Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

COMBINED SCIENCE **0653/03**

Paper 3

October/November 2005

1 hour 15 minutes

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 20.

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	
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9	
Total	

This document consists of **19** printed pages and **1** blank page.

1 A student was asked to prepare some copper sulphate crystals.

The diagrams, **P**, **Q** and **R**, in Fig. 1.1 show three important steps in the method the student used.

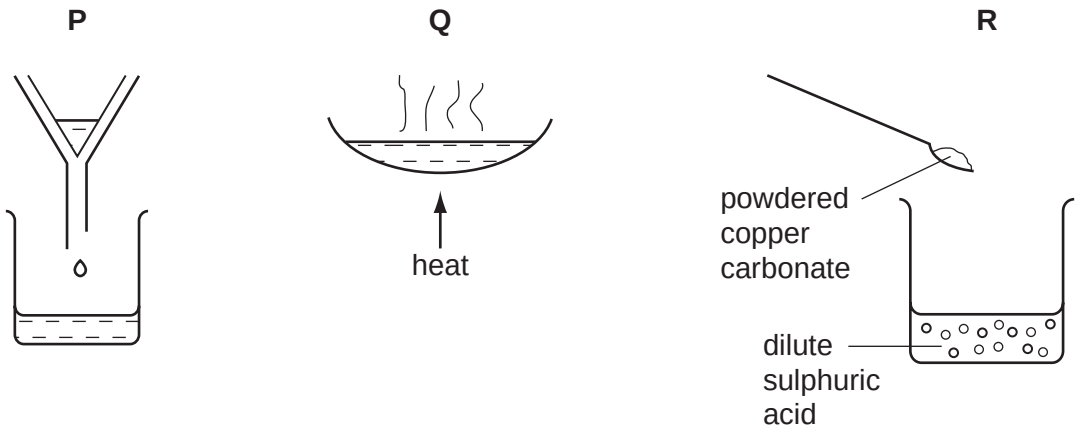


Fig. 1.1

(a) (i) Complete the table, using the letters **P**, **Q** and **R**, to show the order in which these processes should be carried out to produce copper sulphate crystals.

first	
second	
third	

[1]

(ii) Suggest how the student made certain that all of the sulphuric acid had reacted.

.....

..... [1]

(iii) Explain why the process shown in step **P** in Fig. 1.1 needs to be included in the method.

.....

..... [1]

(iv) Complete the symbolic equation below for the reaction between copper carbonate and dilute sulphuric acid.

$$\square + CuCO_3 \longrightarrow CuSO_4 + \square + \square$$

[2]

(b) The student then carried out electrolysis on the solution of copper sulphate that she had made.

Fig. 1.2 shows a simplified diagram of the apparatus she used.

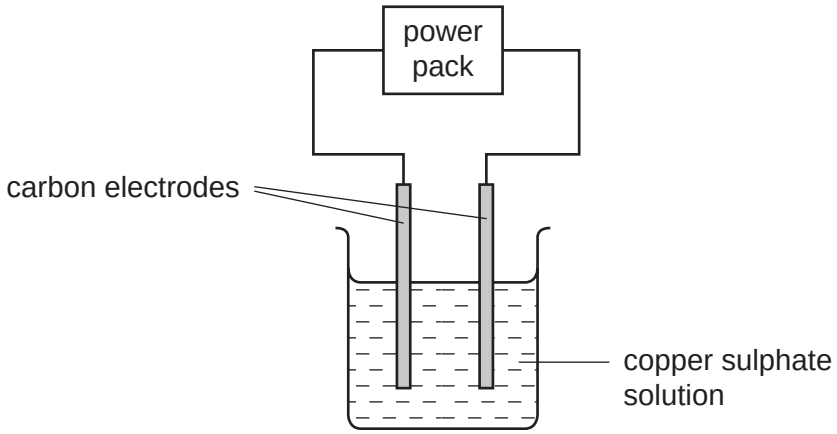


Fig. 1.2

(i) Describe what is observed at the positive electrode (anode) in this process.

.....

..... [1]

(ii) Copper ions have the symbol Cu^{2+}. Describe and explain what happens to these ions during electrolysis.

.....

.....

.....

..... [3]

2 **(a)** Fig. 2.1 shows a radioactive source emitting beta radiation. This radiation is directed at sheets of paper, aluminium and lead.

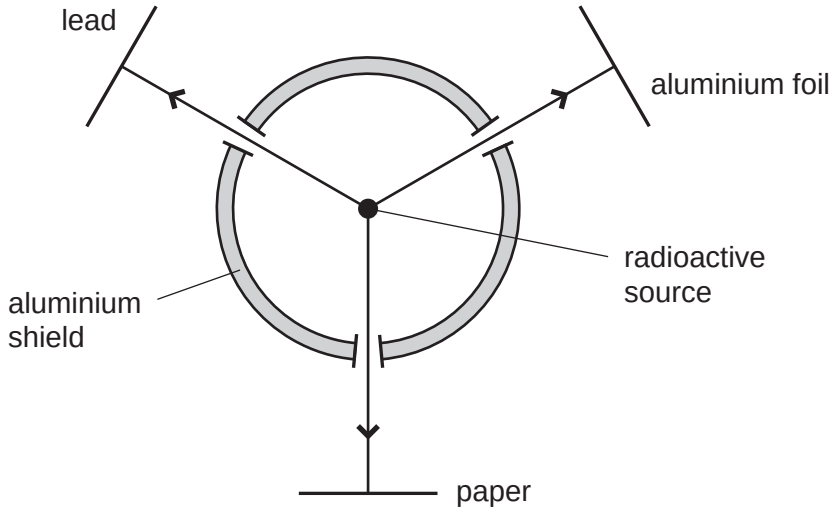


Fig. 2.1

(i) Describe how you would compare the effectiveness of the sheets of material in absorbing the beta radiation.

.....

.....

..... [3]

(ii) Alpha, beta and gamma radiations are passed between two electrically charged plates as shown in Fig. 2.2.

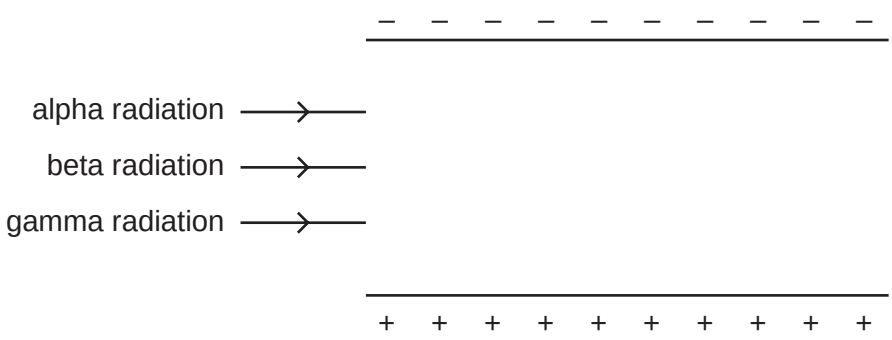


Fig. 2.2

Complete the diagram to show the path of each type of radiation as it passes between the charged plates.

Explain your answer.

.....

.....

.....

..... [3]

(b) Alpha radiation is described as ionising radiation.

(i) Explain the meaning of the term *ionising radiation*.

.....

..... [1]

(ii) Explain why it is more dangerous to swallow a substance that emits alpha radiation than one that emits gamma radiation.

.....

.....

.....

..... [2]

(c) Electricity can be generated by nuclear fission.

Describe what happens to an atom during nuclear fission.

.....

.....

.....

..... [2]

[Turn over

3 **(a)** A small child has to learn how to balance herself when riding a bicycle.

Once she has learned, the many small movements needed to stay balanced become reflex actions.

(i) What is meant by the term *reflex action*?

.....

..... [2]

(ii) Give **one** advantage of reflex actions compared to voluntary actions.

.....

..... [1]

(b) Some professional cyclists who have taken part in international competition have carried out a procedure called blood doping. Anyone who is found to have done this is now disqualified.

Blood doping involves taking about one litre of blood from the person's body. Some of the liquid is removed from it and then it is stored for a month or two at a low temperature. Meanwhile, the body makes more blood to replace the blood that was removed.

A day before the competition, the saved blood is transfused back into the person's body.

Table 3.1 shows how this affects the person's blood and ability to exercise.

Table 3.1

	before the saved blood was transfused	after the saved blood was transfused
concentration of haemoglobin in the blood / g per cm^3	13.8	17.6
length of time the person could run on a treadmill at top speed / seconds	793	918

(i) Suggest why the blood which has been removed is stored at a low temperature.

.....

.....

..... [2]

(ii) Using the information in Table 3.1, and your own knowledge, explain how blood doping affects the concentration of haemoglobin in the blood.

.....

.....

.....

..... [2]

(iii) Using the information in Table 3.1, and your own knowledge, suggest how blood doping can help a cyclist to win a race.

.....

.....

.....

.....

.....

..... [3]

4 The chemical symbols for two elements are shown below.

$$^{65}_{30}Zn \qquad ^{16}_{8}O$$

(a) Complete the table which refers to one atom of each element.

element	number of protons	number of neutrons	number of electrons
zinc			
oxygen			

[2]

(b) When zinc is burned in oxygen, zinc oxide is formed.

The formula of zinc oxide is ZnO. If the symbol and charge of an oxide ion is O^{2-}, deduce the charge of a zinc ion.

Explain your answer.

.....

.....

.....

..... [2]

(c) A small piece of zinc was added to three solutions of metal salts.

The results are shown in Fig. 4.1.

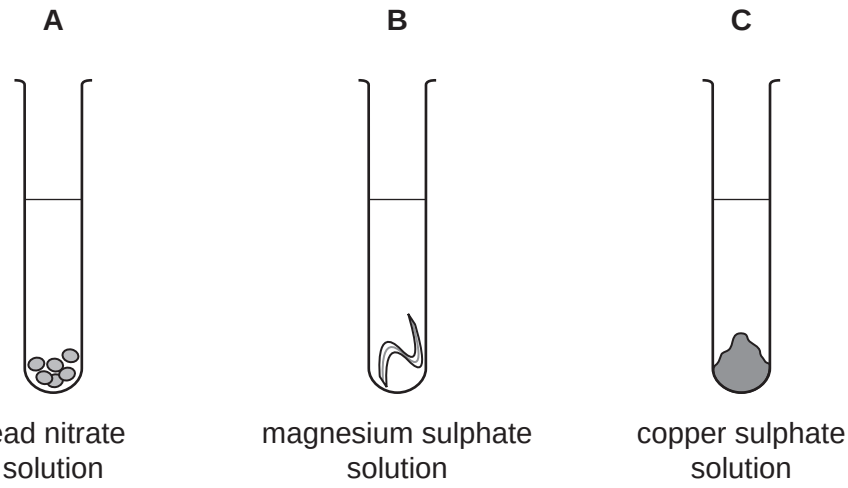


Fig. 4.1

Grey crystals appeared in tube **A** and a brown solid appeared in tube **C**. There was no reaction in tube **B**.

(i) Name the type of reaction occurring in tubes **A** and **C**.

..... [1]

(ii) Explain the observations in tubes **B** and **C**.

.....

.....

.....

..... [3]

(iii) What are the grey crystals which appeared in tube **A**?

..... [1]

[Turn over

5 **(a)** A student set up the circuit shown in Fig. 5.1.

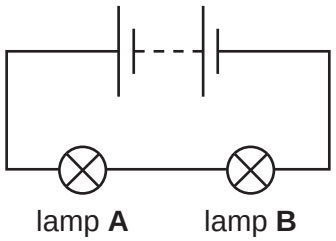


Fig. 5.1

The student noticed that neither lamp **A** nor lamp **B** lit up. She found nothing wrong with lamp **A,** but the filament in lamp **B** was broken.

(i) Explain why lamp **A** did not light up.

.....

..... [1]

(ii) She replaced lamp **B** with a new lamp **C**. The resistance of each lamp was 4 ohms when lit.

Calculate the combined resistance of both lamps in the working circuit.

..... [1]

(iii) She then made the circuit shown in Fig. 5.2 using lamps **A** and **C**.

Calculate the combined resistance of both lamps in this circuit.

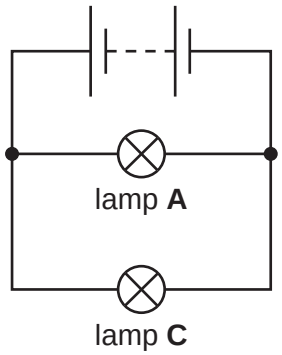


Fig. 5.2

Show your working and state the formula that you use.

formula used

working

..... [2]

(b) Electricity is distributed for use at home using alternating current.

(i) Explain the meaning of the term *alternating current*.

.....

..... [1]

(ii) Explain why alternating current is used rather than direct current.

.....

.....

..... [2]

6 **(a)** Fig. 6.1 shows a section through a leaf.

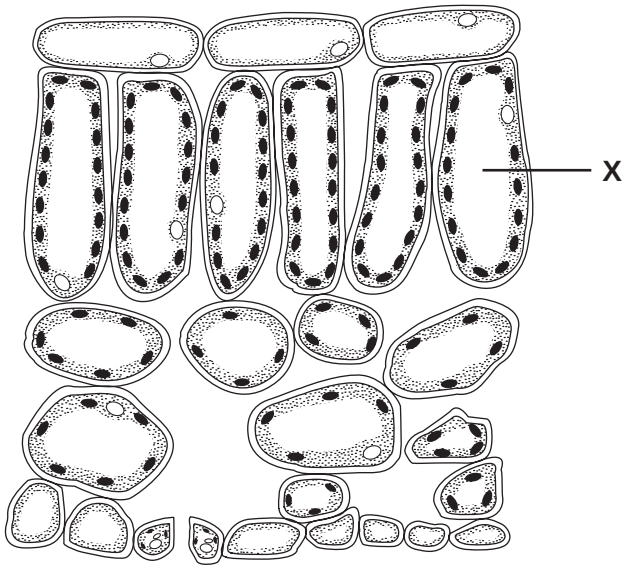


Fig. 6.1

(i) On Fig. 6.1 draw a line to show how carbon dioxide enters the leaf and travels to cell **X**. [1]

(ii) Describe and explain **one** way in which cell **X** is adapted for photosynthesis.

.....

.....

..... [2]

(b) The leaves of tomato plants are sometimes eaten by insect pests. One variety of tomato plants contains a substance which makes its leaves taste unpleasant, so that insects do not eat them.

The allele which causes tomato plants to contain this substance is a dominant allele, **A**.

Draw a genetic diagram to show the offspring which could result from a heterozygous parent with this substance, and a parent which does not have it.

[3]

(c) Fig. 6.2 shows some of the ways in which the tomato plants and insects both contribute to the carbon cycle.

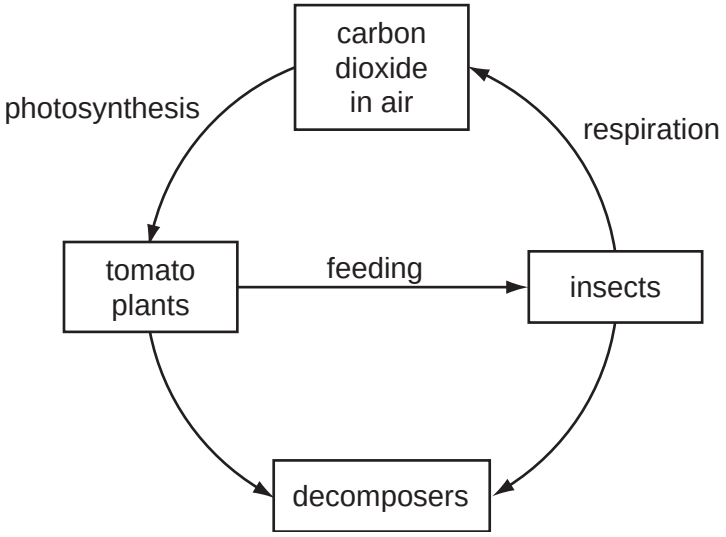
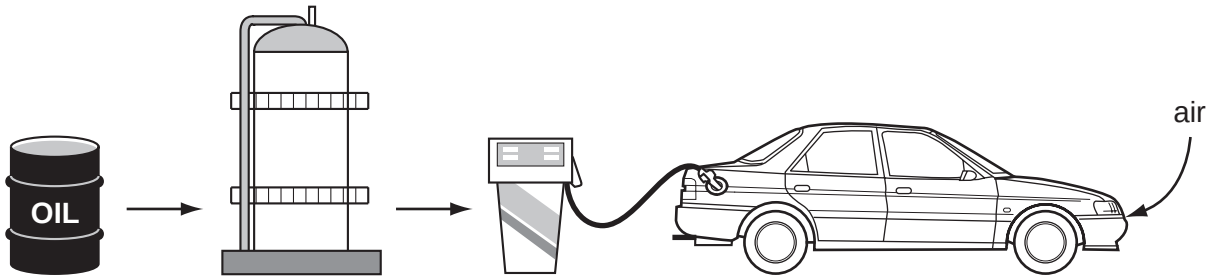


Fig. 6.2

On Fig. 6.2 draw and label **two** more arrows to show how carbon dioxide is returned to the air. [2]

7 Petroleum (crude oil) is obtained from the Earth's crust, and is the raw material for liquid fuel used in cars. Petroleum is a mixture of compounds. Most of these compounds are hydrocarbons.



(a) Name the process used at an oil refinery to separate petroleum into useful materials, such as gasoline and diesel for use as fuel for cars.

.....

[1]

(b) When liquid hydrocarbon fuel is oxidised in a car's engine, waste gases are produced. In modern cars, the waste gases pass through a catalytic converter. In the converter, chemical reactions take place which reduce the amount of poisonous gases entering the air.
Fig. 7.1 shows a simplified diagram of a catalytic converter.

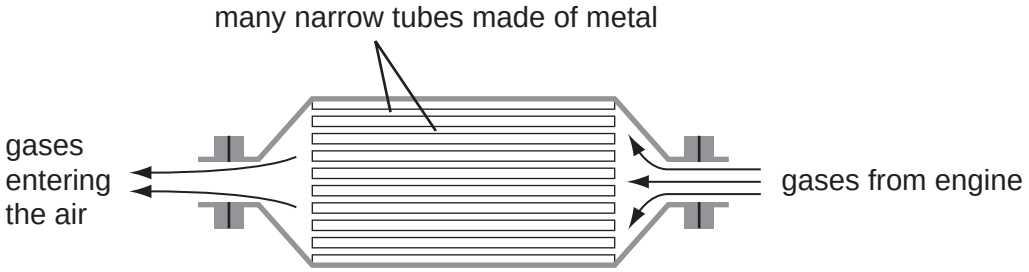


Fig. 7.1

(i) Suggest why the alloy used to make the narrow tubes contains transition metals.

.....

.....

[1]

(ii) The higher the temperature inside the converter the greater the amount of poisonous gases which it removes.

Suggest a reason for this.

.....

.....

[1]

(c) (i) The symbolic equation for one of the reactions which occurs in the converter is shown below. The equation is not balanced.
Balance the equation.

$$NO + CO \longrightarrow N_2 + CO_2$$

[1]

(ii) Explain how the compound whose formula is CO is formed in the car's engine.

.....

.....

..... [2]

(iii) Explain why the reaction shown in part **(c)(i)** is an example of a redox reaction.

.....

.....

..... [2]

(iv) Draw a diagram to show how the outer electrons are arranged in a molecule of carbon dioxide.

[2]

8 **(a)** Fig. 8.1 is a graph showing the speed of a caterpillar measured over 300 seconds.

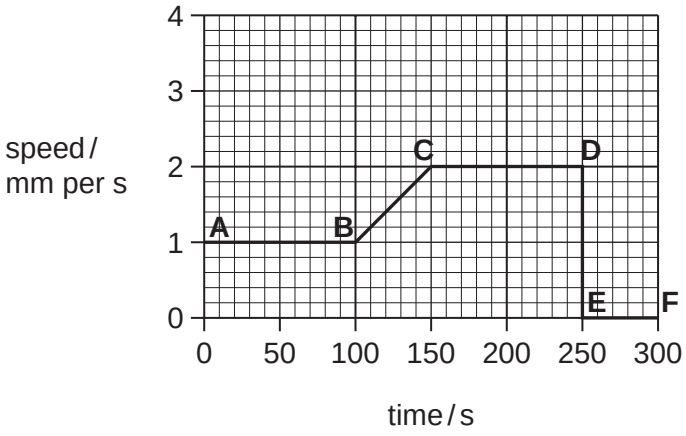


Fig. 8.1

(i) How can you tell that the caterpillar is moving at a constant speed between **A** and **B**?

.....

..... [1]

(ii) Between which times is the caterpillar accelerating?
Explain your answer.

.....

..... [1]

(iii) How far did the caterpillar travel in 300 seconds?
Show your working.

..... [2]

(b) The student looks at the caterpillar using a magnifying glass as shown in Fig. 8.2.

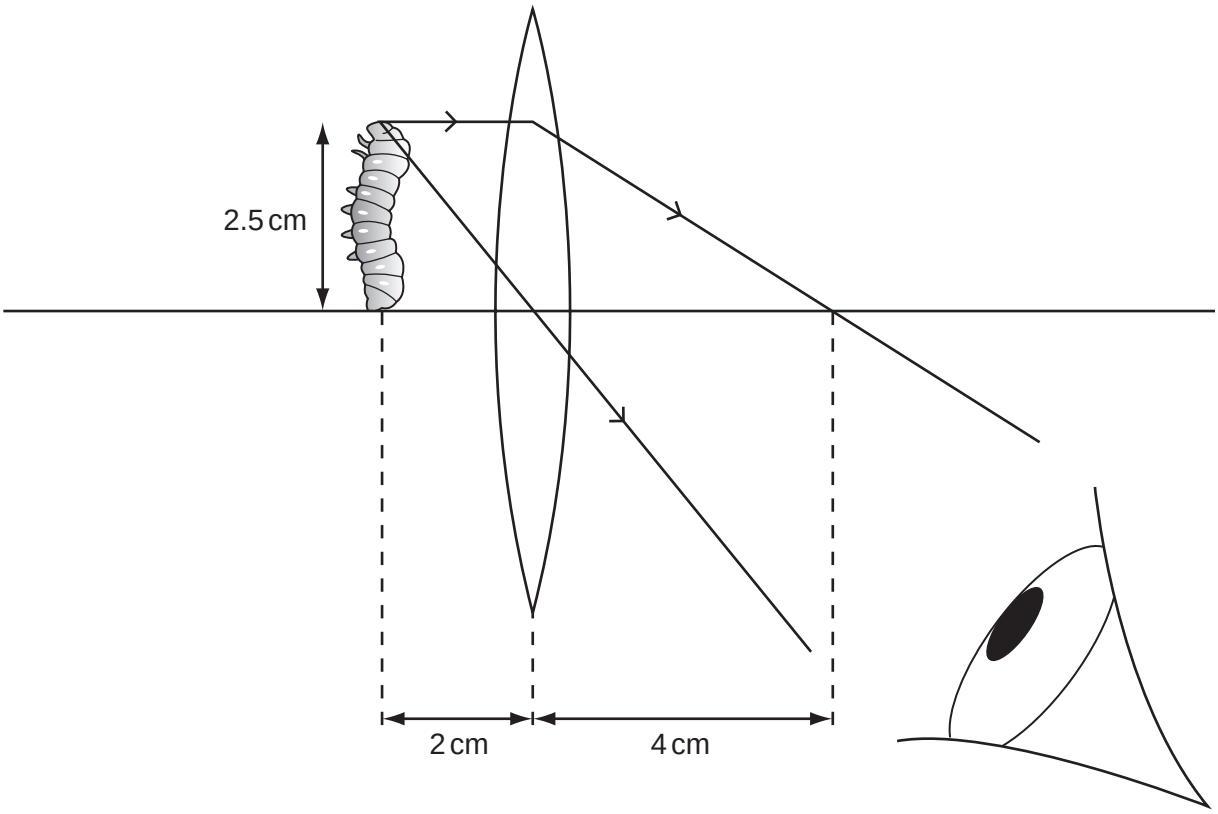


Fig. 8.2

(i) State the focal length of the lens.

.....cm [1]

(ii) Complete the ray diagram to show how the eye sees an enlarged image of the caterpillar. [2]

(iii) This image is called a virtual image.

Explain the meaning of the term *virtual image*.

.....

..... [1]

9 **(a)** Fig. 9.1 shows the male reproductive system.

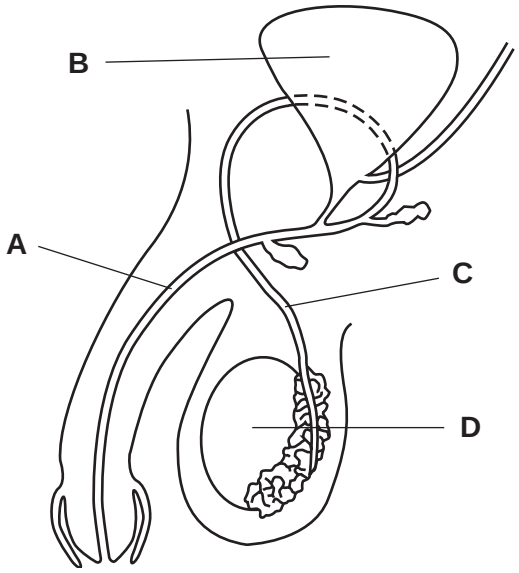


Fig. 9.1

(i) Name the parts labelled **A** and **C**.

A .....

C ..... [2]

(ii) State the functions of parts **B** and **D**.

B .....

D ..... [2]

(b) Some organisms are able to reproduce both asexually and sexually.

(i) Describe the differences between asexual reproduction and sexual reproduction.

.....

.....

..... [2]

(ii) Explain **one** advantage to an organism of reproducing asexually.

.....

.....

..... [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
X
b

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.).