

Centre Number	Candidate Number	Name
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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

**CO-ORDINATED SCIENCES** **0654/02**

Paper 2 May/June 2004

**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 in the spaces provided on the Question Paper.  
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.

Answer **all** questions.  
The number of marks is given in brackets [ ] at the end of each question or part question.  
A copy of the Periodic Table is printed on page 24.

For Examiner's Use	
1	
2	
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11	
<b>Total</b>	

If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

- 1 (a) Fig. 1.1 shows diagrams of particles in five materials **A** to **E**.

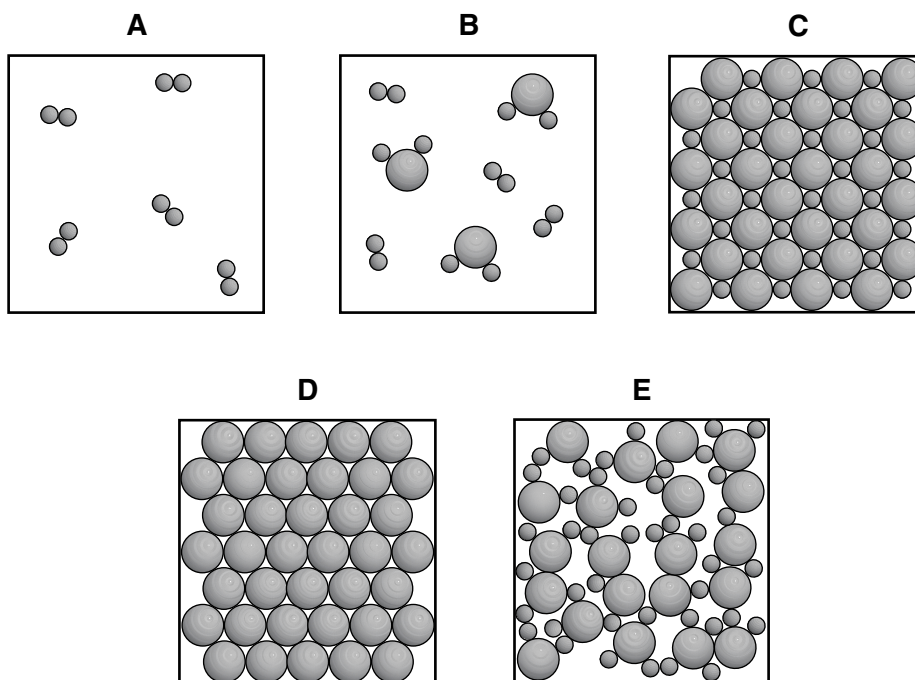


Fig. 1.1

- (i) State which diagram, **A B C D** or **E**, represents
- a solid compound, .....
- a solid element, .....
- a gaseous mixture. .... [3]
- (ii) State the letters of the particle diagrams in Fig. 1.1 that represent
- giant structures, .....
- simple molecules. .... [2]

- (b) The full chemical symbol of an atom of manganese is



- (i) State the number of neutrons in the nucleus of this atom. .... [1]
- (ii) State the number of electrons in a manganese atom. .... [1]
- (iii) Explain why the manganese ion,  $\text{Mn}^{2+}$ , has very nearly the same mass as a manganese atom.

.....

..... [2]

2 (a) (i) Explain how friction is reduced between the bones of the arm when the elbow is bent.

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

(ii) Describe how friction is reduced between the lungs and the rib cage as the lungs inflate and deflate.

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

(b) In the alimentary canal, friction between the food and the walls of the canal is reduced by slippery mucus.

Describe **one** other function of mucus in the human body.

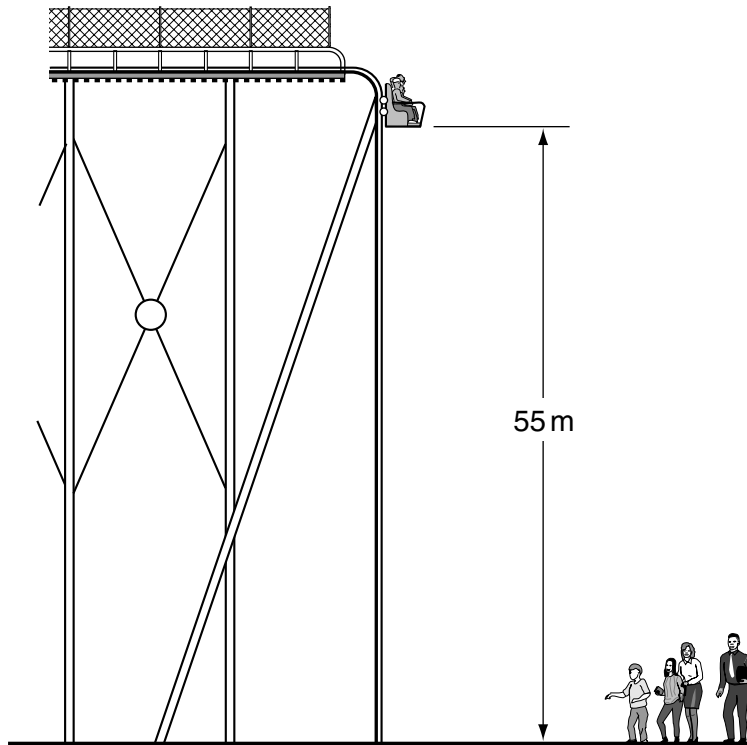
.....  
.....  
..... [2]

(c) The inner lining of blood vessels is normally very smooth, so that blood can flow through them easily. However, sometimes deposits of cholesterol can build up on the inner surface of the blood vessels supplying the heart wall. This makes the surface much rougher. When blood platelets come into contact with a rough surface, they tend to form blood clots.

Use this information, and your own knowledge, to explain why a person whose diet contains a lot of animal fat has an increased risk of having a heart attack.

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

- 3 A ride at a theme park consists of a car of mass 4800 kg, which holds 20 people and falls a vertical distance of 55 m. Its maximum speed during this fall is 30 m/s.



- (a) If the average mass of a passenger is 60 kg, calculate the total mass of the car and 20 passengers.

..... kg [1]

- (b) Calculate the maximum kinetic energy of the ride during its fall.

Show your working and state the formula that you use.

formula

working

..... J [2]

- (c) Calculate the weight of the car and 20 passengers.

Earth's gravitational force is 10 N/kg.

..... N [1]

- (d) Calculate the work done in raising the car and 20 passengers from the bottom to the top of its 55 metre fall.

Show your working and state the formula that you use.

formula

working

..... J [2]

- (e) The electric motor which lifts the car and passengers is rated at 100 kW. Calculate the time it would take for the car and passengers to be raised from the bottom to the top of the fall.

Show your working and state the formula that you use.

formula

working

..... s [2]

- (f) In practice, the time taken to reach the top of the fall will be longer than your answer to part (e). Explain why.

..... [1]

(g) The passengers in the car scream when the car begins to drop.

(i) Explain how the sound of the screams travels through the air to people watching the ride.

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

(ii) Sound is an example of a longitudinal wave.  
Give **one** example of a transverse wave.

..... [1]



4 A rock sample, thought to be limestone, is tested in a laboratory.

(a) Fig. 4.1 shows apparatus used for one of the tests applied to the rock sample.

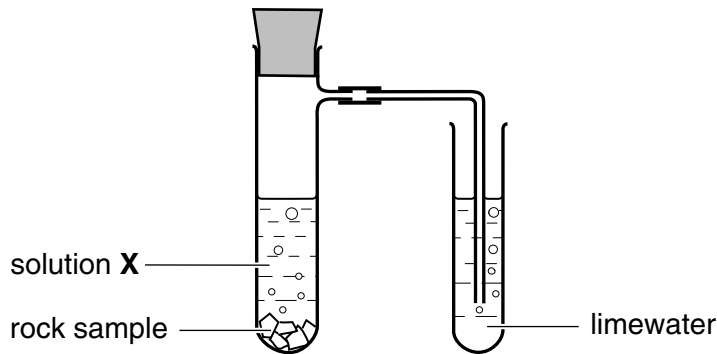


Fig. 4.1

During the test the limewater turns cloudy.

(i) Name the gas produced when solution X reacts with the rock sample.

..... [1]

(ii) Suggest the name of solution X.

..... [1]

(iii) Explain how this test provides some evidence that the rock may be limestone.

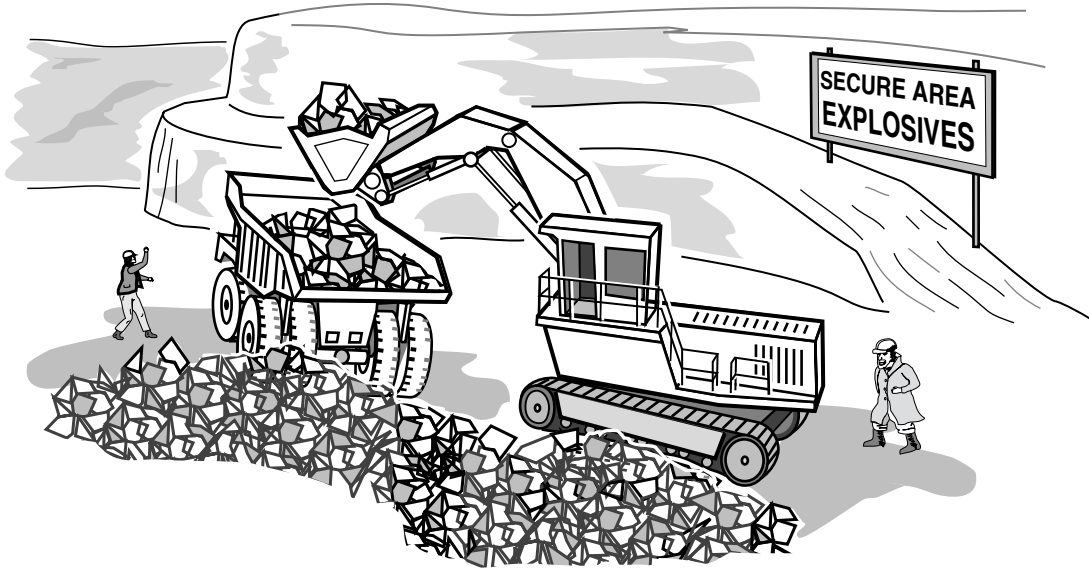
.....  
 .....  
 ..... [2]

(b) Describe another test which could be applied to the rock sample to find out whether it contained any **calcium** compounds.

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



- (c) Limestone is extracted from the Earth's crust by quarrying. Explosives are used to break up the rocks which are then taken away in large trucks.



Suggest **one** environmental problem caused by the extraction process.

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

5 Fig. 5.1 shows part of the nitrogen cycle.

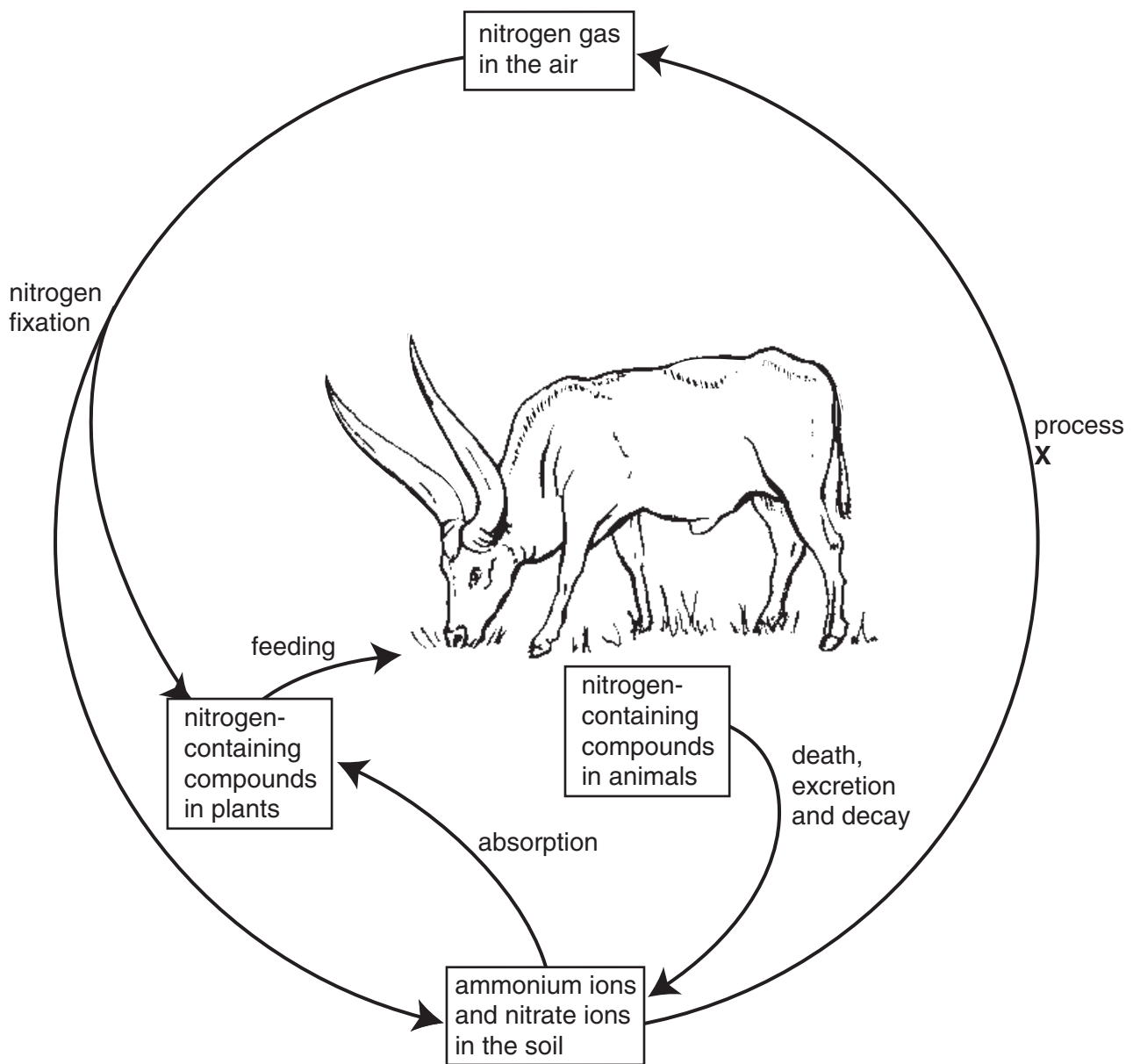


Fig. 5.1

(a) Name **one** type of molecule, found in both animals and plants, which contains nitrogen.

..... [1]

(b) Describe **one** way in which nitrogen fixation can occur.

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

(c) Name process X.

..... [1]

(d) (i) Describe how plants take up nitrate ions from the soil.

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

(ii) Name the tissue in which these ions are transported within the plant.

..... [1]

- 6 (a) A small balloon was charged negatively by rubbing it on a piece of woollen cloth. It was hung from a nylon thread supported by a metal stand. A plastic rod, which had been rubbed on a different cloth, was held near the balloon. The balloon moved away from the plastic rod as shown in Fig. 6.1.

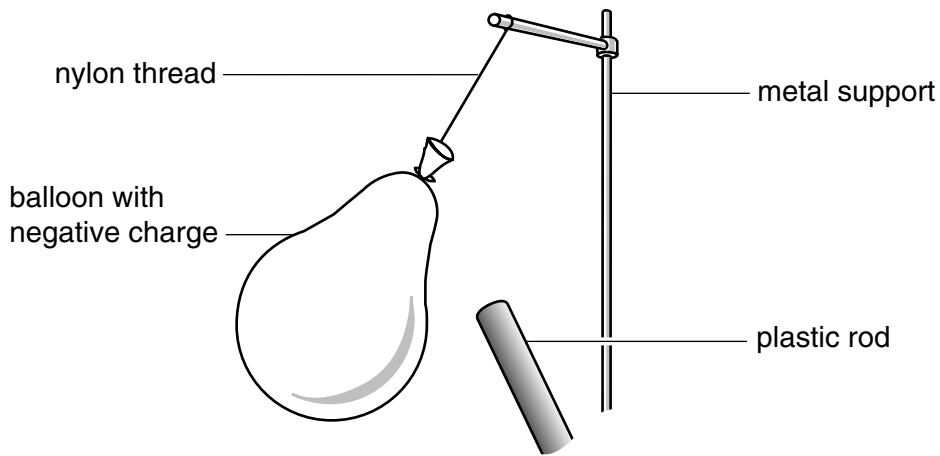


Fig. 6.1

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

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

- (ii) Explain why the balloon moved away from the plastic rod.

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

- (iii) Describe and explain what would happen if the nylon thread is replaced with a thin metal wire and the experiment repeated.

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

(b) Fig. 6.2 shows a large hot air balloon.



Fig. 6.2

(i) Explain why a hot air balloon rises when the air inside the balloon is heated.

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

(ii) Hot air balloons, which are designed to travel long distances, are often painted a silver colour.

Suggest a reason for this.

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

(c) A small object falls from the balloon.

Choose the best words or phrases from the list to complete the sentences below.

- |                    |                     |                                |
|--------------------|---------------------|--------------------------------|
| <b>accelerates</b> | <b>air pressure</b> | <b>falls at a steady speed</b> |
| <b>friction</b>    | <b>gravity</b>      | <b>slows down</b>              |

The weight of an object is the force of gravity acting on it.

When an object is dropped, it initially .....

The faster it falls the bigger the force of ..... acting on it.

Eventually the object ..... [3]

7 Sugars, starch and proteins from plants provide food for other organisms. Starch and proteins are natural polymer molecules.

(a) (i) Describe briefly **one** major difference between a polymer molecule and a molecule such as carbon dioxide.

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

(ii) Name the monomer molecules which have reacted to form the polymer molecules in starch.

..... [1]

(b) A student extracted the coloured material from some green leaves. She ground up the leaves to break the cell walls so that the green substance could form a solution in ethanol.

She then carried out paper chromatography using the solution and obtained the chromatogram shown in Fig. 7.1.

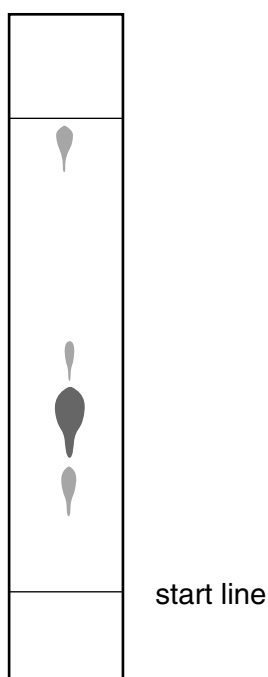


Fig. 7.1

(i) Suggest why the solution used in the experiment was made by using ethanol and not water.

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

(ii) Describe briefly what the student had to do to obtain the chromatogram shown in Fig. 7.1.

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

(iii) From the chromatogram, what conclusion can the student draw about the coloured material she extracted from the leaves?

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

8 Scientists have predicted that by 2010 more people will be dying because of illness caused by obesity (being very overweight) than from most other causes. People become obese when they take in much more energy in food than their bodies use each day.

(a) (i) Name the **three** types of nutrient that contain energy which our bodies can use.

..... [1]

(ii) State how any extra energy taken in as food is stored in the body.

..... [1]

(b) One of the illnesses that often develops as a result of obesity is diabetes. In this illness, the body is not able to control the level of glucose in the blood.

(i) Name the hormone that is secreted when the blood glucose level goes too high, and which helps to bring the level down to normal.

..... [1]

(ii) Name the organ that secretes this hormone.

..... [1]

(iii) Using your knowledge of osmosis, suggest why it is dangerous for the body if blood glucose levels become much higher than normal.

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



(c) Energy in food is converted by respiration into a form that the body can use. Fig. 8.1 shows a group of respiring cells and a blood capillary.

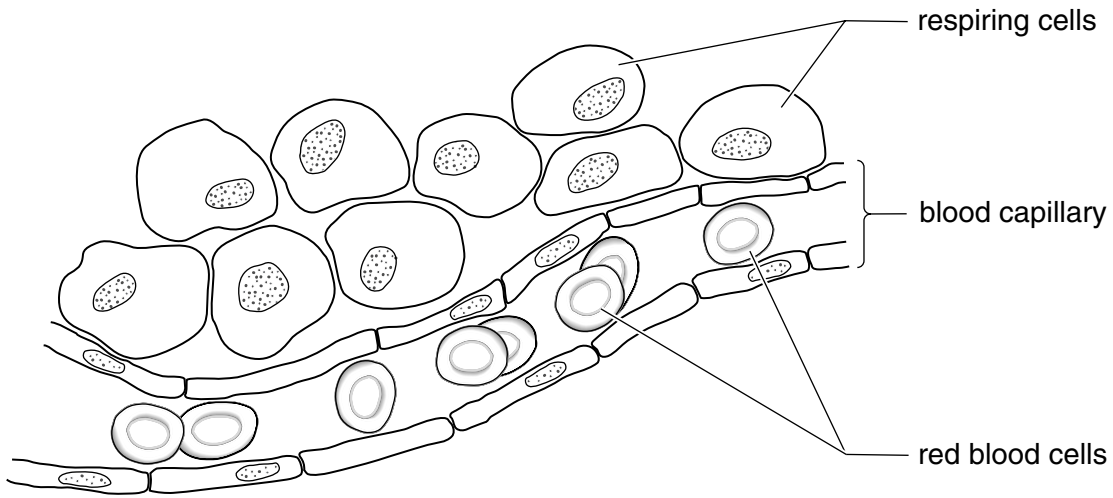


Fig. 8.1

(i) Describe how oxygen passes from the blood into the respiring cells.

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

(ii) Describe what happens in respiring muscle cells if the blood capillary does not deliver as much oxygen as they need.

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

- 9 Read the passage and then answer the questions which follow.

Some power stations generate electricity using nuclear fission. In 1986, an accident occurred in a power station at Chernobyl in Ukraine. This released many radioactive isotopes into the atmosphere. Wind and rain caused these materials to contaminate grass all over Europe.

One of the most important radioactive isotopes is caesium-137 because it remains in the environment for a long time. After sheep had been eating contaminated grass for five weeks, their bodies contained this isotope. Young lambs feeding on their mother's milk were found to have a very high concentration of caesium-137 in their tissues.



- (a) Explain what happens to an atom when nuclear fission occurs.

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

- (b) Explain the meaning of the term *isotope*.

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

- (c) Suggest why young lambs became very contaminated as a result of their diet.

..... [1]

- (d) A scientist suggested that it was safer to walk on the radioactive grass than to eat meat from a sheep a few weeks after the accident.

Explain why this was correct.

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

- (e) The accident increased the background radiation present in the environment. Give **one** natural cause of background radiation.

..... [1]

- (f) State **one** advantage of nuclear power as a method of generating electricity compared to the burning of fossil fuels.

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

- 10 A student investigates the rate of reaction between dilute sulphuric acid and magnesium ribbon. The apparatus he uses is shown in Fig. 10.1. When the conical flask is gently shaken, the container of sulphuric acid tips over, allowing the reaction to start.

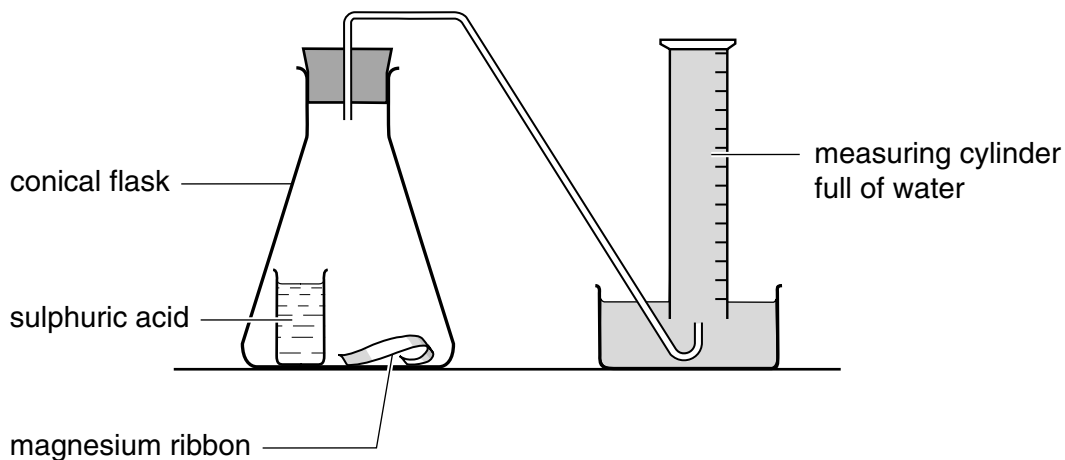


Fig. 10.1

In this reaction hydrogen gas is formed and it bubbles into the measuring cylinder.

- (a) (i) The reaction is exothermic.

State the observation which would show that the reaction is exothermic.

..... [1]

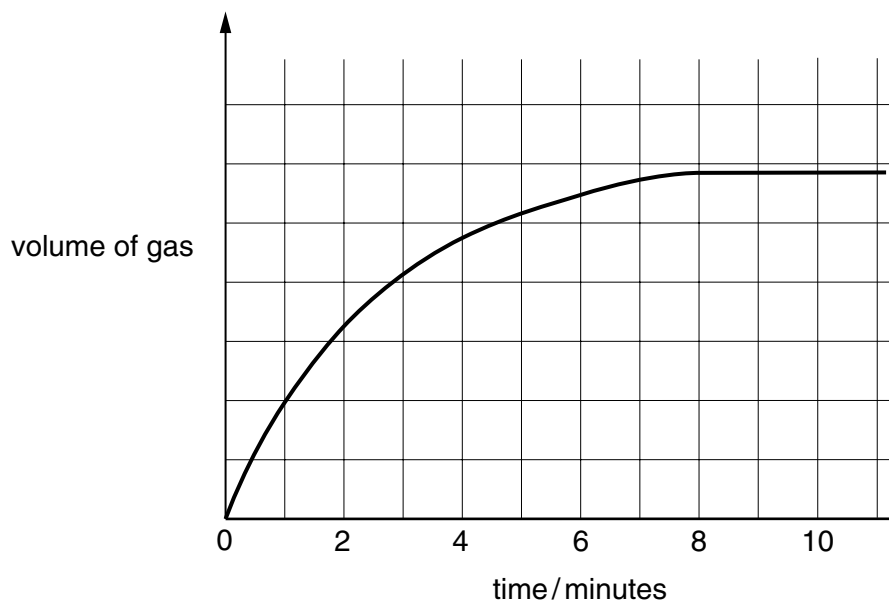
- (ii) Write the **word** equation for the reaction.

..... [1]

- (iii) Describe the test for hydrogen.

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

(b) Fig. 10.2 shows a graph of the results obtained by the student.



**Fig. 10.2**

(i) For what length of time did the reactants produce gas?

..... [1]

(ii) The student repeats the experiment using the **same amount** of the acid and the **same mass** of magnesium. This time, however, he uses magnesium powder instead of magnesium ribbon.

On Fig. 10.2, sketch a curve which shows the results of the experiment using magnesium powder. [2]

(iii) Explain your answer to (ii).

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

11 Fig. 11.1 shows the structure of a seed.

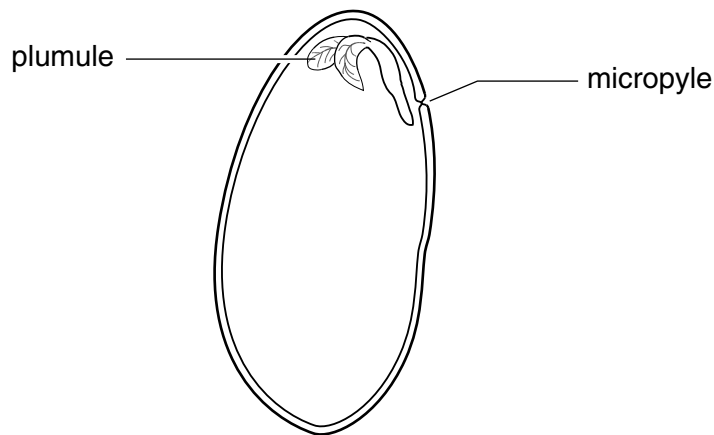


Fig. 11.1

(a) On the diagram, draw label lines to each of the following parts, and label them:

- the testa
- a cotyledon
- the radicle

[3]

(b) State **one** substance, other than water, that seeds need for germination.

..... [1]

(c) Twenty seeds were placed on wet cotton wool and allowed to germinate. Ten were kept in a light place, while the other ten were kept inside boxes with a hole in one side.

Fig. 11.2 shows the appearance of one seedling from each group.

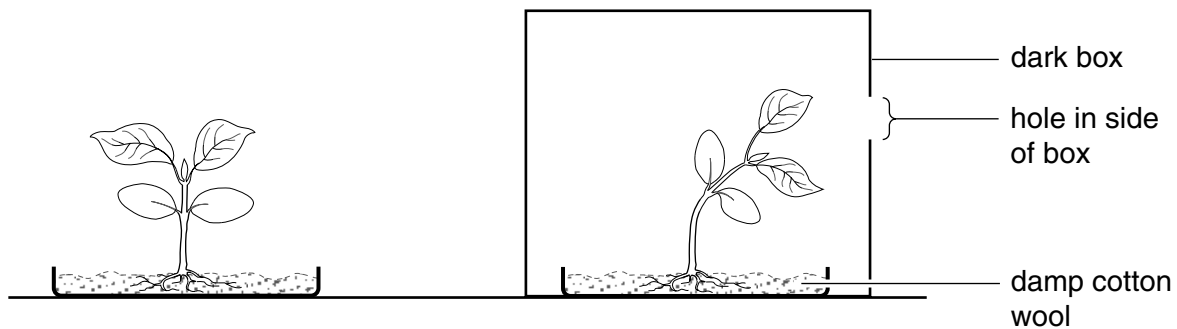


Fig. 11.2

(i) Name the stimulus to which the seedling in the box has responded.

..... [1]

(ii) Explain how this response of the seedling in the box may increase the chance of its survival.

.....

.....

..... [2]

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

		Group															
		I	II	III	IV	V	VI	VII	VIII	IX	X						
		1 <b>H</b> Hydrogen 1															
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4																
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12																
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20	45 <b>Sc</b> Scandium 21	48 <b>Ti</b> Titanium 22	51 <b>V</b> Vanadium 23	52 <b>Cr</b> Chromium 24	55 <b>Mn</b> Manganese 25	56 <b>Fe</b> Iron 26	59 <b>Co</b> Cobalt 27	59 <b>Ni</b> Nickel 28	64 <b>Cu</b> Copper 29	65 <b>Zn</b> Zinc 30	70 <b>Ga</b> Gallium 31	73 <b>Ge</b> Germanium 32	75 <b>As</b> Arsenic 33	79 <b>Se</b> Selenium 34	80 <b>Br</b> Bromine 35	84 <b>Kr</b> Krypton 36
85 <b>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38	89 <b>Y</b> Yttrium 39	91 <b>Zr</b> Zirconium 40	93 <b>Nb</b> Niobium 41	96 <b>Mo</b> Molybdenum 42	101 <b>Ru</b> Ruthenium 44	103 <b>Rh</b> Rhodium 45	106 <b>Pd</b> Palladium 46	108 <b>Ag</b> Silver 47	112 <b>Cd</b> Cadmium 48	115 <b>In</b> Indium 49	119 <b>Sn</b> Tin 50	122 <b>Sb</b> Antimony 51	128 <b>Te</b> Tellurium 52	127 <b>I</b> Iodine 53	131 <b>Xe</b> Xenon 54	
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	139 <b>La</b> Lanthanum 57	178 <b>Hf</b> Hafnium 72	181 <b>Ta</b> Tantalum 73	184 <b>W</b> Tungsten 74	190 <b>Os</b> Osmium 76	192 <b>Ir</b> Iridium 77	195 <b>Pt</b> Platinum 78	197 <b>Au</b> Gold 79	201 <b>Hg</b> Mercury 80	204 <b>Tl</b> Thallium 81	207 <b>Pb</b> Lead 82	209 <b>Bi</b> Bismuth 83	210 <b>Po</b> Polonium 84	210 <b>At</b> Astatine 85	222 <b>Rn</b> Radon 86	
87 <b>Fr</b> Francium	88 <b>Ra</b> Radium	89 <b>Ac</b> Actinium															
		140 <b>Ce</b> Cerium 58															
		141 <b>Pr</b> Praseodymium 59															
		144 <b>Nd</b> Neodymium 60															
		150 <b>Sm</b> Samarium 62															
		152 <b>Eu</b> Europium 63															
		157 <b>Gd</b> Gadolinium 64															
		162 <b>Dy</b> Dysprosium 66															
		167 <b>Er</b> Erbium 68															
		169 <b>Tm</b> Thulium 69															
		173 <b>Yb</b> Ytterbium 70															
		175 <b>Lu</b> Lutetium 71															
		232 <b>Th</b> Thorium 90															
		238 <b>U</b> Uranium 92															
		91 <b>Pa</b> Protactinium															
		93 <b>Np</b> Neptunium															
		94 <b>Pu</b> Plutonium															
		95 <b>Am</b> Americium															
		96 <b>Cm</b> Curium															
		97 <b>Bk</b> Berkelium															
		98 <b>Cf</b> Californium															
		99 <b>Es</b> Einsteinium															
		100 <b>Fm</b> Fermium															
		101 <b>Md</b> Mendelevium															
		102 <b>No</b> Nobelium															
		103 <b>Lr</b> Lawrencium															

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

**Key**

a	<b>X</b>
= relative atomic mass	
= atomic symbol	
= proton (atomic) number	

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