

Candidate Name _____

Centre Number	Candidate Number

**International General Certificate of Secondary Education
CAMBRIDGE INTERNATIONAL EXAMINATIONS**

CO-ORDINATED SCIENCES

PAPER 3

0654/3

MAY/JUNE SESSION 2002

2 hours

Candidates answer on the question paper.
No additional materials are required.

TIME 2 hours

INSTRUCTIONS TO CANDIDATES

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

Answer **all** questions.

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

INFORMATION FOR CANDIDATES

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	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	

This question paper consists of 24 printed pages.

- 1 Fig. 1.1 shows three animals that belong to the same phylum (group).

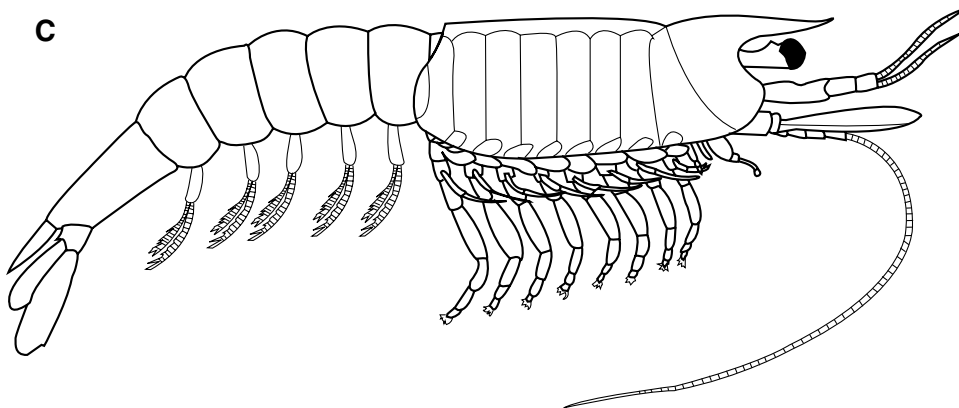
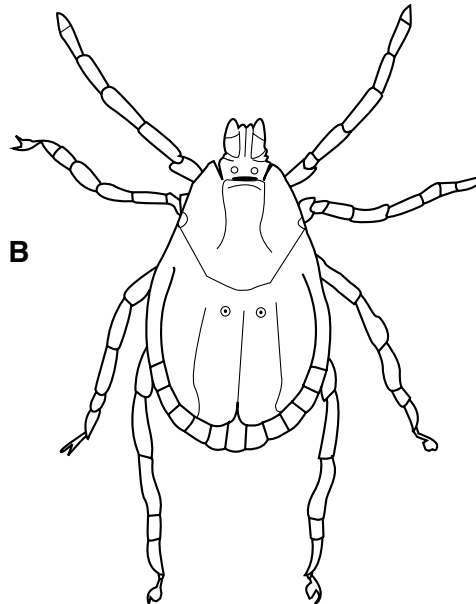
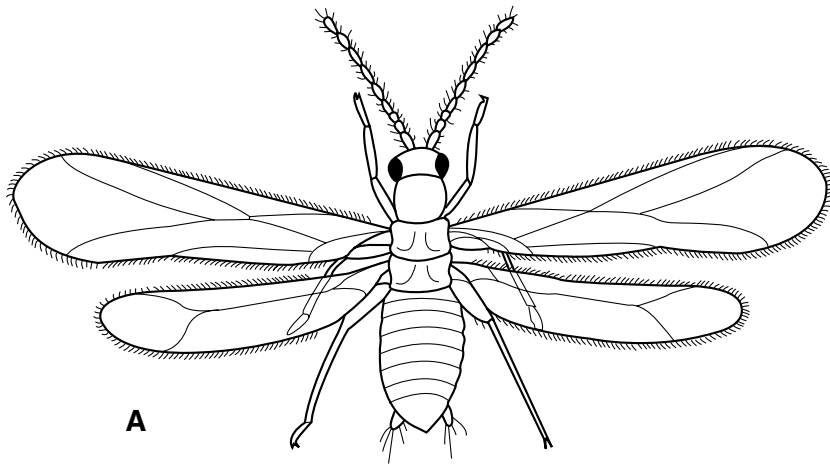


Fig. 1.1

(a) Name the group to which all three animals belong.

..... [1]

(b) Name the class to which each animal belongs. In each case, give one reason for your answer.

Animal A

Animal B

Animal C

[6]

- 2 A particular type of sand contains quartz (silicon(IV) oxide) grains, sodium chloride and small pieces of shell made of calcium carbonate.

A student analyses a sample of this sand to find out the percentage by mass of quartz, sodium chloride and shells.

First she washes 50.0 g of the sand with water to remove sodium chloride.

She then reacts another 50.0 g of the sand with dilute hydrochloric acid, which removes both the sodium chloride and the calcium carbonate.

Her results are shown in Fig. 2.1.

mass of dried mixture after washing with water / g	49.0
mass of dried residue after reaction with dilute acid / g	36.5

Fig. 2.1

- (a) Find the mass of sodium chloride present in 50 g of sand and hence show that the percentage by mass of calcium carbonate in the sand is 25%.

[2]

- (b) (i) Complete the balanced equation for the reaction of dilute hydrochloric acid with calcium carbonate.



- (ii) Calculate the number of moles of calcium carbonate in 50.0 g of the sand used by the student.

Show your working.

.....

[3]

- (iii) Calculate the number of moles of hydrochloric acid that is required to react with all the calcium carbonate in 50.0 g of the sand.

Show your working.

..... [2]

- (c) Draw diagrams to show the electron configurations of a sodium **ion** and a chloride **ion**.

Your diagram should show all the electrons in each ion.

sodium ion	chloride ion

[4]

- 3 A student has six resistors as shown in Fig. 3.1.

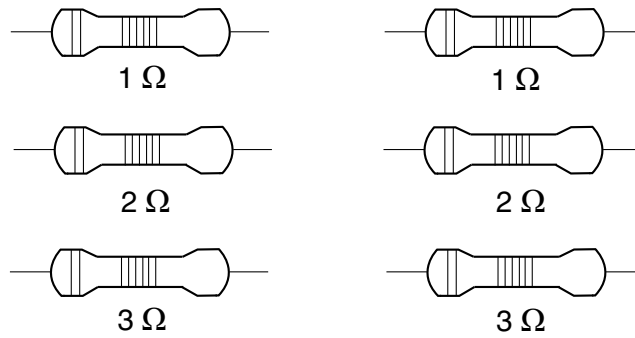


Fig. 3.1

- (a) Which two resistors could he combine to get a total resistance of 5 ohms?

Explain your answer.

..... [2]

- (b) Which two resistors could he combine to get a total resistance of 1.5 ohms?

Explain your answer.

..... [3]

(c) Another student is investigating three electronic gates:

an AND gate;
an OR gate;
a NOT gate.

(i) In Fig. 3.2, which type of gate is component X?

Explain your answer.

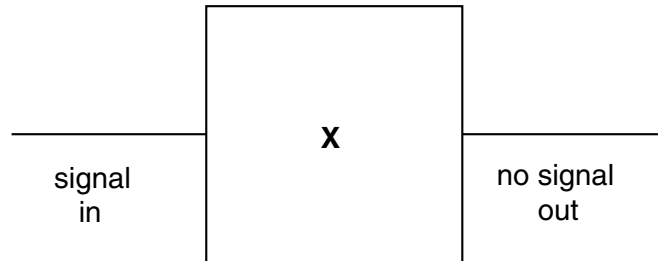


Fig. 3.2

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

(ii) In Fig. 3.3, which type of gate is component Y?

Explain your answer.

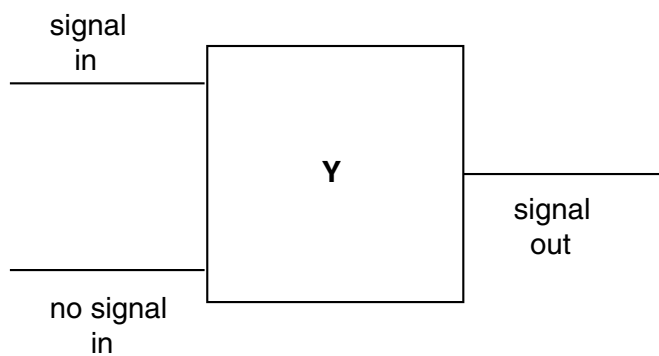


Fig. 3.3

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

- 4 Fig. 4.1 shows the positions of some of the parts of a person's breathing system, just as they have finished breathing out.

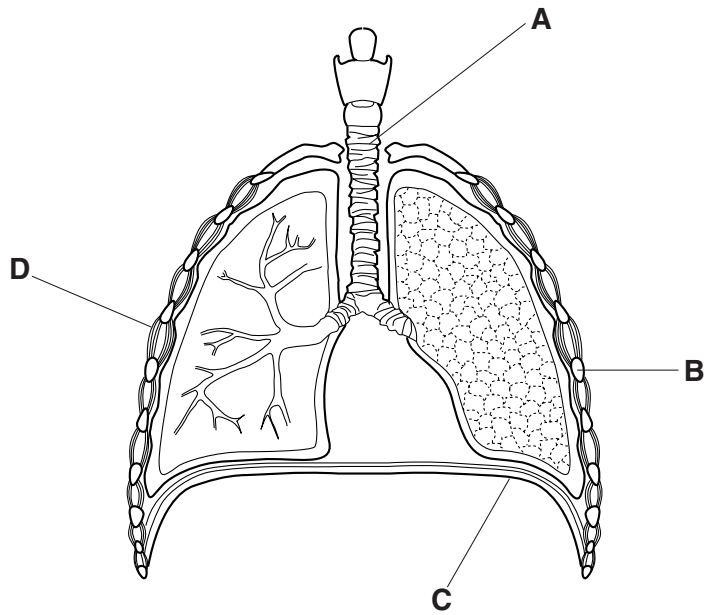


Fig. 4.1

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

A

B

[2]

- (b) (i) Describe what happens to parts **C** and **D** as the person breathes in.

C

.....

D

..... [2]

- (ii) Explain how the events you have described in (i) cause air to move into the lungs.

.....

.....

.....

..... [3]

(c) Smoking cigarettes affects the breathing system. Explain how smoking can increase the risk of getting bacterial infections in the lungs.

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

(d) Smoking also increases the risk of developing heart disease. The table in Fig. 4.2 shows the relationship between the number of cigarettes smoked and the death rate from heart disease in men aged between 45 and 54, in a European country.

number of cigarettes smoked per day	number of men dying from heart disease per thousand population
0	120
1-14	220
15-25	380
more than 25	400

Fig. 4.2

(i) Do these data prove that smoking causes heart disease? Explain your answer.

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

(ii) Apart from not smoking, state two other ways by which a person can reduce their risk of developing heart disease.

1.
.....
2.
..... [2]

- 5 Fig. 5.1 shows a modern hot air balloon.

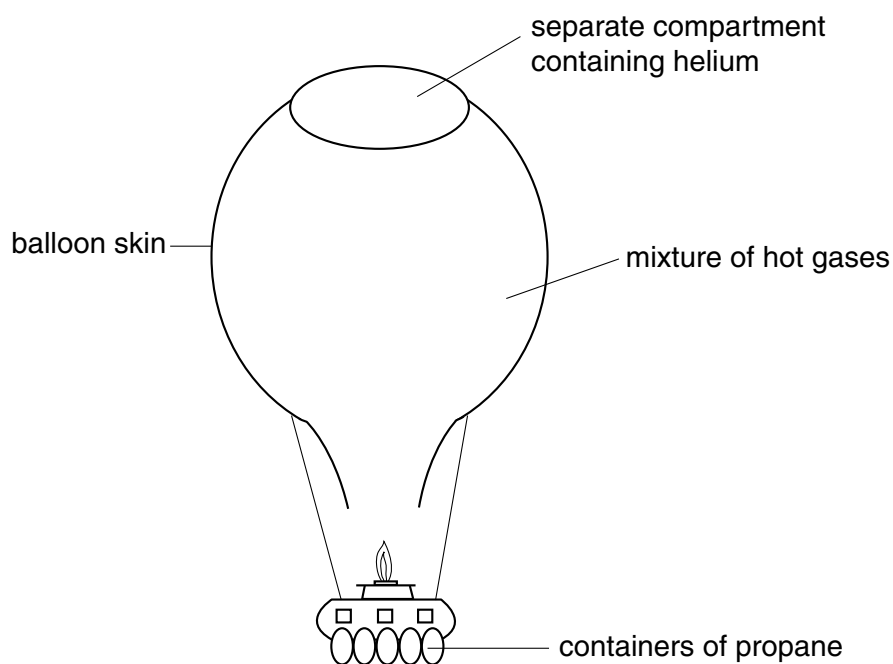


Fig. 5.1

- (a) The balloon contains a separate compartment filled with helium.

Explain, in terms of the electron configuration of its atoms, why helium is a safe gas to use in the balloon.

.....

.....

..... [2]

- (b) Heat from the combustion of propane increases the temperature of the gases in the balloon.

- (i) Propane is obtained from petroleum (crude oil).

Name the process used to separate propane from petroleum.

..... [1]

- (ii) Suggest **one** reason why petroleum would not be suitable for use as the fuel in the burners of the balloon.

.....

..... [1]

(iii) Propane is an alkane whose molecules each contain three carbon atoms.

Draw the displayed formula of one molecule of propane.

[2]

(iv) Write the molecular formula of an alkane which has a **lower** boiling point than propane.

Explain why this alkane has a lower boiling point than propane.

.....

.....

..... [2]

(v) Suggest and explain how the composition of the hot gases inside the balloon in Fig. 5.1 differs from the composition of the air outside.

.....

.....

.....

..... [3]

- (c) The skin of the balloon is made from a material which contains molecules made by condensation polymerisation.

Fig. 5.2 shows simplified diagrams of four monomer molecules which can react together to form part of a condensation polymer molecule.

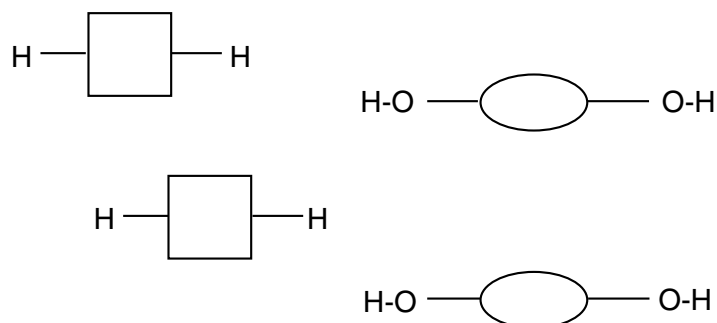


Fig. 5.2

- (i) Draw the short length of the condensation polymer molecule which forms when these four monomer molecules react.

[2]

- (ii) Name the other substance which forms when the monomers in Fig. 5.2 react.

..... [1]

6 Thorium-228 and thorium-230 are two radioactive isotopes with half-lives of 1.9 years and 80 000 years respectively.

(a) Using the Periodic Table on page 24, determine how many protons, neutrons and electrons there are in one atom of thorium-228.

protons

neutrons

electrons [3]

(b) With reference to thorium-228 and thorium-230, explain the meaning of the word *isotopes*.

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

(c) A sample of thorium-228 of mass 16 g was stored for 10 years.

Calculate the mass of thorium-228 that will remain after 5.7 years.

Show your working.

..... [2]

(d) In a nuclear power station, energy is released by nuclear fission.

Describe briefly the process of nuclear fission.

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

7 Aluminium, zinc and copper are produced industrially using electrolysis.

(a) (i) Explain why metallic elements are formed at the **cathode** in electrolysis.

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

(ii) Suggest why a molten aluminium compound and **not** an aqueous solution is used as the electrolyte in the production of aluminium.

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

(iii) Aluminium is in Group III of the Periodic Table. Deduce the number of aluminium ions that are reduced by 12 electrons during electrolysis.

Explain your answer.

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

(b) Bronze is an alloy of copper and tin.

(i) Suggest how bronze is made.

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

- (ii) Metals are described as malleable because they can be beaten into different shapes without breaking.

Explain, using diagrams to show sizes of atoms, why bronze is **less** malleable than both copper and tin.

[3]

8 A radio beacon floating in the open sea is shown in Fig. 8.1.

As the waves pass by the beacon goes up and down, but has no other movement.

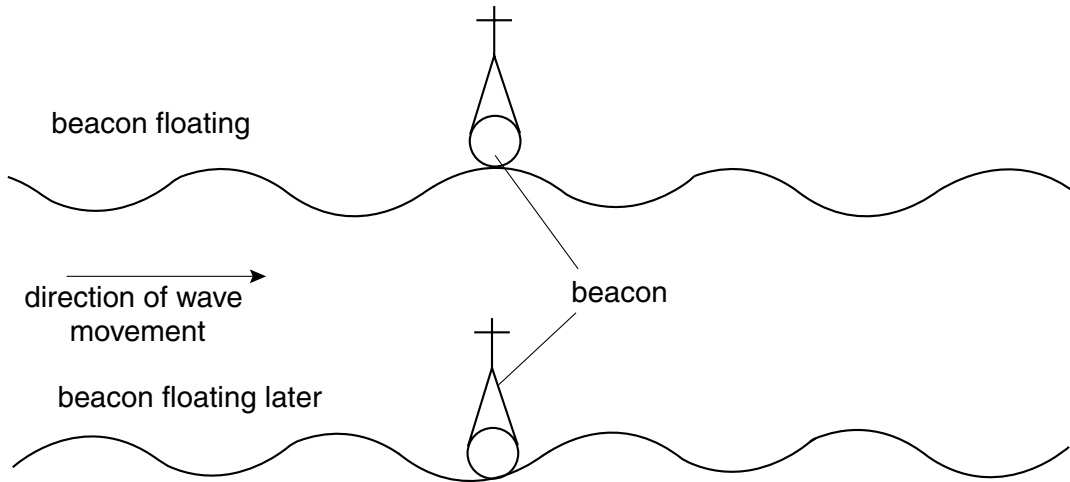


Fig. 8.1

(a) Are the waves on the sea transverse or longitudinal? Explain your answer.

.....
 [1]

(b) The radio beacon sends an analogue signal.

(i) Explain the difference between an analogue signal and a digital signal.

.....

 [2]

(ii) State **one** disadvantage of using analogue signals.

.....
 [1]

- (c) A girl wants to row her boat across a river from **A** to **B** as shown in Fig. 8.2. The velocity of the water in the river is 0.3 m/s as shown. She sets off in the direction **AC** at 0.5 m/s and arrives at **B**.

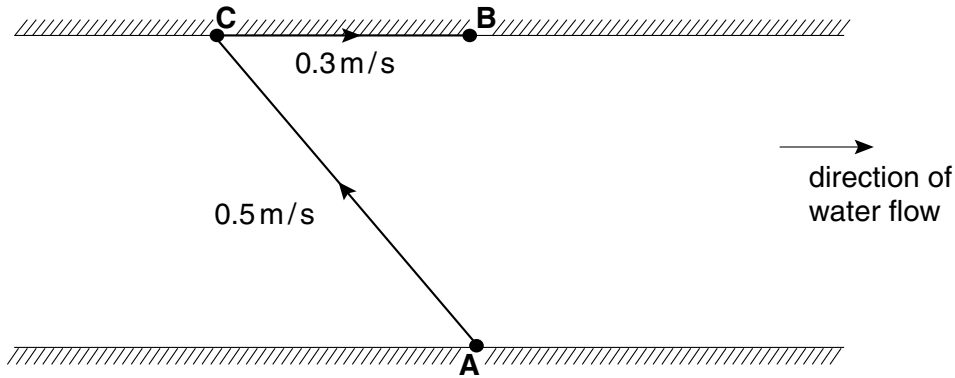


Fig. 8.2

- (i) Use the diagram to find the magnitude of the resultant velocity of the boat from **A** to **B**.

..... [1]

- (ii) The river is 10 m wide between **A** and **B**. How long will it take the boat to go from **A** to **B**?

..... [1]

- (iii) The girl has a mass of 50 kg and the boat has a mass of 100 kg. When she gets to point **B** she jumps out of the boat with a horizontal velocity of 5 m/s.

Use the idea of conservation of momentum to calculate the velocity with which the boat begins to move backwards.

Show your working and state any formula that you use.

..... [3]

9 Rice is a cereal crop that is grown in many tropical and temperate parts of the world. Rice plants begin to flower about 60 days after the seeds are sown. The flowers are very small, without any coloured petals.

Rice is grown for its seeds, called grains, which contain large amounts of starch and protein, and form the staple food for many people.

(a) Suggest how rice flowers are pollinated, giving a reason for your answer.

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

(b) Describe what must happen in the rice flowers, after pollination, before the grains will begin to grow.

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

(c) The starch is made inside the growing rice grains from sugars that are transported into the grain from other parts of the plant.

(i) Describe how and where these sugars are made in the plant.

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

(ii) Describe how the sugars are transported from the place where they are made to the growing rice grains.

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

- (d) Rice is often attacked by pests and diseases, which can greatly reduce the yield of grain. One such disease is caused by a fungus called rice blast.

There are some varieties of rice that are resistant to rice blast, but some of the most valuable rice varieties are non-resistant. Rice farmers spray fungicides (pesticides that kill fungi) onto the plants of the non-resistant varieties to prevent damage by rice blast. However, the fungicides are very expensive. Also, farmers are finding that they have to spray more and more fungicide to control the fungus.

A two-year experiment has been carried out in China to see if growing a mixture of rice varieties together, rather than just one variety on its own, could reduce the damage done by rice blast fungus. In the experiment, they used two non-resistant varieties, **A** and **B**, and two resistant varieties, **C** and **D**. They grew **A** and **B** in plots on their own, and then in plots where they were mixed up with one of the other varieties, in the same field. Some of the results are shown in the graph in Fig. 9.1 below.

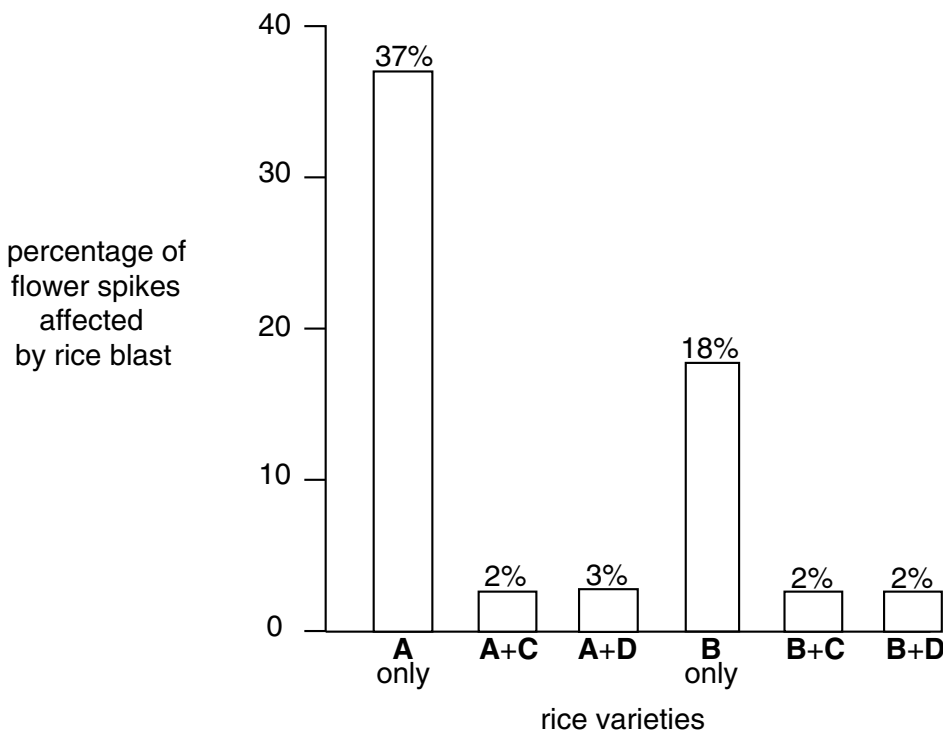


Fig. 9.1

- (i) Explain why, in this experiment, the non-resistant varieties were grown on their own in some of the plots.

.....
 [1]

- (ii) Suggest why it was important to compare results from plots in the same field, rather than from different fields.

.....

 [2]

(iii) Calculate the difference between the percentage of flower spikes of variety **A** that were infected by rice blast when grown alone, and when grown with variety **C**.

..... [1]

(iv) At the end of the two-year experiment, none of the farmers who had taken part wanted to use fungicides again. Apart from cost, suggest the possible benefits of this decision.

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

Please turn over the page for Q10.

10 The burning chemicals in a firework rocket produce a lot of hot gases. The escaping gases produce a constant force on the rocket of 2.4 N.

(a) State two of the energy transfers taking place as the rocket takes off.

1.

2. [2]

(b) The rocket has a mass of 0.08 kg. If the gravitational field strength on Earth is 10 N/kg, calculate the minimum force required for the rocket to take off.

Show your working.

..... [2]

(c) Calculate the acceleration of the rocket as it takes off.

Show your working and state any formula that you use.

..... [2]

(d) Explain why the acceleration of the rocket will increase as the chemicals in the rocket are used up.

.....

.....

..... [2]

(e) The speed-time graph for another rocket, after launching, is shown in Fig. 10.1.

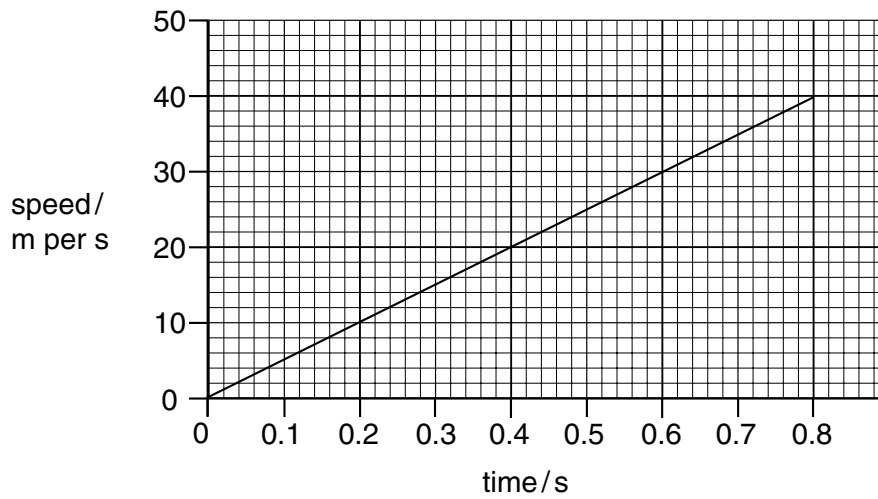


Fig. 10.1

Calculate the distance travelled vertically in the first 0.5 seconds.

Show your working on the graph.

..... [2]

DATA SHEET
The Periodic Table of the Elements
Group

I	II	III	IV	V	VI	VII	O	
7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1					2 He Helium 2	4 He Helium
23 Na Sodium 11	24 Mg Magnesium 12	11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10	
39 K Potassium 19	40 Ca Calcium 20	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	
85 Rb Rubidium 37	88 Sr Strontium 38	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36	
133 Cs Caesium 55	137 Ba Barium 56	65 Zn Zinc 30	64 Cu Copper 29	106 Pd Palladium 46	108 Ag Silver 47	127 I Iodine 53	131 Xe Xenon 54	
226 Ra Radium 88	227 Ac Actinium 89	112 Cd Cadmium 48	109 Pt Platinum 78	195 Pt Platinum 78	197 Au Gold 79	209 Po Polonium 84	210 Po Polonium 84	
*58-71 Lanthanoid series †90-103 Actinoid series		59 Co Cobalt 27	59 Co Cobalt 27	103 Rh Rhodium 45	106 Pd Palladium 46	201 Hg Mercury 80	209 Po Polonium 84	
140 Ce Cerium 58	141 Pr Praseodymium 59	55 Mn Manganese 25	56 Fe Iron 26	101 Ru Ruthenium 44	101 Ru Ruthenium 44	159 Tb Terbium 65	167 Er Erbium 68	
232 Th Thorium 90	238 U Uranium 92	52 Cr Chromium 24	55 Mn Manganese 25	186 Re Rhenium 75	186 Re Rhenium 75	162 Dy Dysprosium 66	167 Er Erbium 68	
144 Nd Neodymium 60	144 Nd Neodymium 60	48 Ti Titanium 22	48 Ti Titanium 22	184 W Tungsten 74	184 W Tungsten 74	165 Ho Holmium 67	167 Er Erbium 68	
141 Pr Praseodymium 59	144 Nd Neodymium 60	91 Zr Zirconium 40	91 Zr Zirconium 40	190 Os Osmium 76	190 Os Osmium 76	165 Ho Holmium 67	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	45 Sc Scandium 21	45 Sc Scandium 21	192 Ir Iridium 77	192 Ir Iridium 77	162 Dy Dysprosium 66	167 Er Erbium 68	
232 Th Thorium 90	238 U Uranium 92	23 V Vanadium 23	23 V Vanadium 23	181 Ta Tantalum 73	181 Ta Tantalum 73	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	22 Ti Titanium 22	22 Ti Titanium 22	178 Hf Hafnium 72	178 Hf Hafnium 72	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	93 Nb Niobium 41	93 Nb Niobium 41	192 Os Osmium 76	192 Os Osmium 76	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	89 Y Yttrium 39	89 Y Yttrium 39	184 W Tungsten 74	184 W Tungsten 74	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	41 V Vanadium 23	41 V Vanadium 23	190 Os Osmium 76	190 Os Osmium 76	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	25 Cr Chromium 24	25 Cr Chromium 24	186 Re Rhenium 75	186 Re Rhenium 75	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	192 Ir Iridium 77	192 Ir Iridium 77	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	25 Cr Chromium 24	25 Cr Chromium 24	190 Os Osmium 76	190 Os Osmium 76	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	25 Cr Chromium 24	25 Cr Chromium 24	186 Re Rhenium 75	186 Re Rhenium 75	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	192 Ir Iridium 77	192 Ir Iridium 77	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	190 Os Osmium 76	190 Os Osmium 76	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	186 Re Rhenium 75	186 Re Rhenium 75	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	192 Ir Iridium 77	192 Ir Iridium 77	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	190 Os Osmium 76	190 Os Osmium 76	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	186 Re Rhenium 75	186 Re Rhenium 75	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	192 Ir Iridium 77	192 Ir Iridium 77	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	190 Os Osmium 76	190 Os Osmium 76	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	186 Re Rhenium 75	186 Re Rhenium 75	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	192 Ir Iridium 77	192 Ir Iridium 77	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	190 Os Osmium 76	190 Os Osmium 76	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	186 Re Rhenium 75	186 Re Rhenium 75	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	192 Ir Iridium 77	192 Ir Iridium 77	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	190 Os Osmium 76	190 Os Osmium 76	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	186 Re Rhenium 75	186 Re Rhenium 75	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	192 Ir Iridium 77	192 Ir Iridium 77	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	190 Os Osmium 76	190 Os Osmium 76	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	186 Re Rhenium 75	186 Re Rhenium 75	162 Dy Dysprosium 66	167 Er Erbium 68	
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140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	190 Os Osmium 76	190 Os Osmium 76	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	186 Re Rhenium 75	186 Re Rhenium 75	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	192 Ir Iridium 77	192 Ir Iridium 77	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	190 Os Osmium 76	190 Os Osmium 76	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	186 Re Rhenium 75	186 Re Rhenium 75	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	192 Ir Iridium 77	192 Ir Iridium 77	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	190 Os Osmium 76	190 Os Osmium 76	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	186 Re Rhenium 75	186 Re Rhenium 75	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	192 Ir Iridium 77	192 Ir Iridium 77	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	190 Os Osmium 76	190 Os Osmium 76	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	186 Re Rhenium 75	186 Re Rhenium 75	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	192 Ir Iridium 77	192 Ir Iridium 77	162 Dy Dysprosium 66	167 Er Erbium 68	
140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	190 Os Osmium 76	190 Os Osmium 76	162 Dy Dysprosium 66	167 Er Erbium 68	
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140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	190 Os Osmium 76	190 Os Osmium 76	162 Dy Dysprosium 66	167 Er Erbium 68	
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140 Ce Cerium 58	141 Pr Praseodymium 59	24 Cr Chromium 24	24 Cr Chromium 24	192 Ir Iridium 77	192 Ir Iridium 77	162		