Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

ADDITIONAL COMBINED SCIENCE **5130/02**

Paper 2

October/November 2006

2 hours 15 minutes

Additional Materials: Answer Booklet/Paper

READ THESE INSTRUCTIONS FIRST

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.
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 or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B
Answer **one** part of each of the three questions.
Write your answers on the separate answer paper provided.

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

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	
Section A	
10	
11	
12	
Total	

This document consists of **17** printed pages and **3** blank pages.

Section A

Answer **all** the questions.

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

1 Fig. 1.1 shows a plant cell.

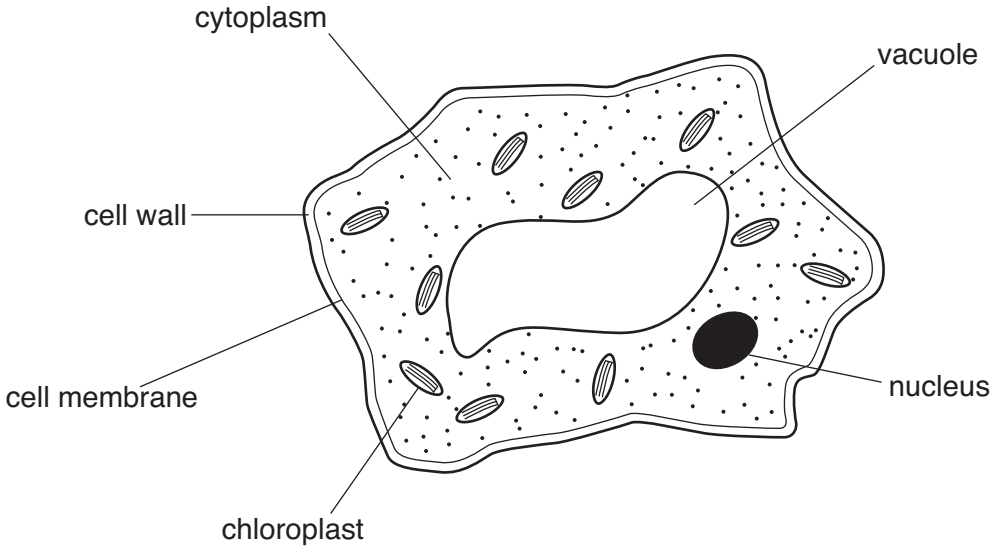


Fig. 1.1

(a) Name the part of the cell that

(i) controls the movement of substances into and out of the cell,

.....[1]

(ii) makes food by the process of photosynthesis.

.....[1]

(b) Root hair cells are specialised plant cells.

(i) Which part, labelled in Fig. 1.1, is not present in a root hair cell?

.....[1]

(ii) Why is this part not needed in a root hair cell?

.....

.....[1]

(iii) Explain how the shape of a root hair cell helps it to carry out its function.

.....

.....

.....[2]

(c) Suggest **two** ways in which animal cells differ from the plant cell shown in Fig. 1.1.

.....

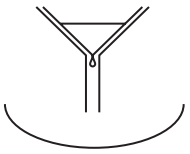
.....

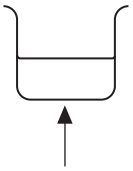
.....[2]

2 A student makes crystals of magnesium sulphate. She follows the procedure shown in step **A** to step **E** in Fig. 2.1, but these steps are shown in the wrong order.

A  Add magnesium oxide a bit at a time until it is in excess and stir.

B  Set aside to cool.

C  Filter the mixture into an evaporating dish.

D  Warm 100 cm^3 of dilute sulphuric acid.

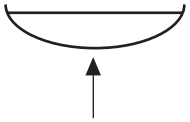
E  Gently heat to evaporate some of the water.

Fig. 2.1

(a) (i) In the boxes, write the letters of steps **A**, **B**, **C** and **E** in the correct order. Step **D** has already been written in the correct place for you.

D				

[3]

(ii) Suggest how she should separate the crystals of magnesium sulphate from the liquid that is left at the end of this procedure.

.....[1]

(b) Magnesium oxide and sulphuric acid react according to this equation.

$$MgO + H_2SO_4 \rightarrow MgSO_4 + H_2O$$

The crystals that the student makes have the formula $MgSO_4.7H_2O$.

She uses 50 cm^3 of 1.0 mol / dm^3 sulphuric acid and an excess of magnesium oxide.

(i) Calculate the number of moles of sulphuric acid contained in 50 cm^3 of 1.0 mol / dm^3 sulphuric acid.

moles of sulphuric acid = ... [1]

(ii) Calculate the maximum mass of anhydrous magnesium sulphate, $MgSO_4$, that could be formed.
Show how you work out your answer.
[A_r: Mg,24; O,16; S,32.]

mass of anhydrous magnesium sulphate = ... g [3]

(iii) Calculate the maximum mass of crystals of magnesium sulphate, $MgSO_4.7H_2O$, that the student could obtain.
Show how you work out your answer.
[A_r: Mg,24; O,16; S,32.]

mass of magnesium sulphate crystals = ... g [2]

3 Fig. 3.1 shows a go-kart accelerating on a level track. The directions and sizes of two forces, **A** and **B**, acting on the go-kart are shown by arrows.

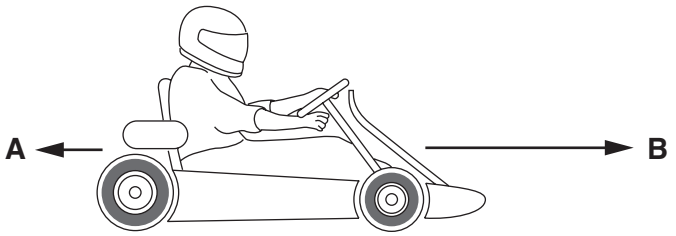


Fig. 3.1

(a) The force **B**, pushing the go-kart forwards, is from the engine.
What is the cause of the force **A**, acting in the opposite direction?

.....[1]

(b) While it is accelerating, the force **B** pushing the go-kart forwards is greater than the force **A** acting in the opposite direction.
Compare the sizes of forces **A** and **B** when

(i) the go-kart is at a constant speed,

.....[1]

(ii) the go-kart is slowing down.

.....[1]

(c) **(i)** The go-kart and rider have a mass of 150 kg. The acceleration of the go-kart is $2.0\,m/s^2$.
Calculate the resultant force needed to give this acceleration.
Show how you work out your answer.

force = ... unit ..... [3]

(ii) The energy released from burning the hydrocarbon fuel is greater than the energy needed to produce force **B**.
Suggest a reason for this.

.....

.....[1]

4 Fig. 4.1 shows apparatus used to heat a piece of limestone.

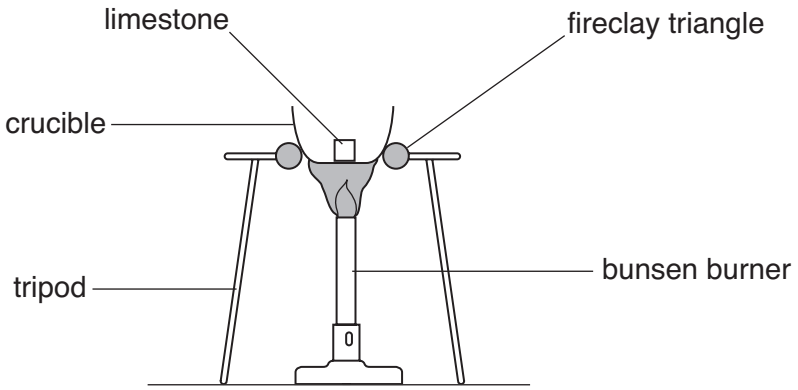


Fig. 4.1

(a) Limestone is calcium carbonate. After the limestone was heated, calcium oxide remained in the crucible.

(i) Write a balanced equation for the reaction that took place when limestone was heated.

.....[2]

(ii) What scientific term can be used to describe this reaction?

.....[1]

(b) When the calcium oxide had cooled, water was added to it. An exothermic reaction took place, forming calcium hydroxide.

(i) What is the meaning of the term *exothermic*?

.....[1]

(ii) Farmers sometimes spread calcium hydroxide on their fields. Suggest why.

.....

.....[2]

(c) Calcium carbonate has uses other than the manufacture of calcium hydroxide. State **one** of these other uses.

.....[1]

5 A student investigates the relationship between the current passing through a device and the potential difference across it. He uses the circuit shown in Fig. 5.1.
His results are shown in Fig. 5.2.

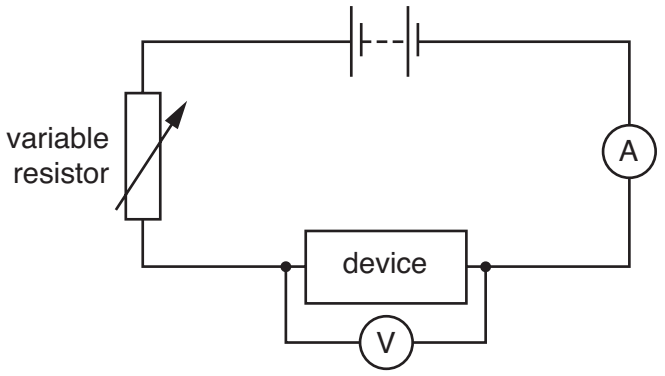


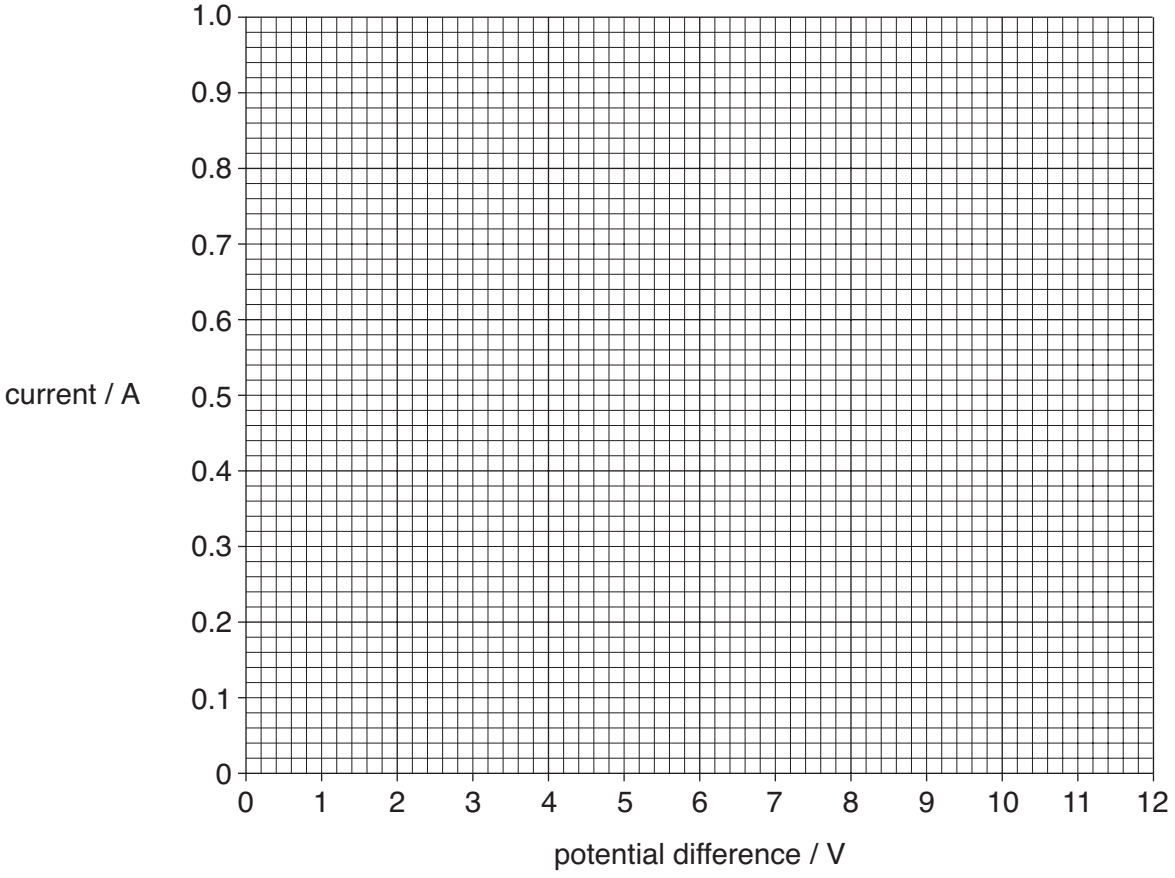
Fig. 5.1

potential difference / V	0	2.0	4.0	8.0	10.0	12.0
current / A	0	0.16	0.34	0.64	0.80	0.96

Fig. 5.2

(a) (i) Plot the student's results on the grid. [2]

(ii) Finish the graph by drawing the best line through the points. [1]



(iii) The student did not obtain a result for the current at a potential difference of 6.0 V. Use your graph to predict this result.

current at potential difference of 6.0 V = ... A [1]

(b) Use the result shown in Fig. 5.2 at a potential difference of 12.0 V to calculate

(i) the power of the device,

power = ... unit..... [3]

(ii) the resistance of the device.

resistance = ... ohms [2]

[Turn over

6 A scientist studying genetics measured the height of ten 18-year-old male students and ten 18-year-old female students. Her results are shown in Fig. 6.1.

height / cm			
male students		female students	
171	177	156	155
173	169	160	158
174	180	164	162
165	173	162	150
174	175	169	166

Fig. 6.1

(a) (i) Calculate the average height of the male students and the average height of the female students. Give your answers to the nearest cm.

average height of male students = ... cm

average height of female students = ... cm [2]

(ii) Explain why the average height of the male students is greater than the average height of the female students.

.....

.....[2]

(b) Both of the samples of students, male and female, show a variation in height.

(i) What name is given to this type of variation?

.....[1]

(ii) Suggest a reason for this variation, different from your answer to **(a)(ii)**.

.....

.....[1]

7 A student set up the apparatus shown in Fig. 7.1.

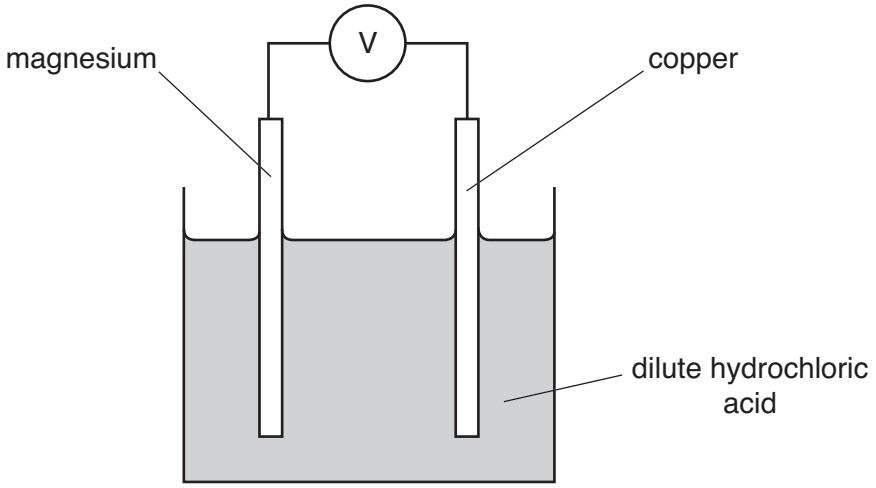


Fig. 7.1

(a) Bubbles of gas are seen around the magnesium.
How could you prove that this gas is hydrogen?

.....

.....[2]

(b) The reaction of the magnesium produces electrons that will flow through the circuit, producing a current.
Complete this ionic equation to show how these electrons are produced.

$$Mg \rightarrow \ldots\ldots + 2e^-$$ [1]

(c) A reading of 2.7 V is shown on the voltmeter.
The student repeats the experiment using zinc in place of magnesium.

(i) Describe **two** ways that the observations using zinc differ from the observations using magnesium.

.....

.....

.....[2]

(ii) Explain these differences.

.....

.....[1]

(d) The apparatus shown in Fig. 7.1 could be used as a portable source of electrical energy.
Why would this apparatus **not** be as good for this purpose as a dry cell battery?

.....

.....[1]

8 **(a)** Each of the two diagrams in Fig. 8.1 shows a ray of light travelling in a glass block.
The critical angle for glass is 42°.
Complete the two diagrams to show the paths of the light rays. [4]

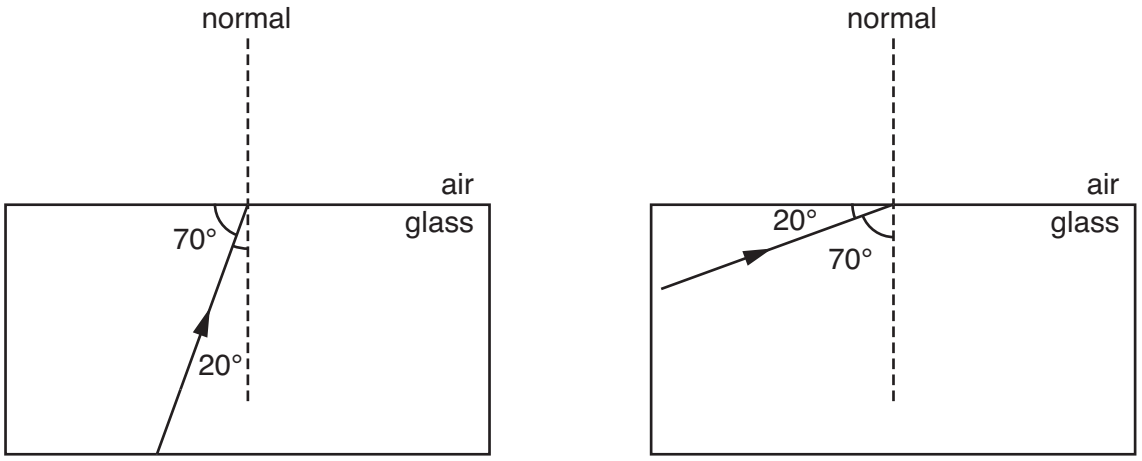


Fig. 8.1

(b) Red light has a wavelength of 6.4×10^{-7} m and a speed of 3×10^{8} m / s.
Calculate the frequency of this red light.
Show how you work out your answer.

frequency = ... unit ..... [3]

9 Fig. 9.1 compares some daily nutrient and energy requirements of a one-year-old baby with those of a man and a woman, both aged 18 years.

			daily requirement		
age / years	sex	body mass / kg	iron / mg	protein / g	energy / kJ
1	either	7	6	20	3 200
18	male	60	10	80	12 000
18	female	55	12	58	9 000

Fig. 9.1

(a) Calculate the energy requirement to the nearest kilojoule per kg of body mass

(i) for the one-year-old baby,

energy requirement = ... kJ / kg [1]

(ii) for the 18-year-old man.

energy requirement = ... kJ / kg [1]

(b) The energy requirement, per kg, is much larger for the one-year-old baby than for the 18-year-old man.
Suggest why.

.....

.....[1]

(c) The 18-year-old woman requires more iron per day than the 18-year-old man.
Suggest why.

.....

.....

.....

.....[3]

(d) A scientist measured the daily energy requirements of several 18-year-old men. He found that they varied from 9000 to 15000 kJ.
Suggest an explanation for this variation.

.....

.....

.....[2]

(e) Why does the body need protein?

.....

.....[1]

Section B

Answer **one** part, **(a)** or **(b)** of each of the three questions.

Write your answers on the separate answer paper provided.

10 Either

(a) When the enzyme amylase is added to starch solution under suitable conditions, starch molecules are quickly broken down to maltose. Starch reacts with iodine to give a dark blue/black colour, but maltose does not react with iodine.

(i) Use this information to design an experiment to investigate the effect of an increase in temperature on the activity of amylase. Describe clearly how you would carry out the experiment and give the results you would expect. [7]

(ii) Explain why an increase in temperature has an effect on the enzyme activity. [3]

Or

(b) Cigarette smoking is associated with an increased risk of coronary heart disease.

(i) State other health problems that are thought to be caused by cigarette smoking and suggest what measures might be taken by government to reduce the harmful effects of smoking on health. [5]

(ii) Describe coronary heart disease. Suggest other factors, in addition to cigarette smoking, that contribute to this disease. [5]

11 Either

(a) (i) List the gases that are found in normal air, and give its approximate composition by percentage volume.
Give examples of the uses of **two** of the gases present in the air. [6]

(ii) Name **one** major pollutant of air.
State the source of this pollutant and describe the problems that it causes. [4]

Or

(b) (i) Describe how the unsaturated hydrocarbons called alkenes are manufactured and explain why they are useful industrial chemicals. [5]

(ii) Construct an equation for the formation of poly(ethene) and describe some uses of this polymer. [5]

[Turn over

12 Either

(a) (i) Describe how you would show that a bar magnet will induce an electric current in a coil of copper wire.
State **two** factors that affect the magnitude of the induced e.m.f. [6]

(ii) Explain how the principle of electromagnetic induction is used in an a.c. generator. [4]

Or

(b) (i) List **three** ways of transfer of thermal energy. For each of these ways of energy transfer state which take place in a solid, in a liquid, and in a gas. [4]

(ii) Fig. 12.1 shows the outline of a house in a hot country. Air conditioning maintains the temperature in the house at 20 °C, whilst the temperature outside the house is usually between 25 and 35 °C. The air conditioning has to be run continuously because heat energy is transferred into the house.

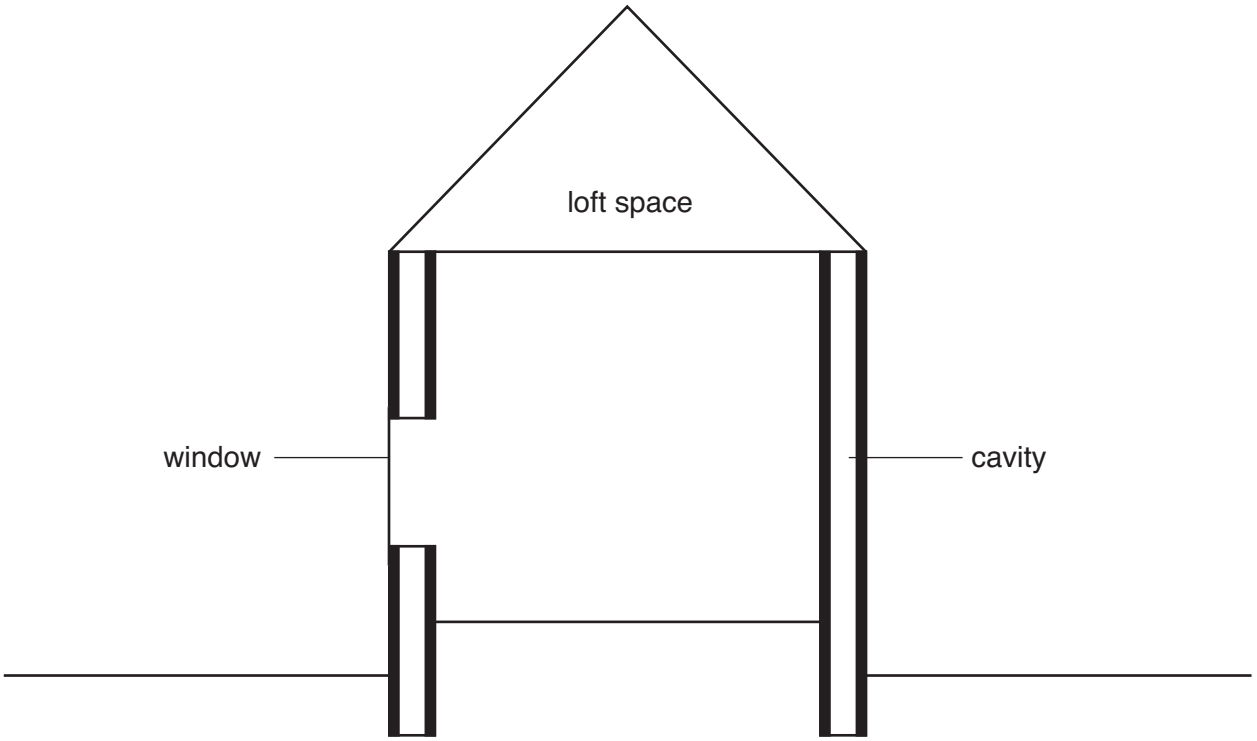


Fig. 12.1

State and explain **three** ways to reduce the transfer of heat into the house. [6]

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DATA SHEET
The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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 Radium 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.).