



7.2.2 Changing State



43 minutes



56 marks

- Q1.** Air is a gas at room temperature. The chemical formulae below show some of the substances in the air.

Ar CO₂ H₂O N₂ Ne O₂

- (a) Put these formulae in the correct columns in table A to show which substances are elements and which are compounds.

table A

element	compound

1 mark

- (b) Put the formulae in the correct columns in table B to show whether the formula of each substance represents an atom or a molecule.

table B

atom	molecule

1 mark

- (c) The coldest possible temperature is 'absolute zero', which is -273°C . As air is cooled towards absolute zero it liquefies. Table C gives the boiling points of the substances in air.

table C

formula	boiling point in $^{\circ}\text{C}$
Ar	-186
CO_2	-78
H_2O	100
N_2	-196
Ne	-246
O_2	-183


A sample of air at a temperature close to absolute zero is allowed to warm up.
Which substance boils first?

.....

1 mark

- (d) Each particle of neon can be represented by a circle.

Carefully complete the diagrams below to show the arrangement of particles in neon gas and liquid neon.

Use circles about  in size.

neon gas, Ne

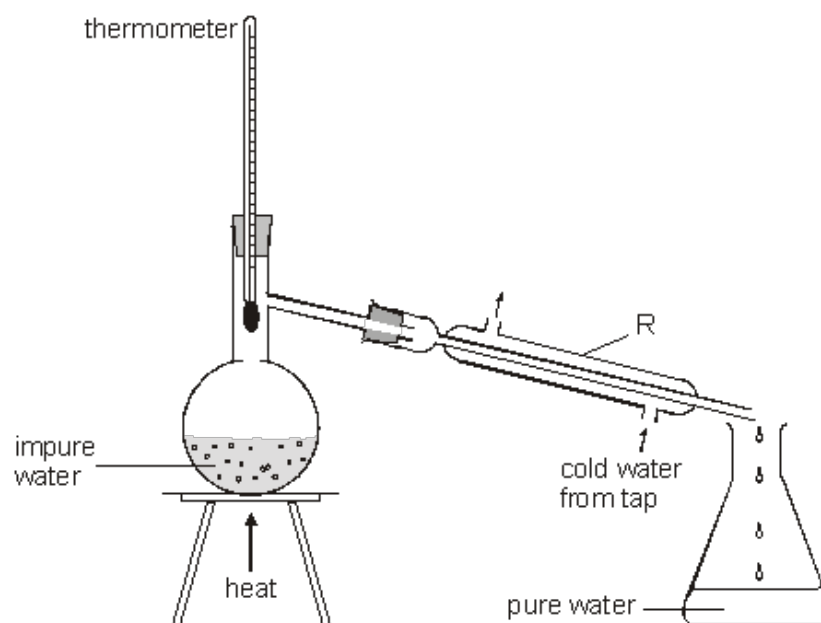


liquid neon, Ne



4 marks
Maximum 7 marks

- Q2.** (a) The apparatus in the diagram below is used to obtain pure water from impure water.



- (i) What temperature would the thermometer show?

..... °C

1 mark

- (ii) What is the function of the piece of apparatus labelled R?

.....
.....

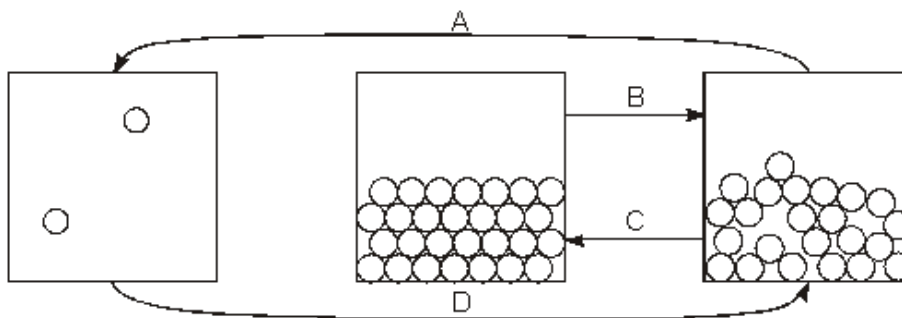
1 mark

- (iii) Give the name of the process which purifies water in this way.

.....

1 mark

- (b) The diagram below shows particles in a gas, a solid and a liquid. Each arrow, A, B, C and D, represents a change of state.



- (i) Choose from the following words to complete the sentences below.

boiling **condensing** **distilling** **evaporating**
filtering **freezing** **melting**

Change of state A is called

Change of state B is called

Change of state C is called

Change of state D is called

4 marks

- (ii) Look back to the apparatus in part (a).
 Give the letter, A, B, C or D, from the diagram above, for the change of state which occurs:

in the round-bottomed flask

in the piece of apparatus labelled R.

2 marks

Maximum 9 marks

##

The table shows the melting points and boiling points of four substances present in the air.

substance	melting point, in °C	boiling point, in °C
carbon dioxide	−78	−78
nitrogen	−210	−196
oxygen	−219	−183
water vapour	0	100

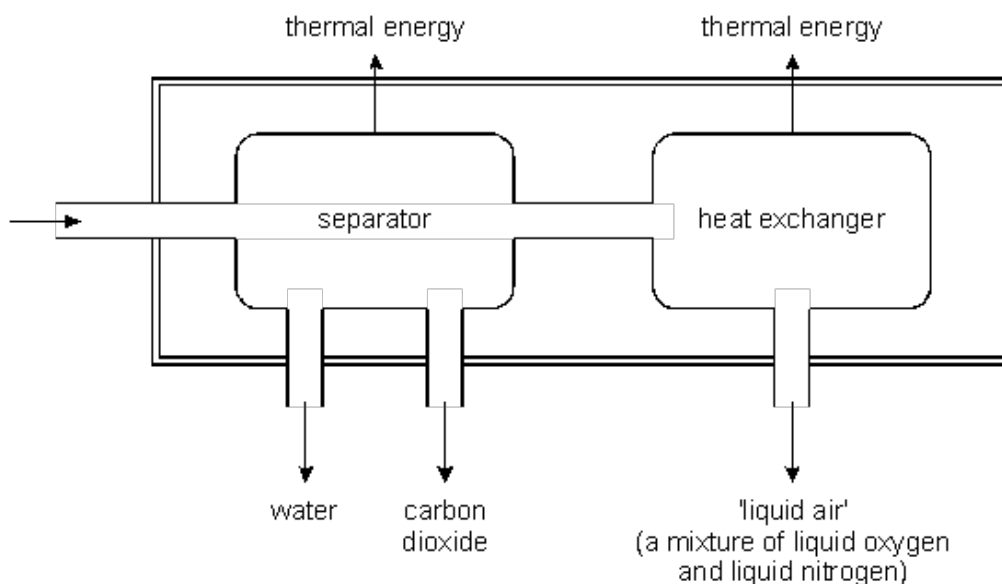
- (a) What happens to a piece of solid carbon dioxide if it is heated from −100°C to −78°C?

.....

.....

1 mark

- (b) 'Liquid air' can be formed from air in a heat exchanger. As the air passes through, thermal energy is transferred from the air to the surroundings. This is shown in the flow diagram below.



- (i) Suggest a likely temperature for the 'liquid air' that leaves the heat exchanger.

.....°C

1 mark

- (ii) Use the information in the table to explain why carbon dioxide and water vapour need to be removed from the air before it is pumped through pipes to the heat exchanger. State the consequences of **not** removing these two gases.

.....

2 marks

- (c) The 'liquid air' is a mixture of liquid nitrogen and liquid oxygen. Use the information in the table to suggest how liquid oxygen could be obtained from the mixture.

.....

1 mark

(d) A room measures 4 m x 3 m x 2.5 m.

- (i) The density of air is approximately 1.2 kg/m^3 .
What is the approximate mass of air in the room?
Give the unit.

.....
.....

2 marks

- (ii) If the air in the room is cooled to a low enough temperature, it will change from a gas to a liquid.
The density of 'liquid air' is 1125 kg/m^3 . What volume of 'liquid air' would the air in the room produce? Give the unit.

.....
.....

1 mark

- (iii) How does the distance between the particles in atmospheric air compare to the size of the particles themselves?

.....
.....

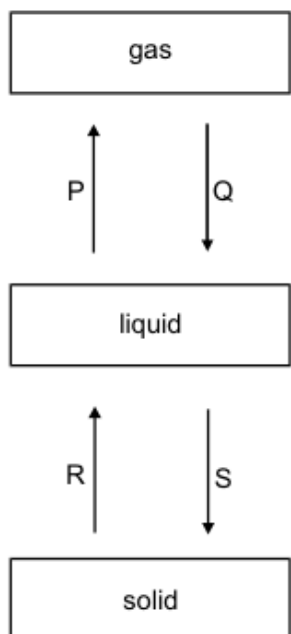
1 mark

Maximum 9 marks

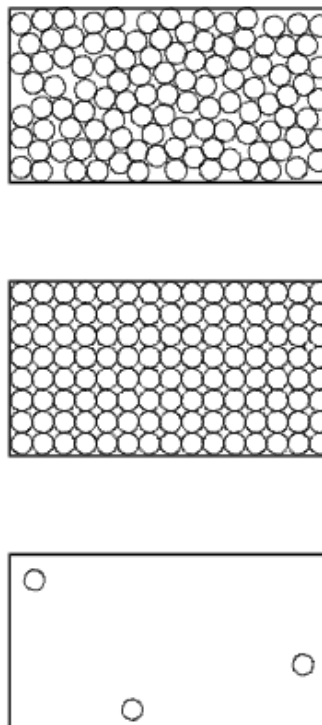
- Q4.** (a) Methane can be a gas, a liquid or a solid. In the diagram below, arrows P, Q, R and S represent changes of state.

The boxes on the right show the arrangement of particles of methane in the three different physical states.
Each circle represents a particle of methane.

physical state of methane



arrangement of particles



- (i) Draw a line from each physical state of methane to the arrangement of particles in that physical state.
Draw only **three** lines.

1 mark

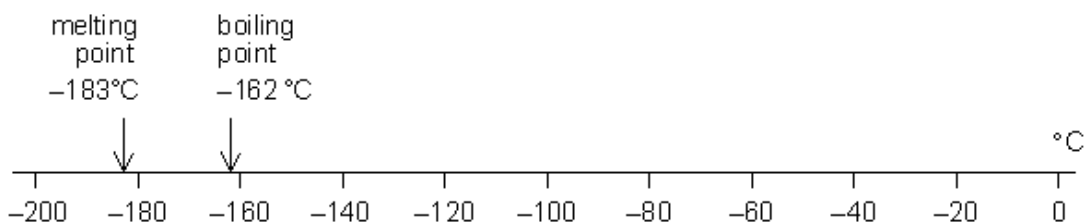
- (ii) Arrows P, Q, R and S represent changes of state.
Which arrow represents:

evaporation?

melting?

2 marks

- (b) Methane is the main compound in natural gas. The scale below shows the melting point and the boiling point of methane.



Methane has three physical states: solid, liquid and gas.

- (i) What is the physical state of methane at -170°C ?

.....

1 mark

- (ii) The formula of methane is CH_4 . The symbols for the two elements in methane are C and H.

Give the names of these two elements.

element C

element H

2 marks

- (iii) When methane burns, it reacts with oxygen.
One of the products is water, H_2O .

Give the name of the other product.

.....

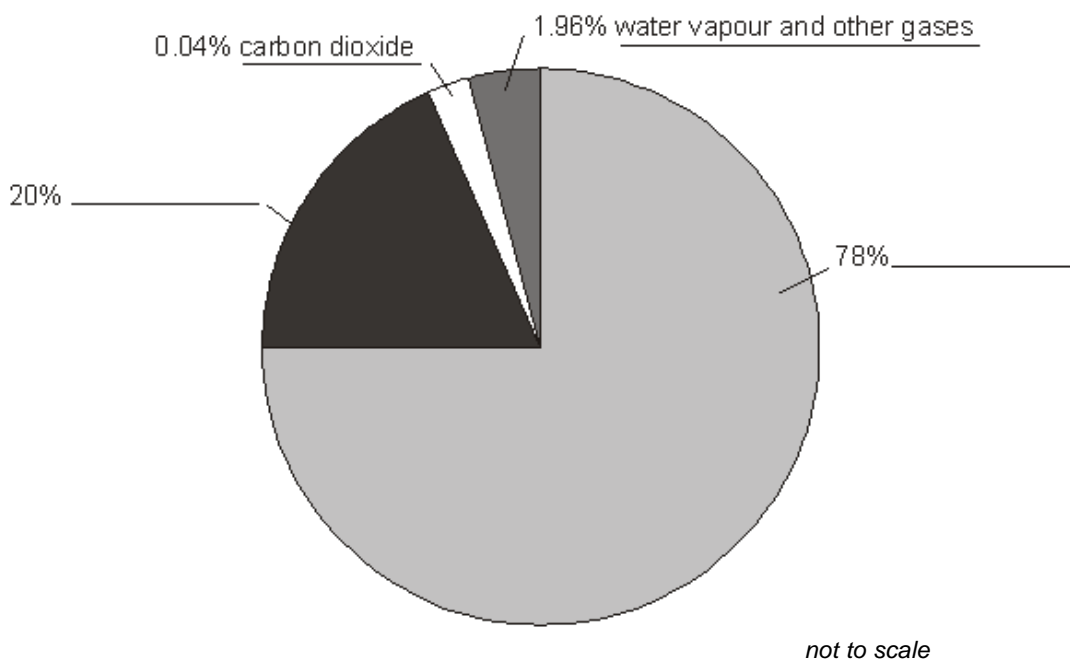
1 mark

Maximum 7 marks

Q5.

- (a) Air is a mixture of gases. The pie chart represents the percentages of different gases in air.

On the line by each section of the pie chart, write the name of the correct gas.
Two have been done for you.



2 marks

- (b) On a cold day, droplets of water form on a cold window.

Explain how these droplets form.

.....

.....

.....

2 marks

- (c) The word equation below represents a process taking place in the cells of the human body.

glucose + oxygen → carbon dioxide + water

- (i) What process does this word equation represent?

.....

1 mark

- (ii) As a result of this process, the proportions of oxygen and carbon dioxide in air breathed in and air breathed out change.

Which **one** of the statements below is true?

Tick the correct box.

Air breathed out has less carbon dioxide
and more oxygen than air breathed in.

☐

Air breathed out has less carbon dioxide
and less oxygen than air breathed in.

☐

Air breathed out has more carbon dioxide
and less oxygen than air breathed in.

☐

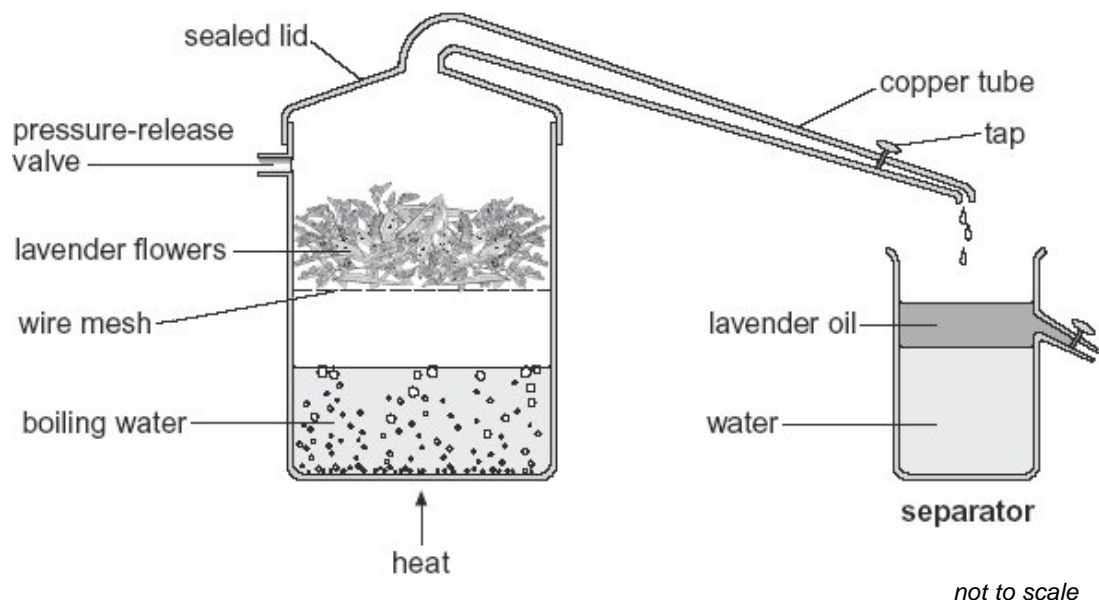
Air breathed out has more carbon dioxide
and more oxygen than air breathed in.

☐

1 mark
maximum 6 marks

##

Lavender oil is a perfume obtained from lavender flowers.
Steam at 100°C is passed through the flowers in the apparatus below.



Water vapour and lavender oil vapour pass down a copper tube towards a separator.

- (a) (i) The lavender flowers are heated in a container with a sealed lid.

Why must the lid be sealed?

.....
.....

1 mark

- (ii) What would happen if the container did **not** have a pressure-release valve?

.....
.....

1 mark

- (b) Lavender oil vapour and water vapour cool as they pass down the copper tube.
A mixture of lavender oil and water collects in the separator.

- (i) What is the change in the physical state of both lavender oil vapour and water vapour as they cool?

from to

1 mark

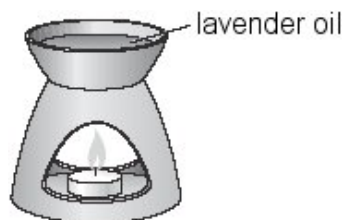
- (ii) Look at the separator.

How does this show that the water is denser than lavender oil?

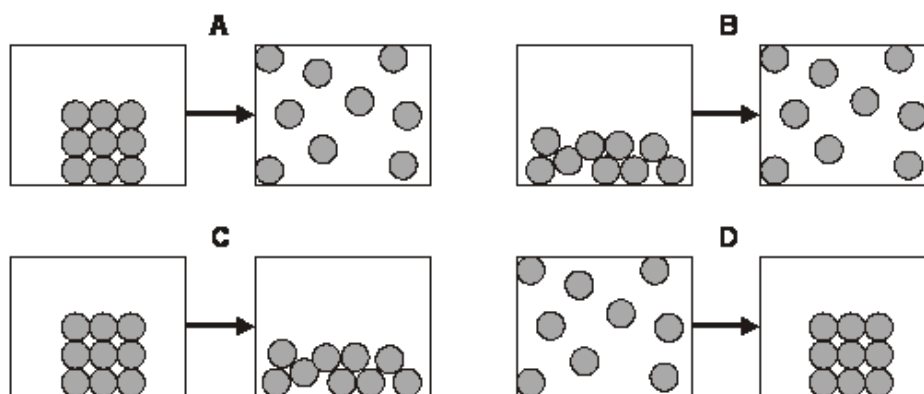
.....
.....

1 mark

- (c) Rosie poured some lavender oil into an oil burner. She heated it with a candle.



The oil changed state.



Which diagram represents this change of state?
Write the letter.

.....

1 mark
maximum 5 marks

- Q7.** Stefan is on holiday in the mountains. It is snowing.



- (a) (i) Choose words from the box to complete the sentence below.

solid	liquid	gas
--------------	---------------	------------

A snowflake falls on Stefan's nose and melts.
When the snowflake melts, it changes

from a to a

1 mark

- (ii) Snow that falls on the ground melts slowly.
Snow that falls on Stefan's nose melts **very quickly**.
Give a reason for this.

.....

1 mark

- (iii) In his hotel, Stefan sees some changes.
Are the changes below reversible?
Write **yes** or **no**.

ice melting

wood burning

toasting bread

1 mark

- (b) (i) Stefan is snowboarding. Gravity acts on Stefan.
On the diagram below, draw an arrow to show the direction of the force of gravity.



1 mark

- (ii) When Stefan wants to slow down, he pushes one edge of the snowboard into the snow.

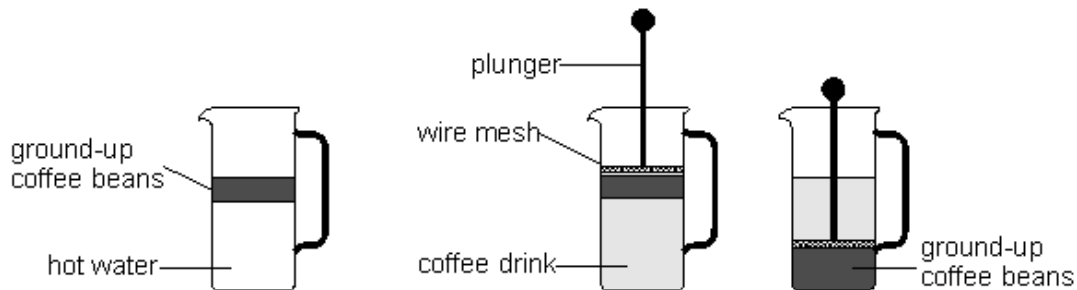


What force between the board and the snow makes him slow down?

.....

1 mark
maximum 5 marks

- Q8.** Russell put ground-up coffee beans in a coffee maker and added hot water.



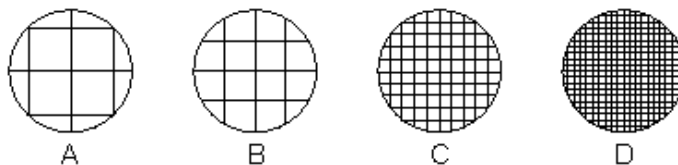
He pushed the plunger down.
This separated the coffee drink from the ground-up coffee beans.

- (a) How could Russell see that some coffee had dissolved in the water?

.....

1 mark

- (b) The end of the plunger is a circle of wire mesh.

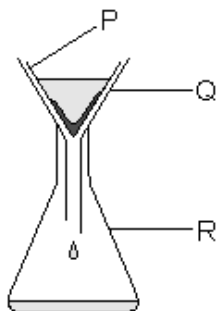


- (i) Which mesh would be best to separate the coffee drink from all the ground-up coffee beans? Write the letter.

.....

1 mark

- (ii) This method of making coffee uses a type of filter.
The apparatus used for filtration in a school laboratory is drawn below.

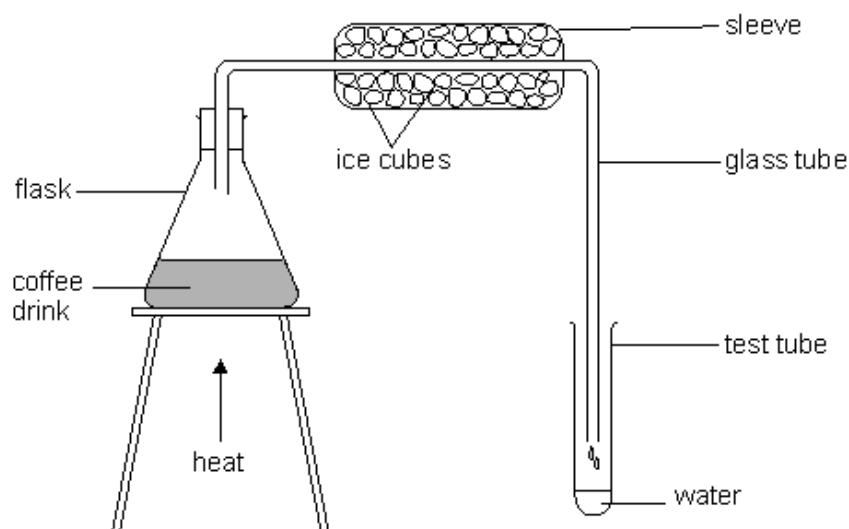


Which part of the apparatus above works in the same way as the wire mesh? Write the letter.

.....

1 mark

- (c) Russell wanted to separate the water from the coffee drink.
He set up the apparatus shown below.



- (i) Why did Russell put ice cubes around the glass tube?

.....

1 mark

- (ii) Choose words from the box below to fill the gaps in the following sentences.

an acid	a gas	a liquid	a solid
condensation	crystallisation	evaporation	filtration

Russell heats the water. Water in the drink changes from

..... into

This change of state is called

Water vapour changes into liquid. This change of state is called

.....

4 marks
maximum 8 marks

