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Cambridge Assessment International Education

Cambridge IGCSE™ (9–1)

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CO-ORDINATED SCIENCES **0973/31**

Paper 3 Theory (Core) **October/November 2025**

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.
- Take the weight of 1.0 kg to be 9.8 N (acceleration of free fall = 9.8 m / s^2).

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)** There are two types of reproduction.

Complete Table 1.1 to compare asexual reproduction and sexual reproduction.

Table 1.1

	asexual	sexual
number of parents	.....	.....
offspring	genetically	genetically .....

[2]

(b) Fig. 1.1 shows a diagram of the male reproductive system in humans.

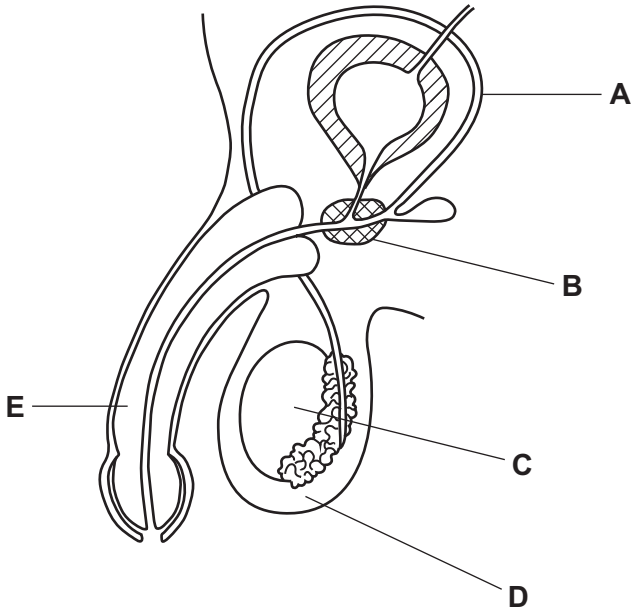


Fig. 1.1

Using letters **A–E** in Fig. 1.1, identify the part that:

produces sperm .....

secretes a fluid to make semen .....

deposits semen into the female. .....

[3]

(c) Flowers are the reproductive organs of plants.

Complete the sentences about pollination and fertilisation.

Pollination is the transfer of pollen grains from an .....

to a ..... .

Fertilisation occurs when a pollen nucleus fuses with a nucleus in

an ..... .

[3]

[Total: 8]

2 **(a)** **(i)** State **all** the elements found in the molecules of:

protein .....

.....

glycogen. .....

.....

[2]

(ii) State the names of the **two** different smaller molecules that make up a molecule of fat.

..... and .....

[2]

(iii) State the test for protein and give the observation for a positive result.

test .....

positive result .....

[2]

(b) **(i)** Enzymes are proteins.

Complete the sentence about enzymes.

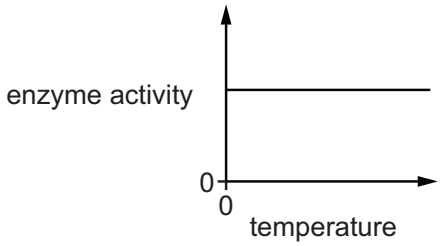
Enzymes are proteins that are involved in all .....

reactions, where they function as biological ..... .

[2]

(ii) Enzymes are affected by temperature.

Place a tick (✓) in the box next to the graph which shows the effect of temperature on enzyme activity.



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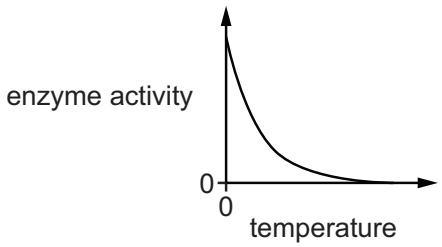

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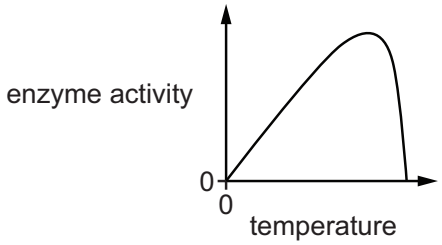

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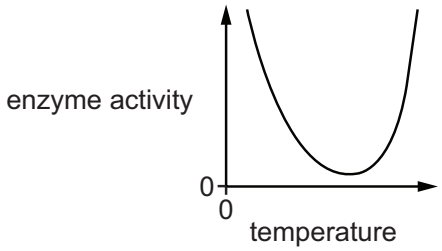

☐

[1]

[Total: 9]

3 Fig. 3.1 is a diagram of a heart.

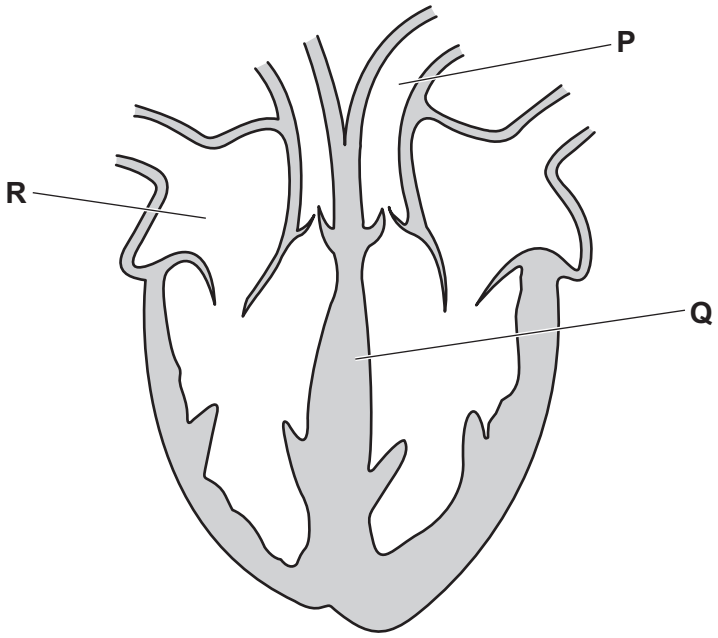

Fig. 3.1

(a) (i) Identify the parts labelled **Q** and **R** on Fig. 3.1.

Q .....

R .....

[2]

(ii) Blood vessel **P** is an artery.

Describe **two** differences between the structure of an artery and the structure of a vein.

1 .....

.....

2 .....

.....

[2]

(b) (i) State the name of the blood vessels that supply the muscular wall of the heart with oxygen.

..... [1]

(ii) Lack of exercise is one possible risk factor for heart disease.

State **two other** possible risk factors for heart disease.

1 .....

.....

2 .....

.....

[2]

(iii) Physical activity increases heart rate.

A person measures their heart rate before and after physical activity.

Table 3.1 shows the results.

Table 3.1

	heart rate / beats per minute
before physical activity	64
after physical activity	104

Calculate the percentage increase in heart rate.

percentage increase = ... % [2]

(c) Plants have two different types of transport tissue, xylem and phloem.

(i) Fig. 3.2 is a diagram of a root.

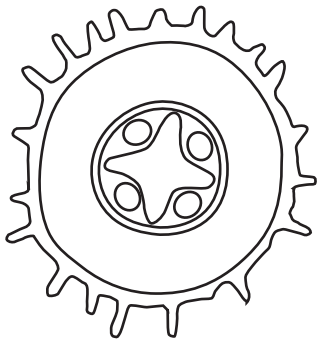

Fig. 3.2

On Fig. 3.2 draw:

- a line and the letter **X** to label the xylem
- a line and the letter **P** to label the phloem.

[2]

(ii) Complete the sentences about transport in the xylem and the phloem.

The xylem transports ..... and ..... .

The phloem transports ..... and ..... .

[2]

[Total: 13]

Question 4 starts on the next page.

4 **(a)** Fig. 4.1 shows an example of habitat destruction.

Fig. 4.1

(i) The trees have been removed to create an area for housing.

Describe **two other** reasons for habitat destruction by humans.

1 .....

.....

2 .....

.....

[2]

(ii) Habitat destruction can cause species to become endangered.

Describe **two** ways in which an endangered species can be conserved.

1 .....

.....

2 .....

.....

[2]

(b) Fig. 4.2 shows a food web.

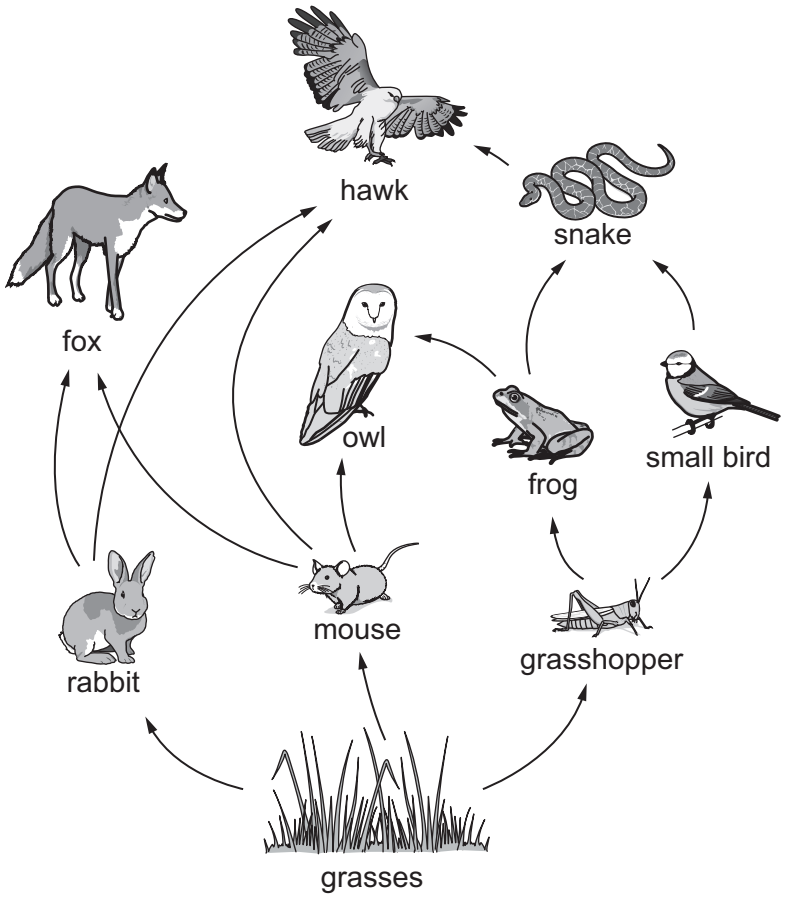

Fig. 4.2

(i) Use Fig. 4.2 to construct a complete food chain that includes the frog.

..... [2]

(ii) Table 4.1 shows some terms that can be used to describe some of the organisms in Fig. 4.2.

Complete Table 4.1 by placing ticks (✓) in the boxes to show the terms to describe each organism.

Table 4.1

	producer	herbivore	carnivore	primary consumer	secondary consumer
small bird					
grasses					
grasshopper					
snake					

[4]

[Total: 10]

5 **(a)** The Periodic Table of elements shows the symbols of all the chemical elements.

Complete the sentences about the Periodic Table.

The elements are listed in order of their ..... number.

Moving from left to right across the Periodic Table, the elements become

..... metallic.

The metals in the middle of the Periodic Table include copper and iron. These metals form coloured compounds and are known as the ..... elements.

[3]

(b) Fig. 5.1 shows the position of 10 elements in part of the Periodic Table.

The letters used are **not** the symbols of the elements.

I	II											III	IV	V	VI	VII	VIII
							S										X
P																T	Y
Q																V	Z
R																W	

Fig. 5.1

Use the letters of the elements given in Fig. 5.1 to identify:

(i) one element that is a diatomic gas at room temperature

..... [1]

(ii) one element that is solid at room temperature

..... [1]

(iii) one element that is an alkali metal

..... [1]

(iv) one element that is a noble gas

..... [1]

(v) the most reactive metal

..... [1]

(vi) the most reactive halogen.

..... [1]

[Total: 9]

Question 6 starts on the next page.

6 Methane, CH_4, is a saturated hydrocarbon.

(a) When hydrocarbons are completely combusted in oxygen, carbon dioxide and water are the products.

(i) Write the word equation for the complete combustion of methane.

methane + ... → ..... + ...
[1]

(ii) State a different product obtained from the incomplete combustion of methane.

..... [1]

(iii) Explain why methane is described as a saturated hydrocarbon.

.....

..... [1]

(iv) Aqueous bromine is used to distinguish between a saturated hydrocarbon and an unsaturated hydrocarbon.

Describe the colour change that is observed when aqueous bromine is mixed with an unsaturated hydrocarbon.

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

(b) Determine the relative molecular mass, M_r, of methane, CH_4.

[A_r: C, 12; H, 1]

relative molecular mass, M_r = ... [1]

(c) Complete the dot-and-cross diagram in Fig. 6.1 to show the electron arrangement of methane. Show outer electrons only.

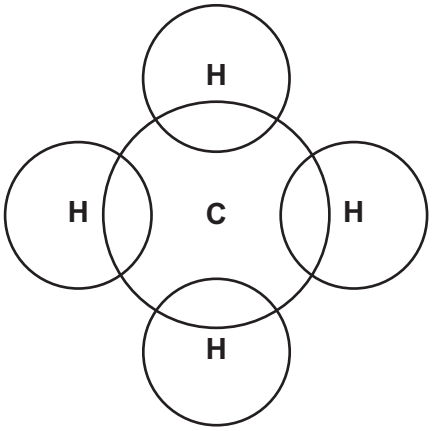

Fig. 6.1

[2]

(d) Methane is the main constituent of natural gas.

Natural gas is a fossil fuel.

State the name of one other fossil fuel.

..... [1]

(e) Carbon is an element, methane is a compound.

Complete the sentences below to show the difference between an element and a compound.

Carbon is an element because it contains .....

.....

Methane is a compound because it contains .....

..... that are chemically combined.

[2]

[Total: 10]

7 **(a)** Lead is extracted from lead oxide by reaction with carbon.

The reaction is endothermic.

The word equation for the reaction is shown.

lead oxide + carbon → lead + carbon dioxide

(i) Explain why this reaction shows both oxidation and reduction.

.....

.....

.....

..... [2]

(ii) Explain what is meant by an endothermic reaction.

.....

..... [1]

(b) Lead is also extracted from molten lead bromide by electrolysis.

Fig. 7.1 shows the apparatus used.

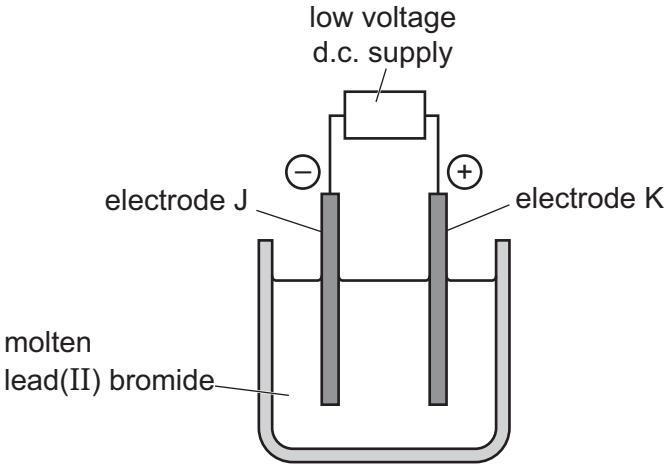

Fig. 7.1

(i) Graphite is used as the inert electrodes.

Graphite is a giant covalent structure made of carbon atoms.

State the name of one other giant covalent structure made of carbon atoms.

..... [1]

(ii) State the name of each electrode.

negative electrode J .....

positive electrode K .....

[1]

(iii) Identify the products at each electrode.

electrode J product .....

electrode K product .....

[1]

(iv) The molten lead bromide cools and turns solid.

Suggest why the electrolysis stops.

.....

..... [1]

(c) Lead is a very soft, ductile metal.

Lead is often used in alloys.

(i) State the meaning of the term alloy.

.....

..... [1]

(ii) Solder is an alloy of lead.

The composition of solder is shown in Table 7.1.

Table 7.1

metal	percentage
lead	37%
tin	63%

Calculate the mass of lead found in 4 kg of solder.

mass of lead = ... kg [1]

(d) Lead reacts slowly with dilute hydrochloric acid.

Hydrogen gas and a compound of lead are made.

(i) Suggest the name of this compound of lead.

..... [1]

(ii) Describe the chemical test for hydrogen and state the observation for a positive result.

test .....

observation .....

.....

[2]

[Total: 12]

Question 8 starts on the next page.

8 **(a)** The element calcium is represented on the Periodic Table as shown.

20
Ca
calcium
40

The symbol for a calcium ion is Ca^{2+}.

(i) State the number of protons in this calcium ion.

..... [1]

(ii) State the number of electrons the calcium atom loses when it becomes a calcium ion.

..... [1]

(b) Calcium carbonate reacts with dilute sulfuric acid.

The symbol equation for the reaction is

$$CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + CO_2 + H_2O$$

(i) Carbon dioxide is one of the products of the reaction.

State the names of the other two products of the reaction.

1 .....

2 .....
[2]

(ii) 1.00 g of calcium carbonate makes 240 cm^3 of carbon dioxide gas at room temperature and pressure.

Calculate the mass of calcium carbonate needed to make 360 cm^3 of carbon dioxide gas at room temperature and pressure.

mass of calcium carbonate = ... g [1]

(c) Identify which of the changes decrease the rate of the reaction between calcium carbonate and dilute sulfuric acid.

Place ticks (✓) in the boxes next to the changes that **decrease** the rate of reaction.

decrease the concentration of the dilute sulfuric acid	
use larger pieces of calcium carbonate	
increase the temperature of the dilute sulfuric acid	
use a catalyst	

[2]

(d) Calcium carbonate is a solid.

Carbon dioxide is a gas.

Table 8.1 shows a list of properties for solids and gases.

Complete Table 8.1 by identifying which properties refer to a solid (**S**) and which properties refer to a gas (**G**).
One has been done for you.

Table 8.1

property	solid (**S**) or gas (**G**)
able to be compressed	
able to diffuse	
able to flow	**G**
has a fixed shape	
has a fixed volume	

[2]

[Total: 9]

9 Table 9.1 shows data about six metals.

Table 9.1

metal	melting point / °C	boiling point / °C	density / kg / m^3
aluminium	660	2470	2700
iron	1538	2862	7900
lead	328	1749	11400
mercury	–39	357	13500
tin	232	2602	7300
uranium	1132	4131	19100

(a) (i) Identify the metal in Table 9.1 that has the greatest density.

..... [1]

(ii) Water has a density of 1000 kg / m^3.

Use data from Table 9.1 to explain why all the metals in Table 9.1 sink when placed in water.

.....

..... [1]

(b) (i) Mercury is a liquid at room temperature (20 °C).

Explain how Table 9.1 shows this.

.....

..... [1]

(ii) Describe the structure of liquid mercury in terms of the arrangement and separation of the particles.

arrangement

.....

.....

separation

.....

.....
[2]

(iii) Describe how the motion of particles in liquid mercury changes as the temperature decreases.

.....

..... [1]

(c) Uranium-238 has the nuclide notation $^{238}_{92}U$.

Describe the composition of the nucleus of a uranium-238 atom.

.....

..... [2]

(d) An alloy of lead and tin is used to make fuse wire.

The alloy has a melting point of 200 °C.

A fuse contains fuse wire and is used to protect electrical devices in electrical circuits.

Describe how the fuse protects the electrical circuit from the heating effect of an electric current.

.....

.....

.....

..... [2]

[Total: 10]

10 (a) Table 10.1 shows information about the planets in the Solar System.

Table 10.1

planet	mass / kg
Mercury	3×10^{23}
Venus	5×10^{24}
Earth	6×10^{24}
Mars	6×10^{23}
X	2×10^{27}
Saturn	6×10^{26}
Uranus	9×10^{25}
Neptune	1×10^{26}

(i) Identify planet X.

..... [1]

(ii) The mass of the Sun is 2×10^{30} kg.

A student says that the Sun has 100 times the mass of planet X.

Use data from Table 10.1 to show that the student is incorrect.

[1]

(b) (i) The Sun is a stable star that formed as a protostar from two materials.

State the two materials from which protostars form.

1 .....

2 .....

[2]

(ii) The Sun is a small mass star.

Use words or phrases from the list to describe the next stages of the life cycle of the Sun by filling in the gaps in the sequence below.

black hole	**neutron star**	**red giant**
red super giant	**supernova**	**white dwarf**

Sun (stable star)

↓

.....

↓

..... and planetary nebula

[1]

(c) Visible light travels 1.5×10^{11} m from the Sun to the Earth at a speed of 3.0×10^{8} m/s.

Show that the time for visible light to travel from the Sun to the Earth is approximately 8 minutes.

[2]

(d) On Fig. 10.1 complete the ray diagram to show how a lens is able to focus rays of light from the Sun onto some dry grass.

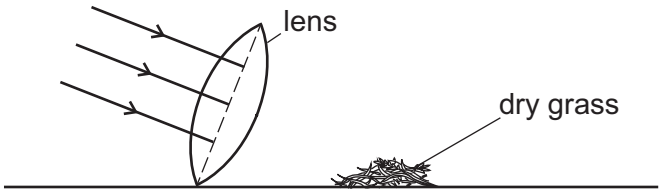

Fig. 10.1

[1]

[Total: 8]

11 **(a)** X-rays and γ-radiation are both used in hospitals.

Write X-rays in the correct place in the incomplete electromagnetic spectrum in Fig. 11.1.

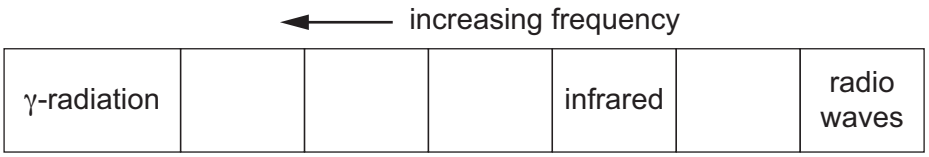

Fig. 11.1

[1]

(b) **(i)** State **one** use for X-rays in a hospital.

..... [1]

(ii) Ultrasound waves are used in a hospital to scan unborn babies.

Explain why ultrasound is used in preference to X-rays.

.....

.....

..... [1]

(iii) Suggest the frequency of ultrasound waves in kHz.

Use your knowledge of the range of frequencies audible to humans to explain your answer.

frequency = ... kHz

explanation .....

.....

[2]

(c) γ-radiation with a frequency of 6×10^{19} Hz travels at a speed of 3×10^{8} m/s.

Calculate the wavelength of γ-radiation.

State the unit of your answer.

wavelength = ... unit ..... [3]

(d) γ-radiation is used in the treatment of cancer.

The source of γ-radiation is the isotope cobalt-60 which has a half-life of 5.3 years.

(i) Complete the sentence to define the half-life of a radioactive isotope.

The half-life of a radioactive isotope is the time taken for .....

.....

..... [2]

(ii) A sample of cobalt-60 contains 1600 cobalt-60 atoms.

Calculate how many cobalt-60 atoms will remain after 31.8 years.

number of atoms remaining = ... [2]

[Total: 12]

12 (a) Complete Table 12.1 by drawing the circuit symbol for each electrical component.

Table 12.1

component	circuit symbol
motor	
variable resistor	

[2]

(b) Fig. 12.1 shows a house with solar panels on the roof.

The solar panels contain many solar cells.

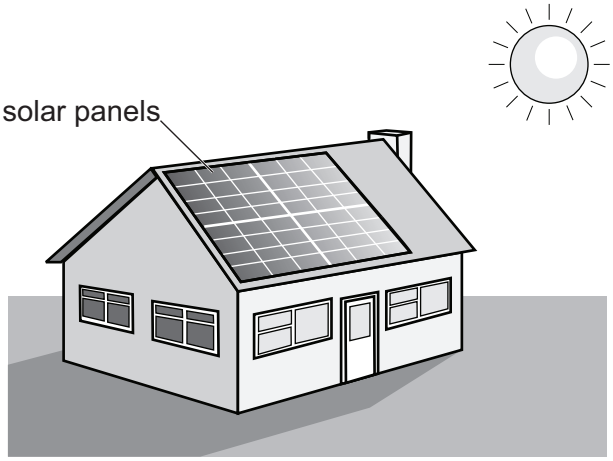

Fig. 12.1

State **one** advantage and **one** disadvantage of generating electricity using solar cells.

advantage

.....

.....

disadvantage

.....

.....

[2]

(c) A washing machine in the house uses electricity generated from the solar cells.

Fig. 12.2 shows the washing machine connected to a 230 V supply.

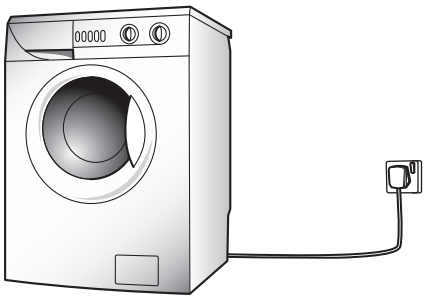

Fig. 12.2

(i) The washing machine uses 2500 W of power when switched on.

Calculate the current in the washing machine.

current = ... A [2]

(ii) The water in the washing machine is heated by a heating element.

A current of 3.0 A passes through the heating element when the voltage across the heating element is 230 V.

Calculate the resistance of the heating element.

resistance = ... Ω [2]

(iii) Inside the washing machine, some of the water evaporates.

During evaporation water changes state from liquid to gas.

Describe the process of evaporation in terms of particles.

.....

.....

.....

..... [2]

[Total: 10]

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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.).