Cambridge
O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **5129/21**

Paper 2 **May/June 2016**

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.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
A copy of the Periodic Table is printed on page 24.

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.

CAMBRIDGE
International Examinations

1 A plant cell is shown in Fig. 1.1.

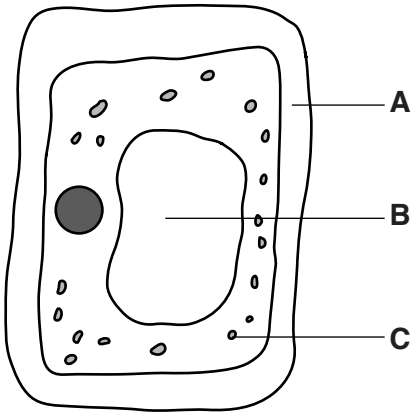


Fig. 1.1

(a) Name the structures **A**, **B** and **C**.

A .....

B .....

C .....

[3]

(b) A root hair cell is shown in Fig. 1.2.

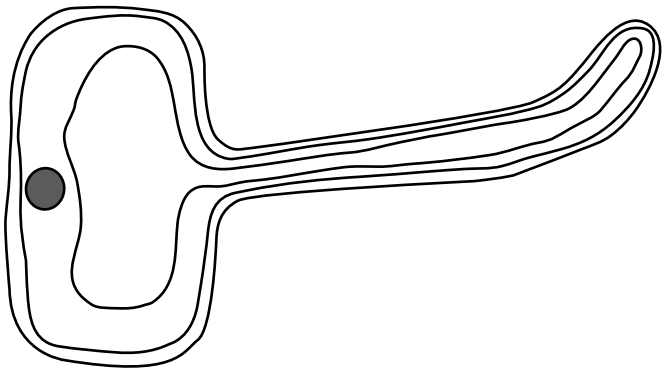


Fig. 1.2

State **two** ways in which the root hair cell is different in structure from the cell in Fig. 1.1. Explain the reason for each difference.

Write your answers in Table 1.1.

Table 1.1

	difference	reason for difference
1		
2		

[4]

2 The speed-time graph of part of a journey is shown in Fig. 2.1.

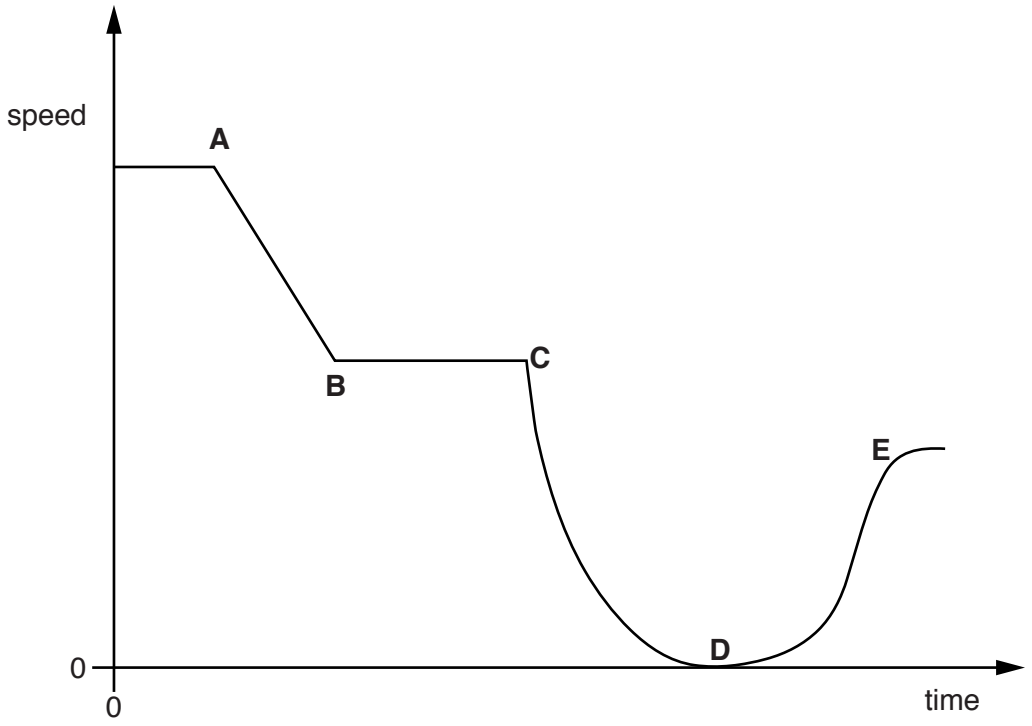


Fig. 2.1

Using the letters **A** to **E**, identify the point on the speed-time graph at which the motion changes

(a) from constant speed to constant deceleration, ... [1]

(b) from rest to non-uniform acceleration. ..... [1]

3 A boy kicks a football into the air, as shown in Fig. 3.1.

Fig. 3.1

(a) Complete the sentences below.

As the ball is kicked, energy is transferred from the boy to the ball.

This energy has been stored as ..... energy

in the muscles of the boy's legs.

As it rises after being kicked, the ball gains .....

energy and loses ..... energy. [3]

(b) The energy transferred to the ball is 72 J.

(i) The boot is in contact with the ball for 0.09 s.

Calculate the power of the kick.

power = ... W [1]

(ii) The weight of the ball is 4 N.

Calculate the vertical distance travelled by the ball into the air.

distance = ... m [1]

[Turn over

4 Fig. 4.1 shows a paper chromatogram obtained from three coloured dyes and three inks **R**, **S** and **T**.

The three coloured dyes are yellow, blue and red.

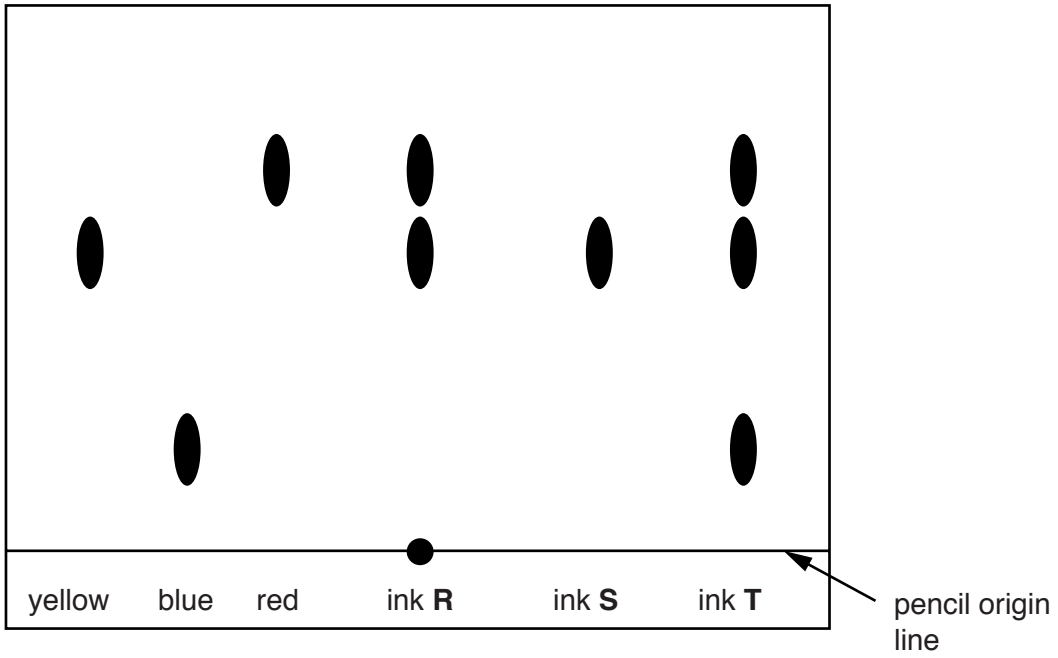


Fig. 4.1

(a) Name the ink that contains all three coloured dyes. .....[1]

(b) Explain how the chromatogram shows that ink **S** is a pure substance.

.....

.....[1]

(c) **(i)** Explain why a pencil is used to draw the origin line.

.....

.....[1]

(ii) Name the ink that contains a colour which is insoluble in the solvent used for this chromatography experiment.

.....[1]

5 Maize plants photosynthesise and produce maize cobs.

In an investigation, different quantities of nitrogen-containing fertiliser are added to six similar fields of maize plants.

The fields are the same size.

Fig. 5.1 shows the mass of maize cobs produced in each field.

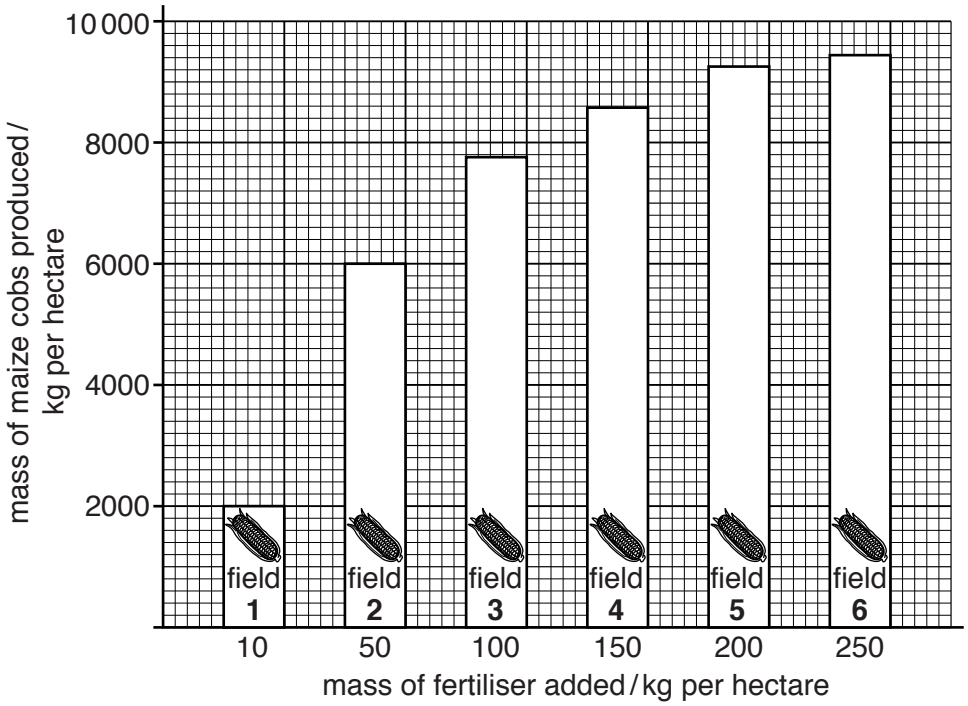


Fig. 5.1

(a) (i) Calculate the difference in the mass of maize cobs produced per hectare between field **1** and field **2**.

..... kg per hectare [1]

(ii) Describe **two** trends shown in Fig. 5.1.

1 .....

.....

2 .....

.....[2]

(b) State a factor which affects the rate of photosynthesis.

.....

.....[1]

6 Two steel cans, each containing 100 cm^3 of water at 20 °C, are heated by an infra-red lamp, as shown in Fig. 6.1.

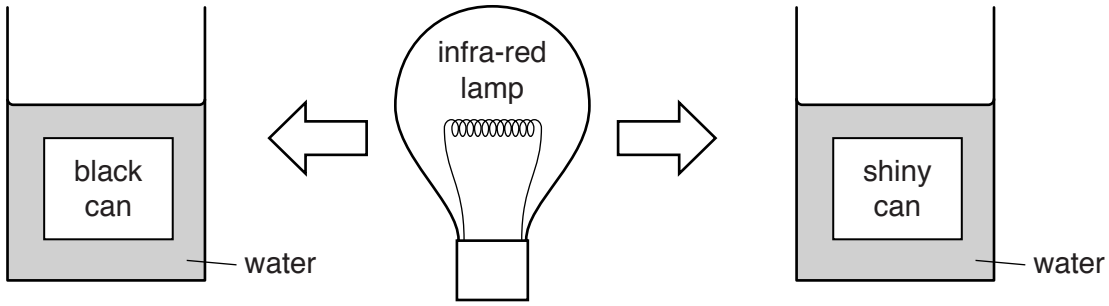


Fig. 6.1

The cans have different surface coatings. Each can is heated for 10 minutes and the final temperature of the water in each can is recorded.

Three results are obtained for each can.

The results are shown in Table 6.1.

Table 6.1

surface coating of can	temperature of water after 10 minutes / °C			
	test 1	test 2	test 3	average
black	40	38	38	38.7
shiny	22	24	25	

(a) Complete Table 6.1 to show the average temperature of the water after 10 minutes in the can with the shiny surface. [1]

(b) Complete the sentences below.

Energy is transferred from the lamp to the steel can by ..... .

Energy is then transferred through the steel can by ..... . [2]

(c) Explain why the water in the black can has a larger temperature rise than the water in the shiny can.

.....

.....[1]

7 Mercury(II) oxide decomposes when it is heated.

The equation for the reaction is shown.

$$2HgO \longrightarrow 2Hg + O_2$$

[A_r: O, 16; Hg, 201]

The relative molecular mass of mercury(II) oxide is 217.

(a) Complete the following sentences.

434 g of mercury(II) oxide produces ..... g of mercury and

.....g of oxygen.

10.85 g of mercury(II) oxide produces ..... g of mercury. [3]

(b) A sample of the gas produced in this reaction is collected.

State a test, and the result, which shows that this gas is oxygen.

test .....

result .....

.....[2]

(c) State one use of oxygen in industry.

.....[1]

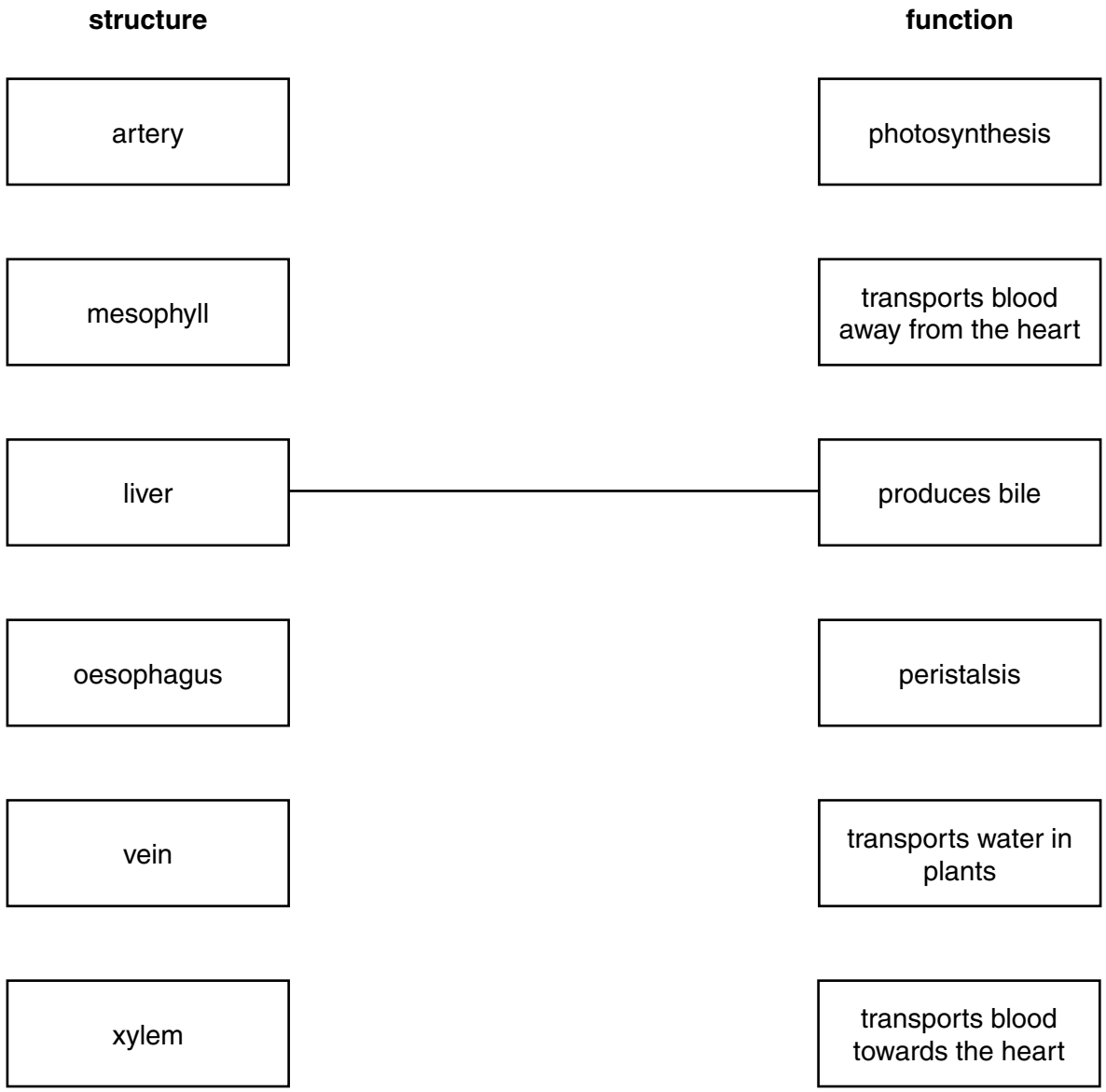
(d) Complete the equation by adding the state symbols.

$$2HgO (.....) \longrightarrow 2Hg (.....) + O_2 (.....)$$ [1]

8 Biological structures and their functions are shown in Fig. 8.1.

Draw a straight line to connect each structure with its function.

One line has been drawn for you.



[5]

Fig. 8.1

9 Light enters a glass block as shown in Fig. 9.1.

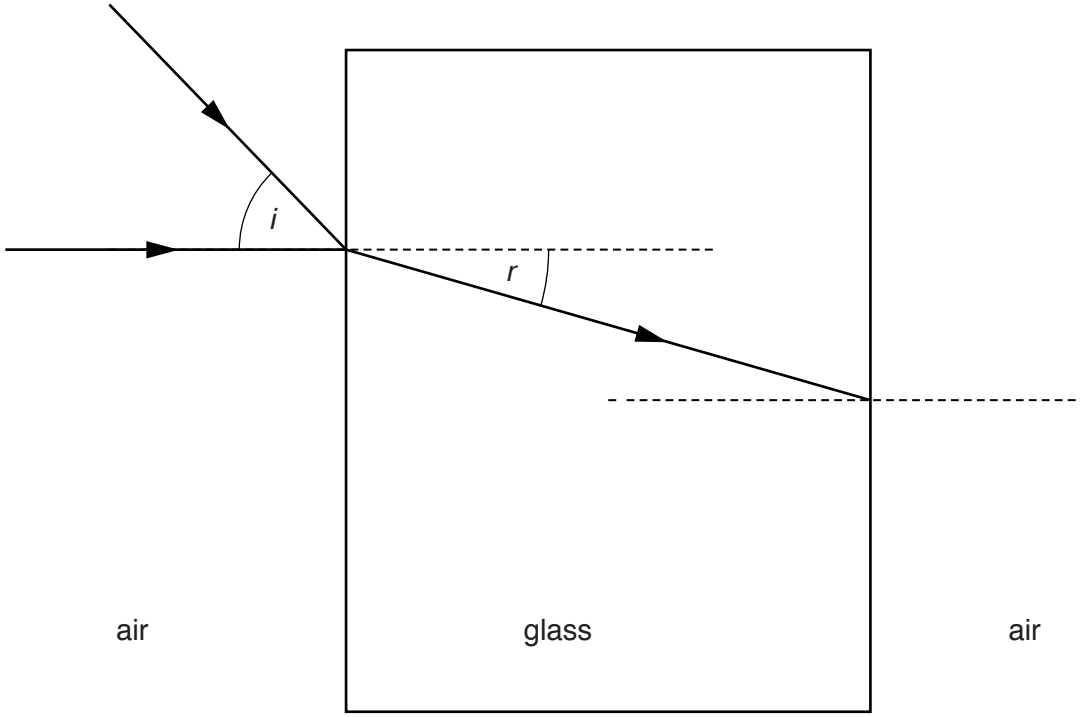


Fig. 9.1

(a) On Fig. 9.1, draw a ray to show the direction of the light after it has left the glass block. [1]

(b) Calculate the angle *r* when the angle *i* is 54°.

The refractive index of the glass is 1.5.

Show your working.

r = ... ° [2]

10 The structure of an atom of fluorine is shown in Fig. 10.1.

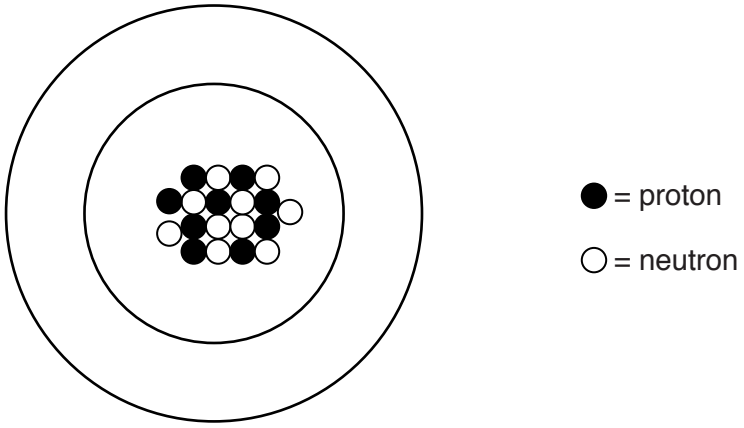


Fig. 10.1

(a) For this atom, state

(i) the proton number, ...

(ii) the nucleon number. ..... [2]

(b) Complete Fig. 10.1 to show the electronic structure of this atom of fluorine. [1]

(c) Fluorine is in Group VII of the Periodic Table.

(i) State the general name given to the elements in Group VII.

.....[1]

(ii) State how the reactivity of the elements changes as the group is descended.

.....[1]

11 Five test-tubes are set up as shown in Fig. 11.1.

Each test-tube contains 20 seeds.

The seeds in each tube are provided with different environmental conditions.

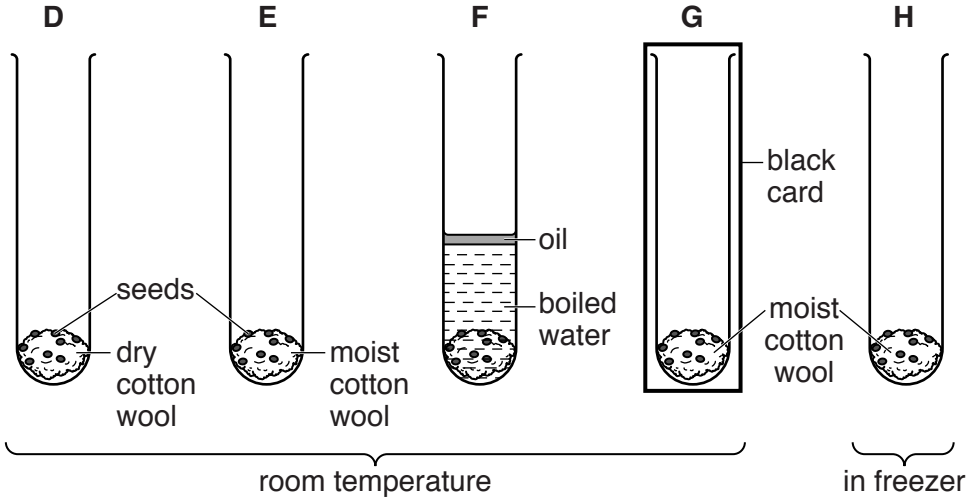


Fig. 11.1

(a) (i) State **three** environmental conditions that are investigated in this experiment.

1 .....

2 .....

3 .....[3]

(ii) Predict which two test-tubes contain seeds that germinate.

tube ..... and tube ..... [2]

(b) Explain how the enzyme amylase helps the seeds to germinate.

.....

.....

.....

.....

.....[3]

12 A circuit diagram containing three resistors **P**, **Q** and **R** is shown in Fig. 12.1.

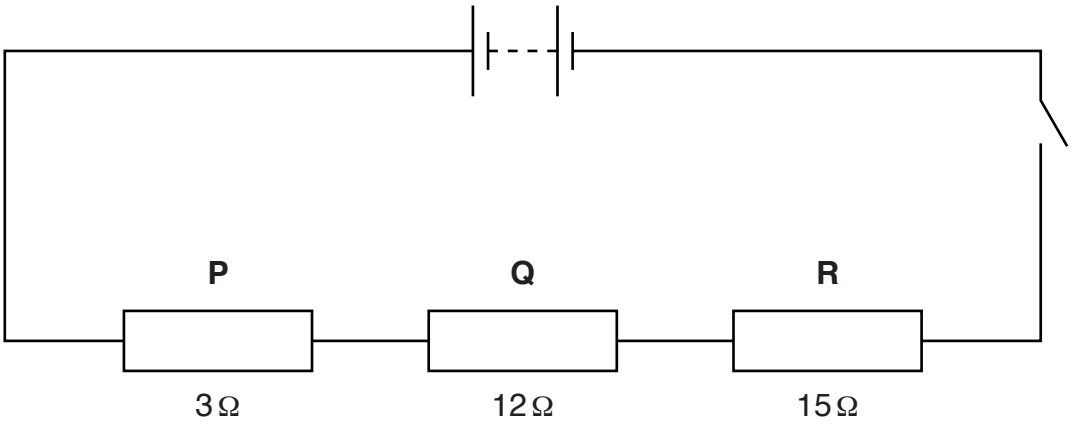


Fig. 12.1

(a) Calculate the combined resistance of resistors **P**, **Q** and **R**.

resistance = ... Ω [1]

(b) The circuit is switched on for 40 seconds.

The current in resistor **P** is 0.5 A.

(i) Calculate the potential difference (p.d.) across resistor **P**. State the unit.

potential difference = ... unit ..... [2]

(ii) Calculate the charge passing through resistor **P** in 40 seconds.

charge = ... C [1]

(c) Explain why resistor **R** is the resistor with the largest potential difference across it.

.....

.....[2]

13 Some reactions of ethene are shown in Fig. 13.1.

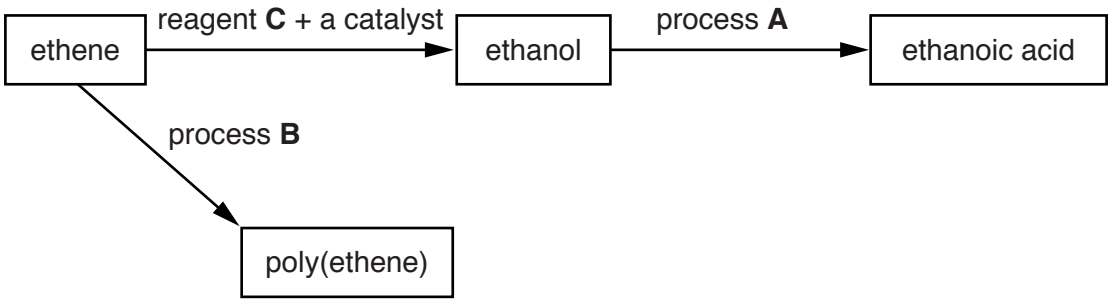


Fig. 13.1

(a) Identify processes **A** and **B** and reagent **C**.

process **A** .....

process **B** .....

reagent **C** ..... [3]

(b) Explain why a catalyst is used in the reaction to make ethanol from ethene.

.....

.....[1]

(c) In the space below, draw the structure of poly(ethene).

[2]

14 A microphone contains a coil of wire positioned in a strong magnetic field.

Sound waves are incident on a metal plate.

The plate is attached to a coil of wire.

The sound waves incident on the metal plate make the coil vibrate in a magnetic field.

A diagram of the microphone is shown in Fig. 14.1.

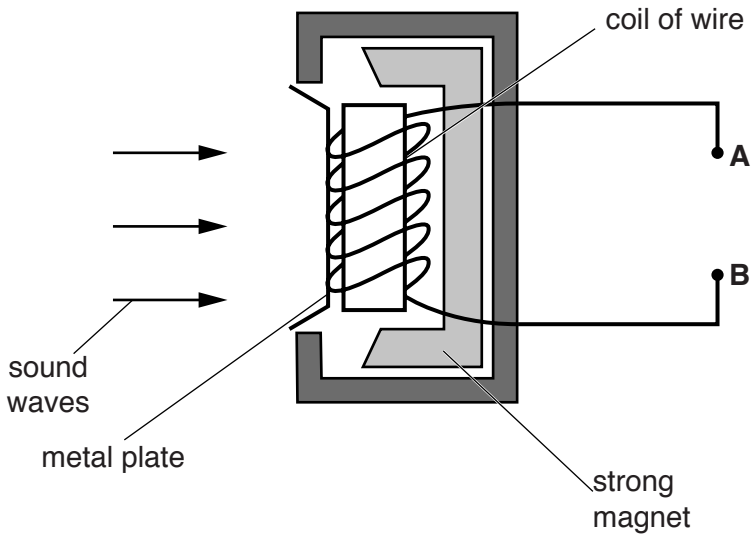


Fig. 14.1

(a) An electromotive force (e.m.f.) is induced between points **A** and **B** when the sound waves vibrate the metal plate.

State **three** changes that increase the magnitude of the induced e.m.f.

1 .....

2 .....

3 .....[3]

(b) (i) Sound waves in air have a speed of 330 m/s.

The sound waves incident on the metal plate have a constant frequency of 60 Hz.

Calculate the wavelength of the sound waves.

wavelength = ... m [2]

(ii) The sound waves incident on the metal plate are of constant amplitude as well as constant frequency.

On Fig. 14.2, sketch how the e.m.f. induced in the microphone by the sound waves varies with time for **two** complete periods of the sound wave.

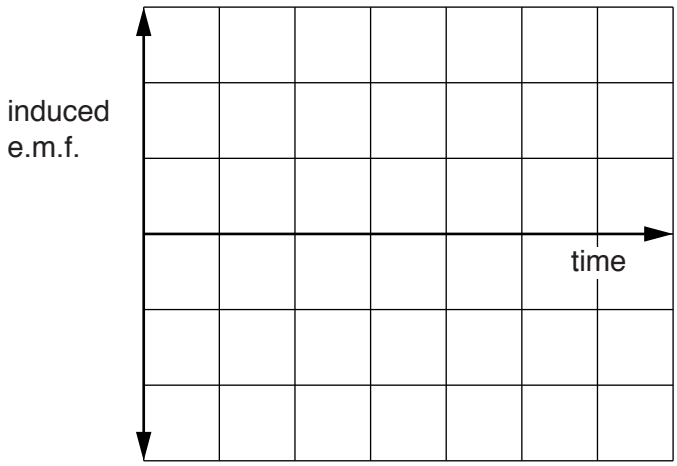


Fig. 14.2

[2]

15 Choose words from the list to complete the sentences below.

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

acid **alcohol** **bacteria** **enamel**

plaque **saliva** **viruses**

Teeth are used to chew food.

Pieces of sugary food left between the teeth are acted on by ..... .

This produces ..... which attacks

the ..... of the teeth. [3]

16 Magnesium reacts with dilute hydrochloric acid to form a solution of magnesium chloride and hydrogen.

(a) Complete the equation for the reaction.

Mg + ...HCl ⟶ MgCl_2 + ... [1]

(b) Hydrogen is used to make ammonia.

State two **other** uses of hydrogen.

1 .....

2 .....[2]

(c) Describe how magnesium chloride crystals may be obtained from the magnesium chloride solution.

.....

.....

.....[2]

(d) Magnesium is a metal.

State **two** general physical properties of magnesium which show that it is a metal.

1 .....

2 .....[2]

17 The male reproductive system is shown in Fig. 17.1.

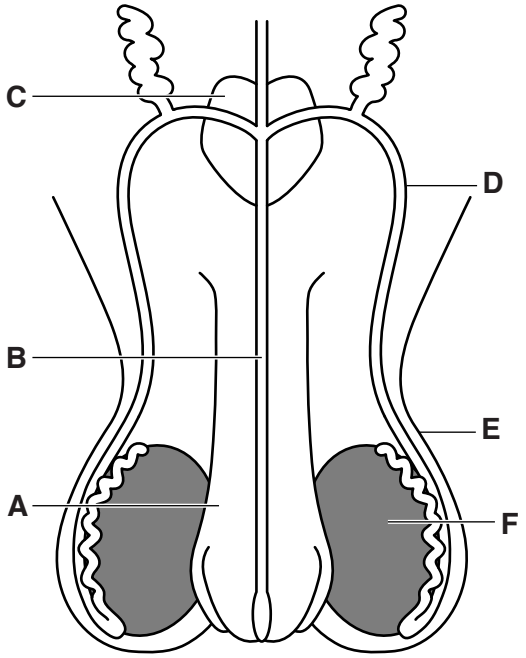


Fig. 17.1

State which letter shows the

structure which holds the testes outside the body cavity, ...

gland which produces fluid to add to sperm, ...

tube which is cut during vasectomy. .....

[3]

18 A magnet is used to attract an unmagnetised steel bar, as shown in Fig. 18.1(a).

The steel bar is removed from the magnet and is then able to attract a small iron nail, as shown in Fig. 18.1(b).

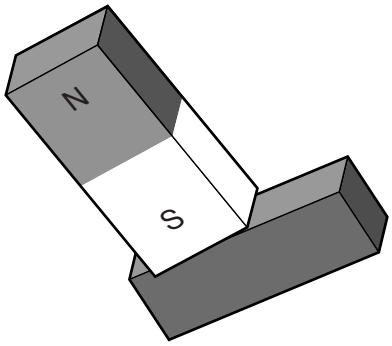


Fig. 18.1(a)

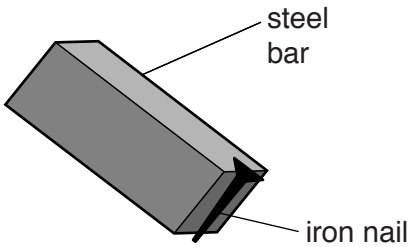


Fig. 18.1(b)

(a) State one property of magnets other than attraction.

.....[1]

(b) Explain why the steel bar is able to attract the small iron nail.

.....

.....[1]

(c) The steel bar in Fig. 18.1(a) is replaced by a bar made from soft iron.

The soft iron bar is then placed near a small iron nail.

State how what is observed is different to the behaviour shown in Fig. 18.1(b).

.....

.....[1]

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

The equation for the reaction is

$$N_2 + 3H_2 \longrightarrow 2NH_3$$

Ammonia is used to manufacture the fertiliser ammonium sulfate.

(a) State the source of the nitrogen and of the hydrogen for this process.

nitrogen .....

hydrogen ..... [2]

(b) Name the catalyst used in this reaction. .....[1]

(c) Ammonia dissolves in water to produce an alkaline solution.

(i) State the name of the ion which causes the solution to be alkaline.

.....[1]

(ii) Name the acid which reacts with ammonia to make ammonium sulfate.

.....[1]

20 State **three** medical problems associated with the excessive consumption of alcohol for many years.

1 .....

.....

2 .....

.....

3 .....

.....[3]

21 Sn-121 is a radioactive isotope of tin.

Sb-121, an isotope of antimony, is produced by the radioactive decay of Sn-121.

Part of the equation for this decay is shown.

$$^{121}_{50}\text{Sn} \longrightarrow {}^{121}_{51}\text{Sb} + \text{.....}$$

(a) Determine the number of neutrons in the nucleus of an atom of Sn-121.

.....[1]

(b) (i) State the type of emission that occurs when Sn-121 decays to Sb-121.

.....[1]

(ii) Describe the change that occurs in the nucleus of an atom of Sn-121 as it decays to Sb-121.

.....

.....[1]

The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
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	18 Ar argon 40
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	31 Ga gallium 70	32 Ge germanium 73	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	49 In indium 115	50 Sn tin 119	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	81 Tl thallium 204	82 Pb lead 207	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 –		114 Fl flerovium –		116 Lv livermorium –		

Key

atomic number
atomic symbol
name
relative atomic mass

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
actinoids	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 –

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