Cambridge Assessment International Education

Cambridge IGCSE™ (9–1)

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

CO-ORDINATED SCIENCES **0973/31**

Paper 3 Theory (Core) **October/November 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 **28** pages. Any blank pages are indicated.

[Turn over

1 **(a)** *Euglena* are single-celled organisms that have features of both animal and plant cells.

Fig. 1.1 is a labelled diagram of a *Euglena*.

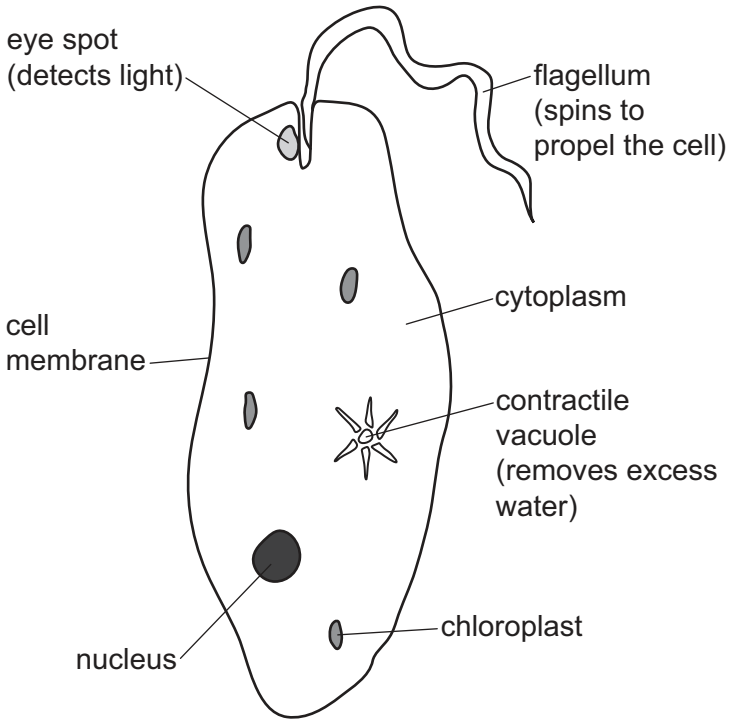


Fig. 1.1

(i) The parts labelled in Fig. 1.1 are responsible for different characteristics of living organisms.

Identify the part responsible for:

excretion .....

movement .....

nutrition .....

sensitivity. .....

[4]

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

.....

..... [1]

(iii) State **one** part from Fig. 1.1 that *Euglena* have in common with plant cells but **not** with animal cells.

..... [1]

(b) *Euglena* and animal cells do not have cell walls.

State the function of the cell wall.

.....

.....

..... [1]

(c) Cell walls are made from a type of carbohydrate called cellulose.

Cellulose is made up of smaller molecules of glucose.

(i) List the chemical elements in all carbohydrates.

.....

..... [1]

(ii) Circle **two** other larger carbohydrate molecules made from glucose.

fat	**glycerol**	**glycogen**
oil	**protein**	**starch**

[2]

[Total: 10]

2 **(a)** A list of formulae is shown.

CH_4 Cl_2 $MgCl_2$ N_2 $NaCl$ NH_3 O_2

Identify the formula from the list which represents:

(i) a compound that is the main constituent of natural gas

..... [1]

(ii) an element that bleaches damp litmus paper

..... [1]

(iii) an element that makes up 21% of clean air

..... [1]

(iv) a compound containing an ion with a 1+ charge

..... [1]

(v) a gas made by displacement from an ammonium salt.

..... [1]

(b) A student investigates the rate of reaction between excess dilute hydrochloric acid and powdered magnesium carbonate.

Carbon dioxide gas is produced in this reaction.

Fig. 2.1 shows the apparatus the student uses.

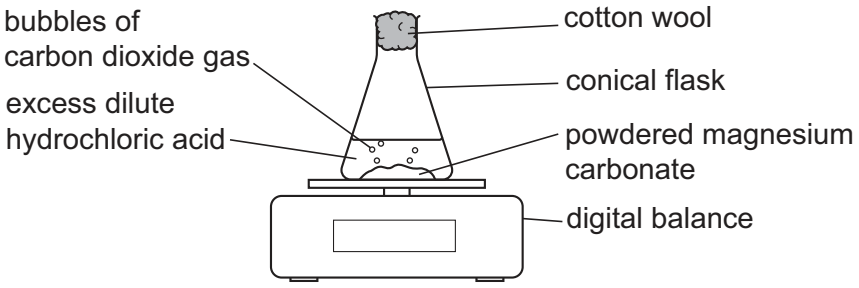


Fig. 2.1

The student measures the mass of the conical flask and its contents during the reaction.

(i) Explain why the mass of the conical flask and its contents decreases during the reaction.

.....

..... [1]

(ii) The student wants to increase the rate of reaction. They do **not** change the particle size of the magnesium carbonate.

State **two** changes to the reaction conditions that the student makes to increase the rate of reaction.

1 .....

2 .....
[2]

(iii) Complete the word equation for the reaction.

magnesium carbonate	+	hydrochloric acid	→	magnesium chloride	+		+	

[2]

(c) Magnesium chloride is soluble in water.

State the separation technique used to obtain solid magnesium chloride from a solution of magnesium chloride.

..... [1]

[Total: 11]

3 **(a)** A rock that travels through space and hits the Earth's surface is called a meteorite.

Fig. 3.1 shows a speed–time graph for a meteorite as it:

- travels through space
- slows down through the Earth's atmosphere
- hits the Earth's surface.

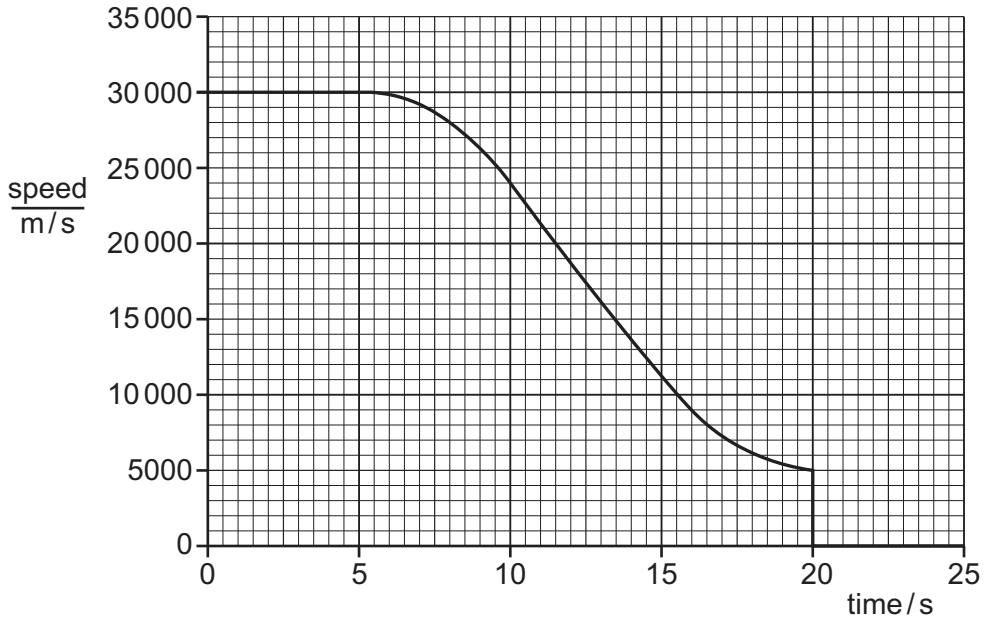


Fig. 3.1

(i) State the maximum speed of the meteorite.

maximum speed = ... m / s [1]

(ii) State the time at which the meteorite hits the surface of the Earth.

time = ... s [1]

(iii) State the name of the force that causes the meteorite to slow down through the Earth's atmosphere.

..... [1]

(b) **(i)** The weight of the meteorite is 3.3×10^8 N.

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

Calculate the mass of the meteorite.

mass = ... kg [2]

(ii) The volume of the meteorite is 4200 m^3.

Use your answer to **(b)(i)** to calculate the density of the meteorite.

State the units of your answer.

density = ... units ..... [3]

(c) The meteorite contains large amounts of iron.

Magnets are made from iron. A piece of iron can be magnetised by stroking it with a magnet.

Describe **one** other method of magnetisation.

.....

.....

..... [1]

(d) The nuclide notations for two iron isotopes are shown.

$^{54}_{26}Fe$ $^{56}_{26}Fe$

isotope **A** isotope **B**

(i) Complete the sentence to define the term isotope.

Isotopes are atoms of the same element which have the same .....

number but a different ..... number. [1]

(ii) State the number of neutrons in an atom of isotope **A** and in an atom of isotope **B**.

isotope **A** .....

isotope **B** .....

[1]

[Total: 11]

4 **(a)** The number of new infections of HIV in one country was estimated in 2000 and 2018.

Table 4.1 shows the results.

Table 4.1

year	number of new infections of HIV
2000	280
2018	170

(i) Calculate the percentage decrease in the number of new infections of HIV between 2000 and 2018 in Table 4.1.

percentage decrease = ... % [2]

(ii) Suggest **three** reasons for this decrease.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

(iii) State the type of organism that causes the HIV disease.

.....

..... [1]

(b) Fig. 4.1 is a photomicrograph of human blood.

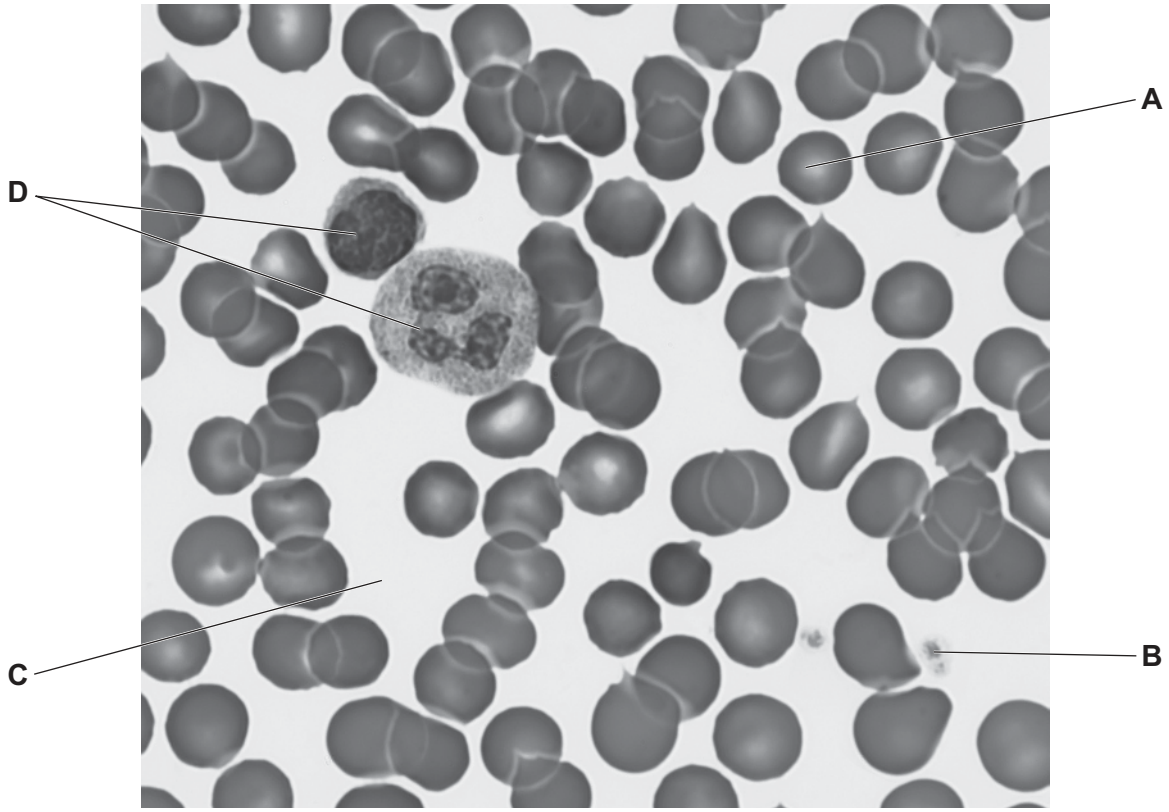


Fig. 4.1

(i) Table 4.2 shows some information about the components of blood shown in Fig. 4.1.

Complete Table 4.2.

Table 4.2

letter in Fig. 4.1	name of component	function
.....	.....	phagocytosis / antibody production
.....	.....	transports oxygen
B	platelet	.....
C	.....	transports hormones and carbon dioxide

[4]

(ii) A student knows the actual size of the component labelled **A** in Fig. 4.1.

Describe how the student determines the magnification of the image of the component labelled **A**.

.....

.....

..... [2]

[Total: 12]

5 **(a)** Table 5.1 shows the observations for the reactions of four metals with water.

Table 5.1

metal	observation
copper	no reaction
lithium	reacts quickly
potassium	reacts very quickly
calcium	reacts slowly

(i) Place the four metals in order of reactivity from the most reactive to the least reactive.

..... most reactive

.....

.....

..... least reactive

[2]

(ii) Name **one** metal from Table 5.1 that is found in Group I of the Periodic Table.

..... [1]

(iii) Name **one** metal from Table 5.1 that is a transition element.

..... [1]

(b) Copper is extracted from its ore. Copper(II) oxide is made and then copper.

(i) The extraction of copper involves an endothermic reaction.

State what is meant by an endothermic reaction.

.....

..... [1]

(ii) Explain why copper(II) oxide is described as a basic oxide.

.....

.....

..... [1]

(c) Copper is also extracted from its ore by electrolysis.

Define electrolysis by completing the sentence.

Electrolysis is the breakdown of an ionic compound when .....

or in aqueous solution by the passage of ..... . [2]

(d) Brass is an alloy of copper and zinc.

(i) Apart from cost, suggest why brass is used to make keys but pure copper is **not** used to make keys.

.....

.....

..... [1]

(ii) Copper has a melting point of 1084 °C.

Zinc has a melting point of 420 °C.

The brass alloy has a range of melting points from 905 °C to 932 °C.

Explain why brass does not have a single melting point.

.....

.....

..... [1]

[Total:10]

6 **(a)** Fig. 6.1 shows two horizontal forces acting on a truck as it moves forwards along a flat, level road.

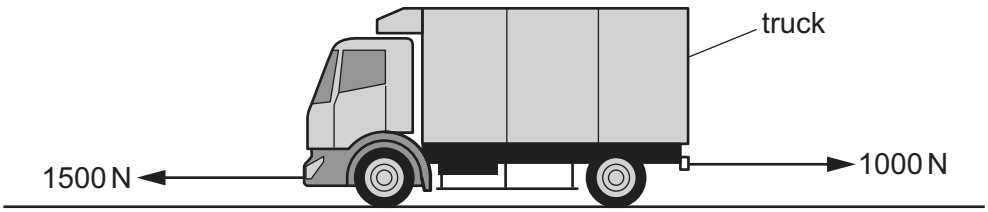


Fig. 6.1

(i) Calculate the magnitude of the resultant horizontal force on the truck.

Draw an arrow on the diagram to show the direction of the resultant force.

magnitude = ... N [2]

(ii) Describe the motion of the truck as the resultant force is applied.

..... [1]

(b) The truck has two identical headlamps.

The lamps are connected in parallel across a 12 V battery. One switch turns on both lamps. A fuse protects the circuit.

(i) Fig. 6.2 shows an incomplete circuit diagram for this circuit.

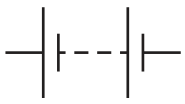


Fig. 6.2

Complete Fig. 6.2 using standard electrical symbols. [4]

(ii) State **one** advantage of connecting the lamps in parallel.

.....

..... [1]

(iii) Complete the sentences about the fuse.

The purpose of a fuse is to ..... the circuit. A large ..... in the circuit causes the fuse to get hot and melt, breaking the circuit. [2]

[Total: 10]

7 **(a)** Tick (✓) the correct definition of inheritance.

Inheritance is the transmission of genetic information from the environment. ☐

Inheritance is the transmission of physical information from the nervous system. ☐

Inheritance is the transmission of genetic information from generation to generation. ☐

Inheritance is the transmission of verbal information from the environment. ☐

[1]

(b) The shape of peas is an inherited characteristic controlled by a single gene.

The allele for smooth peas is dominant **R**.

The allele for wrinkled peas is recessive **r**.

Fig. 7.1 is a photograph of two peas with different shapes.

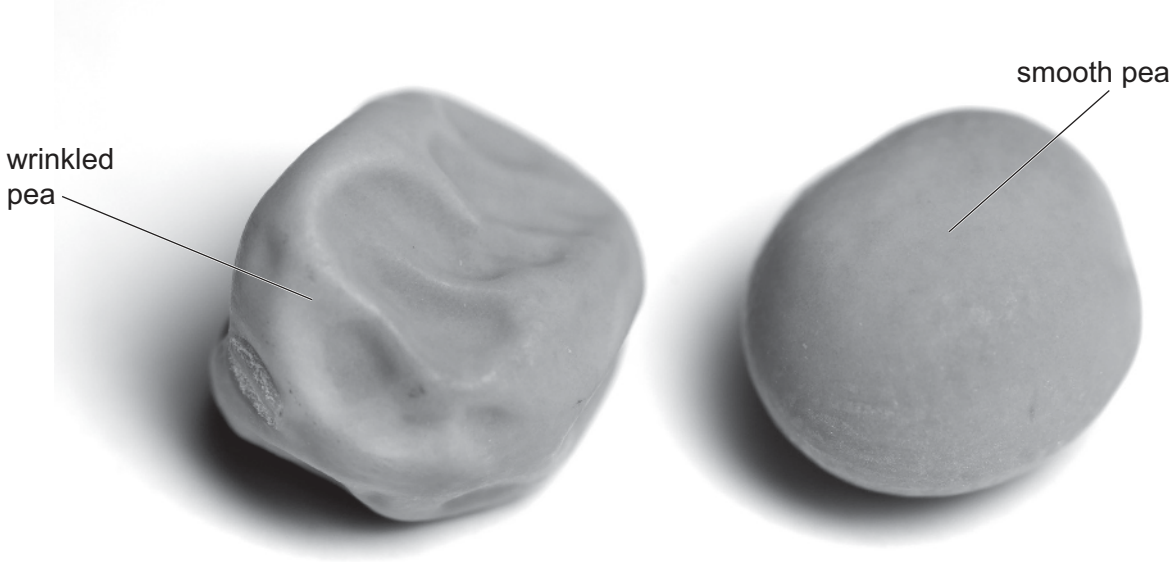


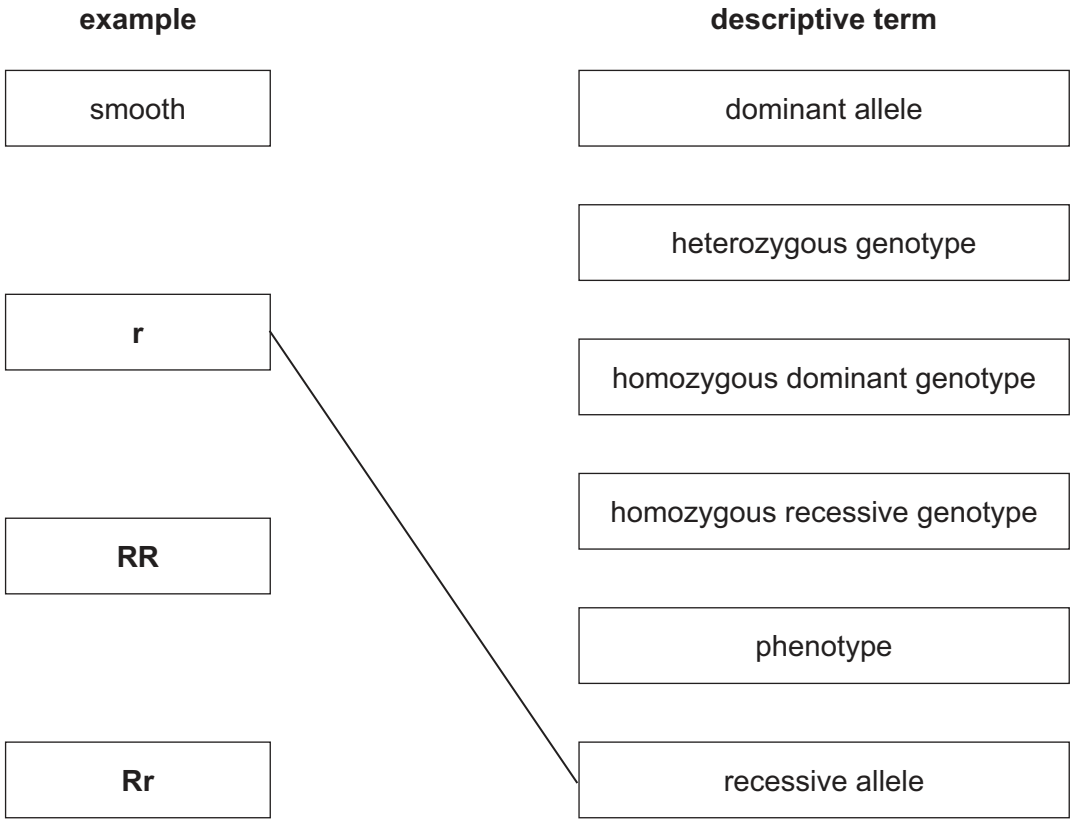
Fig. 7.1

(i) The boxes on the left show some examples used to show inheritance of shape in peas.

The boxes on the right show descriptive terms.

Draw lines to link each box on the left to its descriptive term on the right.

One has been done for you.



[3]

(ii) Complete the genetic diagram in Fig. 7.2 to calculate the likelihood of the offspring having a wrinkled shape.

	R	**r**
R	.....	.....
r	.....	.....

Fig. 7.2

percentage likelihood of offspring having a wrinkled shape = ... %

[2]

(c) The list shows some structures involved in inheritance.

cell **chromosome** **gene** **nucleus**

Put these in order from smallest to largest.

One has been done for you.

smallest gene

.....

.....

largest .....

[2]

[Total: 8]

BLANK PAGE

8 (a) (i) Fig. 8.1 shows the changes of state of water.

Fig. 8.1

Identify the changes of state represented by **X** and **Y**.

X .....

Y .....

[2]

(ii) State if boiling is a chemical change or a physical change.

Give a reason for your answer.

change .....

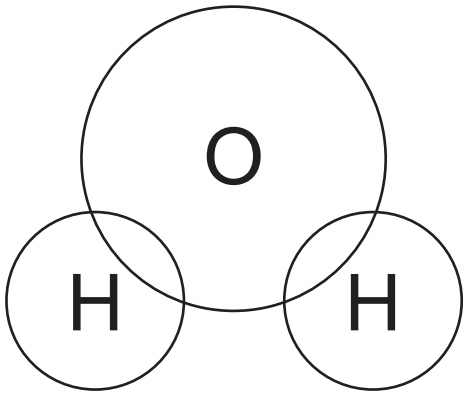
reason .....

.....

[1]

(b) (i) Complete the dot-and-cross diagram to show the electron arrangement in a molecule of water.

Show outer shell electrons only.



[2]

(ii) State the type of chemical bonds in a water molecule.

..... [1]

(c) Filtration and chlorination are both used in the treatment of the water supply.

State the purpose of each process.

filtration .....

.....

chlorination .....

.....

[2]

(d) Water is made when hydrogen reacts with oxygen.

Balance the symbol equation for the reaction between hydrogen and oxygen.

..... H_2 + O_2 → ..... H_2O [2]

[Total: 10]

9 Fig. 9.1 shows a moth.

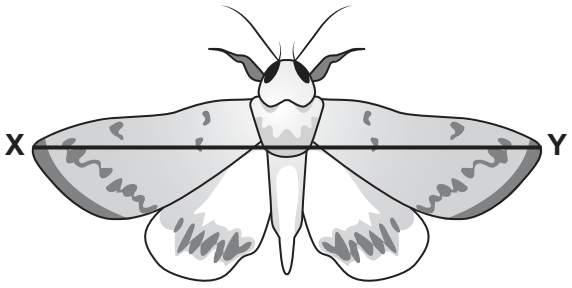


Fig. 9.1

(a) A student forms an image of the moth on a screen using a thin converging lens.

A ray of light has been drawn from each of the moth's wings to the screen on the ray diagram in Fig. 9.2.

The start of another ray of light has been drawn from the moth's body.

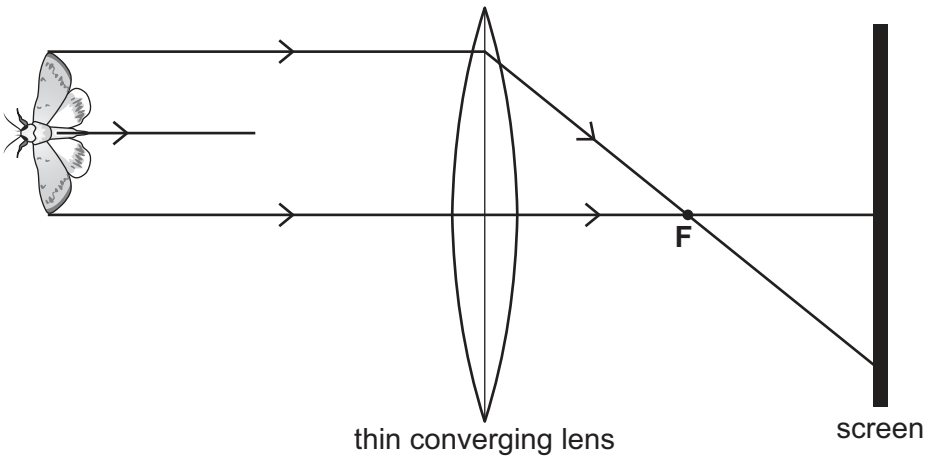


Fig. 9.2

(i) On Fig. 9.2, complete the ray of light from the moth's body to show where it appears on the screen. [2]

(ii) Draw a double headed arrow (↕) on Fig. 9.2 to show the size and position of the image of the moth on the screen. [1]

(iii) State the name of the point labelled **F** on Fig. 9.2.

..... [1]

(b) Moths are able to hear the highest frequency of any animal. The greater wax moth can hear frequencies up to 300 000 Hz.

(i) State the maximum audible frequency for a healthy human ear in Hz.

frequency = ... Hz [1]

(ii) State what is meant by the frequency of a wave.

.....

..... [1]

(c) Fig. 9.3 shows an electric insect trap that uses an ultraviolet lamp to attract insects.

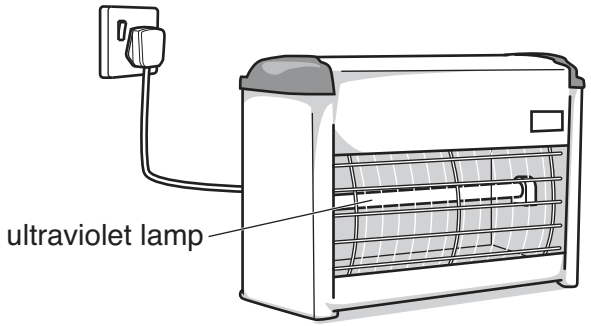


Fig. 9.3

(i) There is a potential difference (p.d.) of 240 V across the ultraviolet lamp.

There is a current of 0.75 A in the ultraviolet lamp.

Calculate the resistance of the ultraviolet lamp.

resistance = ... Ω [2]

(ii) State **one** danger of ultraviolet radiation to humans.

..... [1]

[Total: 9]

10 (a) A student investigates responses in seeds.

They place germinating seeds in a Petri dish.

The Petri dish is left on its side in a dark room.

After two days the student observes the direction of root growth.

Fig. 10.1 shows the investigation.

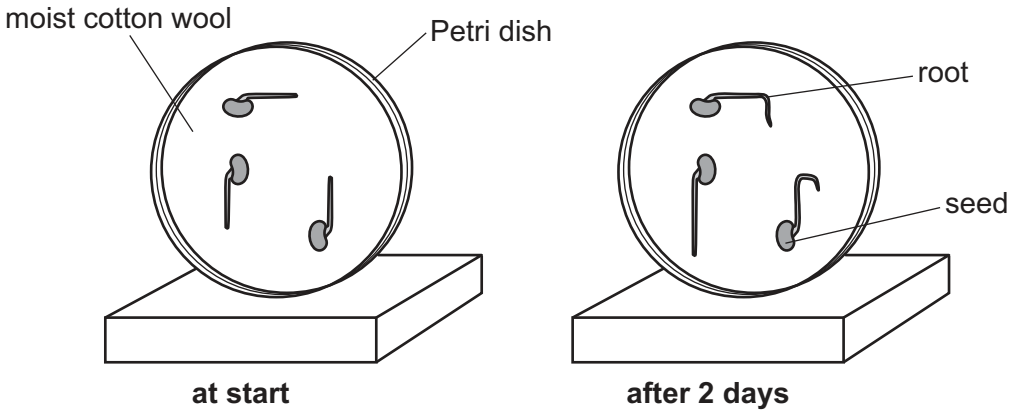


Fig. 10.1

(i) Complete the sentences to describe **and** explain the results in Fig. 10.1.

After 2 days the roots have grown downwards.

This is a tropic response called ..... .

The roots are growing downwards towards ..... to receive more water from the soil.

[2]

(ii) State **two** uses of water in a plant.

1 .....

2 .....

[2]

(iii) State the name of the plant cell that absorbs water from the soil.

..... [1]

(iv) State the name of the vessels that transport water from the roots to the leaves in a plant.

..... [1]

(b) Mineral ions are also absorbed by plants.

Circle the main mineral ion required for the synthesis of chlorophyll.

calcium **iron** **magnesium** **phosphate**

[1]

(c) The boxes show some statements about plants.

Tick (✓) **three** correct statements.

Plants are producers in a food chain.	☐
Plants can be selectively bred.	☐
Plants do not respire.	☐
Plants form the main part of a carnivore's diet.	☐
Plants manufacture carbohydrates.	☐
Plants only reproduce asexually.	☐

[3]

[Total: 10]

11 **(a)** Fig. 11.1 shows the molecular structure of ethene.

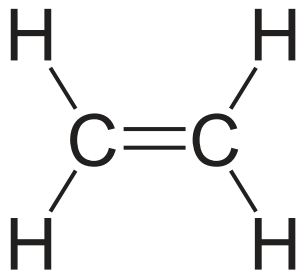


Fig. 11.1

(i) State the total number of atoms in a molecule of ethene.

..... [1]

(ii) State the formula of ethene.

..... [1]

(iii) Use Fig. 11.1 to explain why an ethene molecule is described as unsaturated.

.....

..... [1]

(iv) State the chemical test for an unsaturated hydrocarbon.

Give the observations for a positive result.

test .....

observations .....

[2]

(b) **(i)** State the **two** products of the complete combustion of ethene.

1 .....

2 .....

[2]

(ii) Ethene is made from the breakdown of larger molecules in petroleum.

State the name of this process.

..... [1]

(iii) Polymerisation of ethene produces poly(ethene).

Describe what happens to ethene molecules during polymerisation.

.....

..... [1]

[Total: 9]

12 Visible light travels 1.5×10^8 km from the Sun to the Earth.

(a) The speed of light is 3.0×10^8 m/s.

Calculate the time taken for visible light to travel from the Sun to the Earth.

time = ... s [3]

(b) Visible light is part of the electromagnetic spectrum.

Fig. 12.1 shows an incomplete electromagnetic spectrum.

increasing frequency ⟶

radio waves	**J**	**K**	visible light	ultraviolet	**L**	gamma radiation

Fig. 12.1

Identify regions **J**, **K** and **L** shown in Fig. 12.1.

J .....

K .....

L .....

[3]

(c) Explain why energy is transferred through space from the Sun to the Earth by radiation and **not** by conduction or convection.

.....

.....

..... [2]

(d) Solar energy is a renewable source of energy.

The list shows some renewable energy sources and some non-renewable energy sources.

coal	**geothermal**	**hydroelectric**
natural gas	**waves**	**wind**

(i) Identify **two** renewable energy sources from the list.

1 .....

2 .....

[1]

(ii) Identify **two** non-renewable energy sources from the list.

1 .....

2 .....

[1]

[Total: 10]

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.).