Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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0534573696

CO-ORDINATED SCIENCES **0654/32**

Paper 3 Theory (Core) **October/November 2022**

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.

DC (KN/CT) 302294/5

1 **(a)** Fig. 1.1 is a diagram of a plant cell.

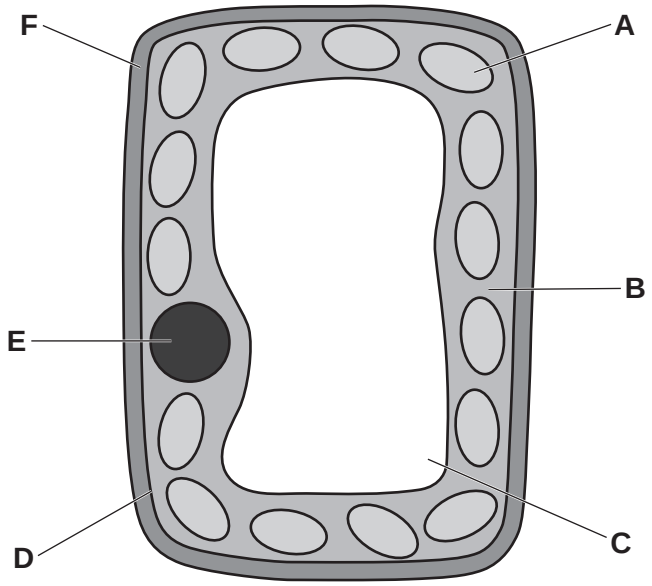

Fig. 1.1

(i) Identify the letter from Fig. 1.1 that represents the part of the plant cell:

where photosynthesis occurs .....

where the genetic material is found .....

that controls what substances enter the cell .....
[3]

(ii) State the name of the part labelled **B** in Fig. 1.1.

..... [1]

(iii) State the name of **two** structures in plant cells that are **not** found in animal cells.

1 .....

2 .....
[2]

(b) A student immerses pieces of potato in different concentrations of sucrose solution for 5 minutes.

The student measures the length of the potato before and after immersion.

Table 1.1 is a summary of the results.

Table 1.1

concentration of sucrose solution / mol/dm^3	length of the potato at the start / mm	length of potato at the end / mm	change in length of potato / mm
0.0	45.5	49.4	+ 3.9
0.2	45.0	47.9	+ 2.9
0.4	45.6	46.7	
0.6	45.0	45.6	+ 0.6
0.8	45.3	44.2	– 1.1
1.0	45.4	42.8	– 2.6

(i) Use Table 1.1 to calculate the change in length of the potato when it is placed in the 0.4 mol/dm^3 sucrose solution.

..... mm [1]

(ii) Complete the sentences to describe and explain the results in Table 1.1.

The potato with the **smallest** change in length has been immersed in a sucrose solution with a concentration of ..... mol/dm^3.

The potato immersed in 0.8 mol/dm^3 sucrose solution changed by

..... mm in length.

The potato immersed in 0.2 mol/dm^3 sucrose solution increases in length because water is absorbed by the potato cells by the process of ..... .

[3]

[Total: 10]

2 **(a)** Five words are shown in the boxes on the left. Five descriptions are shown in the boxes on the right.

Draw **one** straight line from each word to its correct description.

word	description
chromatography	an atom that has gained or lost electrons
ion	an element in Group I of the Periodic Table
sodium	a substance that dissolves in a solvent
solute	a technique used to separate dyes
sulfur	used in the production of sulfuric acid

[4]

(b) A student investigates the reaction between calcium carbonate and dilute hydrochloric acid.

Fig. 2.1 shows the apparatus the student uses.

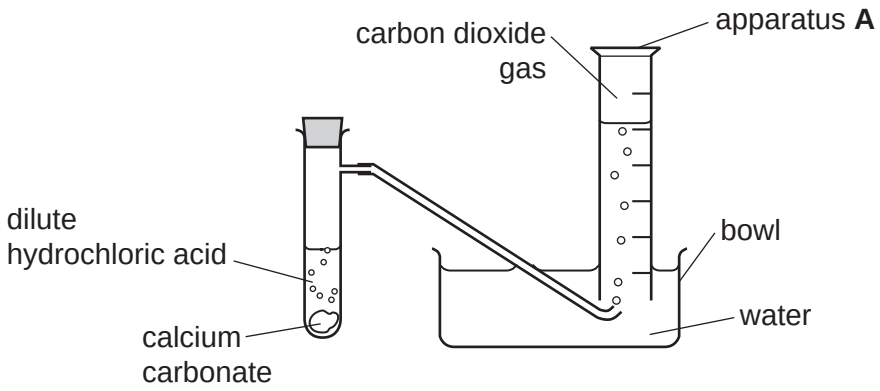

Fig. 2.1

A salt solution and carbon dioxide are made. The carbon dioxide gas is collected in apparatus **A**.

(i) State the name of apparatus **A** shown in Fig. 2.1.

..... [1]

(ii) State the name of the salt made.

..... [1]

(iii) State the chemical test for carbon dioxide. Include the observation for a positive result.

test .....

observation .....
[2]

(iv) It takes 50 seconds to collect 90 cm^3 of carbon dioxide gas.

Calculate the rate at which carbon dioxide is made in cm^3/s.

rate = ... cm^3/s [1]

(v) State **two** changes to the reaction conditions that reduce the rate of reaction.

1 .....

2 .....
[2]

(vi) Calcium carbonate has the formula $CaCO_3$.

State the number of different elements present in calcium carbonate.

..... [1]

[Total: 12]

3 **(a)** Thermal energy is released, by combustion, in a gas-fired power station.

Describe how the thermal energy released is transferred into electrical energy in the power station.

.....

.....

.....

.....

..... [3]

(b) State **one** advantage and **one** disadvantage of a nuclear power station compared with a gas-fired power station.

advantage .....

.....

disadvantage .....

.....

[2]

(c) Cobalt-60 is produced in a nuclear power station.

(i) A sample of cobalt-60 has a mass of 2 g.
The half-life of cobalt-60 is 5.25 years.

Calculate the mass of cobalt-60 remaining after 21 years.

mass = ... g [2]

(ii) Cobalt-60 decays by emitting β-particles and γ-rays.

State the charge on a β-particle.

charge = ... [1]

(iii) Place α-particles, β-particles and γ-rays in order of their penetrating abilities.

most penetrating .....

.....

least penetrating .....

[1]

(iv) Suggest a safe way of storing a small sample of cobalt-60.

.....

..... [1]

[Total: 10]

4 **(a)** Fig. 4.1 is a photomicrograph of a cross-section of a human vein.

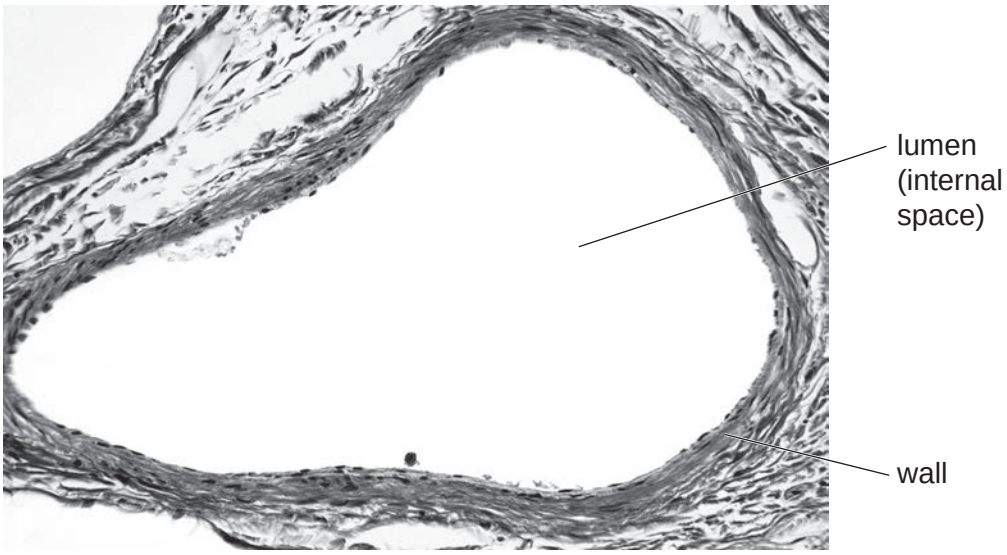

Fig. 4.1

(i) Describe **two** ways the appearance of an artery is different from the vein shown in Fig. 4.1.

1 .....

.....

2 .....

.....
[2]

(ii) State the name of a structure present in veins that is **not** visible in Fig. 4.1.

..... [1]

(b) State the name of **two** veins that transport blood to the heart.

1 .....

2 .....
[2]

(c) Describe the function of capillaries.

.....

..... [1]

(d) Table 4.1 shows the functions of the main components of blood.

Complete Table 4.1.

Table 4.1

name of component of blood	function
	antibody production and phagocytosis
	blood clotting
	transport of blood cells and ions
	transport of oxygen

[4]

[Total: 10]

5 **(a)** An isotope of magnesium has a proton number (atomic number) of 12 and a nucleon number (mass number) of 26.

Complete Table 5.1 to show the numbers of neutrons and electrons in an atom of this isotope.

Table 5.1

isotope	number of protons	number of neutrons	number of electrons
magnesium-26	12		

[2]

(b) Fig. 5.1 shows part of the reactivity series of metals.

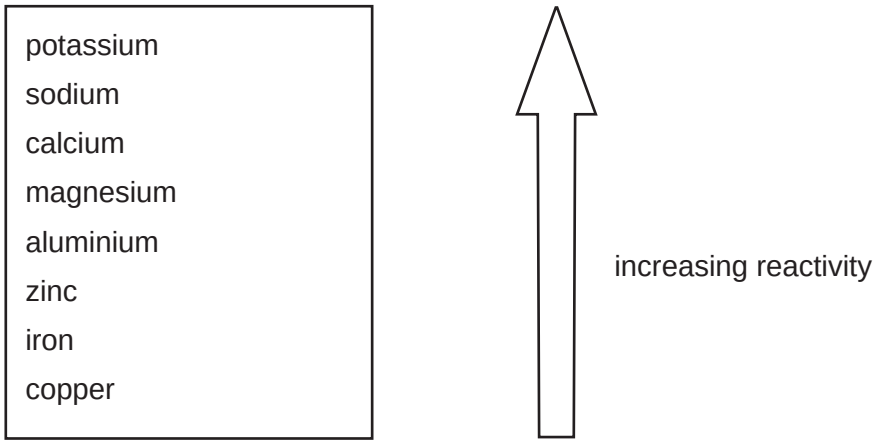

Fig. 5.1

Magnesium reacts slowly with cold water.

Use the reactivity series to predict the result when calcium reacts with cold water.

Explain your answer.

prediction .....

.....

explanation .....

.....

[2]

(c) Magnesium reacts with carbon dioxide. Magnesium oxide and carbon are made.

(i) Write the word equation for this reaction.

[1]

(ii) The reaction between magnesium and carbon dioxide is exothermic.

State what is meant by the term exothermic.

.....

..... [1]

(d) Platinum is a transition metal. Magnesium is not a transition metal.

State **two** properties of platinum that are **not** properties of magnesium.

1 .....

2 .....

[2]

(e) Table 5.2 shows the composition of an alloy of magnesium.

Table 5.2

element	% by mass
aluminium	6.0
calcium	2.0
magnesium	
manganese	0.4
zinc	0.1

Complete the table with the % by mass of magnesium.

Calculate the mass of magnesium in 1.0 kg of the alloy.

mass = ... kg [2]

[Total: 10]

6 **(a)** Fig. 6.1 shows an elephant pushing a log up a hill.

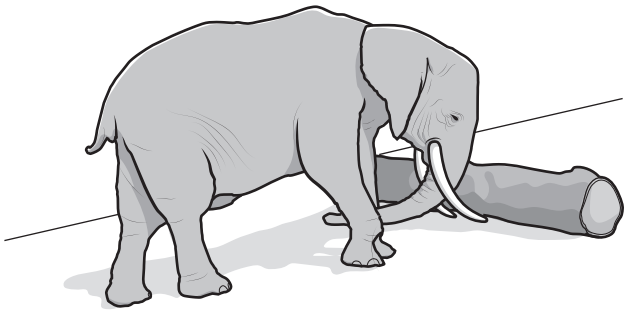

Fig. 6.1

(i) State the **two** quantities that need to be measured to calculate the work done by the elephant on the log.

1 .....

2 .....
[2]

(ii) State the form of energy gained by the elephant as it moves up the hill at constant speed.

..... [1]

(b) The elephant has a mass of 3500 kg and the log has a mass of 180 kg.

(i) Calculate the combined weight of the elephant and the tree trunk.

The gravitational field strength, *g*, is 10 N / kg.

weight = ... N [2]

(ii) The volume of the elephant is $3.4\,m^3$.

Calculate the average density of the elephant.

density = ... kg / m^3 [2]

(c) A scientist takes some measurements of the elephant.
Table 6.1 shows the measurements taken.

Complete Table 6.1 with suitable units for these measurements.
One has been done for you.

Table 6.1

measurement	size	unit
area of one foot	0.13	
length of a tusk	0.75	
mass of elephant	3500	kg
body temperature	35.9	

[2]

[Total: 9]

7 **(a)** Table 7.1 shows the number of different types of teeth in sheep and humans.

Table 7.1

organism	number of each type of teeth				
	incisor	canine	pre-molar	molar	total
human	8	4	8	12	32
sheep	8	0	6	6	

(i) Calculate the total number of teeth for sheep.

..... [1]

(ii) Place ticks (✓) in **two** boxes to show which statements are correct for the data in Table 7.1.

Sheep have canine teeth. ☐

Sheep have the same number of pre-molar and molar teeth. ☐

A human has more incisor teeth than a sheep. ☐

A human has twice the number of molar teeth as a sheep. ☐

Humans have more incisor teeth than pre-molar teeth. ☐

[2]

(b) The boxes on the left contain the different types of teeth.

The boxes on the right contain the different functions of the types of teeth.

Draw **one** line from each type of tooth to its correct function.

Two types of teeth have the same function.

type of tooth	function
incisor	cut food
canine	grind food
pre-molar	pierce and tear food
molar	

[3]

(c) State the names of the **two** outermost layers of a tooth.

1 .....

2 .....

[2]

(d) Teeth are used for one type of digestion.

State the name of this type of digestion.

..... [1]

[Total: 9]

8 Petroleum is a raw material for the production of useful substances.

Fig. 8.1 shows three processes, **X**, **Y** and **Z**, used to make ethanol.

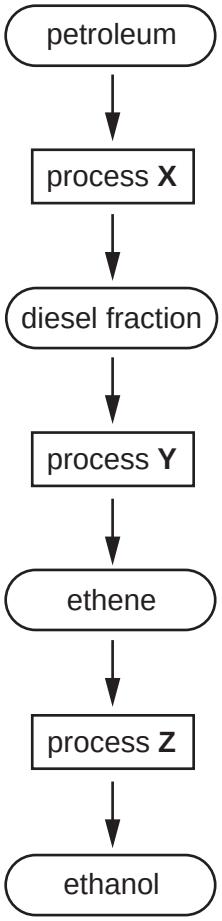

Fig. 8.1

(a) Identify process **X** and process **Y**.

process **X** .....

process **Y** .....
[2]

(b) State the substance added to ethene during process **Z** to make ethanol.

..... [1]

(c) Ethene is a hydrocarbon.

Explain why ethene is described as a hydrocarbon.

.....

..... [2]

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

1 .....

2 .....
[2]

(e) Complete Fig. 8.2 to show the structure of an ethanol molecule, C_2H_5OH. Include all the atoms and bonds.

Fig. 8.2

[2]

[Total: 9]

9 **(a)** Fig. 9.1 shows a rocket about to be launched.

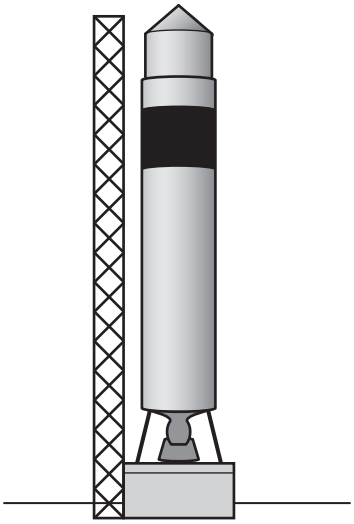

Fig. 9.1

(i) The weight of the rocket is 8 000 000 N.
When the rocket is launched, the upward force exerted by the rocket is 12 000 000 N.

Calculate the resultant upward force on the rocket.

resultant force = ... N [1]

(ii) Explain why the resultant force cannot be zero, when the rocket is launched.

.....

..... [1]

(iii) The rocket travels 385 000 km from the Earth to the Moon in 75 hours.

Calculate the average speed of the rocket in km / s.

speed = ... km / s [3]

(b) An astronaut on the rocket uses a telescope to view a star.

Fig. 9.2 shows a lens that is used in the telescope. Light rays from the star pass through the lens and are focused at the principal focus.

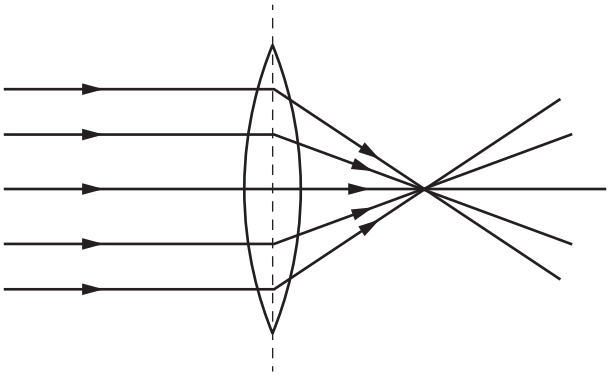

Fig. 9.2

(i) On Fig. 9.2, label the principal focus of the lens with the letter **F**. [1]

(ii) On Fig. 9.2, draw a double headed arrow (↔) to indicate the focal length of the lens. [1]

(iii) State the name of the process that occurs when light passes into the lens and the direction of the light changes.

..... [1]

(c) The astronaut communicates with Earth using radio waves.

(i) Place radio waves in the correct place in the incomplete electromagnetic spectrum shown in Fig. 9.3.

gamma radiation		ultraviolet		infrared		

Fig. 9.3 [1]

(ii) State which part of the electromagnetic spectrum has the greatest frequency.

..... [1]

(iii) Explain why it is **not** possible for the astronaut to use sound waves to communicate directly with Earth.

.....

..... [2]

[Total: 12]

10 **(a)** Fig. 10.1 is a diagram of an insect-pollinated flower.

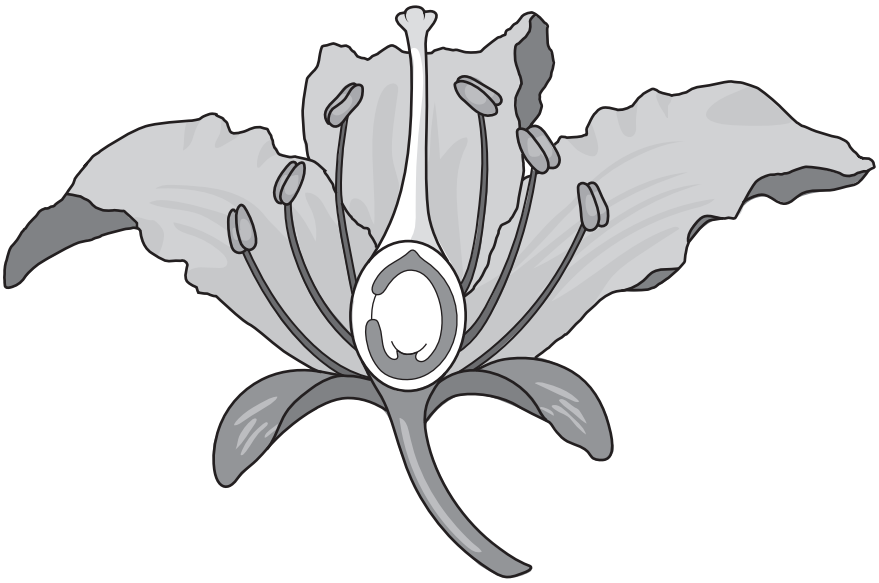

Fig. 10.1

(i) On Fig. 10.1:

- circle the part where pollination occurs,
- draw an **X** on the part where fertilisation occurs,
- identify one part that produces pollen with a label line and the correct name.

[4]

(ii) State the names of **two** parts of the carpel.

1 .....

2 .....

[2]

(iii) Describe the function of the petals.

.....

..... [1]

(b) The sentences describe fertilisation and early development in humans.

Circle the word in bold that makes each sentence correct.

Fertilisation occurs in the **ovary** / **oviduct** / **vagina**.

The nuclei of a sperm and egg fuse to form a **gamete** / **tissue** / **zygote**.

The fertilised cell divides into a ball of cells called an **embryo** / **organ** / **ovule**.

The ball of cells implants into the wall of the **cervix** / **uterus** / **vagina**.

[4]

[Total: 11]

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11 **(a)** Orange bromine gas, Br_2, is put into the bottom of a gas jar which is immediately sealed. After a short time, the bromine gas spreads out to fill the gas jar. This process is called diffusion.

Fig. 11.1 shows the diffusion of bromine.

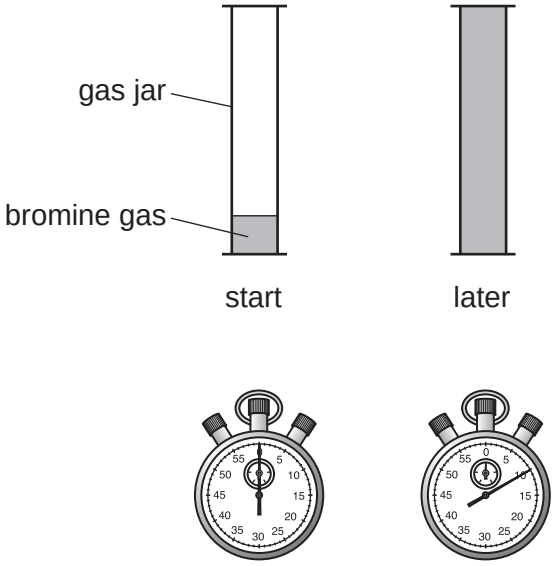


Fig. 11.1

Describe the process of diffusion in terms of the movement of particles.

.....

.....

..... [2]

(b) Chlorine and bromine are both halogens.

State the name of **one** other element that is a halogen.

..... [1]

(c) Chlorine is in Period 3 of the Periodic Table.

Describe the change in metallic character across Period 3.

.....

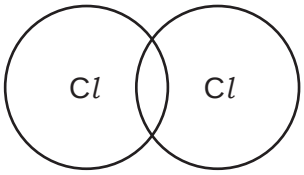
..... [1]

(d) Explain why the drinking water for a city is treated with chlorine.

.....

..... [1]

(e) Complete the dot-and-cross diagram to show the bonding in a molecule of chlorine Cl_2. Only show the outer shell electrons.



[2]

(f) Hydrogen and chlorine combine to make hydrogen chloride, HCl.

(i) Balance the symbol equation for this reaction.

$$H_2 + Cl_2 \rightarrow \text{.....} HCl$$

[1]

(ii) Explain why hydrogen chloride is a covalent compound and **not** an ionic compound.

.....

..... [1]

[Total: 9]

12 **(a)** An electric heater is used to heat a classroom in a school.

The arrows on Fig. 12.1 show the circulation of air around the classroom.
P and **Q** are two positions within the air circulation.

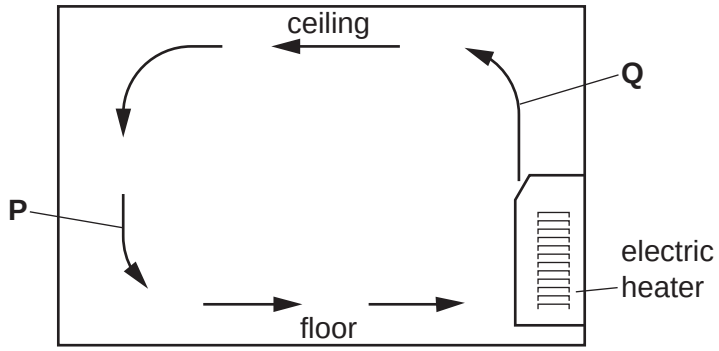


Fig. 12.1

Complete the sentences using words from the list.

conduction **convection** **cooled** **radiation** **warmed**

Position **P** shows ..... air.

Position **Q** shows ..... air.

This method of thermal energy transfer is called ..... .

[1]

(b) In the classroom, a student draws diagrams to represent the three states of matter.

Fig. 12.2 shows the diagrams drawn. Box **X** shows the arrangement of particles in a solid.
Box **Y** shows the arrangement of particles in a liquid.

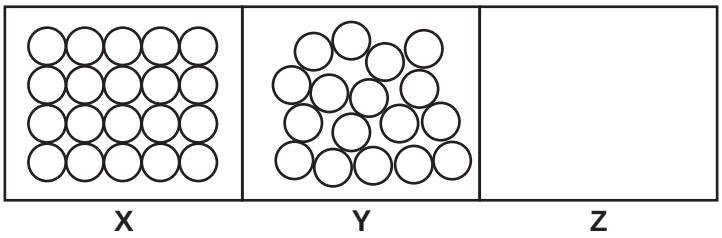


Fig. 12.2

(i) In box **Z**, draw the arrangement of particles in a gas. [1]

(ii) Complete the sentences below using only the words **solid**, **liquid** and **gas**.

Solidification occurs when a ..... turns into a ..... .

Condensation occurs when a ..... turns into a ..... .

[2]

(iii) State the melting point and the boiling point of water at standard atmospheric pressure.

melting point = ... °C

boiling point = ... °C

[1]

(c) In another lesson, the student builds an electric circuit.

Fig. 12.3 shows the circuit diagram.

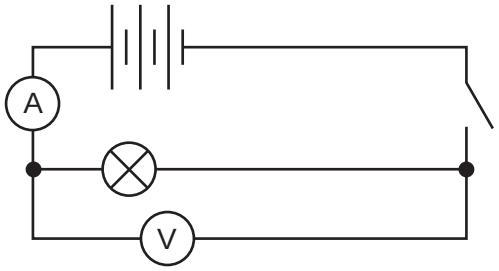


Fig. 12.3

(i) State the name of the components represented by the symbols in Table 12.1.

Table 12.1

symbol	component
	
	

[2]

(ii) When there is a potential difference of 6 V across the lamp, a current of 0.3 A passes through the lamp.

Calculate the resistance of the lamp.

resistance = ... Ω [2]

[Total: 9]

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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.).