1 Describe the separation, arrangement and motion of particles of an elementin the solid state.

separation .....

arrangement .....

motion ..... [3]

[Total: 3]

2 Ammonia gas is prepared at the front of a laboratory.

The pungent smell of ammonia spreads throughout the laboratory slowly.

(a) Name the process that occurs when ammonia gas spreads throughout the laboratory.

..... [1]

(b) Explain, using ideas about particles, why ammonia gas spreads throughout the laboratory.

.....

.....

.....

..... [2]

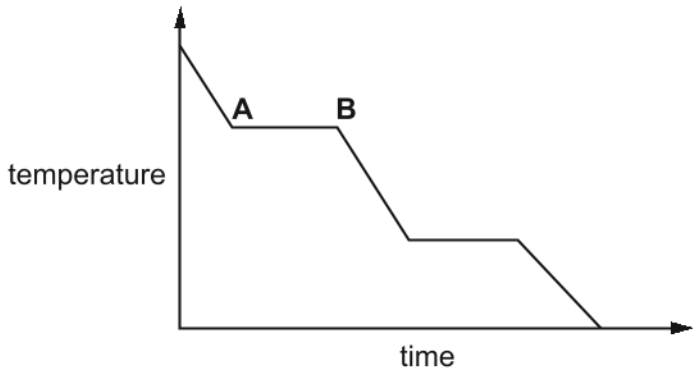
(c) Explain why carbon dioxide gas, CO_2, will spread throughout the laboratory at a slower rate than ammonia gas, NH_3.

.....

..... [1]

[Total: 4]

3 The graph shows the change in temperature as a sample of a gas is cooled.



Name the change of state taking place between **A** and **B**.

..... [1]

[Total: 1]

4 Complete the table about solids, liquids and gases.

	particle separation	particle arrangement	type of motion
solid		regular	vibrate only
liquid	touching		random
gas	apart	random	

[3]

[Total: 3]

5 A bottle of liquid perfume is left open at the front of a room.

After some time, the perfume is smelt at the back of the room.

Name the **two** physical processes taking place.

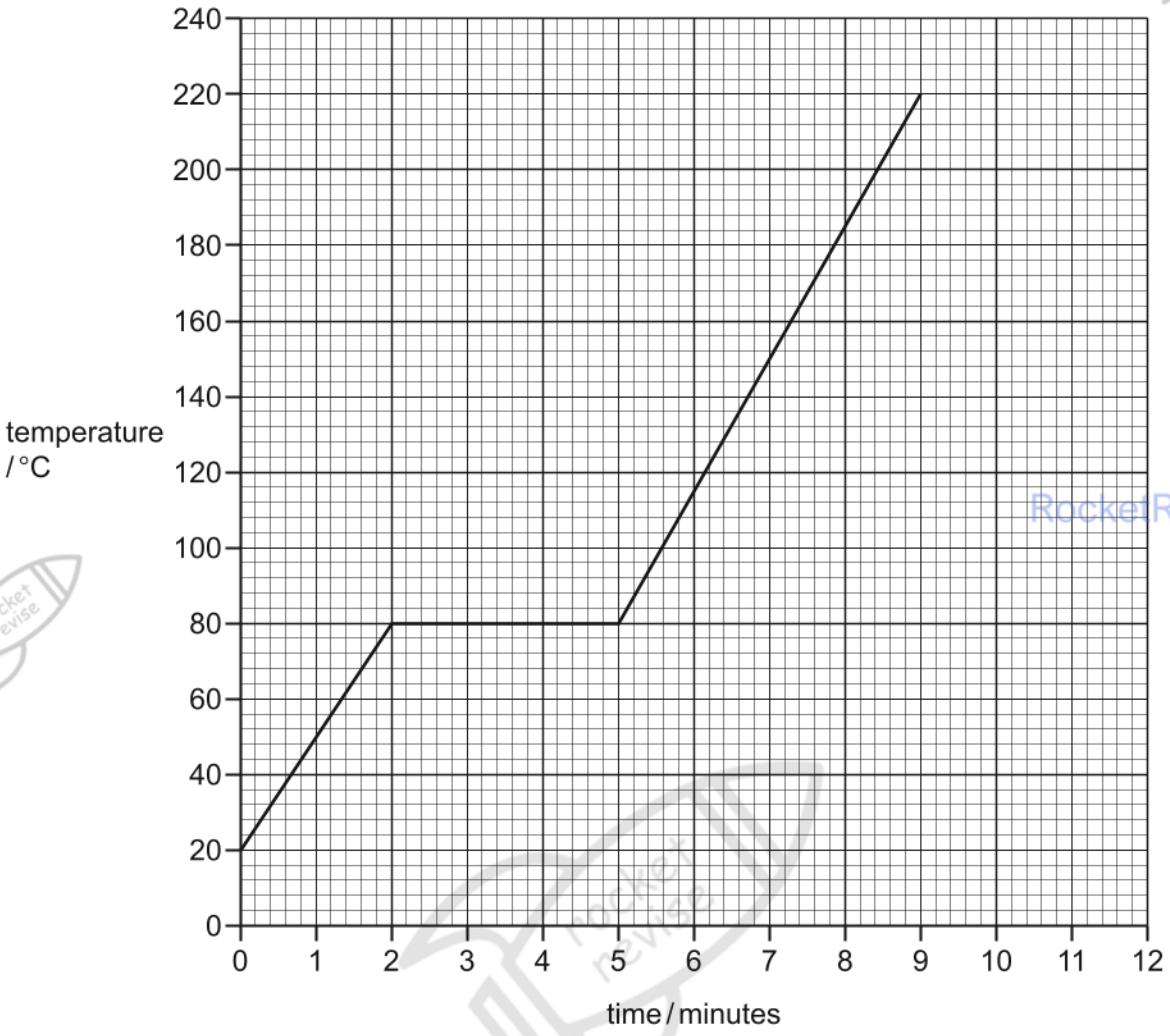
1 .....

2 ..... [2]

[Total: 2]

6 **Z** is a covalent substance. In an experiment, a sample of pure solid **Z** was continually heated for 11 minutes.

The graph shows how the temperature of the sample of pure **Z** changed during the first 9 minutes.



(a) What is the melting point of pure **Z**?

..... °C [1]

(b) The sample of pure **Z** began to boil at 9 minutes. It was boiled for 2 minutes.

Use this information to sketch on the grid how the temperature of the sample of pure **Z** changed between 9 minutes and 11 minutes. [1]

(c) The sample of pure **Z** was continually heated between 2 minutes and 5 minutes.

Explain, in terms of attractive forces, why there was no increase in the temperature of the sample of pure **Z** between 2 minutes and 5 minutes.

.....

.....

..... [2]

(d) Describe how the motion of particles of pure **Z** changed from 0 minutes to 2 minutes.

.....

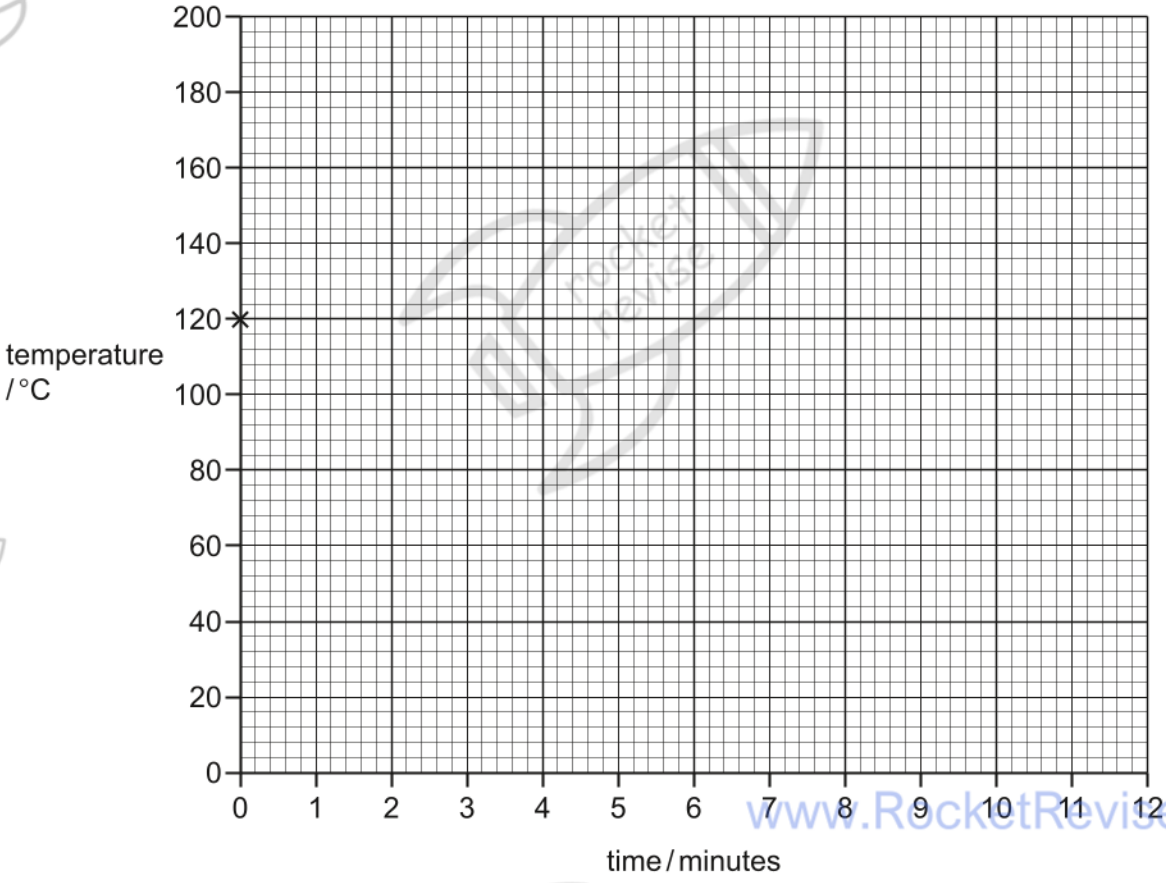
..... [2]

[Total: 6]

7 **Z** is a covalent substance. A sample of pure **Z** was allowed to cool from 120 °C to 20 °C. The total time taken was 8 minutes.

The boiling point of pure **Z** is 220 °C and the melting point of pure **Z** is 80 °C.

Starting from point **x**, sketch on the grid how the temperature of the sample of pure **Z** changed between 0 minutes and 8 minutes.



[2]

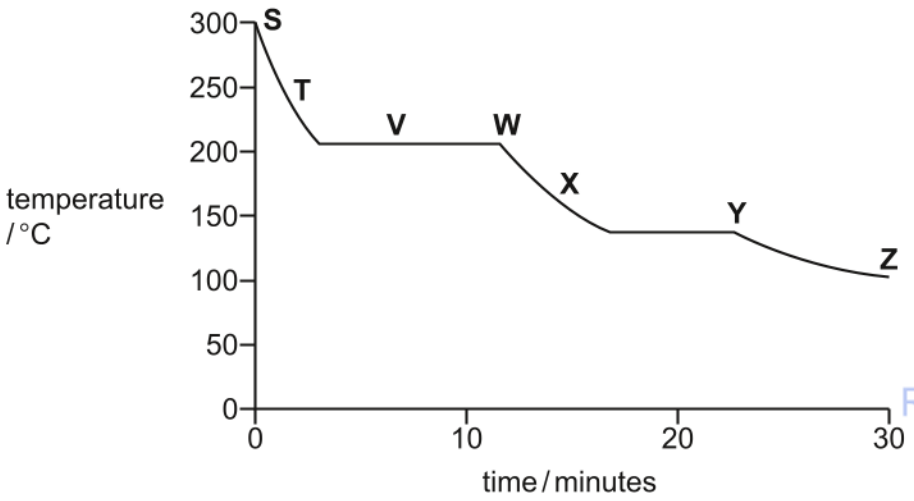
[Total: 2]

8 Name the change of state directly from a solid to a gas.

..... [1]

[Total: 1]

9 The graph shows how the temperature of a substance changes as it is cooled over a period of 30 minutes. The substance is a gas at the start.



Each letter on the graph may be used once, more than once or not at all.

(a) Which letter, **S**, **T**, **V**, **W**, **X**, **Y** or **Z**, shows when

(i) the particles in the substance have the most kinetic energy,

..... [1]

(ii) the particles in the substance are furthest apart,

..... [1]

(iii) the substance exists as both a gas and a liquid?

..... [1]

(b) Use the graph to estimate the freezing point of the substance.

..... °C [1]

[Total: 4]

10 When smoke is viewed through a microscope, the smoke particles in the air appear to jump around.

(a) What term describes this movement of the smoke particles?

..... [1]

(b) Explain why the smoke particles move in this way.

.....

.....

..... [2]

[Total: 3]

11 Dust particles in the air move around in a random way.

(a) What term describes the random movement of the dust particles?

..... [1]

(b) Identify the particles in the air which cause the random movement of the dust particles.

..... [2]

(c) Explain why the dust particles move in this way.

.....

.....

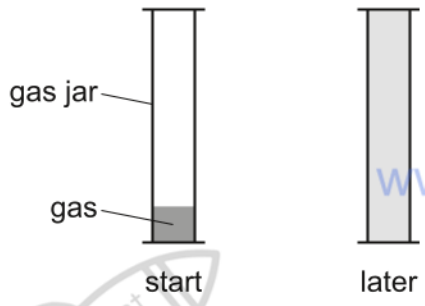
..... [2]

[Total: 5]

12 When chlorine gas, Cl_2, is put into a gas jar, it spreads out to fill the gas jar.

When bromine gas, Br_2, is put into a gas jar, it also spreads out to fill the gas jar.

The process takes longer for bromine gas than for chlorine gas.



(a) What term describes the way that the gas particles spread out?

..... [1]

(b) Use **data** from the Periodic Table to explain why bromine gas takes longer to fill a gas jar than chlorine gas.

.....

.....

..... [2]

(c) Explain why increasing the temperature increases the rate at which the gas particles spread out.

.....

..... [1]

[Total: 4]

13 Use ideas about the movement and arrangement of particles to explain why:

- solids have a definite volume and shape,
- liquids have a definite volume but no definite shape,
- gases have no definite volume or shape.

.....

.....

.....

.....

.....

..... [4]

[Total: 4]

14 Gallium and aluminium are in Group III of the Periodic Table.

The melting point of gallium is 30 °C.
Use the kinetic particle theory to explain what happens when a spoon made of gallium is put into a cup of tea at 40 °C.

In your answer, refer to:

- the change of state which occurs,
- the change in the arrangement of the particles,
- the change in the motion of the particles.

.....

.....

.....

.....

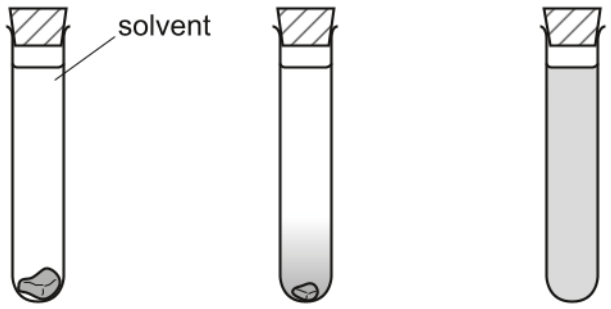
.....

.....

[4]

[Total: 4]

15 A student placed a crystal of iodine in a test tube of solvent.
After two minutes, a dense violet colour was observed at the bottom of the test-tube. After three hours, the violet colour had spread throughout the solvent.



at the start | after 2 minutes | after 3 hours

Use the kinetic particle theory to explain these observations.

In your answer, refer to:
- the arrangement and motion of the molecules in the iodine crystal,
- the arrangement and motion of the molecules in the solution,
- the names of the processes which are occurring.

.....

.....

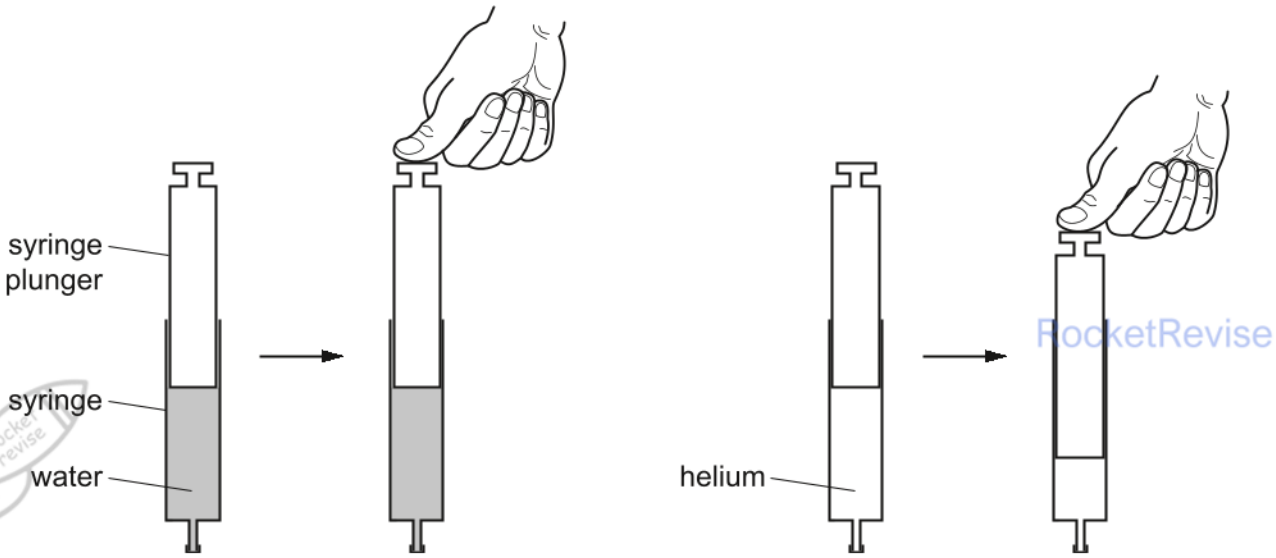
.....

.....

..... [4]

[Total: 4]

16 A student took two identical syringes.
He filled one with water and the other with helium gas and sealed the end of both syringes. He then pushed the syringe plungers with equal force.
The diagram shows what happened.



Describe and explain these results using ideas about particles in liquids and gases.

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 4]

17 The table shows some properties of the Group 0 elements helium, neon, argon and krypton.

element	electron arrangement	density of the liquefied gas in g / cm^3	melting point / °C	boiling point / °C
helium	2	0.15	−272	−269
neon		1.20	−248	−245
argon	2,8,8	1.40	−189	−186
krypton	2,8,18,8	2.15	−157	−152

Which element in the table has the highest melting point?

..... [1]

[Total: 1]

18 The table shows some properties of the Group 0 elements helium, neon, argon and krypton.

element	electron arrangement	density of the liquefied gas in g / cm^3	melting point / °C	boiling point / °C
helium	2	0.15	−272	−269
neon		1.20	−248	−245
argon	2,8,8	1.40	−189	−186
krypton	2,8,18,8	2.15	−157	−152

What is the state of argon at −188 °C?

..... [1]

[Total: 1]

19 A teacher placed some highly-scented flowers at the front of the class.
At first, the students at the back of the class could not smell the scent. After two minutes they could smell the scent.

Use the kinetic particle theory to explain these observations.

.....

.....

.....

.....

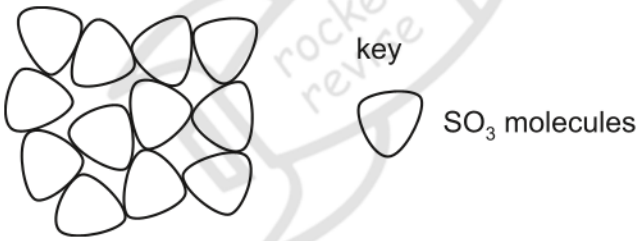
..... [3]

[Total: 3]

20 Copper(II) sulfate is heated strongly. The products are copper(II) oxide and sulfur trioxide.

$$CuSO_4 \xrightarrow{heat} CuO + SO_3$$

The diagram below shows the arrangement of sulfur trioxide molecules at 30 °C.



What is the state of sulfur trioxide at 30 °C?
Use the information in the diagram to explain your answer.

.....

.....

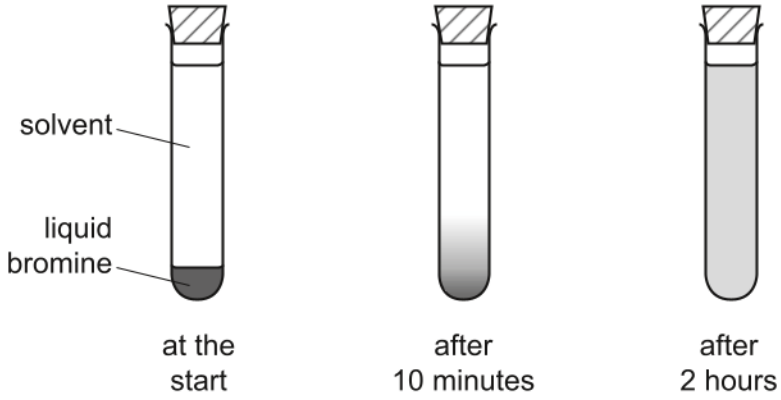
..... [3]

[Total: 3]

21 A teacher placed a few drops of liquid bromine in the bottom of a test-tube containing a solvent.

After 10 minutes, the brown colour of the bromine had spread a little way through the solvent.

After 2 hours, the brown colour had spread throughout the solvent.



Use the kinetic particle theory to explain these observations.

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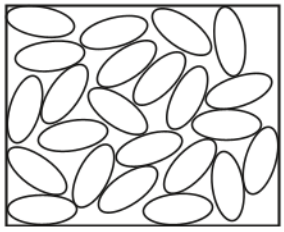
.....

.....

..... [3]

[Total: 3]

22 The diagram shows the arrangement of carbon dioxide molecules at –25 °C and 100 atmospheres pressure.



represents a molecule of carbon dioxide

What is the state of carbon dioxide under these conditions?

Use the kinetic particle theory and the information in the diagram to explain your answer.

.....

.....

..... [3]

[Total: 3]

23 A crystal of sulfur melts when heated.

Explain, using the kinetic particle theory, the differences between the arrangement and motion of the particles in sulfur crystals and liquid sulfur.

.....

.....

.....

.....

..... [4]

[Total: 4]

24 Mercury is a liquid at room temperature. When heated, it changes to mercury vapour.

Explain, using the kinetic particle theory, the differences in the arrangement and motion of the particles in liquid mercury and mercury vapour.

.....

.....

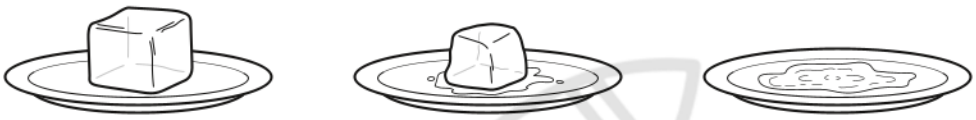
.....

.....

..... [4]

[Total: 4]

25 A student left a cube of ice on a plate in a warm room. The diagrams below show what happened to the ice.



at the start | after 10 minutes | after 30 minutes

Describe and explain what happened to the ice. In your answer,

- describe and explain the change of state which occurs,
- explain this change using the kinetic particle theory.

.....

.....

.....

.....

.....

..... [5]

[Total: 5]

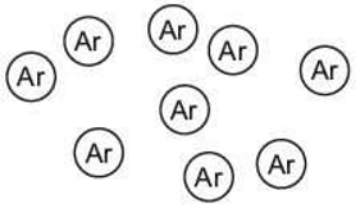
26 When sulfur vapour touches a cold surface it changes directly to a solid.

What is the name given to this change of state?

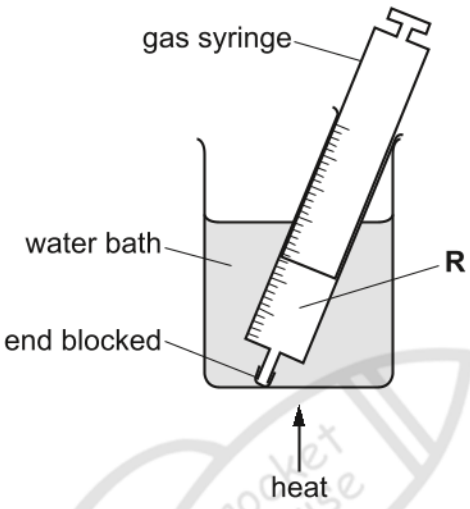
..... [1]

[Total: 1]

27 A closed gas syringe contains substance **R**. The syringe is heated in a water bath.



R



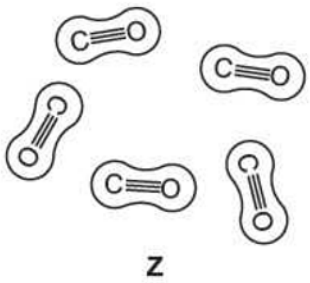
Describe what happens to the volume of substance **R** in the syringe. The pressure remains constant. Explain your answer in terms of particles.

.....

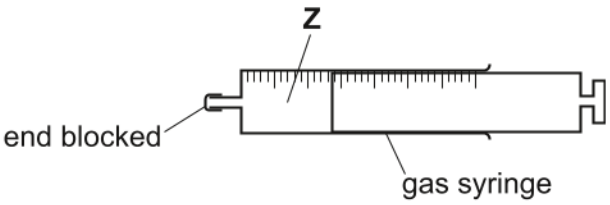
..... [2]

[Total: 2]

28 A closed gas syringe contains substance **Z**.



Z



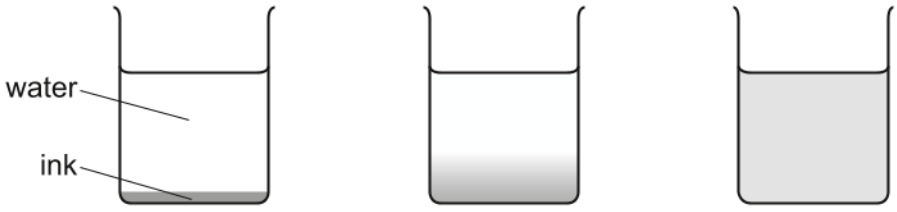
Describe what happens to the volume of substance **Z** in the syringe when the temperature is increased. The pressure remains constant.
Explain your answer in terms of particles.

.....

..... [2]

[Total: 2]

29 Blue ink was placed at the bottom of a beaker containing water.
After 2 days, a blue colour had spread throughout the beaker.



Explain these observations using the kinetic particle model.

.....

.....

.....

.....

..... [3]

[Total: 3]

30 Substances can change state.

(a) Boiling and evaporation are two ways in which a liquid changes into a gas.

Describe **two** differences between boiling and evaporation.

1 .....

2 ..... [2]

(b) Name the change of state when:

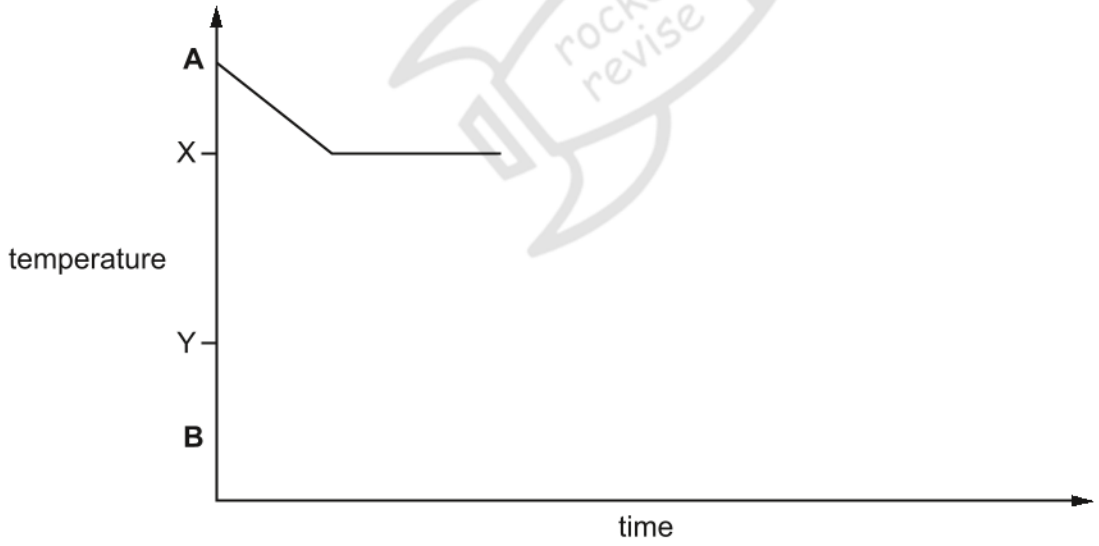
a gas becomes a liquid .....

a solid becomes a gas. ..... [2]

[Total: 4]

31 A substance boils at temperature X and melts at temperature Y.

Complete the graph to show the change in temperature over time as the substance cools from temperature **A** to temperature **B**.

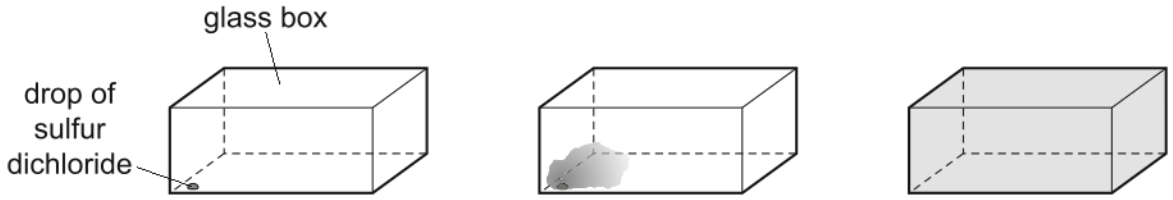


[2]

[Total: 2]

32 Sulfur dichloride, SCl_2, is a red liquid which vaporises easily at room temperature and pressure.

A drop of sulfur dichloride was placed in the corner of a glass box.
The glass box was closed and left for 12 hours.
After 12 hours a red vapour had spread to fill the whole box.



Explain these observations using the kinetic particle model.

.....

.....

.....

.....

..... [3]

[Total: 3]

33 This question is about states of matter.

Complete the table, using ticks (✓) and crosses (✗), to describe the properties of gases, liquids and solids.

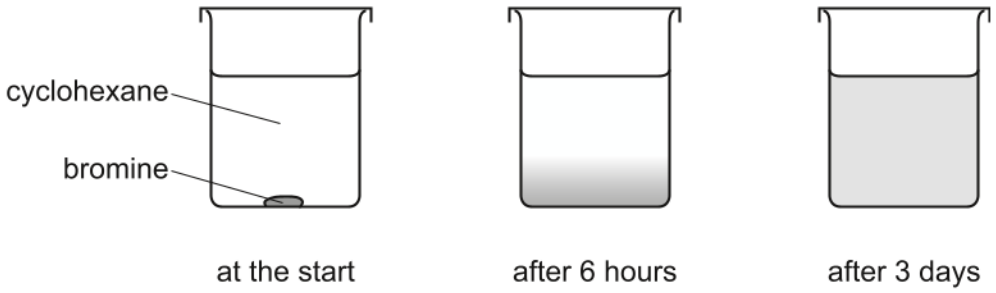
state of matter	particles are touching	particles have random movement	particles are regularly arranged
gas			
liquid			
solid			

[3]

[Total: 3]

34 Bromine is a red-brown liquid which is soluble in cyclohexane.

A few drops of liquid bromine were placed at the bottom of a beaker containing cyclohexane. After 3 days, a red-brown colour had spread throughout the beaker.



Explain these observations using the kinetic particle model.

.....

.....

.....

.....

..... [3]

[Total: 3]

35 Ammonia reacts with chlorine.

(a) Complete the equation for this reaction.

$$.....NH_3 \ + \ .....Cl_2 \ \rightarrow \ N_2 \ + \ 6HCl$$

[2]

(b) A small beaker of aqueous ammonia is placed at the front of a classroom.

At first, the students at the back of the class do not smell the ammonia gas.
After a short time, the students at the back of the class smell the ammonia.

Explain these observations using the kinetic particle model.

.....

.....

.....

.....

..... [3]

[Total: 5]

36 Zinc is manufactured from zinc blende. Zinc blende is an ore which consists mainly of zinc sulfide, ZnS.

(a) Zinc blende is roasted in air. One of the products is zinc oxide.

Name the **other** product formed in this reaction.

..... [1]

(b) Zinc oxide is then converted into zinc.

Zinc oxide and coke, a source of carbon, are heated in a furnace. Hot air is blown into the furnace.

(i) Give **two** reasons why coke is needed.

1 .....

2 ..... [2]

(ii) Write a chemical equation for the formation of zinc in the furnace.

..... [1]

(iii) Zinc has a melting point of 420 °C and a boiling point of 907 °C. The temperature inside the furnace is 1200 °C.

Explain how this information shows that the zinc produced inside the furnace is a gas.

..... [1]

(iv) The gaseous zinc is converted to molten zin.

Name this change of state.

..... [1]

[Total: 6]

37 Zinc is extracted from zinc blende.

When zinc is extracted, it is formed as a gas.

The gaseous zinc is then converted into molten zinc.

State the name of this physical change.

..... [1]

[Total: 1]

38 Graphite is a solid.

Describe the arrangement and motion of the particles in a solid.

arrangement .....

.....

motion .....

..... [2]

[Total: 2]

39 Hydrogen chloride is an acidic gas produced when concentrated hydrochloric acid evaporates.

(a) Describe the arrangement and separation of the molecules in hydrogen chloride gas.

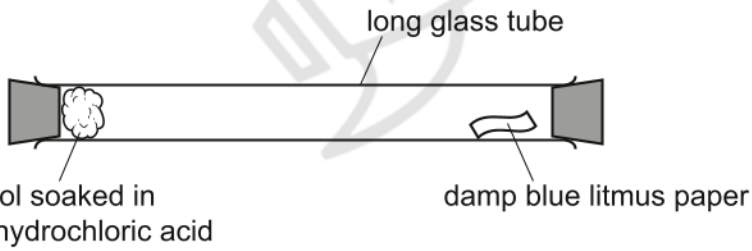
arrangement .....

.....

separation .....

..... [2]

(b) A long glass tube is set up as shown.



At first, the blue litmus paper does not turn red.
After a short time, the litmus paper turns red.

Explain these observations using the kinetic particle model.

.....

.....

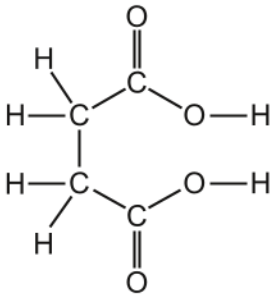
.....

.....

..... [3]

[Total: 5]

40 The structure of succinic acid is shown.



(a) **(i)** On the structure draw a circle around one carboxylic acid functional group.

[1]

(ii) Deduce the formula of succinic acid to show the number of carbon, hydrogen and oxygen atoms.

..... [1]

(b) When succinic acid is heated it undergoes sublimation.

State the meaning of the term *sublimation*.

.....

..... [1]

(c) Succinic acid is heated with compound **F**.

Compound **F** has the formula $HOCH_2CH_2OH$.

(i) State the name of the –OH functional group in compound **F**.

..... [1]

(ii) A polymer is formed when succinic acid is heated with compound **F**.

Choose **one** word from the list that best describes the small molecules that react together to form a polymer.

Draw a circle around the correct answer.

bases **ceramics** **monomers** **plastics**

[1]

[Total: 5]