Cambridge Assessment International Education

Cambridge IGCSE™ (9–1)

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

9394344753

CO-ORDINATED SCIENCES **0973/32**

Paper 3 Theory (Core) **May/June 2024**

2 hours

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 120.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.

This document has **32** pages. Any blank pages are indicated.

[Turn over

1 **(a)** A student watches some scary movies.

The average pulse rate of the student is measured during each movie.

The highest pulse rate of the student is also recorded.

Table 1.1 shows the results.

Table 1.1

movie	average pulse rate during the movie / beats per minute	highest pulse rate / beats per minute	difference in pulse rate / beats per minute
A	82	122	40
B	79	116	37
C	84	132	48
D	80	123	43
E	86	104	18

The student has a 'flight or fight' response to the movies causing adrenaline to be released.

(i) Identify the movie in Table 1.1 that results in the **lowest** average pulse rate.

..... [1]

(ii) Identify the movie in Table 1.1 that results in the **greatest** release of adrenaline.

..... [1]

(iii) Movie **D** lasts 2 hours.

Using the average pulse rate, calculate the total number of heart beats during the movie.

total = ... beats [2]

(iv) Circle the target organ for adrenaline that causes the results in Table 1.1.

heart **kidney** **ovary** **stomach** **skin**

[1]

(b) State **two** other effects of adrenaline on the body.

Do **not** include the effect on pulse rate.

1 .....

2 .....
[2]

(c) State the component of blood that transports the hormone adrenaline.

..... [1]

(d) The 'flight or fight' situation is a response to a change in the environment.

This is an example of one of the characteristics of living things.

(i) State the name of this characteristic.

..... [1]

(ii) State the name of **one** other characteristic of living things.

..... [1]

[Total: 10]

2 **(a)** The list gives the names of seven elements.

calcium

carbon

copper

oxygen

nitrogen

potassium

sulfur

Answer the questions about these elements.

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

State which element:

(i) is in Group I of the Periodic Table.

..... [1]

(ii) is in diamond.

..... [1]

(iii) is 78% of clean air.

..... [1]

(iv) gives a lilac flame test.

..... [1]

(v) is used in electroplating.

..... [1]

(vi) is used in the manufacture of sulfuric acid.

..... [1]

(b) Atoms contain protons, neutrons and electrons.

State which of these particles:

are in shells around the nucleus .....

have a positive charge .....

have the smallest mass. .....

[3]

[Total: 9]

3 **(a)** Doctors use ionising and non-ionising radiations in hospitals.

(i) Table 3.1 lists some radiations.

Table 3.1

radiation	ionising
alpha (α)	
beta (β)	
gamma (γ)	✓
ultrasound	✗
X-rays	

Put a tick (✓) in each row of Table 3.1 to show which radiations are ionising and a cross (✗) to show which radiations are **not** ionising.

Two have been done for you. [2]

(ii) Describe **one** adverse effect of ionising radiations on living things.

.....

..... [1]

(iii) Place alpha (α), beta (β) and gamma (γ) radiations in order of their relative penetrating ability.

most penetrating .....

.....

least penetrating .....

[1]

(iv) State **one** use of X-rays in a hospital.

.....

..... [1]

(v) Ultrasound waves are used to scan unborn babies.

Ultrasound waves have a frequency above the maximum audible frequency for a human.

Suggest a frequency for ultrasound waves.

State the unit of your answer.

frequency = ... unit ..... [2]

(b) (i) Gamma (γ) radiation is used in hospitals to destroy cancer cells.

Fig. 3.1 shows an incomplete electromagnetic spectrum.

Write gamma (γ) radiation in its correct place.

	X-rays				microwaves	radio waves

Fig. 3.1

[1]

(ii) State the region of the electromagnetic spectrum where the waves have the lowest frequency.

..... [1]

(c) A radioactive isotope of iodine, iodine-123, is used by a doctor to examine the thyroid gland of a patient.

The nuclide notation for the isotope is $^{123}_{53}\mathrm{I}$.

State what the numbers 123 and 53 represent.

123 .....

53 .....

[2]

[Total: 11]

4 **(a)** Fig. 4.1 is a diagram of the female reproductive system in humans.

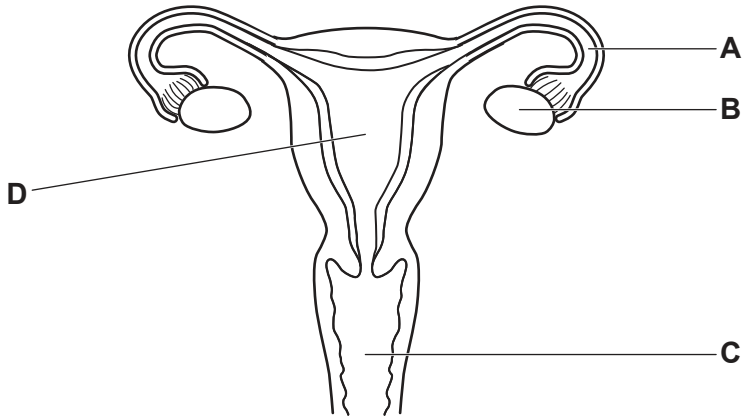


Fig. 4.1

The boxes on the left show the letters of some of the parts in Fig. 4.1.

The boxes on the right show some functions.

Draw **one** line from each letter to its function.

	release of female gametes
A	site of fertilisation
B	where fetus develops
C	ring of muscle at opening of uterus
D	produces semen
	receives penis during sexual intercourse

[4]

(b) A survey records the length of the menstrual cycle in a sample of females.

Fig. 4.2 shows a bar chart of the results.

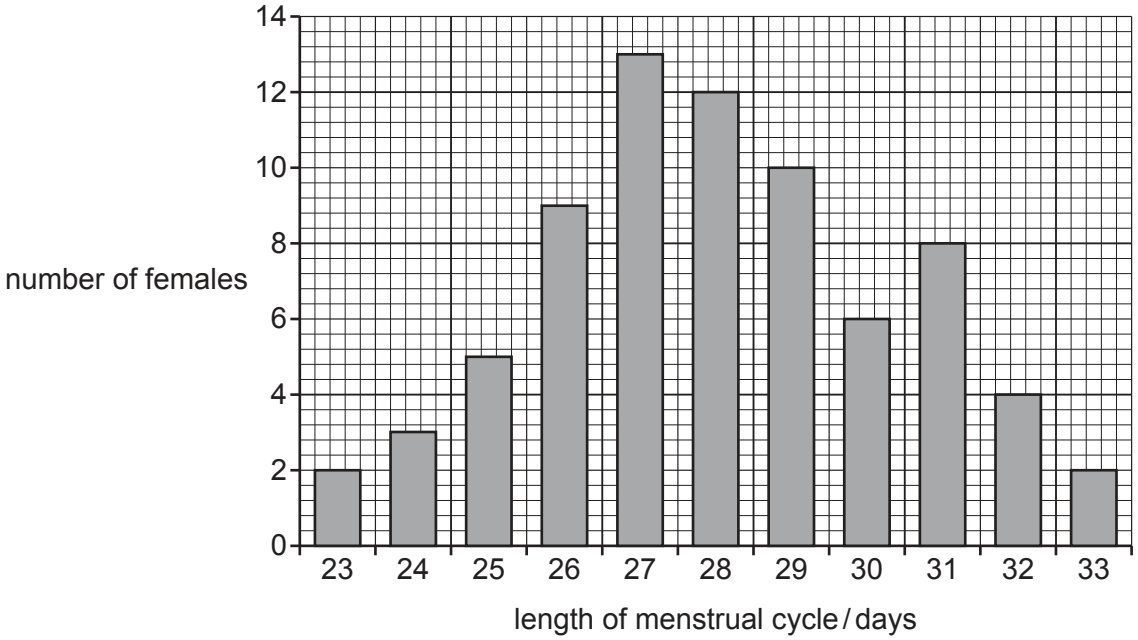


Fig. 4.2

(i) State the most frequent length of the menstrual cycle shown in Fig. 4.2.

..... [1]

(ii) State the number of females that have a 26-day menstrual cycle shown in Fig. 4.2.

..... [1]

(c) State the name of the female gamete in humans.

..... [1]

(d) The list shows several processes that occur before the development and birth of a baby.

Put the stages in the correct order.

Two have been done for you.

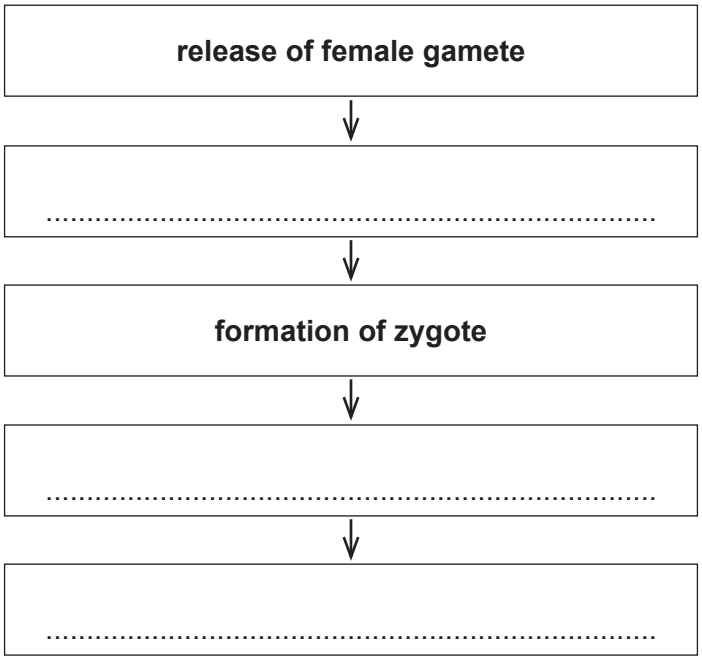
fertilisation

formation of embryo

~~**formation of zygote**~~

implantation

~~**release of female gamete**~~



[2]

(e) State where fertilisation occurs in **plants**.

..... [1]

[Total: 10]

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5 **(a)** Ethanol has the formula C_2H_5OH.

Complete Fig. 5.1 to show the structure of an ethanol molecule.

C—C

Fig. 5.1

[2]

(b) Ethanol is used as a fuel.

(i) State **one** other use for ethanol.

..... [1]

(ii) Write the word equation for the complete combustion of ethanol.

…… **+** …… → …… **+** ……

[2]

(iii) The combustion of ethanol is an exothermic reaction.

State what is meant by an exothermic reaction.

.....

.....

..... [1]

(c) Ethanol is made from ethene.

Ethene reacts at high temperatures with substance **X** in the presence of a catalyst.

(i) State the name of substance **X**.

..... [1]

(ii) Describe the effect of a catalyst on chemical reactions.

.....

..... [1]

(iii) State **one** other method of making ethanol.

..... [1]

(d) Ethanol is a liquid at room temperature.

Describe the motion and separation of the particles in ethanol.

motion .....

separation .....
[2]

[Total: 11]

6 **(a)** A farmer drives his tractor in a field.

Fig. 6.1 shows the forces **J**, **K**, **L** and **M** acting on the tractor as the tractor accelerates towards the right.

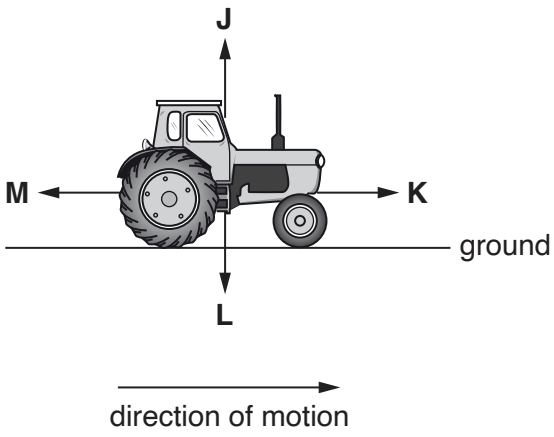


Fig. 6.1

(i) State which force **J**, **K**, **L** or **M** is the weight of the tractor.

..... [1]

(ii) Explain why force **K** must be greater than force **M.**

.....

..... [1]

(b) Fig. 6.2 shows a speed-time graph for the tractor as it travels across the field.

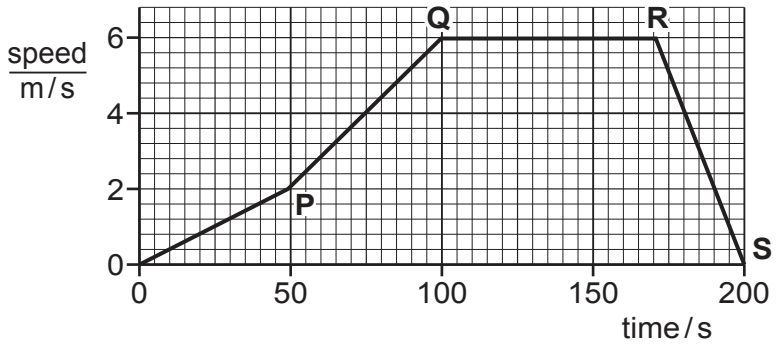


Fig. 6.2

(i) Describe the motion of the tractor during the section **PQ**.

..... [1]

(ii) Calculate the distance travelled by the tractor during section **QR**.

distance = ... m [2]

(c) The tractor pulls a tank full of water.

The mass of the water is 2500 kg.

The density of water is 1000 kg / m^3.

Calculate the volume of the water.

volume = ... m^3 [2]

(d) Suggest **two** renewable sources of energy that the farmer uses to generate electricity for the farm.

1 .....

2 .....
[2]

[Total: 9]

7 **(a)** A student investigates the effect of light on an aquatic plant.

The student counts the number of bubbles of gas released in one minute by the aquatic plant kept in the light.

The experiment is repeated with the aquatic plant kept in the dark.

Table 7.1 shows the results.

Table 7.1

environmental condition	number of bubbles of gas released in one minute
light	32
dark	0

(i) Complete the sentences to explain the results shown in Table 7.1.

The aquatic plant releases more bubbles of ..... gas when kept in the light.

This is because the process of ..... requires energy from light.

This energy is used to react the raw materials .....

and ..... .

This process takes place in plant cell structures called ..... .

[4]

(ii) State the name of the response that causes plants to grow towards light.

..... [1]

(b) Fig. 7.1 is a photomicrograph of a cross-section through a leaf.

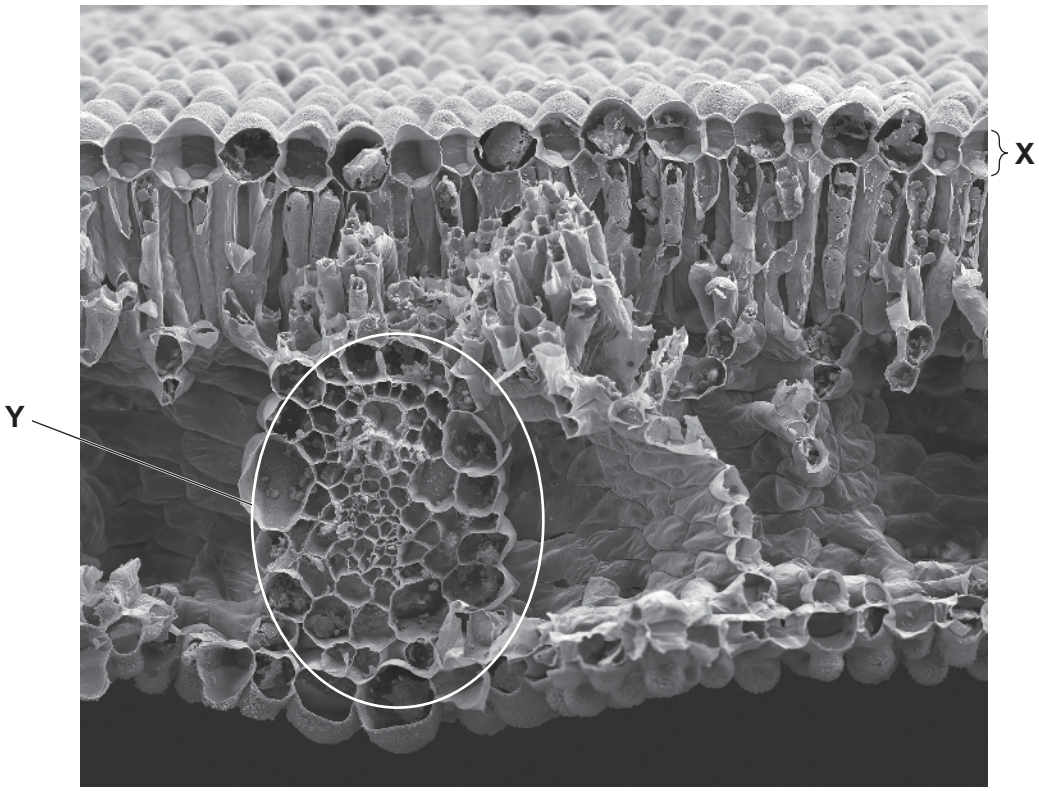


Fig. 7.1

(i) State the name of the part labelled **X** in Fig. 7.1.

..... [1]

(ii) State the names **and** functions of the **two** transport tissues contained in the part labelled **Y** in Fig. 7.1.

name 1 .....

function .....

name 2 .....

function .....
[4]

(c) Describe the importance of nitrate ions in the synthesis of proteins.

.....

.....

..... [1]

[Total: 11]

8 A teacher reacts sodium with water.

Hydrogen and aqueous sodium hydroxide are the products of the reaction.

(a) Balance the symbol equation for this reaction.

$$2Na + ...H_2O \rightarrow .....NaOH + H_2$$

[2]

(b) Before sodium is added to water, the water is neutral.

Aqueous sodium hydroxide is an alkali.

(i) State the pH number of pure water.

pH = ... [1]

(ii) Suggest the pH number of the aqueous sodium hydroxide.

pH = ... [1]

(c) The reaction between sodium and water is described as violent.

Describe the reaction between potassium and water.

Explain your answer.

reaction .....

.....

explanation .....

.....

.....

[2]

(d) Sodium reacts with chlorine to make sodium chloride.

In this reaction, sodium atoms form sodium ions and chlorine atoms form chloride ions.

- the electronic structure of a sodium atom is 2.8.1
- the electronic structure of a chlorine atom is 2.8.7

(i) Deduce the electronic structure for a sodium ion.

..... [1]

(ii) Deduce the electronic structure for a chloride ion.

..... [1]

(e) When concentrated aqueous sodium chloride is electrolysed, gases are released at each inert electrode.

State the names of the gases released at each electrode.

gas at cathode .....

gas at anode .....
[2]

[Total: 10]

9 **(a)** Fig. 9.1 shows water in a steel saucepan being heated on an electric cooker.

The water boils and some of the water changes into steam.

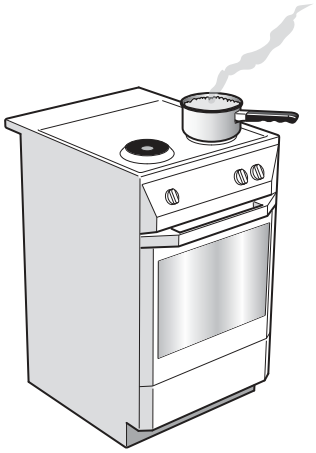


Fig. 9.1

(i) State the main method of thermal energy transfer through:

the water .....

the saucepan. ..... [2]

(ii) Describe what happens to the temperature of the water while it is boiling.

.....

..... [1]

(iii) State the boiling point of water.

..... °C [1]

(iv) Steel is a solid, water is a liquid and steam is a gas.

Complete Table 9.1 by placing ticks (✓) in the correct boxes to show which description describes a solid, a liquid and a gas.

Table 9.1

description	solid	liquid	gas
it takes up all the space available			
it takes up the shape of its container and has a constant volume in an open container			
it has a fixed shape			

[1]

(b) The saucepan is made from steel.

Describe **one** difference between the magnetic properties of steel and the magnetic properties of soft iron.

.....

.....

..... [1]

(c) The weight of the saucepan is 15 N.

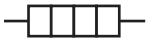
Calculate the mass of the saucepan in **grams**.

The gravitational force on unit mass, *g*, = 10 N / kg.

mass = ... g [2]

(d) The two hotplates on the cooker are connected in parallel so that each can be controlled by a separate switch.

Complete the circuit diagram in Fig. 9.2 for the cooker hotplates.

Use the circuit symbol for a heater  to represent the hotplates.

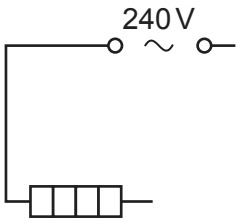


Fig. 9.2

[3]

[Total: 11]

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10 Fig. 10.1 is a diagram of the carbon cycle.

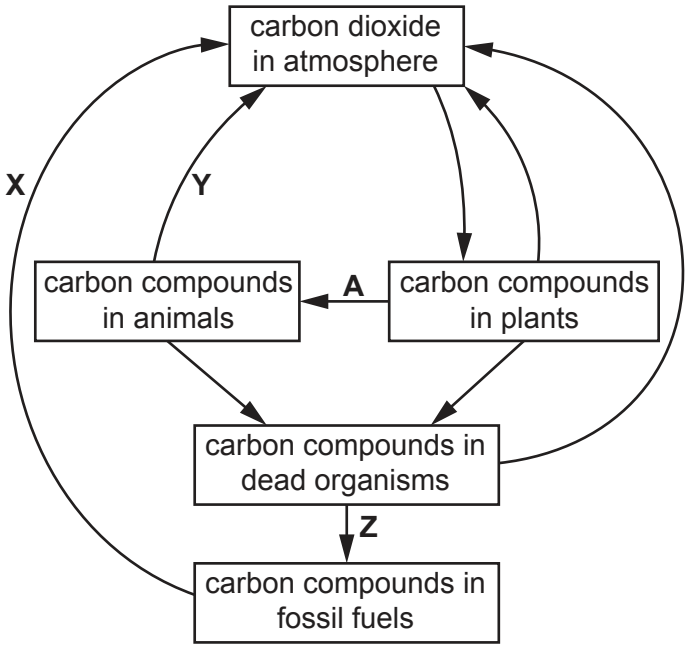

Fig. 10.1

(a) Identify the processes occurring at **X**, **Y** and **Z** in Fig. 10.1.

X .....

Y .....

Z .....

[3]

(b) The concentration of carbon dioxide in the atmosphere is increasing.

Use Fig. 10.1 to state **two** ways humans could increase the **removal** of carbon dioxide from the atmosphere.

1 .....

2 .....

[2]

(c) Process **A** occurs in food chains.

Complete the sentences to define the term food chain.

A food chain is the transfer of ..... from one organism to the next, beginning with a ..... .

[2]

(d) Carbon dioxide dissolves in oceans, acidifying them.

State **two** sources of water pollution.

1 .....

2 .....
[2]

[Total: 9]

11 **(a)** Iron is a metal.

Circle **three** physical properties which are characteristic of metals.

good electrical conductor **high melting point**

low boiling point **malleable**

poor thermal conductor

[2]

(b) Fig. 11.1 shows a spanner made from an alloy of iron.

Fig. 11.1

The composition of the alloy is shown in Table 11.1.

Table 11.1

element	percentage composition %
carbon	
chromium	2
iron	95
manganese	1

(i) Calculate the percentage of carbon in the alloy.

percentage = ...% [1]

(ii) The mass of the spanner is 80 g.

Calculate the mass of chromium contained in the spanner.

mass of chromium = ... g [1]

(iii) Suggest why the spanner is made from an alloy of iron and **not** pure iron.

.....

..... [1]

(c) Iron is extracted from iron oxide using carbon monoxide.

iron oxide + carbon monoxide → iron + carbon dioxide

State the substance that is reduced in this reaction.

..... [1]

(d) Iron reacts with two substances to make rust.

(i) Name the element and the compound that react with iron to make rust.

element .....

compound .....
[2]

(ii) Barrier methods are used to stop iron rusting.

Name **one** substance used in a barrier method of rust prevention.

..... [1]

(e) Recycling iron costs less than extracting iron from iron ore.

Suggest **one** other reason why iron needs to be recycled.

.....

..... [1]

[Total: 10]

12 (a) A student investigates the motion of smoke particles in air using a microscope.

Fig. 12.1 shows the apparatus the student uses.

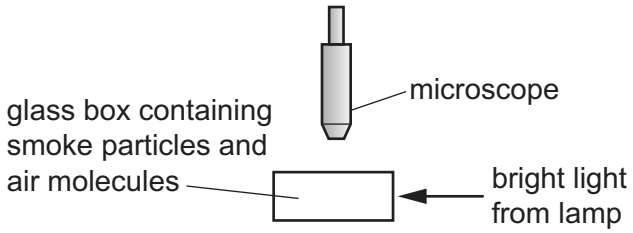

Fig. 12.1

The student sees the smoke particles moving in random directions.

This movement is caused by collisions between smoke particles and moving molecules in the air.

Fig. 12.2 shows the path of one smoke particle observed by the student.

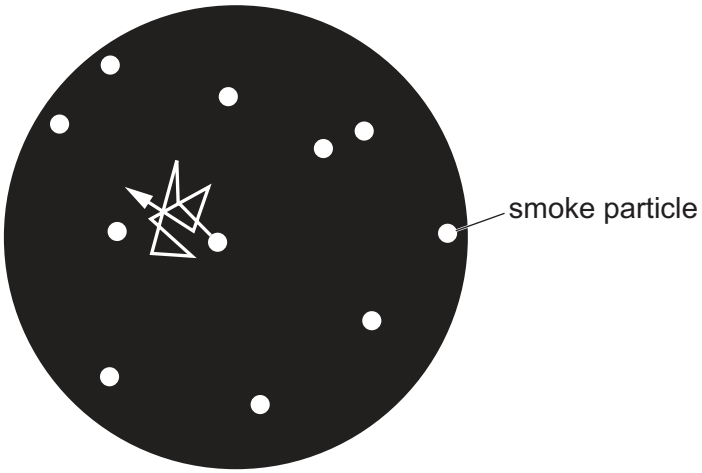

Fig. 12.2

State the name given to the motion of the smoke particles observed by the student.

..... [1]

(b) The lamp in Fig. 12.1 has a current of 0.40A in it when the potential difference across it is 3.0V.

Calculate the resistance of the lamp.

resistance = ... Ω [2]

(c) The microscope in Fig. 12.1 contains lenses.

Fig. 12.3 shows a ray of light from the top of a smoke particle passing through a thin converging lens.

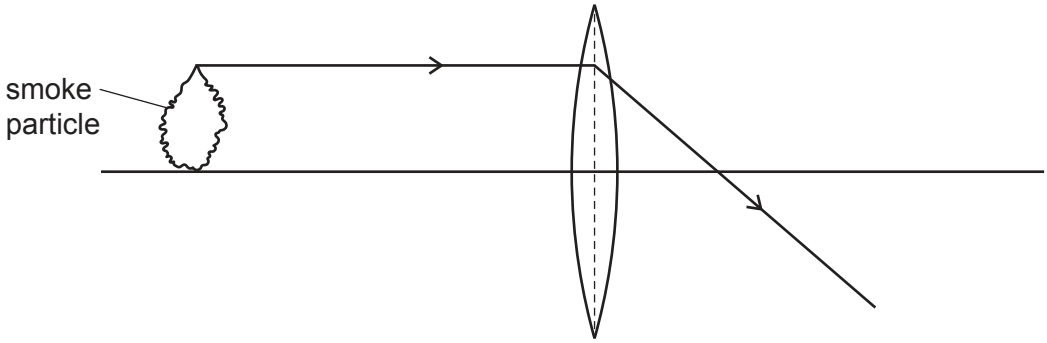

Fig. 12.3

(i) Draw a second ray from the top of the smoke particle to locate the position of the top of the image.

Label the top of the image with the letter **I.** [2]

(ii) On Fig. 12.3, label the principal focus of the lens with the letter **F**. [1]

(iii) On Fig. 12.3, use a double headed arrow (↔) or (↕) to show the focal length of the lens. [1]

(iv) Circle the **two** correct words or phrases that describe the image.

diminished **enlarged** **inverted** **same size** **upright**

[2]

[Total: 9]

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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 –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

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.).