Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

7584600156

CO-ORDINATED SCIENCES **0654/32**

Paper 3 Theory (Core) **February/March 2023**

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 **24** pages. Any blank pages are indicated.

DC (CE/CB) 312401/2

1 **(a)** Fig. 1.1 is a diagram of the circulatory system in humans.

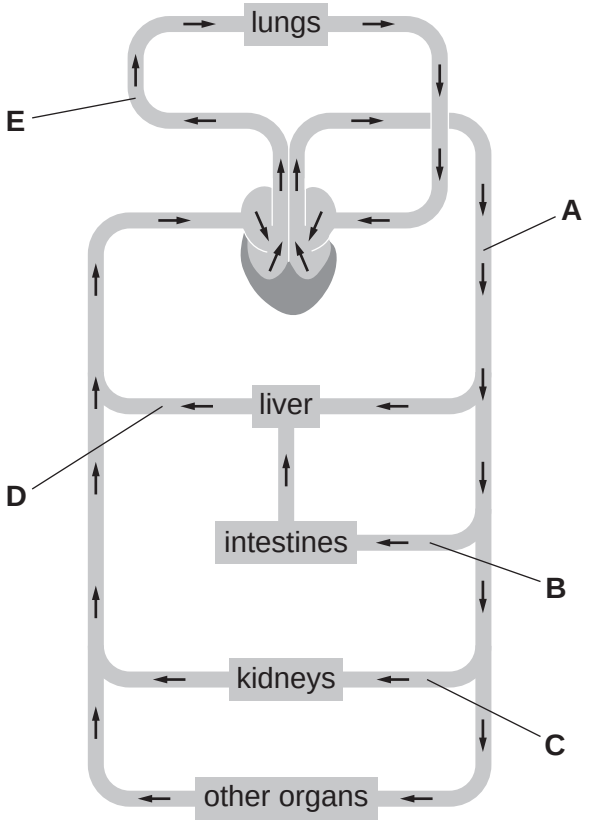

Fig. 1.1

(i) State the name of the blood vessels labelled **A** and **C** in Fig. 1.1.

A .....

C .....
[2]

(ii) Identify blood vessels **B**, **D**, and **E** in Fig. 1.1 as either an artery or a vein.

B .....

D .....

E .....
[2]

(iii) State the name of the structures in the circulatory system that ensure one-way flow of blood.

..... [1]

(iv) State the name of the part that separates the left side of the heart from the right side.

..... [1]

(b) The boxes on the left show the names of three types of blood vessel.
The boxes on the right show the average thickness of the wall of each type of blood vessel.

Draw lines to link each blood vessel with the average thickness of their walls.

blood vessel	**average thickness of wall**
artery	0.0005 mm
capillary	0.5 mm
vein	1 mm

[2]

(c) Describe the function of capillaries.

.....

..... [1]

(d) State the names of **two** main components of blood.

1 .....

2 .....

[2]

[Total: 11]

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

aluminium **carbon** **copper** **chlorine**

helium **phosphorus** **sulfur**

State which of the elements in the list:

(i) forms diamond and graphite ..... [1]

(ii) is a halogen ..... [1]

(iii) is electroplated onto another metal ..... [1]

(iv) is extracted from bauxite ..... [1]

(v) is used in the manufacture of sulfuric acid ..... [1]

(vi) is used to sterilise drinking water ..... [1]

(b) The formula of phosphorus oxide is P_4O_{10}.

State the number of atoms of phosphorus and of oxygen contained in one molecule of phosphorus oxide.

phosphorus .....

oxygen .....
[1]

(c) Explain why phosphorus oxide makes an acidic solution when it dissolves in water.

.....

..... [1]

(d) Phosphorus is contained in fertilisers.

State the two other elements commonly found in fertilisers.

1 .....

2 .....
[2]

[Total: 10]

3 **(a)** High frequency sound waves are called ultrasound.

An ultrasound wave travels 13.5 cm in 0.000 090 s through water.

Calculate the speed of the ultrasound wave in m / s.

speed = ... m / s [3]

(b) Ultrasound waves are used in hospitals to scan unborn babies.

(i) Suggest a reason why it is **not** safe to scan unborn babies with X-rays.

..... [1]

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

..... [1]

(c) **(i)** γ-radiation is used in hospitals to kill cancerous cells.

Fig. 3.1 shows an incomplete electromagnetic spectrum.

Write γ-radiation in its correct place.

← increasing frequency						
	X-rays	ultraviolet		infrared		

Fig. 3.1

[1]

(ii) A source of γ-radiation in a hospital is technetium-99.
Technetium-99 has a half-life of 6 hours.

The source contains 1280 undecayed atoms.
Calculate how many atoms will have decayed after 12 hours.

number of decayed atoms = ... [2]

[Total: 8]

4 **(a)** Albinism is a condition in humans where no pigment is made by the skin.
The allele for no albinism is dominant and represented by the letter **A**.
The allele for albinism is recessive and represented by the letter **a**.

(i) Table 4.1 shows some genotypes, phenotypes and descriptions of the genotypes for three people.

Complete Table 4.1.

Table 4.1

person	genotype	phenotype	description of genotype
1		albinism	homozygous recessive
2	**Aa**		
3	**AA**		homozygous dominant

[4]

(ii) Person **2** and person **3** have a child together.

Complete the Punnett square diagram in Fig. 4.1 to show the possible genotypes of the offspring.

		person **2** gametes	
		A	**a**
person **3** gametes	**A**		
	A		

Fig. 4.1

[1]

(b) Chromosomes carry genetic information.

(i) Complete the definition of the term chromosome.

A chromosome is a thread-like structure of ..... ,

carrying genetic information in the form of ..... .

[2]

(ii) State where chromosomes are found in human cells.

..... [1]

(iii) State the sex chromosomes found in male gametes in humans.

..... **or** ..... [1]

(c) State the name of the male gametes in humans.

..... [1]

(d) State the name of the organ where male gametes are produced in humans.

..... [1]

[Total: 11]

5 **(a)** Fig. 5.1 is a chart showing the composition of clean air.

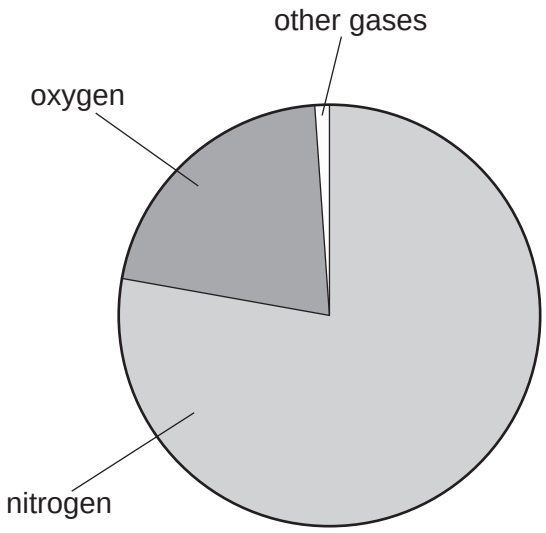

Fig. 5.1 (not to scale)

Use your knowledge of the composition of clean air to determine the percentage of **other gases** in clean air.

Show your working.

percentage = ... % [2]

(b) **(i)** Argon is one of the other gases in clean air.

Use the Periodic Table on page 24 to determine the electronic structure of an argon atom.

..... [1]

(ii) Use your answer to **(b)(i)** to explain why argon is very unreactive.

.....

..... [1]

(iii) State **one** use for argon gas that depends on it being unreactive.

..... [1]

(c) (i) Small quantities of carbon dioxide are found in the air.

State **one** source of the carbon dioxide found in the air.

..... [1]

(ii) Carbon dioxide is a compound formed from the elements carbon and oxygen.

Describe the difference between an element and a compound.

.....

.....

..... [1]

(iii) Carbon dioxide is a greenhouse gas.

State the name of **one** other greenhouse gas.

..... [1]

(d) (i) Water is neutral.

State the pH value of pure water.

pH = ... [1]

(ii) Carbon dioxide in the air dissolves in rainwater. This causes the rainwater to become slightly acidic.

Suggest a pH value for this rainwater.

pH = ... [1]

[Total: 10]

6 **(a)** Fig. 6.1 shows an athlete running on a level road.
Four forces **A**, **B**, **C** and **D** act on the runner.

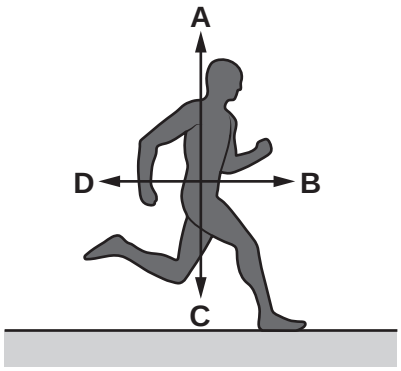

Fig. 6.1

Force **B** is the driving force which moves the athlete forward.

State the names of forces **C** and **D**.

C .....

D .....
[2]

(b) Complete the sentence to describe how forces change a body.

Forces may change the direction of motion of a body,

the ..... of a body

and the ..... of a body.
[2]

(c) The athlete runs up a hill at constant speed.

Use words or phrases from the list below to complete the sentences about the energy transfers taking place. Each word or phrase may be used once, more than once or not at all.

chemical potential **gravitational potential**

kinetic **light**

Stored ..... energy from food is

transferred to ..... energy as the athlete moves.

As the athlete moves up the hill his store of ..... energy

increases.

The speed of the athlete is constant when moving up the hill, so his

..... energy remains constant.
[2]

(d) Explain why the athlete's power output is greater when he runs faster.

.....

.....

..... [1]

(e) A photographer takes a photograph of the athlete using a digital camera with a thin converging lens as shown in Fig. 6.2.

Two rays of light are shown passing from the head of the athlete to the lens.

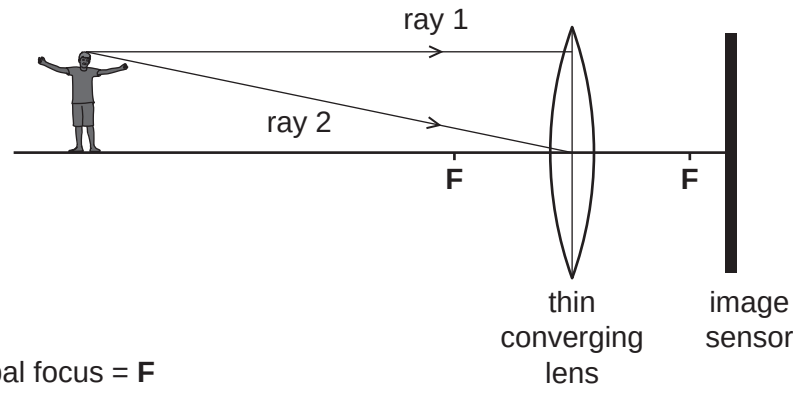

Fig. 6.2

(i) A focused image of the athlete's head is formed on the image sensor.

Complete Fig. 6.2 to show how these two rays pass from the lens to form the image on the sensor. [2]

(ii) On Fig. 6.2, draw a double headed arrow (↔) to show the focal length of the lens. [1]

(iii) Circle **two** words or phrases that describe the image formed.

diminished **enlarged** **inverted**

same size **upright**

[2]

[Total: 12]

7 **(a)** A student investigates the effect of temperature on the rate of transpiration.

Fig. 7.1 shows the apparatus used.

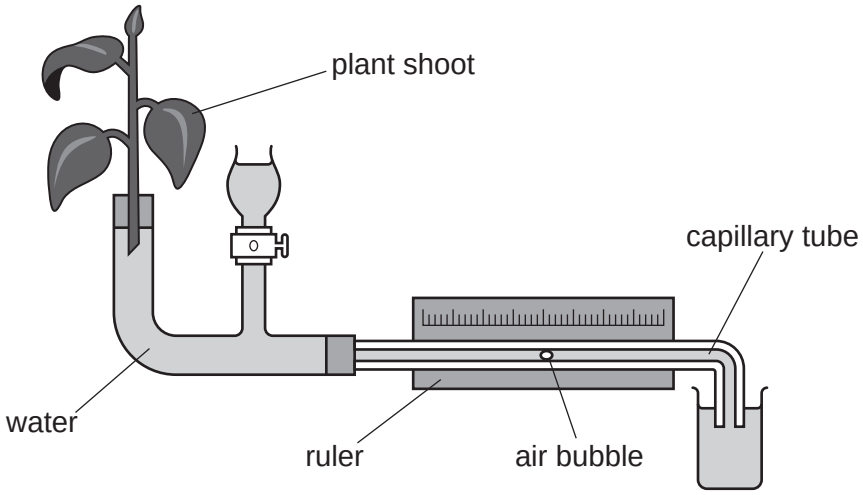

Fig. 7.1

The student measures the distance the air bubble moves in 22 minutes.

The distance the air bubble moves is used to calculate the rate of transpiration.

The experiment is repeated at three different temperatures.

Table 7.1 shows the results.

Table 7.1

temperature / °C	distance the air bubble moves in 22 minutes / mm
4	3
10	7
25	20

(i) Calculate the rate of transpiration at 10 °C.
Give your answer to 1 significant figure.

..... mm / min [2]

(ii) State **one other** factor that affects the rate of transpiration.

..... [1]

(iii) Define the term transpiration.

.....

.....

.....

.....

..... [3]

(b) Fig. 7.2 shows the initial pathway of water through a plant.

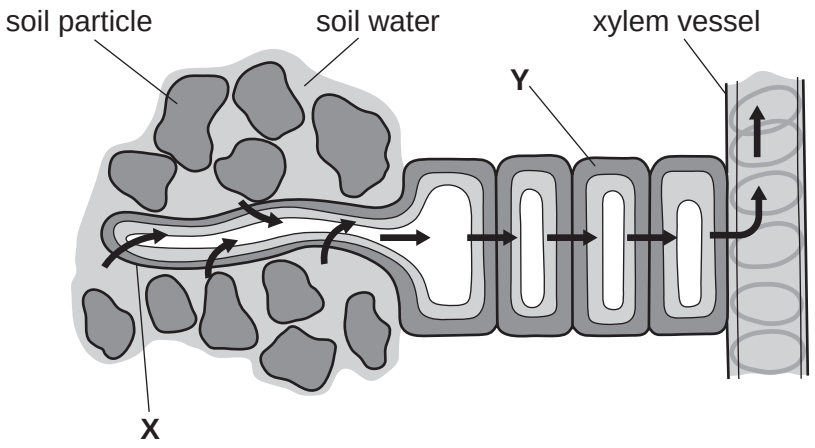

Fig. 7.2

(i) State the names of the cells labelled **X** and **Y** in Fig. 7.2.

X .....

Y .....
[2]

(ii) State the name of the process that causes absorption of water into the plant cells.

..... [1]

[Total: 9]

8 Ethanol has the formula C_2H_5OH.

(a) State the number of different elements in **one** molecule of ethanol.

..... [1]

(b) Complete Fig. 8.1 to show the structure of ethanol.

C C

Fig. 8.1

[2]

(c) State **two** ways of producing ethanol.

1 .....

2 .....

[2]

(d) Complete the word equation for the complete combustion of ethanol.

ethanol + ... → ..... + ...

[2]

(e) Explain why ethanol is **not** a hydrocarbon.

.....

..... [1]

(f) Ethanol is used in alcoholic drinks.

State **one** other use for ethanol.

.....

..... [1]

[Total: 9]

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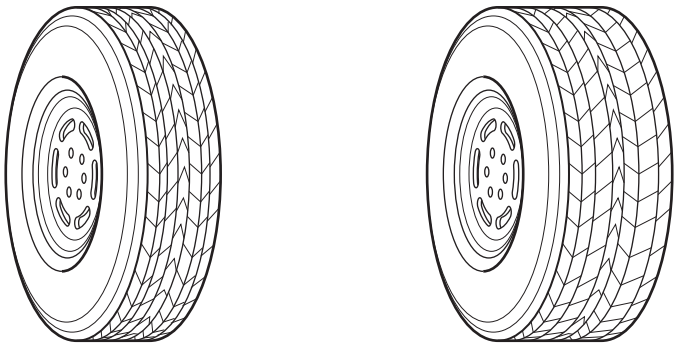
9 **(a)** Fig. 9.1 shows two different car tyres.



tyre **X** tyre **Y**

Fig. 9.1

A car driver observes that her car sinks into soft ground when she uses tyres **X**. She changes the tyres on her car to **Y**, so that it does not sink into the soft ground.

Explain why tyre **Y** will cause less pressure to be exerted on the ground than tyre **X**.

.....

..... [1]

(b) A thermometer is used to measure the temperature of the air in a tyre.

Fig. 9.2 shows a simple liquid-in-glass thermometer.

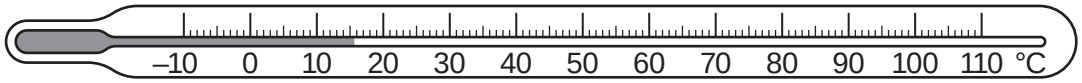


Fig. 9.2

(i) State the name of the temperature scale used in the thermometer in Fig. 9.2.

..... [1]

(ii) The liquid in the thermometer is alcohol.

State the physical property of alcohol that varies with temperature used in this thermometer.

..... [1]

(iii) State the **two** physical properties that define the fixed points on this temperature scale.

1 .....

2 .....
[2]

(c) Fig. 9.3 shows two horizontal forces acting on a car as it moves along a straight road.

Fig. 9.3

(i) Calculate the size and direction of the resultant horizontal force on the car.

size of resultant force = ...

direction of resultant force .....
[2]

(ii) The driver of the car applies the brakes to slow the car.

Fig. 9.4 shows the force from the driver's foot on the brake pedal.

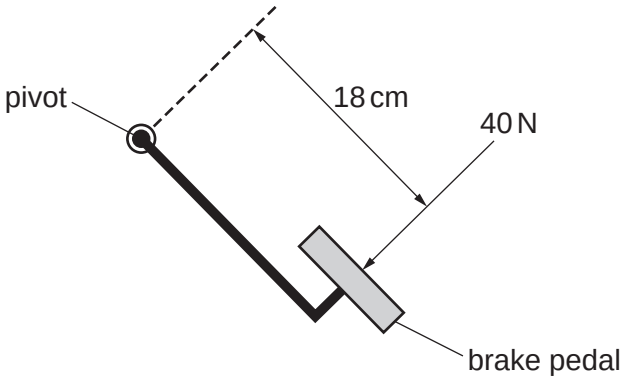


Fig. 9.4

Calculate the moment of the force from the driver's foot about the pivot.

moment = ... N cm [2]

[Total: 9]

10 (a) (i) Define the term enzyme.

.....

.....

..... [2]

(ii) Fig. 10.1 is a graph showing the activity of enzyme **A** at different pH values.

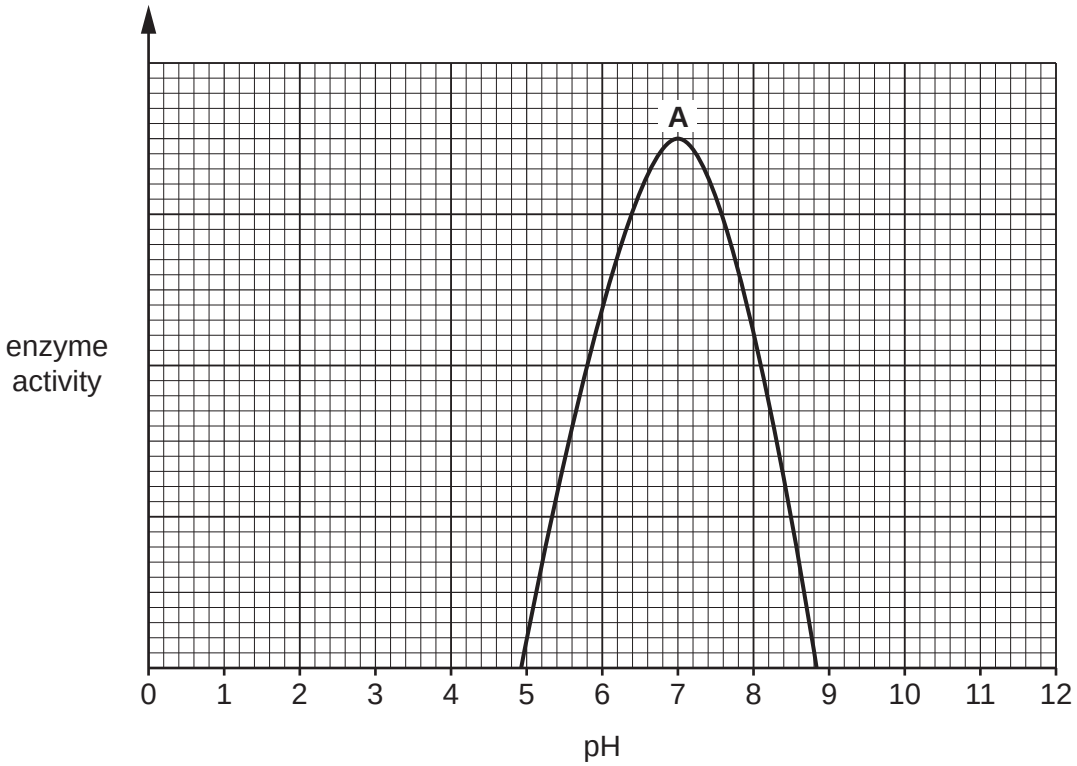


Fig. 10.1

Describe the trend shown in Fig. 10.1.

Use data in your answer.

.....

.....

.....

..... [2]

(b) Photosynthesis and respiration are both enzyme-controlled reactions.

The table shows some features of photosynthesis and aerobic respiration.
Place ticks (✓) in the boxes to show the correct features of each process.

process	occurs in plants	releases carbon dioxide	produces oxygen
photosynthesis			
aerobic respiration			

[2]

(c) Respiration is one of the characteristics of living organisms.

State **three other** characteristics of living organisms.

1 .....

2 .....

3 .....

[3]

[Total: 9]

11 **(a)** State the name given to mixtures made from a metal with other elements.

..... [1]

(b) Iron is an element in Period 4 of the Periodic Table.

State the name of the collection of metals in Period 4 that contains iron.

..... [1]

(c) Describe the test used to identify iron(II) ions and give the observation for a positive result.

test .....

.....

observation .....

.....
[2]

(d) State the **two** substances that react with iron to make rust.

1 .....

2 .....
[2]

(e) An isotope of iron has a proton number of 26 and a nucleon number of 58.

(i) Deduce the number of neutrons and the number of electrons in this isotope of iron.

neutrons = ...

electrons = ...
[2]

(ii) State the meaning of the term isotope.

.....

..... [1]

(f) A teacher reacts dilute hydrochloric acid with four metals.
The observations are shown in Table 11.1.

Table 11.1

metal	observation
calcium	bubbles quickly
iron	only a few bubbles
lithium	bubbles very quickly
silver	no bubbles

Place the four metals in order of their reactivity from the most reactive to the least reactive.

most reactive .....

.....

.....

least reactive .....

[2]

[Total: 11]

12 A room in a house has an electric heater.

(a) Fig. 12.1 shows part of the circuit containing the heater.

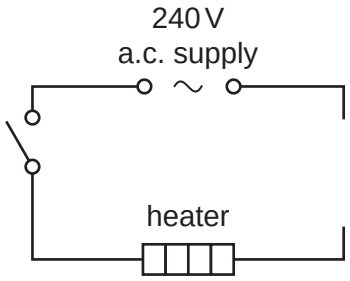


Fig. 12.1

Complete the circuit diagram in Fig. 12.1 by adding the correct electrical symbol for a fuse. [1]

(b) When the circuit is switched on, the current in the heater is 3A and the supply voltage is 240 V.

(i) Calculate the resistance of the heater.

State the unit of your answer.

resistance = ... unit ..... [3]

(ii) The fuse in the circuit needs to be replaced.

Explain why a 5A fuse is used and not a 3A fuse.

.....

..... [1]

(c) Fig. 12.2 shows the heater as part of an underfloor heating system.

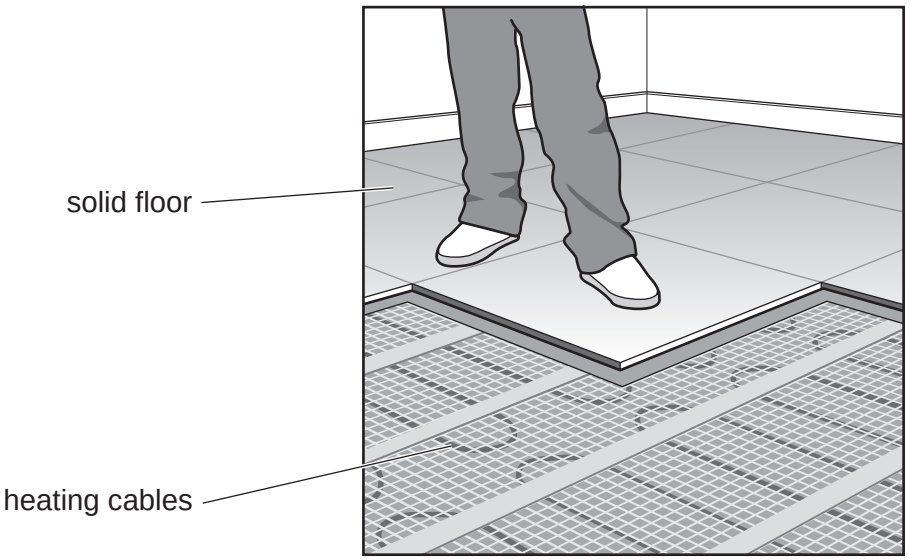


Fig. 12.2

(i) When the heater is switched on, thermal energy passes through the solid floor to heat the air in the room.

The temperature of the air in the room increases slowly.

State the method of thermal energy transfer through the solid floor.

..... [1]

(ii) State the method of thermal energy transfer that heats all the air in the room.

..... [1]

(d) Some water spills onto the floor and evaporates.

Describe evaporation in terms of the motion of water molecules.

.....

.....

..... [2]

(e) There are solar cells on the roof of the house.

State **one** advantage and **one** disadvantage of generating electricity using solar cells. Do not include the cost.

advantage .....

disadvantage .....
[2]

[Total: 11]

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	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.).