

CANDIDATE
NAME

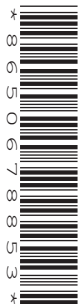
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CENTRE
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COMBINED SCIENCE

5129/22

Paper 2

October/November 2019

2 hours 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.

You may use an HB pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

A copy of the Periodic Table is printed on page 24.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

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.

This document consists of **24** printed pages.

1 A student attaches identical springs to each end of a trolley.

The other ends of each spring are attached to fixed points.

He moves the trolley to the left. Spring **A** is compressed. Spring **B** is extended.

He then releases the trolley.

He observes the trolley as it moves to the right and then back to the left.

Fig. 1.1 shows the position of the trolley at times $t = 0$ s, $t = 0.20$ s and $t = 0.25$ s.

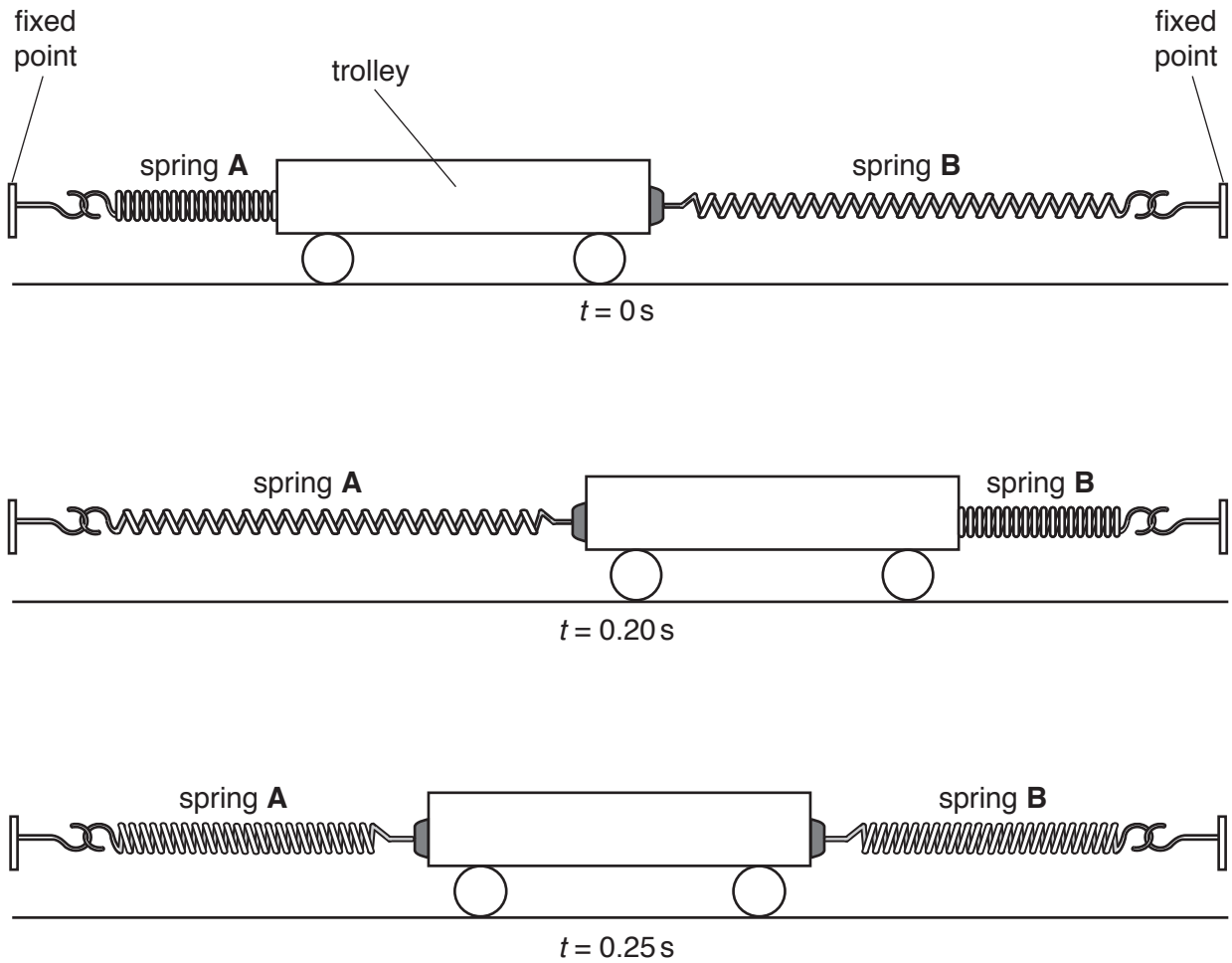


Fig. 1.1

(a) Use ideas about forces to explain why the trolley moves to the right and then back to the left.

.....

.....

.....

..... [3]

(b) The student puts a load on top of the trolley as shown in Fig. 1.2.

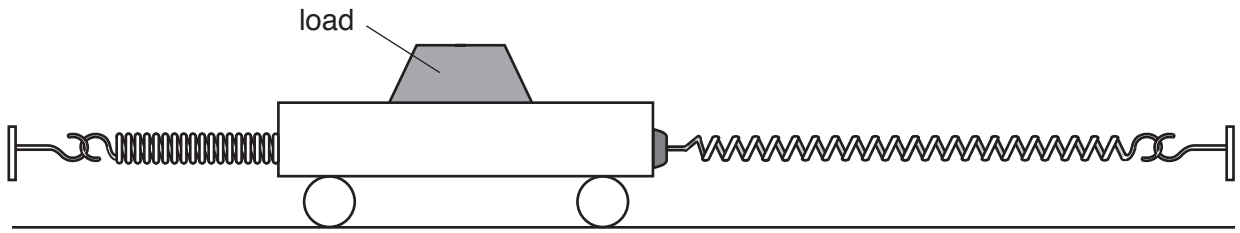


Fig. 1.2

He repeats the experiment.

(i) State and explain how the load affects the movement of the trolley between the springs.

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

(ii) The initial acceleration of the trolley and its load is 15 m/s^2 .

The force needed to produce this acceleration is 27 N.

Calculate the total mass of the trolley and its load.

total mass = kg [2]

[Total: 7]

2 The apparatus used to distil an aqueous solution of ethanol is shown in Fig. 2.1.

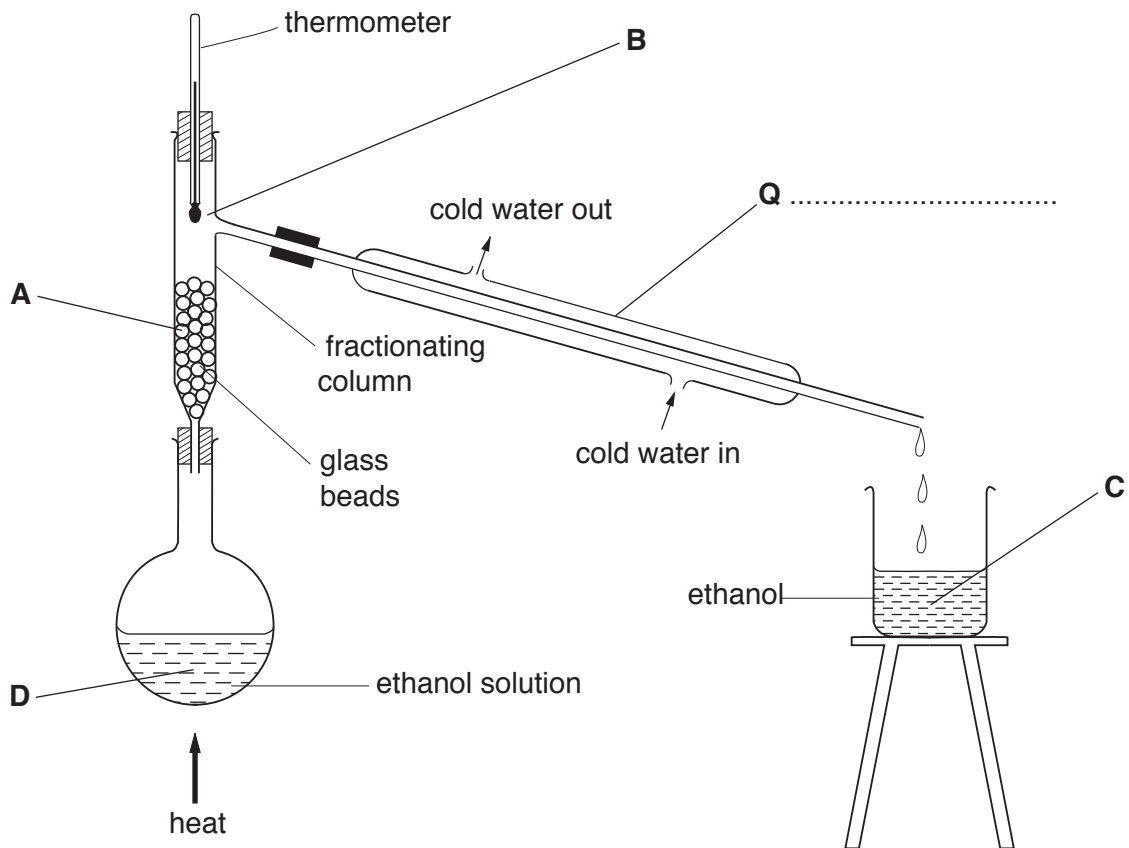


Fig. 2.1

(a) (i) On Fig. 2.1, name the piece of apparatus labelled **Q**. [1]

(ii) Suggest why cold water enters the bottom of apparatus **Q** rather than the top.

.....
 [1]

(iii) Use one letter **A**, **B**, **C** or **D** shown on Fig. 2.1 to identify where all the ethanol molecules are furthest apart and moving in rapid random motion.

letter [1]

(b) Perfumes are made by dissolving solids in ethanol.

State the name given to liquids in which solids dissolve.

..... [1]

(c) Draw the structure of ethanol.

[1]

[Total: 5]

3 Use words from the list to complete the sentences about plants and water.

Each word may be used once, more than once, or not at all.

ions	large	phloem	photosynthesis
respire	small	transpiration	vitamins
	wilt	xylem	

Root hair cells are adapted for absorbing water as they have a surface area.

The root hair cell also absorbs

Water is transported up the stem of a plant in the tissue.

Water is lost from the plant by the process of

When a plant loses more water than it absorbs it will

[5]

4 The apparatus used to investigate the elastic deformation of a test material is shown in Fig. 4.1.

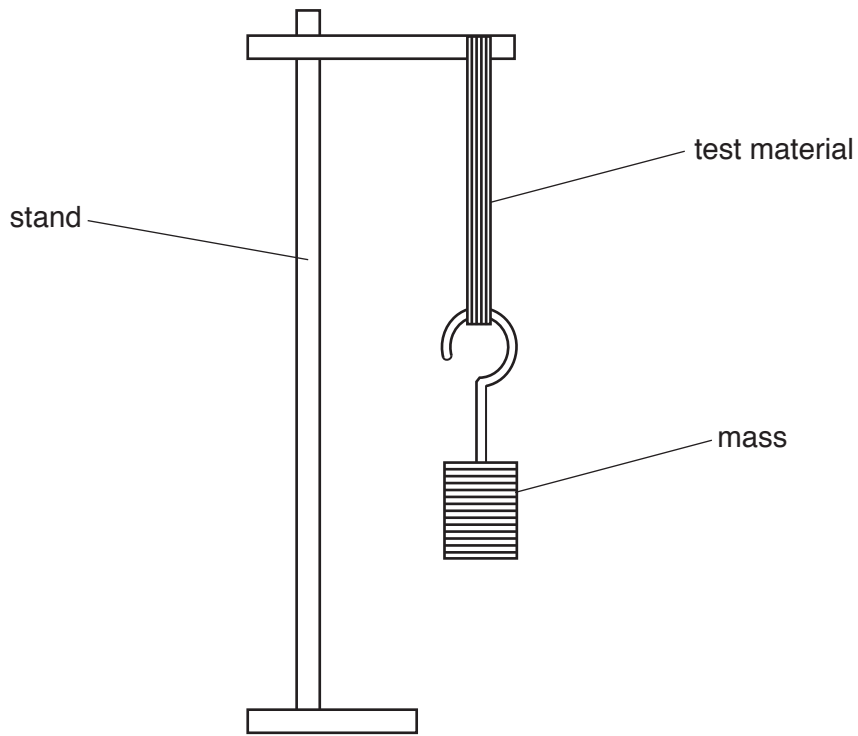


Fig. 4.1

(a) Describe an experimental procedure for this investigation.

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

(b) The test material behaves elastically.

State what happens to the test material when the mass is removed.

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

[Total: 4]

5 An atom of fluorine is represented by ${}^{19}_9\text{F}$.

The numbers 19 and 9 provide information about the structure of this fluorine atom.

(a) (i) Complete the following sentences.

The number 19 is the number of fluorine.

The number 9 is the number of fluorine.

[1]

(ii) Complete Fig. 5.1 to show the electronic structure of a fluorine atom.

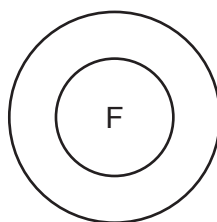


Fig. 5.1

[1]

(iii) Fluorine is a non-metal.

State how this can be deduced from the symbol ${}^{19}_9\text{F}$ and its electronic structure.

.....

 [2]

(b) Fluorine reacts violently with magnesium to produce a white solid.

(i) Name the white solid.

..... [1]

(ii) State the type of bonding present in this solid.

..... [1]

[Total: 6]

6 Fig. 6.1 shows a food web found in Africa.

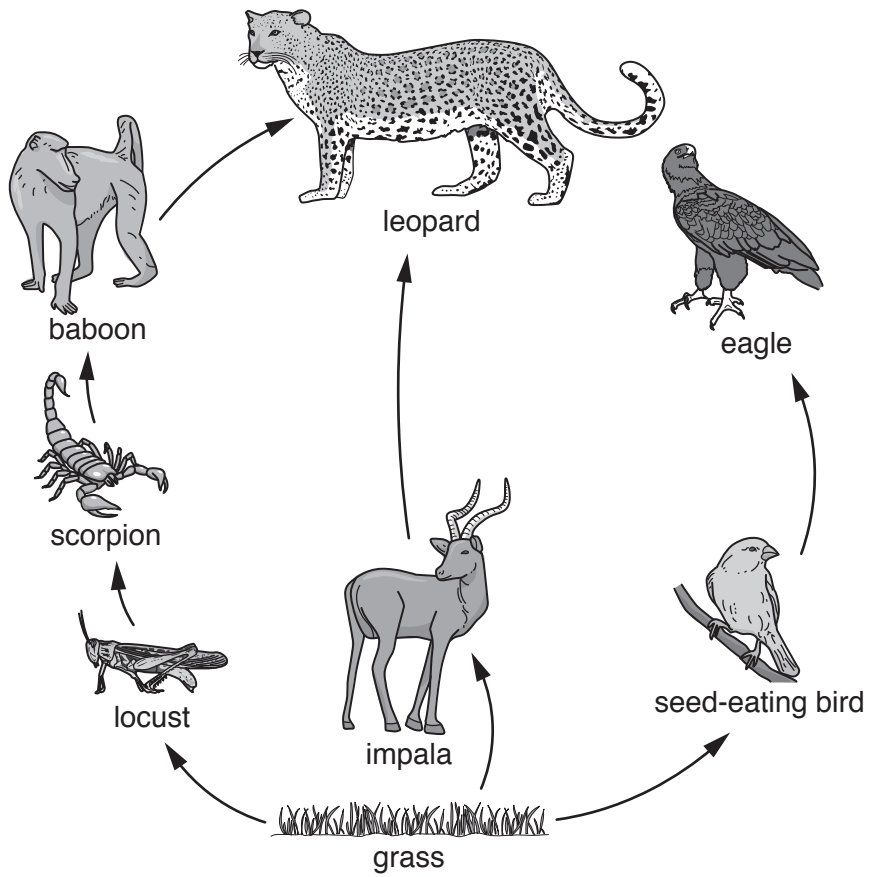


Fig. 6.1

(a) Explain what the arrow means in the following relationship from the food web.



.....
 [1]

(b) State the number of different herbivore and carnivore species in this food web.

number of herbivore species

number of carnivore species

[2]

(c) All the baboons in the food web die from a disease.

Suggest why this may cause the population of impala to:

increase

.....

decrease.

.....

[2]

(d) Two food chains, **A** and **B**, from the food web are shown in Fig. 6.2:

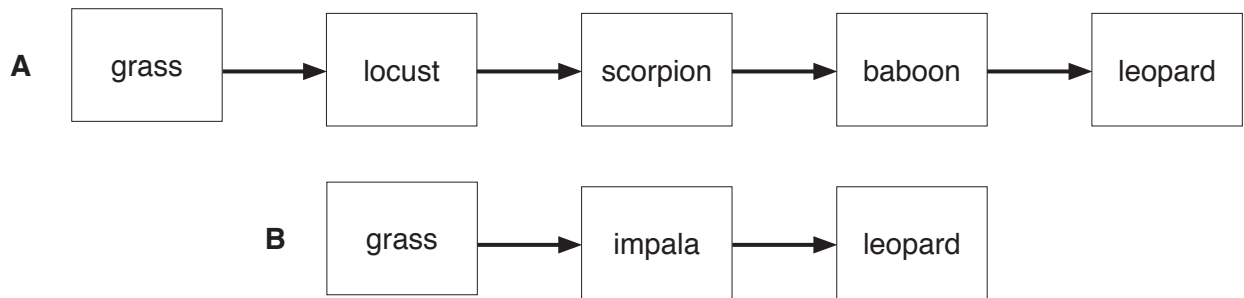


Fig. 6.2

Explain why the short food chain in **B** is better for the leopard than the long food chain in **A**.

.....

.....

.....

..... [2]

[Total: 7]

7 A solar tower is used to produce electricity.

Air flows through a generator and rises up a tower as shown in Fig. 7.1.

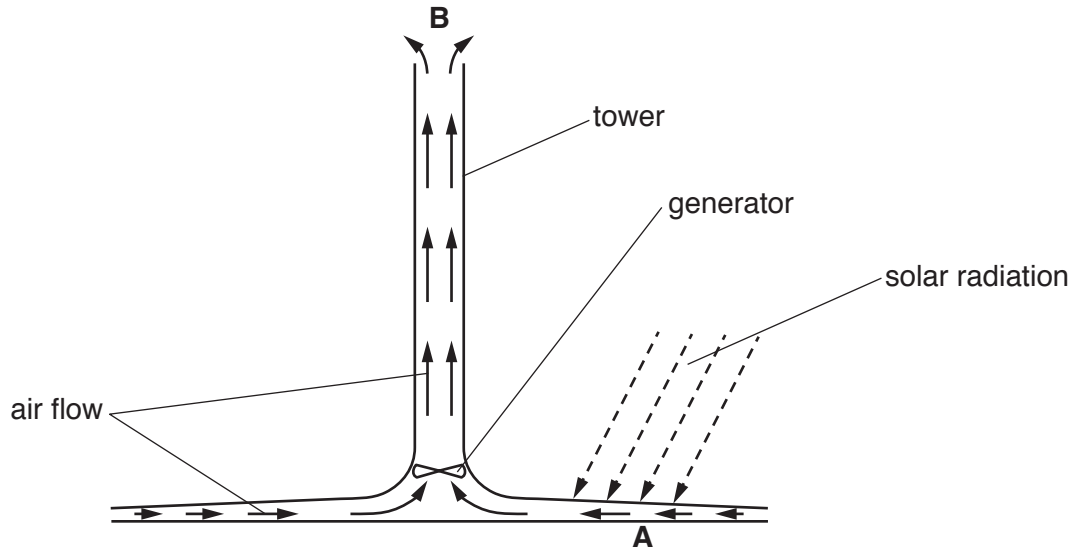


Fig. 7.1

(a) Explain why air at point **A** moves to point **B**.

.....
 [2]

(b) The top surface above point **A** is painted black.

Explain how this increases the production of electricity.

.....

 [2]

(c) Name the type of thermal energy transfer caused by the movement of air in the solar tower.

..... [1]

[Total: 5]

- 8 A hydroxide of metal M reacts with dilute sulfuric acid to produce an aqueous solution of metal sulfate, $M_2(SO_4)_3$.

The equation for the reaction is shown.



- (a) The formula of the sulfate ion is SO_4^{2-} .

Draw a circle around the formula of the ion of metal M.



[1]

- (b) The relative molecular mass of the metal hydroxide, $M(OH)_3$, is 78.

[A_r : O, 16; S, 32; H, 1]

- (i) Calculate the relative atomic mass of metal M.

relative atomic mass = [1]

- (ii) Complete the following sentences.

156 g of the metal hydroxide $M(OH)_3$ produces g of water.

0.78 g of the metal hydroxide $M(OH)_3$ produces g of water.

[2]

- (c) (i) When universal indicator is added to dilute sulfuric acid the indicator turns red.

Suggest the pH of the dilute sulfuric acid. [1]

- (ii) State the type of reaction that occurs when the metal hydroxide reacts with dilute sulfuric acid.

..... [1]

[Total: 6]

- 9 A teacher attaches a container of dry sand to one end of a piece of string. She ties the other end of the string to a stand so that the container swings from side to side. She makes a small hole in the container to allow the sand to flow out slowly. The sand flows out on to a track which moves at a constant speed under the container. The sand grains make a wave, as shown in Fig. 9.1.

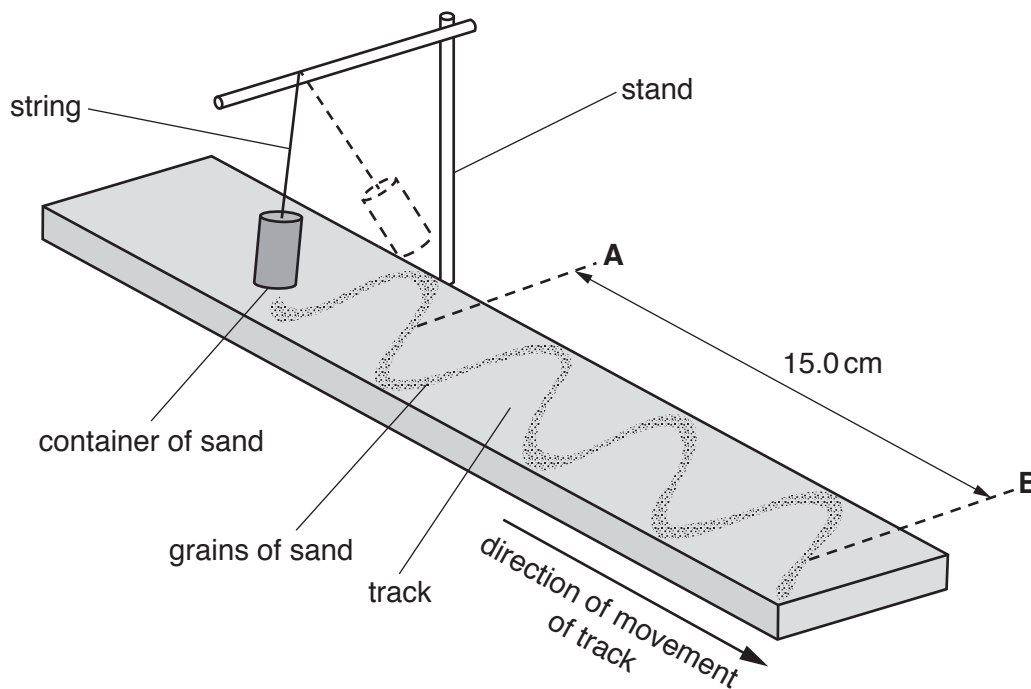


Fig. 9.1 (not to scale)

The teacher says that this is an example of wave motion.

- (a) State the type of wave shown in Fig. 9.1. Explain your answer.

type of wave

explanation

.....

[2]

- (b) The distance between **A** and **B** on Fig. 9.1 is 15.0 cm.

- (i) Use Fig. 9.1 to determine the number of complete waves between **A** and **B**.

number of complete waves = [1]

- (ii) Determine the wavelength of the wave.

wavelength = cm [1]

(c) The container of sand produces waves with a frequency of 0.80 Hz.

Use your answer to **b(ii)** to calculate the speed of movement of the track.

speed = cm/s
[2]

[Total: 6]

10 (a) State how the structure of an artery differs from the structure of a vein in:

the thickness of the wall

.....

the diameter of the lumen

.....

the presence of semi-lunar valves.

.....

[3]

(b) Describe **two** possible causes of coronary heart disease.

1

.....

2

.....

[2]

(c) A diagram of a capillary is shown in Fig. 10.1

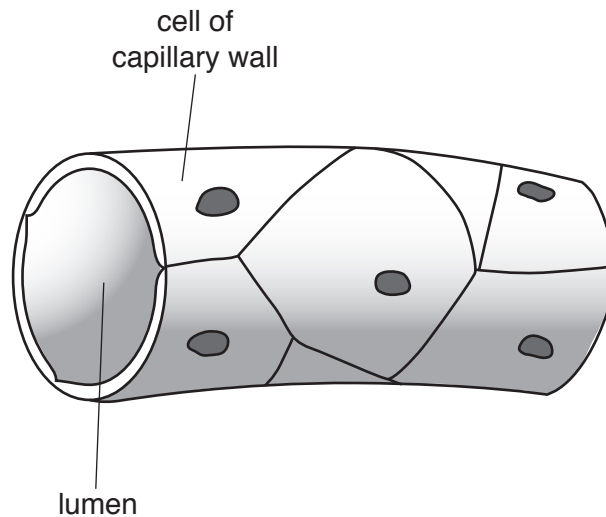


Fig. 10.1

State and explain **one** way in which the capillary is adapted to carry out its function.

adaptation

explanation

.....

[2]

[Total: 7]

- 11 Ammonia is manufactured by reacting nitrogen and hydrogen together in the presence of a catalyst.

Study the flowchart about ammonia shown in Fig. 11.1.

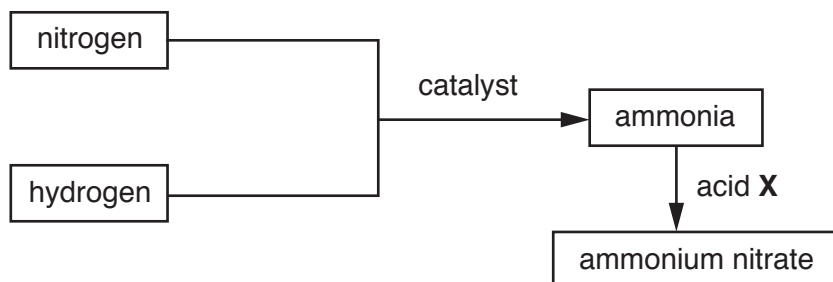


Fig. 11.1

- (a) Name the catalyst used in the manufacture of ammonia.

..... [1]

- (b) Name acid X.

..... [1]

- (c) Balance the equation for the manufacture of ammonia.



- (d) Nitrogen is obtained from liquid air by fractional distillation.

- (i) Explain why liquid nitrogen can be separated from liquid oxygen by fractional distillation.

..... [1]

- (ii) Name the source of hydrogen used in the manufacture of ammonia.

..... [1]

- (e) Ammonium nitrate is used to make fertilisers.

Name the element present in ammonium nitrate which is needed for the growth of plants.

..... [1]

[Total: 6]

12 Fig. 12.1 shows a section through a germinating seed.

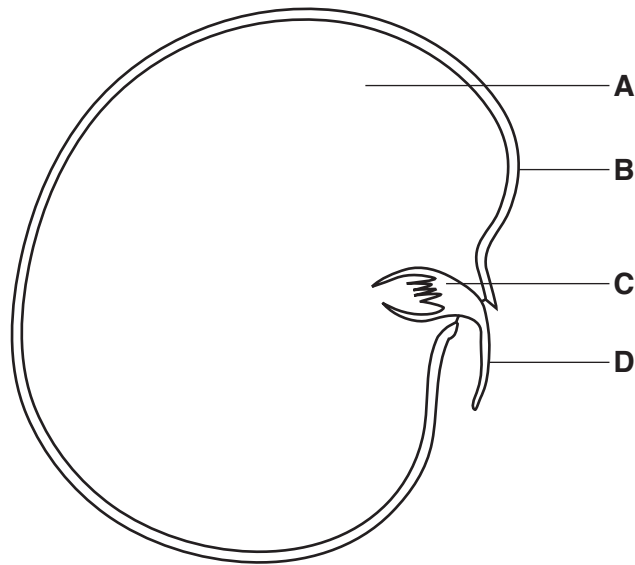


Fig. 12.1

(a) Use letters from Fig. 12.1 to identify:

the testa

the plumule

[2]

(b) A seed needs certain environmental conditions to germinate.

State **two** of these conditions.

1

2

[2]

(c) A seed contains a food store which it uses during germination.

One of the substances in the food store is starch.

State the name of the enzyme the seed uses to digest starch and the name of the substance produced during this digestion.

name of enzyme

name of substance

[2]

(d) Seeds are dispersed away from the parent plant so that they can colonise new areas.

State **two** methods of seed dispersal.

1

2

[2]

[Total: 8]

13 Fig. 13.1 shows the circuit symbol for a battery.

(a)

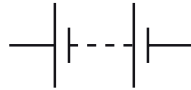


Fig. 13.1

Complete the circuit in Fig. 13.1 by adding the circuit symbols for

- a resistor in series with a lamp,
- a voltmeter to measure the potential difference across the lamp only,
- an ammeter to measure the current in the circuit.

[3]

(b) The current in the completed circuit is 0.65A.

Calculate the charge that passes through the circuit in 200 seconds.

State the unit.

charge = unit [3]

[Total: 6]

- 14 Complete the sentences about the structure and properties of materials using the words or phrases listed.

Each word or phrase may be used once, more than once or not at all.

atom **compound** **conducts** **different**
does not conduct **high** **low** **mixture**
molecule **similar**

Elements contain only one type of

When two elements chemically combine a is formed.

The two elements and the substance formed have properties.

When a metal and a non-metal chemically combine, the substance that is formed has a volatility and it electricity when it is molten.

[5]

15 The boxes on the left of Fig. 15.1 contain functions carried out by different parts of the body.

The boxes on the right contain names of the different parts of the body.

Draw one straight line from each of the listed functions to the part of the body responsible for carrying it out.

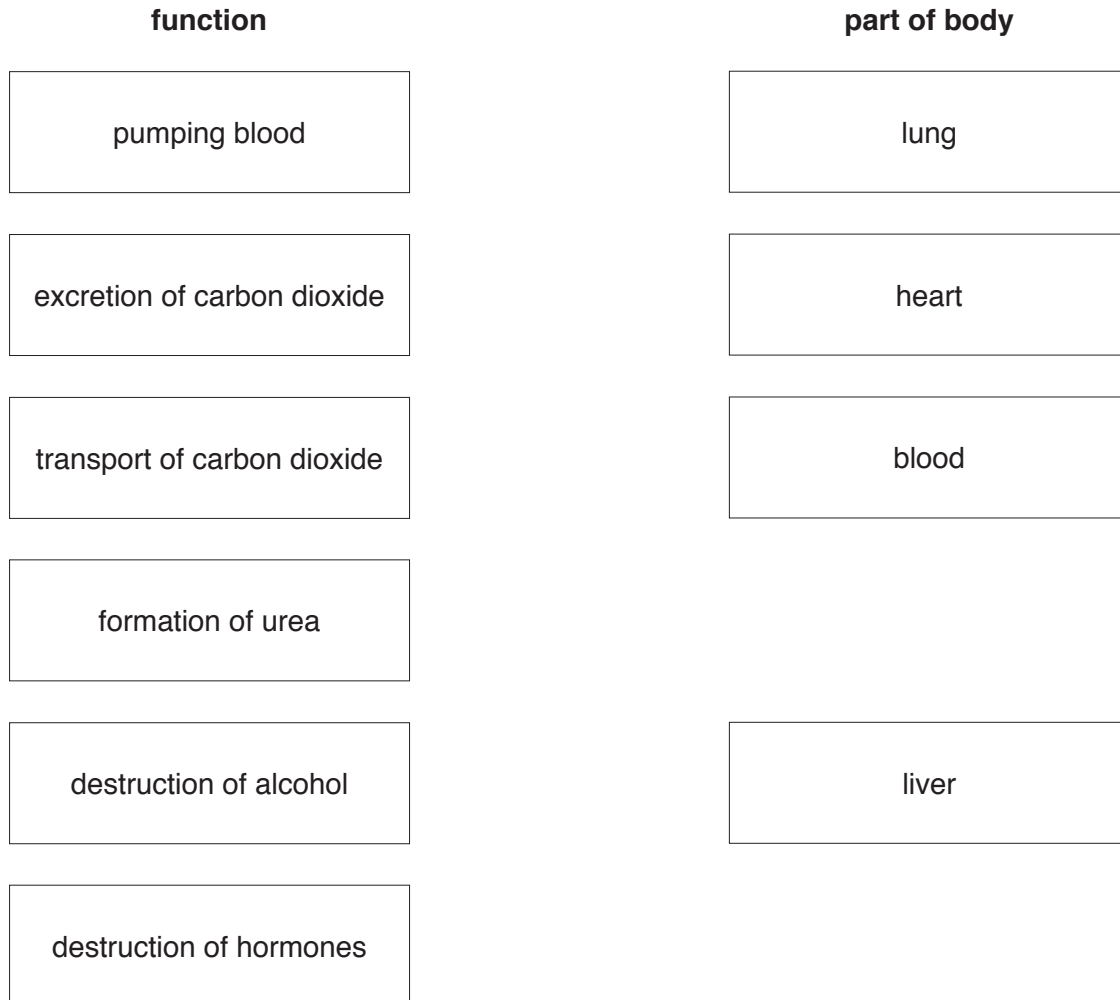


Fig. 15.1

[6]

16 The alkenes are a homologous series of unsaturated hydrocarbons.

(a) State the meaning of the term *hydrocarbon*.

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

(b) Describe a test that distinguishes an unsaturated hydrocarbon from a saturated hydrocarbon.

State the result of the test.

test

result with an unsaturated hydrocarbon

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

(c) State how the boiling point of the members of a homologous series changes as the number of carbon atoms increases.

..... [1]

[Total: 5]

17 A student investigates static electricity.

He suspends a charged rod **X** from a stand so that it can rotate freely.

He places another charged rod **Y** a short distance d away as shown in Fig. 17.1.

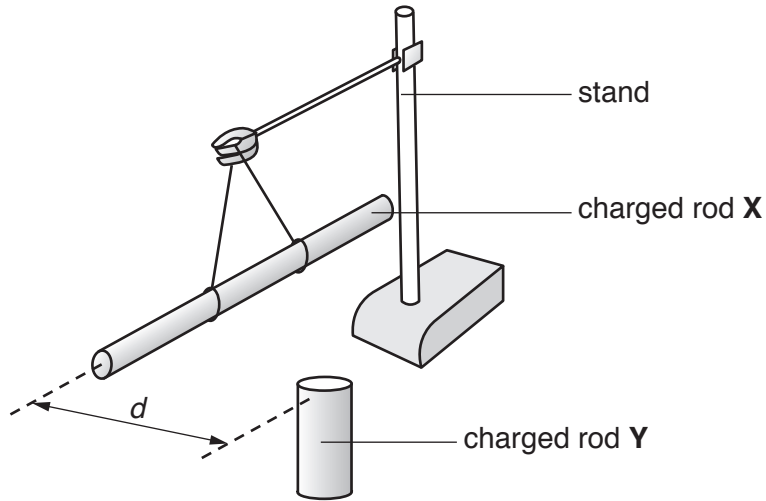


Fig. 17.1

Rod **X** rotates about its centre through an angle of 50° towards rod **Y**. Fig. 17.2 shows this viewed from above.

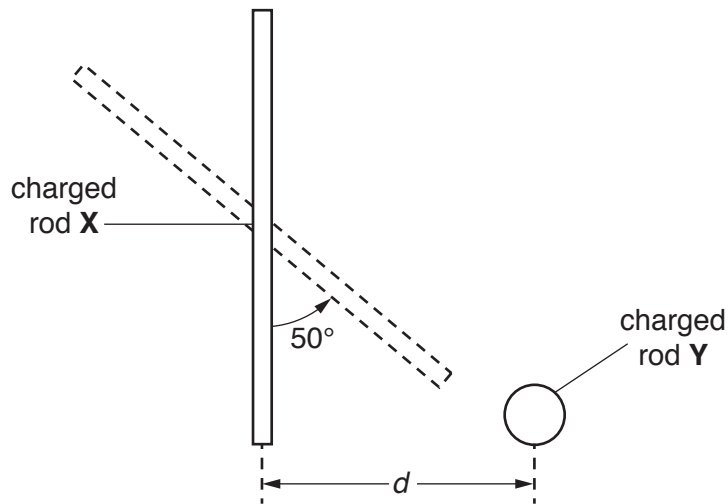


Fig. 17.2 (viewed from above)

The student measures the time taken for rod **X** to rotate through 50° .

(a) Explain why one end of rod **X** rotates towards rod **Y**.

..... [1]

(b) The student does the same experiment two more times.

He then changes the distance d between the two rods and repeats the whole investigation.

His results are shown in Table 17.1.

Table 17.1

distance d/cm	time taken for rod X to rotate through $50^\circ/s$			
	experiment 1	experiment 2	experiment 3	average time
8.0	7.8	7.5	8.4	7.9
10.0	9.6	10.2	10.8	10.2
12.0	18.6	19.6	18.8

(i) Complete Table 17.1 by calculating the average time for distance $d = 12.0\text{ cm}$. [1]

(ii) Describe the relationship between the distance d and the time taken for rod X to rotate through 50° .

.....
 [2]

(iii) Suggest an explanation for the results shown in Table 17.1.

.....
 [2]

[Total: 6]

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The Periodic Table of Elements

Group															
I	II							III	IV	V	VI	VII	VIII		
3 Li lithium 7	4 Be beryllium 9	Key atomic number atomic symbol name relative atomic mass						1 H hydrogen 1	5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	2 He helium 4	
11 Na sodium 23	12 Mg magnesium 24							13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	10 Ne neon 20		
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium —	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	83 Bi bismuth 209	84 Po polonium —	85 At astatine —	86 Rn radon —
87 Fr francium —	88 Ra radium —	89–103 actinoids	104 Rf rutherfordium —	105 Db dubnium —	106 Sg seaborgium —	107 Bh bohrium —	108 Hs hassium —	109 Mt meitnerium —	110 Ds darmstadtium —	111 Rg roentgenium —	112 Cn copernicium —	116 Lv livermorium —	—	—	—

lanthanoids

57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium —	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
89 Ac actinium —	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium —	94 Pu plutonium —	95 Am americium —	96 Cm curium —	97 Bk berkelium —	98 Cf californium —	99 Es einsteinium —	100 Fm fermium —	101 Md mendelevium —	102 No nobelium —	103 Lr lawrencium —

actinoids

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).