Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CO-ORDINATED SCIENCES **0654/02**

Paper 2

October/November 2005

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.

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.

For Examiner's Use	
1	
2	
3	
4	
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6	
7	
8	
9	
10	
Total	

This document consists of **22** printed pages and **2** blank pages.

1 **(a)** Fig. 1.1 shows what happens when a beam of white light passes through a prism. **A** and **B** are the two ends of the visible spectrum seen on the screen.

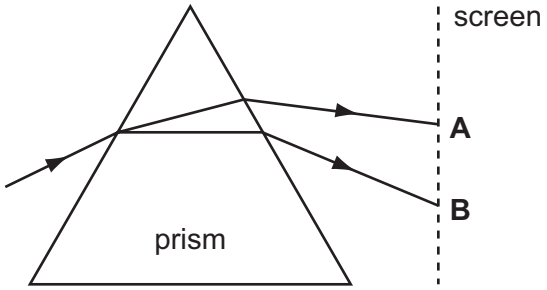


Fig. 1.1

(i) State the colour seen at **A**.

.....

[1]

(ii) State the colour seen at **B**.

.....

[1]

(b) Red is said to be a *primary colour*, while yellow is said to be a *secondary colour*. Explain what is meant by this statement and name one other primary colour and one other secondary colour.

explanation

.....

.....

primary colour .....

secondary colour .....

[3]

(c) Below is a list of some waves.

gamma	**infra-red**	**radio**	**sound**
ultrasound	**ultraviolet**	**visible light**	

Write down **one** wave from the list that is

(i) a transverse wave,

.....

[1]

(ii) a longitudinal wave,

.....

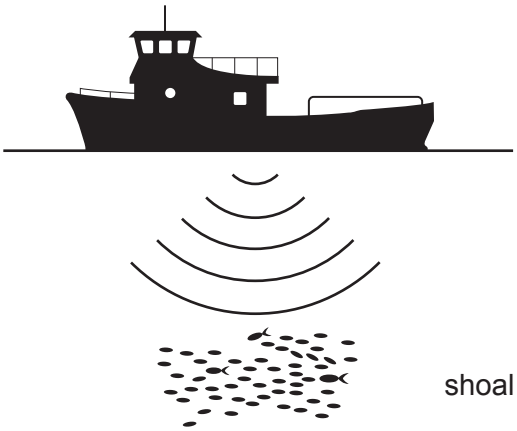
[1]

(iii) emitted by hot objects but cannot be seen by the human eye.

.....

[1]

(d) A fishing boat uses echo sounding to detect a shoal of fish.



shoal of fish

Short pulses of high frequency sound are sent out from the boat and the echo from the shoal of fish is detected 0.2 seconds later.

Sound waves travel through water at a speed of 1600 m / s.

Calculate the distance that the shoal of fish is below the boat.

Show your working and state the formula that you use.

formula used

working

..... m [2]

2 Fig. 2.1 shows the main stages in an industrial process to convert cellulose obtained from trees into cellophane. Cellophane is produced in the form of thin, transparent sheets.

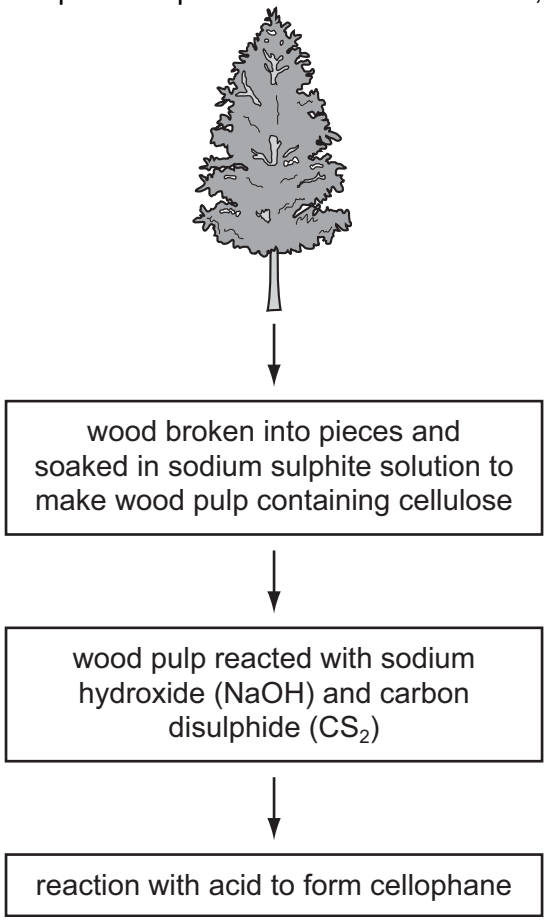


Fig. 2.1

(a) The molecules in cellulose are natural polymers.

(i) Name the monomer which is polymerised to form cellulose.

..... [1]

(ii) Draw a circle around the chemical symbols below which represent the **three** main elements combined in cellulose.

C Ce H He Lu O Os [1]

(iii) Draw a small section of a cellulose molecule.

Use the symbol —(M)— to represent one of the monomer molecules.

[1]

(b) The formula of sodium sulphite is Na_2SO_3.
State the number of different elements which are shown in this formula.

.....

[1]

(c) (i) Suggest the type of chemical bonding in carbon disulphide.

.....

[1]

(ii) Explain your answer to **(c)(i)**.

.....

.....

[1]

(d) Cellophane is used as a partially permeable membrane in haemodialysis. Haemodialysis is a procedure used to remove small toxin molecules and excess water from the blood of patients with kidney disease.

Fig. 2.2 shows a schematic diagram of haemodialysis.

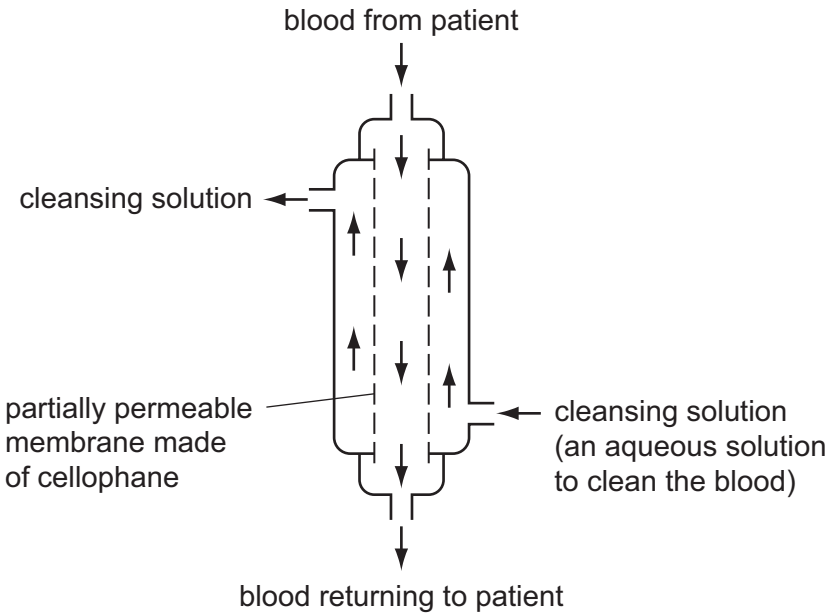


Fig. 2.2

Describe briefly how the partially permeable membrane functions to clean the patient's blood.

.....

.....

.....

.....

[2]

3 Fig. 3.1 shows a vertical section through a human heart.

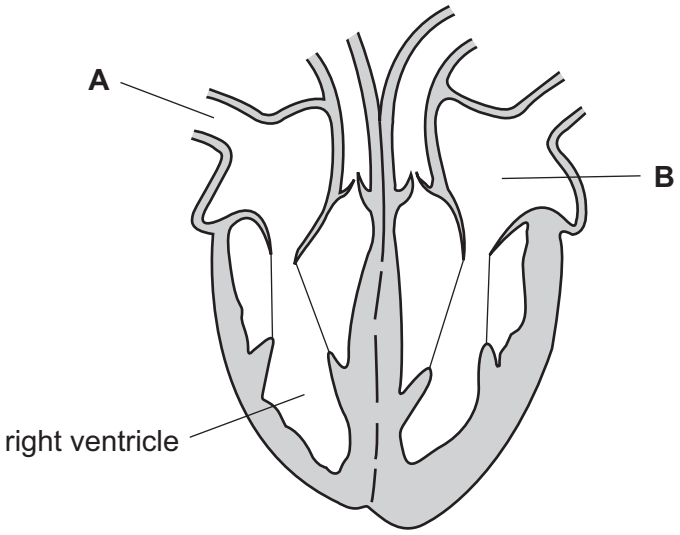


Fig. 3.1

(a) Name the parts labelled **A** and **B**.

A .....

B ..... [2]

(b) Using a labelling line and the letter **M**, label the muscular wall of the left ventricle. [1]

(c) The muscular walls of the heart are supplied with oxygen by blood that flows through the coronary arteries.

Explain why the heart muscle needs a supply of oxygen.

.....

.....

..... [2]

(d) If a coronary artery is blocked, the person may suffer a heart attack.
Table 3.1 shows part of a chart which doctors in New Zealand use to estimate the chances of a woman having a heart attack.

Table 3.1

	percentage of women who are expected to have a heart attack within 5 years			
	age 40	age 50	age 60	age 70
non-smokers	1	3	5	7
smokers	4	6	12	15

(i) Use the information in Table 3.1 to describe how a woman's age affects her chances of having a heart attack, if she does not smoke.

.....

.....

..... [2]

(ii) If a 50 year old woman gives up smoking, suggest how this will affect her chances of having a heart attack.

.....

..... [1]

(iii) Suggest **one** factor, other than age or smoking, which could affect the chances of a person having a heart attack.

..... [1]

4 Fig. 4.1 shows a flying squirrel. A flying squirrel uses large flaps of skin as a form of parachute to enable it to fall, glide and land safely. The air trapped under these flaps, as the squirrel falls, provides an upward force called air resistance.

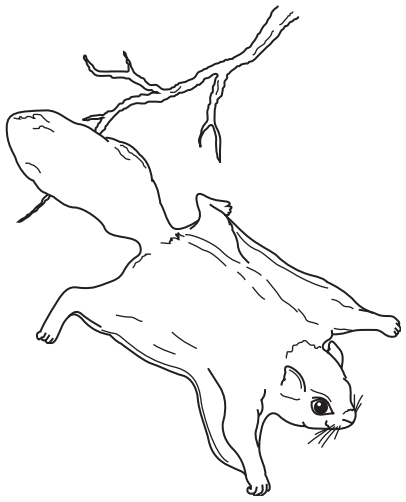


Fig. 4.1

(a) (i) As the squirrel starts to fall, it is accelerating.
State the meaning of the term *accelerating*.

.....

..... [1]

(ii) The squirrel weighs 20 N. Suggest a value for the air resistance while the squirrel is accelerating.

air resistance ..... N

Explain your answer.

.....

..... [2]

(b) As the squirrel falls, it reaches a steady speed (terminal velocity) of 3 m / s.

(i) State the value of the air resistance now.

air resistance ..... N

Explain your answer.

.....

..... [2]

(ii) The surface area of the squirrel on which the air resistance acts is $0.4\,m^2$. Use your answer to **(b)(i)** and the formula

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

to calculate the pressure on the squirrel.

Show your working.

..... N/m^2 [2]

(c) (i) The mass of the squirrel is 2 kg. Calculate the kinetic energy of the squirrel when it is falling at its terminal velocity of $3\,m/s$.

Show your working and state the formula that you use.

formula used

working

..... J [3]

(ii) When the squirrel reaches the ground, it has lost its kinetic energy. Suggest where this energy has gone.

..... [1]

[Turn over

5 **(a)** Table 5.1 shows some information about two elements **X** and **Y**.
Both elements are in the third period of the Periodic Table.
Complete the table by writing the words **high** or **low** in the empty boxes. Two of the boxes have already been completed.

Table 5.1

element	group number in Periodic Table	melting point	electrical conductivity	pH of element oxide in water
X	2	high		
Y	7	low		

[2]

(b) Metallic elements are usually extracted from metal compounds found in rocks.
A compound from which the metal titanium can be extracted is ilmenite, $TiFeO_3$.

(i) **Name** the other metallic element present in ilmenite.

.....

[1]

(ii) In order to obtain titanium, ilmenite is first processed to form titanium chloride. Titanium chloride is then reacted with magnesium as shown in the equation below.

titanium chloride + magnesium $\rightarrow$ magnesium chloride + titanium

Magnesium is an expensive metal. Suggest why magnesium is used rather than a cheaper metal such as iron.

.....

[1]

(iii) The titanium formed in the reaction in **(ii)** has to be melted and allowed to cool before it can be sold. The titanium is melted in a container in which all the air has been replaced by argon.

Suggest and explain why the air is replaced by argon before the titanium is melted.

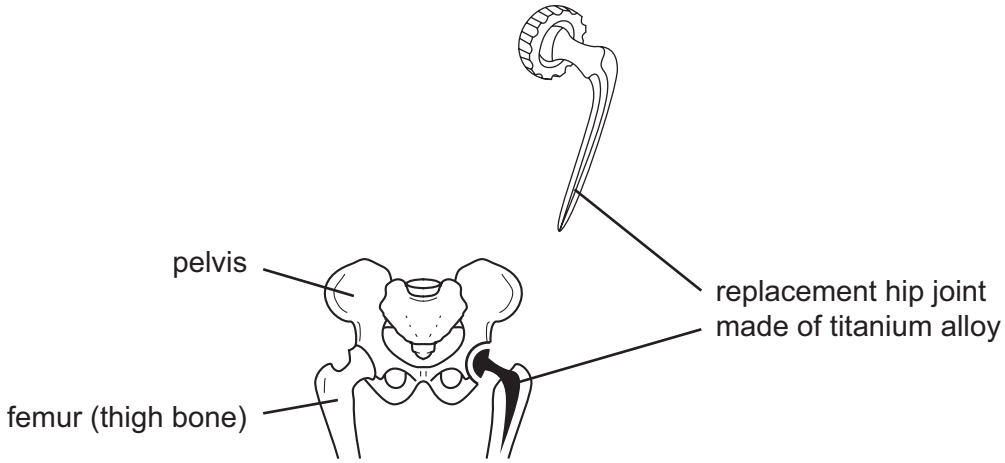
.....

.....

.....

[2]

(c) Alloys containing large amounts of titanium are widely used to make replacement hip joints.



Suggest and explain two properties of titanium alloy which make it a suitable material from which to make replacement hip joints.

property .....

reason .....

.....

property .....

reason .....

..... [4]

6 Fig. 6.1 shows a section through a human eye. The eye is focused on a distant object.

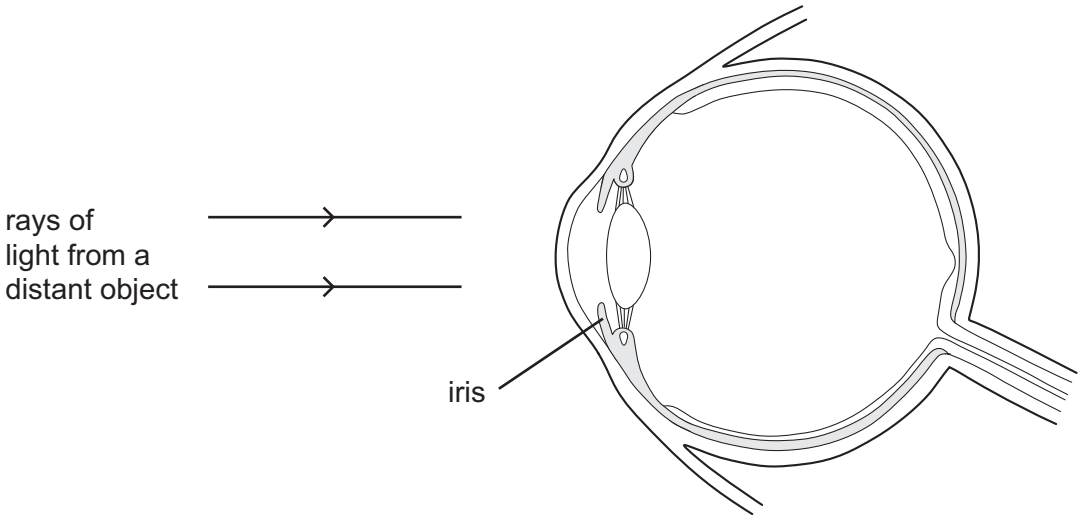


Fig. 6.1

(a) On the diagram, continue the rays of light to show how they are brought to a focus. [3]

(b) The iris is the coloured part of the eye. It can become wider or narrower to regulate the amount of light that can reach the retina.

The colour of the iris of a rabbit is determined by the rabbit's genes. A rabbit with the genotype **Bb** or **BB** has brown eyes. A rabbit with the genotype **bb** has yellow eyes.

(i) Use this information to help you to complete these sentences.

Different forms of a gene, such as **B** and **b**, are called alleles.

In rabbits, allele .....is dominant.

The phenotype of a heterozygous rabbit is ..... .

The two possible homozygous genotypes are ..... and ..... . [3]

(ii) Use a genetic diagram to explain how two rabbits with brown eyes may have young with yellow eyes.

[3]

(c) Occasionally, a mutation occurs in some of the cells of the iris, which may result in the iris becoming a different colour.

(i) What is a *mutation*?

.....

..... [1]

(ii) State **one** type of radiation which may cause mutation and explain how it does this.

.....

.....

..... [2]

7 **(a)** A car has two headlight lamps. The lamps are connected in parallel with each other across a 12 V battery.

(i) Complete the circuit diagram to show how the lamps are connected to the battery. Include a switch in your circuit to control the two lamps.

[3]

(ii) If one lamp fails, the other stays lit. Explain why this happens.

.....

..... [1]

(b) The visible light given out by the lamps forms part of the electromagnetic spectrum.

State one other form of electromagnetic radiation and give a use for it.

electromagnetic radiation .....

use ..... [2]

(c) Fig. 7.1 shows a speaker for a car radio.

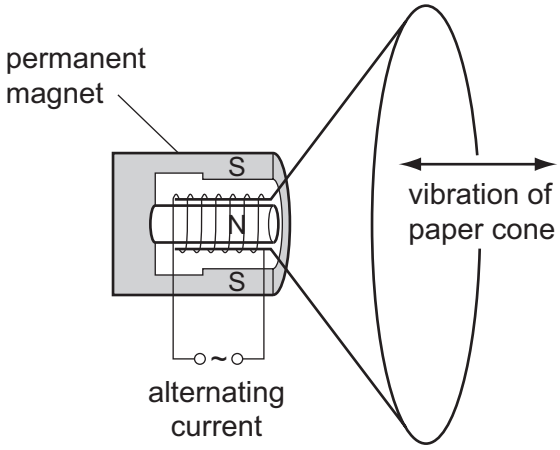


Fig. 7.1

Explain why the cone of the speaker vibrates when an alternating current passes through the coil.

.....

.....

.....

.....

.....

..... [3]

(d) Explain in terms of particles why adding more air to a car tyre increases the pressure in the tyre.

.....

.....

.....

..... [2]

8 The chemical symbol of the element lithium is shown below.

$$^{7}_{3}\mathrm{Li}$$

(a) (i) State the number of neutrons in the nucleus of this lithium atom.

..... [1]

(ii) State the number of electron shells (energy levels) in a lithium atom.

..... [1]

(iii) Lithium is obtained as the free element by electrolysis of molten lithium chloride, LiC*l*.

Explain briefly why lithium ions travel to the cathode in this process.

.....

.....

..... [2]

(iv) Name the other product formed when lithium chloride is electrolysed.

..... [1]

(b) (i) When lithium burns in air, a white solid product is formed.

Suggest the name of this white solid.

..... [1]

(ii) Lithium reacts with water according to the word equation below.

lithium + water → lithium hydroxide + hydrogen

Fire-fighters were called to put out burning lithium at a factory.

Explain why fire-fighters must **not** use water to try to extinguish burning lithium.

.....

.....

..... [2]

(iii) Suggest how the fire-fighters could extinguish the burning lithium.

.....

..... [1]

9 **(a)** Fig. 9.1 shows a tissue from a plant. The cells in this tissue do not photosynthesise. Fig. 9.2 shows some cells from an animal.

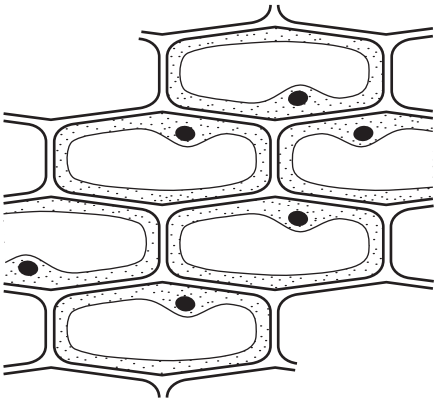


Fig. 9.1

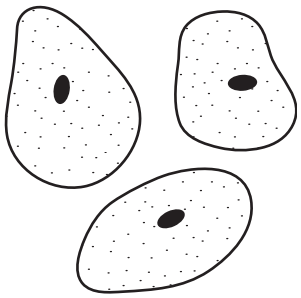


Fig. 9.2

(i) State **one** place in a plant that you would expect to find the cells shown in Fig. 9.1.

..... [1]

(ii) Use what you can see on the diagrams in Fig. 9.1 and Fig. 9.2 to describe two differences between a plant cell and an animal cell.

1. .....

.....

.....

2. .....

.....

..... [2]

(iii) The plant cells in Fig. 9.1 do not photosynthesise. In the space below, draw a diagram of a plant cell from a leaf, which can photosynthesise.

Label your diagram to show how this cell differs from the ones shown in Fig. 9.1.

[3]

(b) A gardener grows pepper plants in a glasshouse. She decides to add some nitrogen-containing fertiliser to make the plants grow faster and larger.

(i) Suggest **one** compound which can be found in a fertiliser and which provides nitrogen to the plants in a form that they can use.

..... [1]

(ii) Explain why extra nitrogen can increase the growth of plants.

.....

.....

..... [2]

(c) Insects called whitefly begin to feed and reproduce on the pepper plants. The gardener puts some small wasps that feed on the whitefly into the glasshouse.

(i) Use this information to construct a food chain.

..... [2]

(ii) Predict what will happen to the size of the whitefly population after the wasps have been put into the glasshouse.

..... [1]

(iii) Suggest why the gardener chose to use wasps to control the whitefly pests rather than using a pesticide.

.....

.....

..... [2]

10 Fig. 10.1 shows the apparatus a student used to investigate the effect of strong heating on sodium hydrogencarbonate, $NaHCO_3$.

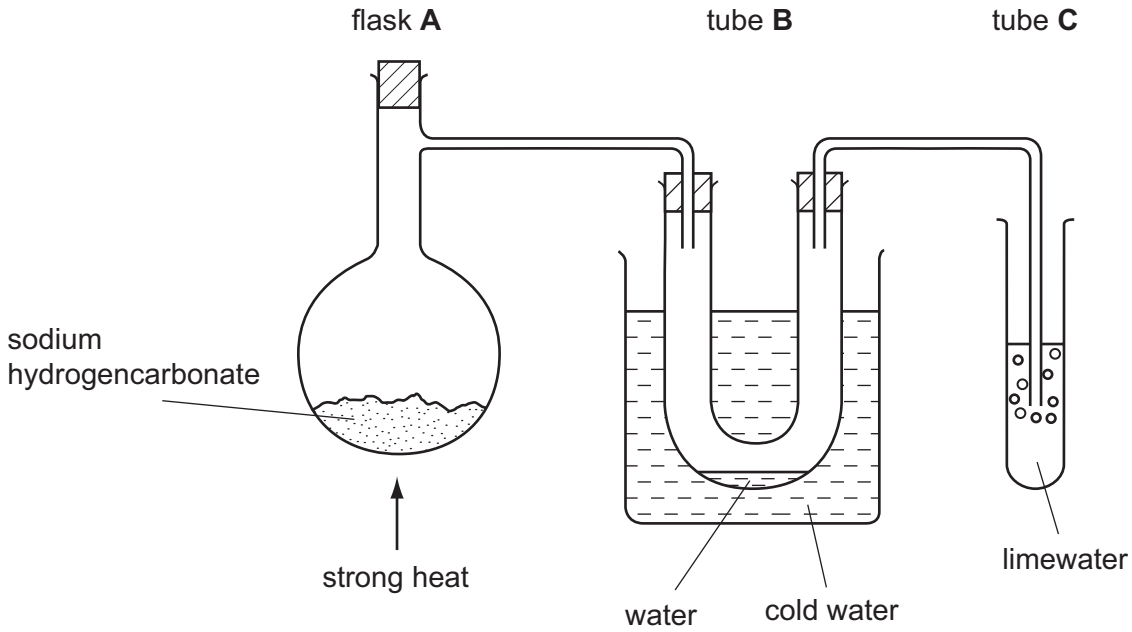


Fig. 10.1

Table 10.1 shows observations the student made before and after heating the sodium hydrogencarbonate for several minutes.

Table 10.1

	before heating	after heating
flask **A**	white solid	white solid
tube **B**	tube empty	water has condensed
tube **C**	clear liquid	liquid has become cloudy

(a) (i) State two observations from Table 10.1 which show that a chemical reaction occurs when sodium hydrogencarbonate is heated.

1. .....

.....

2. .....

..... [2]

(ii) The white solid which remains in flask **A** after heating is sodium carbonate.

Complete the **word** equation for the effect of strong heating on sodium hydrogencarbonate. Do **not** write a symbolic equation.

[2]

(b) A sample of hard water is shaken with soap solution. Describe **two** observations which would show that the water is hard.

.....

.....

..... [2]

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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 Sulphur 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	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radius 88	227 Ac Actinium 89															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	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	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

*58-71 Lanthanoid series
90-103 Actinoid series

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

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