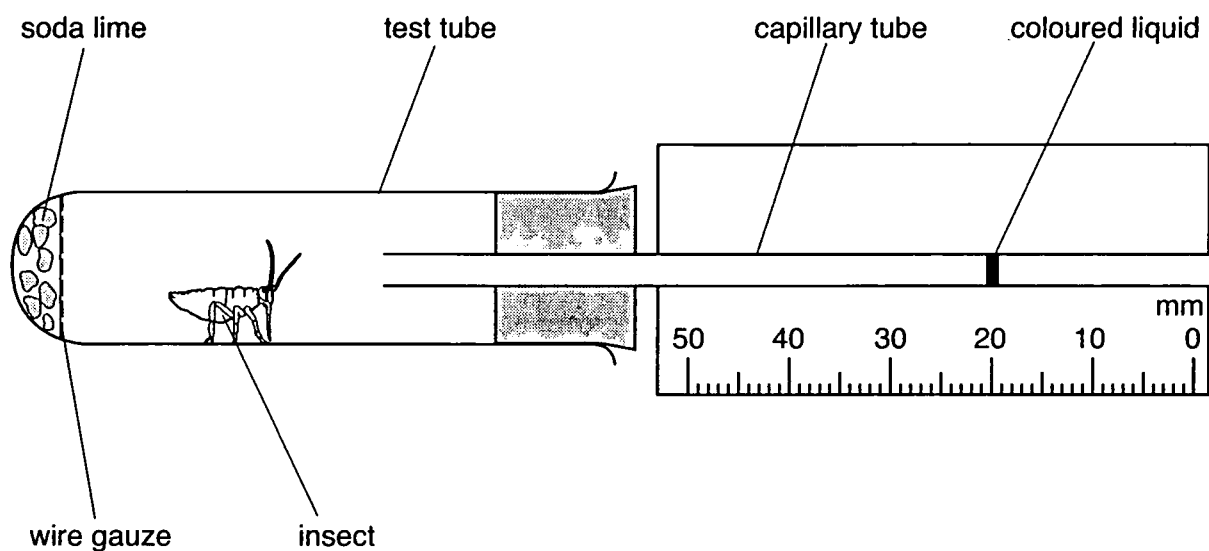


Fig. 18.1

(a) Name the process under investigation.

.....[1]

(b) What is the purpose of soda lime in the test-tube?

.....[1]

(c) After 20 minutes, would the coloured liquid move towards or away from the test-tube?

.....[1]

Explain your answer.

.....

[2]

19 Fig. 19.1 shows two types of cells **A** and **B**.

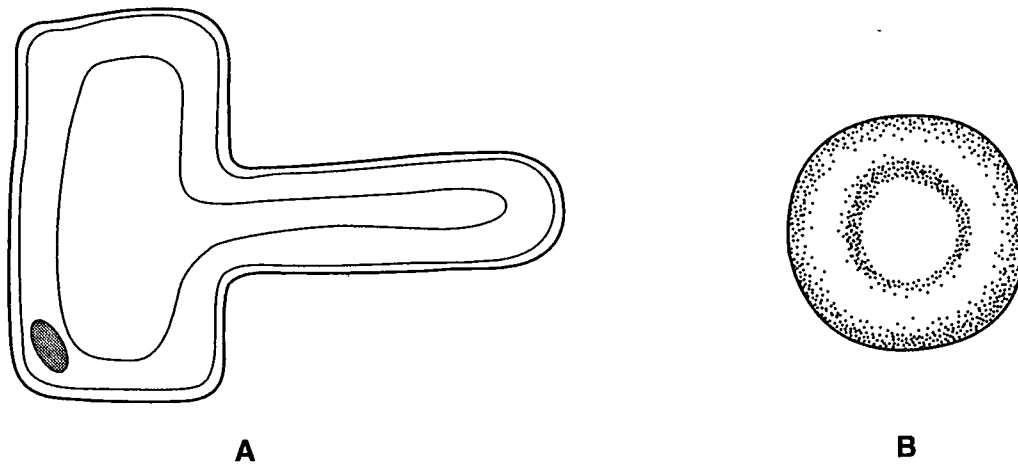


Fig. 19.1

(a) Name cells **A** and **B**.

A

B[2]

(b) Give **two** visible differences between cells **A** and **B**.

	A	B
1
2

[2]

(c) For each cell **A** and **B** state its function and describe how it is adapted for the named function.

A function

adaptation

.....[2]

B function

adaptation

.....[2]

DATA SHEET
The Periodic Table of the Elements

Group																	
I	II											III	IV	V	VI	VII	0
																	<div> <div>4</div> <div>He</div> <div>Helium</div> <div>2</div> </div>
<div> <div>7</div> <div>Li</div> <div>Lithium</div> <div>3</div> </div>	<div> <div>9</div> <div>Be</div> <div>Beryllium</div> <div>4</div> </div>	<div> <div>1</div> <div>H</div> <div>Hydrogen</div> <div>1</div> </div>															
<div> <div>23</div> <div>Na</div> <div>Sodium</div> <div>11</div> </div>	<div> <div>24</div> <div>Mg</div> <div>Magnesium</div> <div>12</div> </div>																
<div> <div>39</div> <div>K</div> <div>Potassium</div> <div>19</div> </div>	<div> <div>40</div> <div>Ca</div> <div>Calcium</div> <div>20</div> </div>																
<div> <div>85</div> <div>Rb</div> <div>Rubidium</div> <div>37</div> </div>	<div> <div>88</div> <div>Sr</div> <div>Strontium</div> <div>38</div> </div>																
<div> <div>133</div> <div>Cs</div> <div>Cesium</div> <div>55</div> </div>	<div> <div>137</div> <div>Ba</div> <div>Barium</div> <div>56</div> </div>																
<div> <div>226</div> <div>Ra</div> <div>Radium</div> <div>88</div> </div>	<div> <div>227</div> <div>Ac</div> <div>Actinium</div> <div>89</div> </div>																
																	<div> <div>175</div> <div>Lu</div> <div>Lutetium</div> <div>71</div> </div>
																	<div> <div>173</div> <div>Yb</div> <div>Ytterbium</div> <div>70</div> </div>
																	<div> <div>169</div> <div>Tm</div> <div>Thulium</div> <div>69</div> </div>
																	<div> <div>167</div> <div>Er</div> <div>Erbium</div> <div>68</div> </div>
																	<div> <div>165</div> <div>Ho</div> <div>Holmium</div> <div>67</div> </div>
																	<div> <div>162</div> <div>Dy</div> <div>Dysprosium</div> <div>66</div> </div>
																	<div> <div>159</div> <div>Tb</div> <div>Terbium</div> <div>65</div> </div>
																	<div> <div>157</div> <div>Gd</div> <div>Gadolinium</div> <div>64</div> </div>
																	<div> <div>152</div> <div>Eu</div> <div>Europium</div> <div>63</div> </div>
																	<div> <div>150</div> <div>Sm</div> <div>Samarium</div> <div>62</div> </div>
																	<div> <div>144</div> <div>Nd</div> <div>Neodymium</div> <div>60</div> </div>
																	<div> <div>141</div> <div>Pr</div> <div>Praseodymium</div> <div>59</div> </div>
																	<div> <div>140</div> <div>Ce</div> <div>Cerium</div> <div>58</div> </div>
																	<div> <div>232</div> <div>Th</div> <div>Thorium</div> <div>90</div> </div>
																	<div> <div>238</div> <div>U</div> <div>Uranium</div> <div>92</div> </div>
																	<div> <div>232</div> <div>Th</div> <div>Thorium</div> <div>90</div> </div>
																	<div> <div>141</div> <div>Pr</div> <div>Praseodymium</div> <div>59</div> </div>
																	<div> <div>144</div> <div>Nd</div> <div>Neodymium</div> <div>60</div> </div>
																	<div> <div>150</div> <div>Sm</div> <div>Samarium</div> <div>62</div> </div>
																	<div> <div>152</div> <div>Eu</div> <div>Europium</div> <div>63</div> </div>
																	<div> <div>157</div> <div>Gd</div> <div>Gadolinium</div> <div>64</div> </div>
																	<div> <div>159</div> <div>Tb</div> <div>Terbium</div> <div>65</div> </div>
																	<div> <div>162</div> <div>Dy</div> <div>Dysprosium</div> <div>66</div> </div>
																	<div> <div>165</div> <div>Ho</div> <div>Holmium</div> <div>67</div> </div>
																	<div> <div>167</div> <div>Er</div> <div>Erbium</div> <div>68</div> </div>
																	<div> <div>169</div> <div>Tm</div> <div>Thulium</div> <div>69</div> </div>
																	<div> <div>173</div> <div>Yb</div> <div>Ytterbium</div> <div>70</div> </div>
																	<div> <div>175</div> <div>Lu</div> <div>Lutetium</div> <div>71</div> </div>
																	<div> <div>103</div> <div>Lr</div> <div>Lawrencium</div> <div>103</div> </div>
																	<div> <div>102</div> <div>No</div> <div>Nobelium</div> <div>102</div> </div>
																	<div> <div>101</div> <div>Md</div> <div>Mendelevium</div> <div>101</div> </div>
																	<div> <div>100</div> <div>Fm</div> <div>Fermium</div> <div>100</div> </div>
																	<div> <div>99</div> <div>Es</div> <div>Einsteinium</div> <div>99</div> </div>
																	<div> <div>98</div> <div>Cf</div> <div>Californium</div> <div>98</div> </div>
																	<div> <div>97</div> <div>Bk</div> <div>Berkelium</div> <div>97</div> </div>
																	<div> <div>96</div> <div>Cm</div> <div>Curium</div> <div>96</div> </div>
																	<div> <div>95</div> <div>Am</div> <div>Americium</div> <div>95</div> </div>
																	<div> <div>94</div> <div>Pu</div> <div>Plutonium</div> <div>94</div> </div>
																	<div> <div>93</div> <div>Np</div> <div>Neptunium</div> <div>93</div> </div>
																	<div> <div>92</div> <div>U</div> <div>Uranium</div> <div>92</div> </div>
																	<div> <div>91</div> <div>Pa</div> <div>Protactinium</div> <div>91</div> </div>
																	<div> <div>90</div> <div>Th</div> <div>Thorium</div> <div>90</div> </div>

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