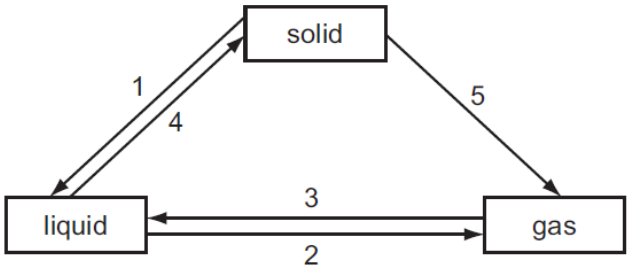
Kinetic Particle Theory (5070 Multiple Choice Questions)

1 The diagram shows some of the changes of state.



Which statement is correct?

A Although the change is not shown on the diagram, a gas can change directly to a solid.

B The changes 1 and 3 involve particles moving closer together.

C The changes 2 and 4 involve particles moving further apart.

D The changes 3, 4 and 5 all involve the release of energy.

5070_s12_qp12

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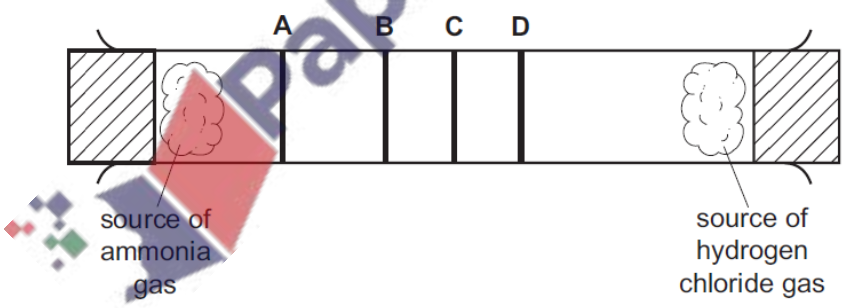
12 The diagram shows an apparatus used to compare rates of diffusion.

At which labelled position did a white deposit of ammonium chloride form?



5070_s12_qp11

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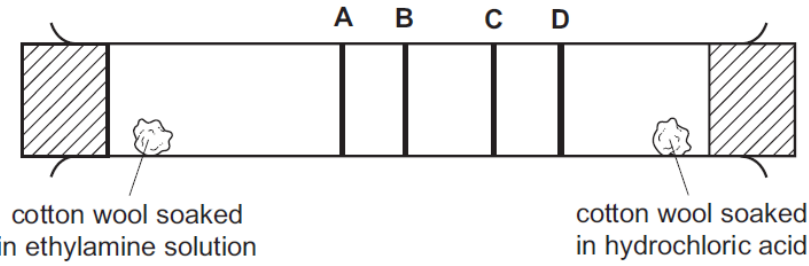
3 Ethylamine gas, $C_2H_5NH_2$, and hydrogen chloride gas, HCl, react together to form a white solid, ethylamine hydrochloride.

At which position in the tube would a ring of solid white ethylamine hydrochloride form?



5070_s14_qp11

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1 When drops of bromine are placed on a table-top at one side of a room, the smell of bromine can eventually be detected at the other side of the room.

What is **not** part of the explanation of this?

After evaporation, the bromine particles

A collide with air particles.

B move in a random way.

C spread out to occupy the total available space.

D vibrate from side to side.

5070_w13_qp12

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1 Which process provides the best evidence for the particle theory of matter?

A dehydration

B diffusion

C filtration

D neutralisation

5070_w13_qp11

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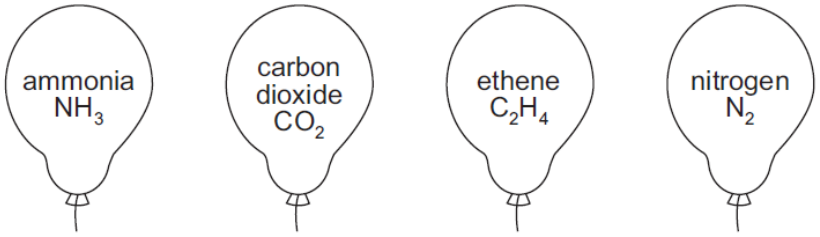
2 Four identical balloons are filled with different gases all at the same temperature and pressure.



The gases gradually diffuse out of the balloons.

Which pair of balloons will deflate at the same rate?

A P and Q **B** Q and R **C** R and S **D** S and P

5070_w12_qp12

4 Which statement explains why the gases propane, C_3H_8, and carbon dioxide, CO_2, diffuse at the same rate at room temperature and pressure?

A Both are denser than air.

B Both compounds contain carbon.

C Both molecules contain covalent bonds.

D They have the same relative molecular mass, M_r.

5070_w12_qp11

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2 A drop of liquid bromine is placed in the bottom of a gas jar. Brown fumes of bromine vapour slowly spread through the covered gas jar.

Why does this happen?

A Bromine vapour is less dense than air.

B Bromine molecules and the molecules in air are always moving around.

C Bromine molecules are smaller than the molecules in air.

D Bromine molecules move faster than the molecules in air.

5070_s11_qp11

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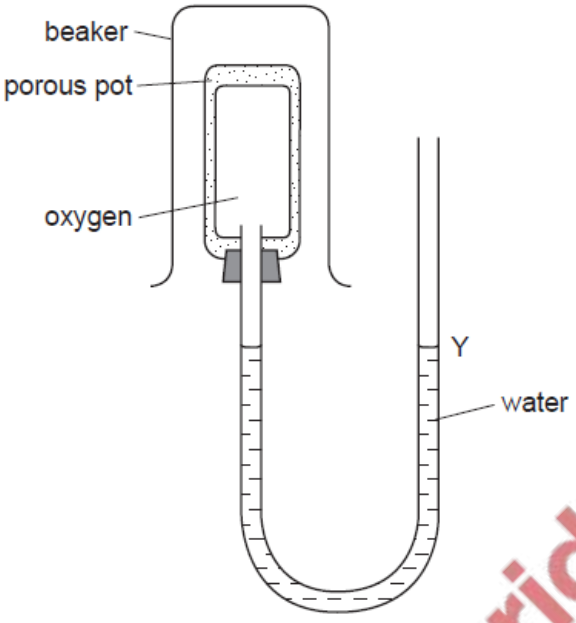
2 The diagram shows a diffusion experiment.



Which gas, when present in the beaker over the porous pot, will cause the water level at Y to rise?

A carbon dioxide, CO_2

B chlorine, Cl_2

C methane, CH_4

D nitrogen dioxide, NO_2

5070_w10_qp11

4 The boiling points of various gases found in the air are shown below.

	°C
argon	–186
carbon dioxide	–78
nitrogen	–198
oxygen	–183

If the air is cooled, the first substance to condense is water.

If the temperature is lowered further, what is the next substance to condense?

A argon

B carbon dioxide

C nitrogen

D oxygen

5070_w10_qp11

2 What correctly describes the molecules in **very dilute** sugar solution at room temperature?

	sugar molecules	water molecules
A	close together, moving at random	close together, moving at random
B	widely separated, moving at random	close together, moving at random
C	widely separated, moving at random	close together, not moving
D	widely separated, not moving	widely separated, moving at random

5070_s10_qp11

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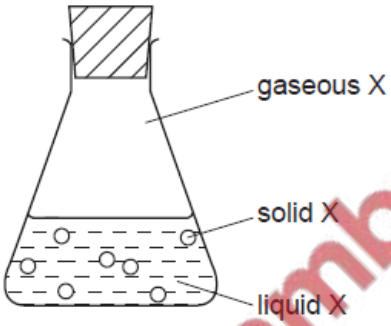
4 The conical flask contains compound X which is present in solid, liquid and gaseous states.



Which statement is correct?

A A gaseous X molecule has a lower mass than a liquid X molecule.

B Energy is released when X changes from liquid to solid.

C Liquid X is at a higher temperature than solid X.

D Liquid X molecules vibrate about fixed positions.

5070_w09_qp1

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2 Why does neon gas, Ne, diffuse faster than carbon dioxide gas, CO_2?

A Neon atoms have the lower mass.

B Neon does not form molecules.

C Neon is a noble gas.

D Neon is less dense than air.

5070_w09_qp1

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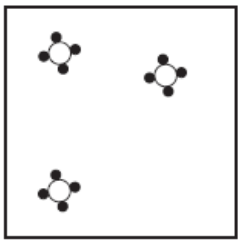
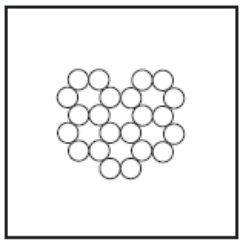
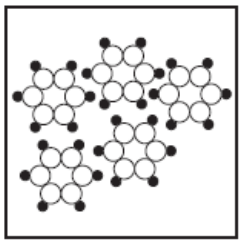
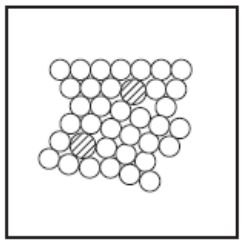
7 Which diagram represents the arrangement of particles in a gas?

A 

B 

C 

D 

5070_w08_qp1

8 Which gas diffuses at the same rate as nitrogen gas?

A carbon dioxide

B carbon monoxide

C neon

D sulphur dioxide

5070_w08_qp1

5 Which property shows that a liquid is pure?

A It turns anhydrous copper(II) sulphate blue.

B It is colourless and odourless.

C It has no effect on red or blue litmus paper.

D It boils at a fixed temperature at a given pressure.

5070_w08_qp1

1 The table shows the boiling points of the elements found in a sample of liquid air.

element	argon	helium	neon	nitrogen	oxygen
boiling point/°C	–186	–269	–246	–196	–183

Which elements would be gaseous at –190 °C?

A argon, helium and nitrogen

B argon, nitrogen and oxygen

C helium, neon and nitrogen

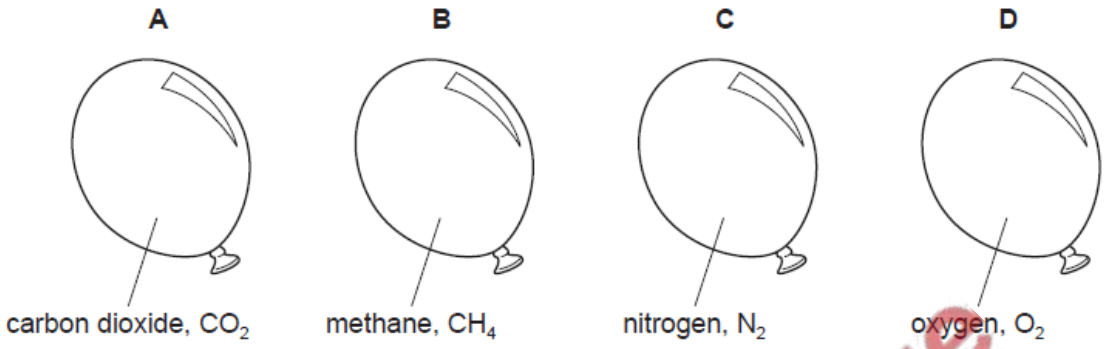
D helium, neon and oxygen

5070_w08_qp1

1 An inflated balloon goes down because gas molecules can diffuse through the rubber.

Four balloons are filled with different gases at the same temperature and pressure.

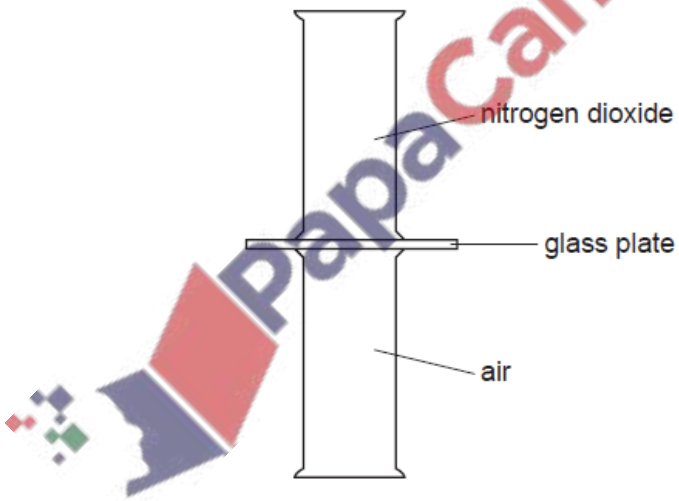
Which balloon would go down quickest?



5070_s09_qp1

3 Nitrogen dioxide is a dark brown gas and is more dense than air.

A gas jar containing nitrogen dioxide is sealed with a glass plate and is then inverted on top of a gas jar containing air.



The glass plate is removed.

Which one of the following correctly describes the colours inside the gas jars after a long period of time?

	upper gas jar	lower gas jar
A	brown	brown
B	dark brown	light brown
C	colourless	dark brown
D	light brown	dark brown

s/08/qp1

1 Which property of a gas affects the rate at which it spreads throughout a laboratory?

A boiling point

B molecular mass

C reactivity

D solubility in water

s/07/qp1

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5 What correctly describes the molecules in **very dilute** sugar solution at room temperature?

	sugar molecules	water molecules
A	widely separated, moving at random	close together, moving at random
B	widely separated, moving at random	close together, not moving
C	widely separated, not moving	widely separated, moving at random
D	close together, moving at random	close together, moving at random

w/07/qp1

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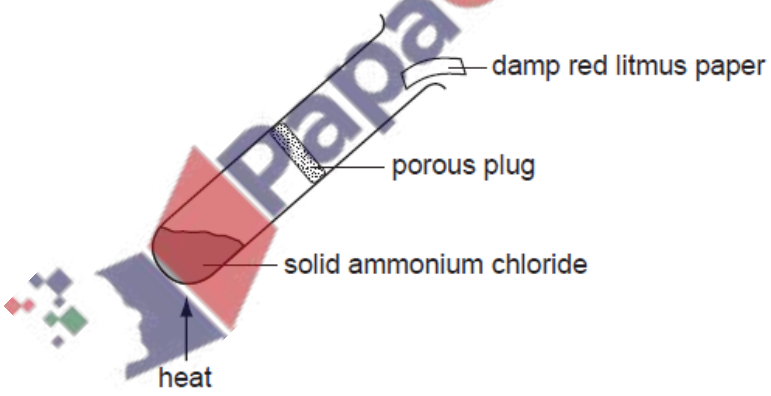
2 Solid ammonium chloride decomposes on heating according to the following equation.

$$NH_4Cl(s) \rightarrow NH_3(g) + HCl(g)$$



Which change occurs to the damp red litmus paper in the experiment above?

A remains red

B turns blue and is then bleached

C turns blue and remains blue

D turns blue and then turns red

w/07/qp1

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1 A test-tube containing a liquid **X** is placed in a beaker of boiling water. The liquid **X** starts to boil immediately.

What is the boiling point of liquid **X**?

A 100 °C

B above 100 °C

C between 0 °C and room temperature

D between room temperature and 100 °C

w/07/qp1

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1 At which temperature does a concentrated aqueous solution of sodium chloride begin to boil?

A 96 °C **B** 99 °C **C** 100 °C **D** 104 °C

w/06/qp1

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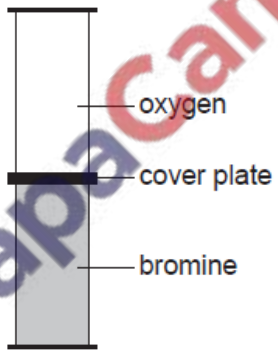
3 The coverplate is removed from the gas jars shown in the diagram. After several days, the colour of the gas is the same in both jars.



Which statement explains this change?

A Oxygen and bromine gases have equal densities.

B Oxygen and bromine molecules are in random motion.

C Oxygen and bromine molecules diffuse at the same rate.

D Equal volumes of oxygen and bromine contain equal numbers of molecules.

w/05/qp1

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3 A liquid boils at a temperature of 100 °C.

Which other property of the liquid proves that it is pure water?

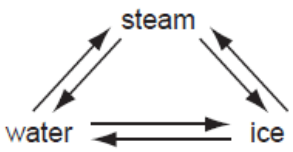
A It does not leave a residue when boiled.

B It freezes at 0 °C.

C It is neither acidic nor alkaline.

D It turns white anhydrous copper(II) sulphate blue.

5 In which conversion do H_2O molecules lose speed?



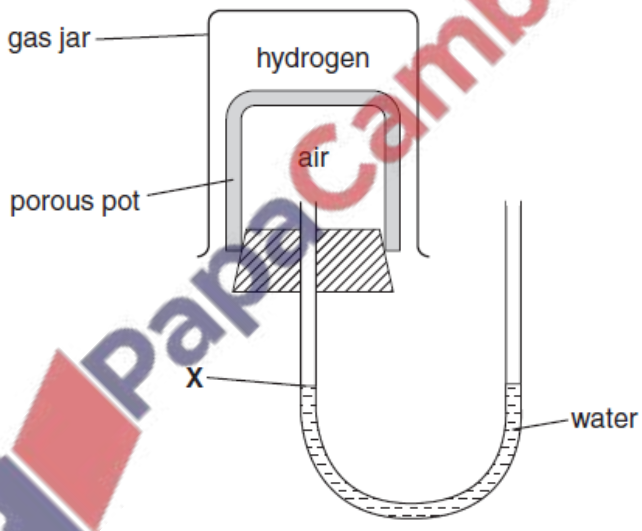
A ice → water

B ice → steam

C steam → ice

D water → steam

3 The apparatus shown in the diagram was set up.



Over a period of time how will the water level at **X** change?

A It will fall, then rise and return to **X**.

B It will fall and remain at a lower level.

C It will rise, then fall then return to **X**.

D It will rise and remain at a higher level.

1 Which property of a gas affects the rate at which it spreads throughout a laboratory?

A boiling point

B molecular mass

C reactivity

D solubility in water

w/02/qp1

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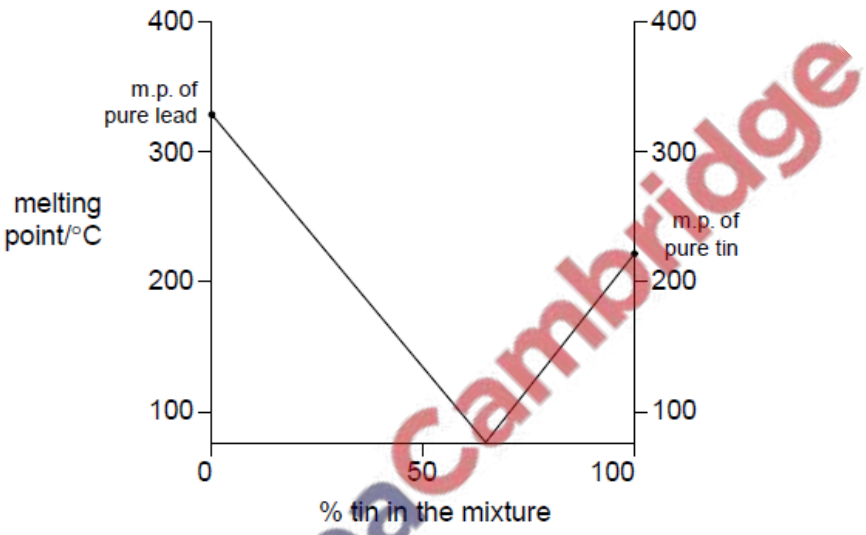
2 The graph gives the melting points of mixtures of lead and tin.



The graph shows that any mixture of lead and tin must have a melting point

A above that of tin.

B below that of lead.

C below that of both tin and lead.

D between that of tin and lead.

w/02/qp1

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4 Which test could be used to show that a sample of water is pure?

A It freezes at exactly 0 °C.

B It turns anhydrous copper(II) sulphate blue.

C It turns cobalt(II) chloride paper pink.

D When it evaporates, it leaves no residue.

s/06/qp1

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1 The table gives data about four substances.

Which substance has particles in a disorderly arrangement at room temperature?

	melting point/°C	boiling point/°C
A	–114	–80
B	120	445
C	750	1407
D	1610	2230

s/06/qp1

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2 Which gas has the slowest rate of diffusion?

A ammonia, NH_3

B methane, CH_4

C oxygen, O_2

D nitrogen, N_2

s/06/qp1

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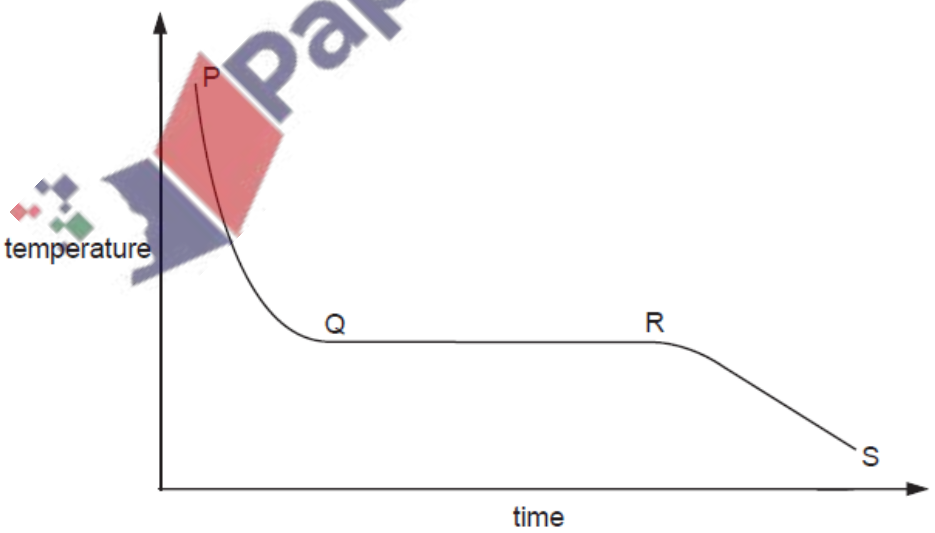
3 A sample of a pure compound is heated until it is completely molten and the compound is then allowed to cool until it is completely solid again.

The graph shows how the temperature of the compound changes with time.



When are liquid and solid both present?

A P to Q and R to S

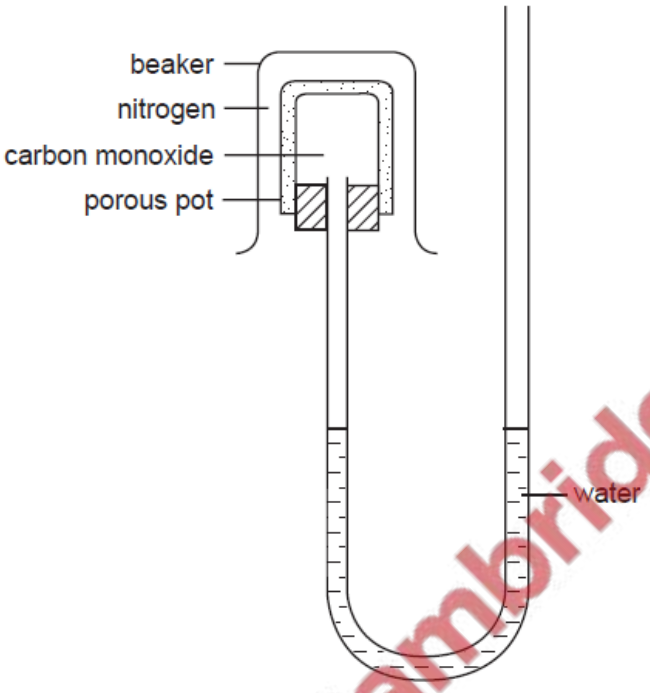
B P to Q

C Q to R

D R to S

4 A beaker of nitrogen is inverted over a porous pot containing carbon monoxide as shown.

The water level does not change.



What is the reason for this?

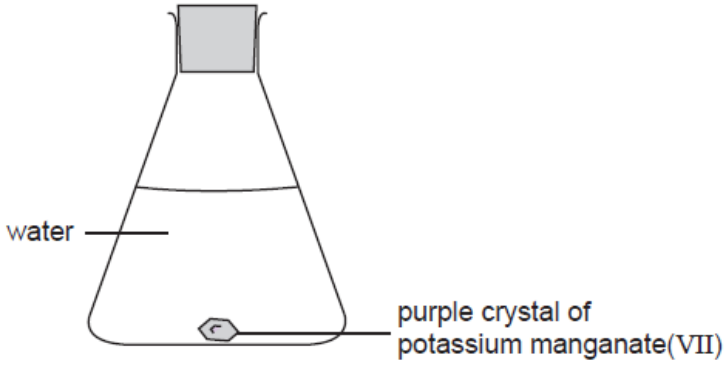
A Both gases are diatomic.

B Nitrogen is an unreactive gas.

C The gas particles are too large to pass through the porous pot.

D The two gases have the same relative molecular mass.

1 The experiment is set up as shown and left until there is no further change.



What is observed?

A a colourless layer below a purple layer

B a colourless liquid with the purple crystal unchanged

C a purple layer below a colourless layer

D a uniformly purple solution

s/05/qp1

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3 In a sample of air at 25 °C, the molecules of oxygen, nitrogen and carbon dioxide all move with different average speeds.

Which of the following lists the molecules in order of decreasing average speed?

	fastest →		slowest
A	carbon dioxide	oxygen	nitrogen
B	nitrogen	oxygen	carbon dioxide
C	oxygen	carbon dioxide	nitrogen
D	oxygen	nitrogen	carbon dioxide

s/04/qp1

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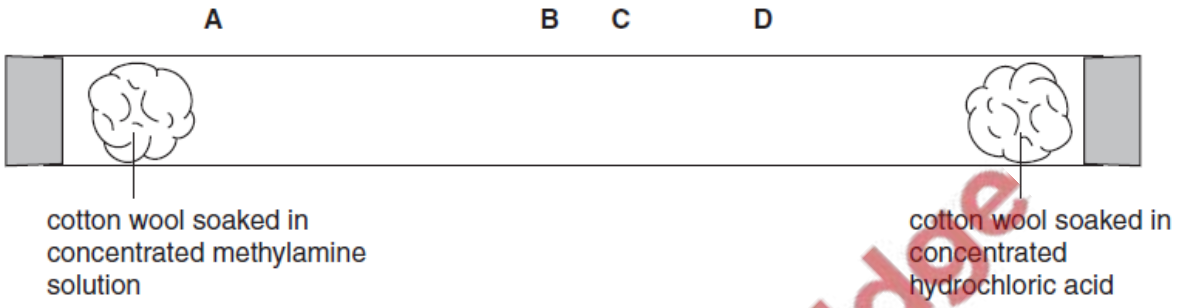
4 Methylamine, CH_3NH_2 ($M_r = 31$), and hydrogen chloride, HCl ($M_r = 36.5$) are both gases which are soluble in water.

The gases react together to form a white solid, methylammonium chloride.

In an experiment to demonstrate rates of diffusion the following apparatus is set up.

Where will the white solid form?



s/03/qp1

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10 Propene, $CH_3CH=CH_2$, has a very low boiling point because of the weakness of the

A C–C bond.

B C=C bond.

C C–H bond.

D intermolecular forces.

5070_w14_qp12

6 Why does ammonia gas diffuse faster than hydrogen chloride gas?

A Ammonia has a higher boiling point than hydrogen chloride.

B Ammonia is a base, hydrogen chloride is an acid.

C The ammonia molecule contains more atoms than a hydrogen chloride molecule.

D The relative molecular mass of ammonia is smaller than that of hydrogen chloride.

5070_w14_qp12

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6 What can be deduced about two gases that have the same relative molecular mass?

A They have the same boiling point.

B They have the same number of atoms in one molecule.

C They have the same rate of diffusion at room temperature and pressure.

D They have the same solubility in water at room temperature.

5070_s13_qp11

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7 Pentane, C_5H_{12}, has a higher boiling point than propane, C_3H_8. Which statement explains the difference in boiling point?

A Carbon-carbon single bonds are stronger than carbon-hydrogen bonds.

B Pentane has more covalent bonds to break.

C Pentane does not burn as easily as propane.

D The forces of attraction between pentane molecules are stronger than those between propane molecules

5070_s12_qp12

Kinetic Particle Theory (0620 Multiple Choice Questions)

1 A few drops of perfume were spilt on the floor. A few minutes later the perfume could be smelt a few metres away.

Which two processes had taken place?

A distillation and condensation

B distillation and diffusion

C evaporation and condensation

D evaporation and diffusion

0620_w/14/qp13

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1 Which statement is an example of diffusion?

A A kitchen towel soaks up some spilt milk.

B Ice cream melts in a warm room.

C Pollen from flowers is blown by the wind.

D The smell of cooking spreads through a house.

0620_w/14/qp11

1 A gas jar of bromine vapour and a gas jar of air are set up as shown in diagram 1.

The glass slide is removed. Diagram 2 shows the appearance of the gas jars after one hour.

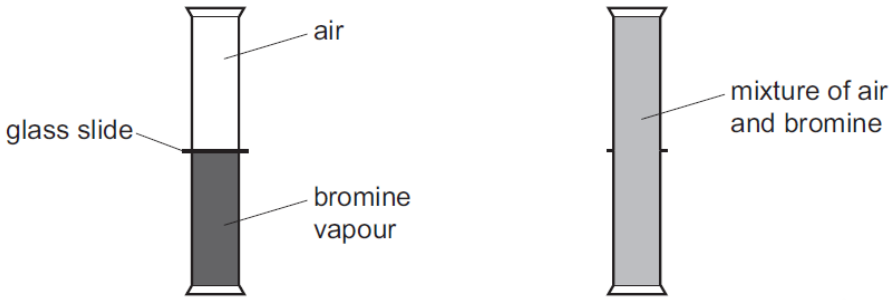


diagram 1 diagram 2

Which statement explains why the bromine and air mix together?

A Bromine is denser than air.

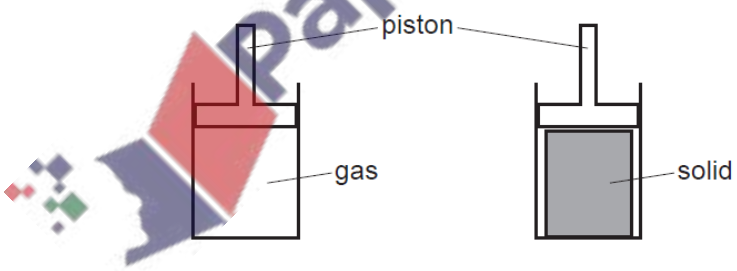
B Bromine is lighter than air.

C Bromine molecules moved upwards and molecules in air moved downwards.

D Molecules in bromine and air moved randomly.

0620_w/13/qp13

1 An attempt was made to compress a gas and a solid using the apparatus shown.



Which substance would be compressed and what is the reason for this?

	substance	reason
A	gas	the gas particles are close together
B	gas	the gas particles are far apart
C	solid	the solid particles are close together
D	solid	the solid particles are far apart

0620_w/13/qp11

1 'Particles moving **very slowly** from an area of high concentration to an area of low concentration.'

Which process is being described above?

A a liquid being frozen

B a solid melting

C a substance diffusing through a liquid

D a substance diffusing through the air

0620_w/12/qp13

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1 What are the processes W, X, Y and Z in the following diagram?

$$\text{solid} \underset{Y}{\overset{W}{\rightleftharpoons}} \text{liquid} \underset{Z}{\overset{X}{\rightleftharpoons}} \text{gas}$$

	W	X	Y	Z
A	condensing	boiling	freezing	melting
B	condensing	freezing	melting	boiling
C	melting	boiling	freezing	condensing
D	melting	freezing	condensing	boiling

0620_w/12/qp11

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1 In which substance are the particles close together and slowly moving past each other?

A air

B ice

C steam

D water

0620_w/11/qp11

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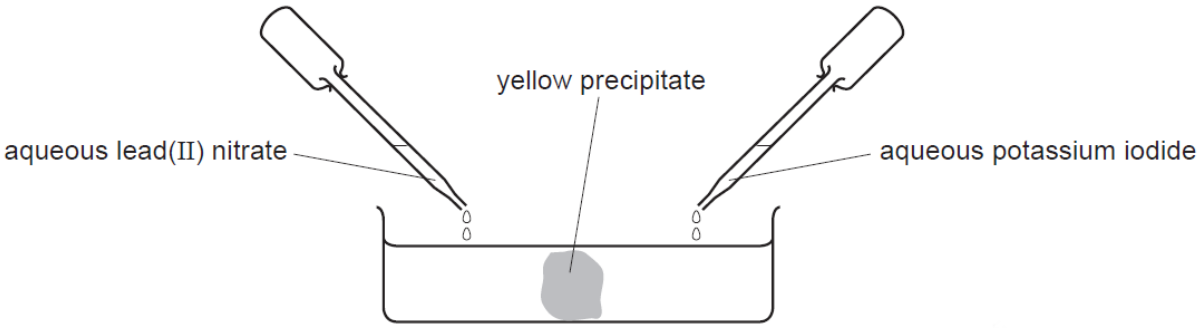
1 In which changes do the particles move further apart?

$$\text{gas} \underset{Y}{\overset{W}{\rightleftharpoons}} \text{liquid} \underset{Z}{\overset{X}{\rightleftharpoons}} \text{solid}$$

A W and X **B** W and Z **C** X and Y **D** Y and Z

0620_w/10/qp11

1 Aqueous lead(II) nitrate and aqueous potassium iodide are added to a dish containing water, as shown.



A yellow precipitate forms after a few minutes.

Which process occurs before the precipitate forms?

A diffusion

B distillation

C fermentation

D filtration

0620_w/09/qp11

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1 In which substance are the particles furthest apart at room temperature?

A ethanol

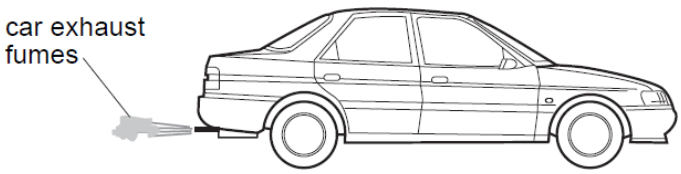
B methane

C salt

D sugar

0620_w/08/qp1

1 Oxides of nitrogen from car exhausts can spread through the atmosphere.



This occurs because gas molecules move from a region of ……1…… concentration to a region of ……2…… concentration by a process called ……3…… .

Which words correctly complete the gaps?

	1	2	3
A	high	low	diffusion
B	high	low	evaporation
C	low	high	diffusion
D	low	high	evaporation

0620_w/07/qp1

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1 In which change of state do the particles become more widely separated?

A gas to liquid

B gas to solid

C liquid to gas

D liquid to solid

0620_w/06/qp1

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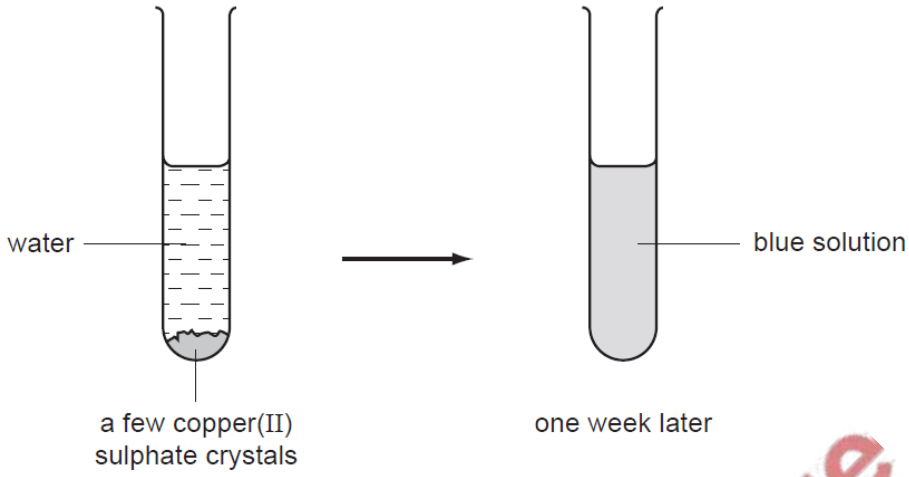
1 Blue copper(II) sulphate crystals are soluble in water.



What has happened after one week?

A crystallisation

B diffusion

C distillation

D filtration

0620_w/05/qp1

2 The melting points and boiling points of four substances are shown.

Which substance is liquid at 100 °C?

substance	melting point / °C	boiling point / °C
A	–203	–17
B	–25	50
C	11	181
D	463	972

0620_w/04/qp1

1 When steam at 100 °C condenses to water at 25 °C, what happens to the water molecules?

A They move faster and closer together.

B They move faster and further apart.

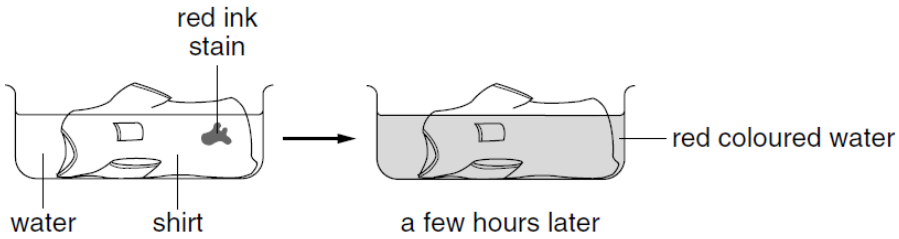
C They move slower and closer together.

D They move slower and further apart.

0620_w/04/qp1

1 A shirt is stained with red ink from a pen.

The shirt is left to soak in a bowl of water.



Which process causes the red colour to spread?

A diffusion

B evaporation

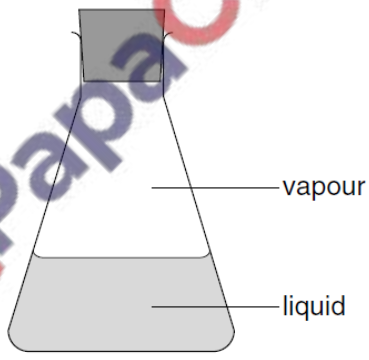
C melting

D neutralisation

0620_w/03/qp1

---

2 A sealed conical flask contains a liquid and its vapour, as shown.



What happens when a molecule in the vapour enters the liquid?

	the molecule stops moving	the molecule becomes smaller
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

0620_w/03/qp1

---

1 Heating a liquid causes it to become a vapour.

What happens to the molecules of the liquid during this process?

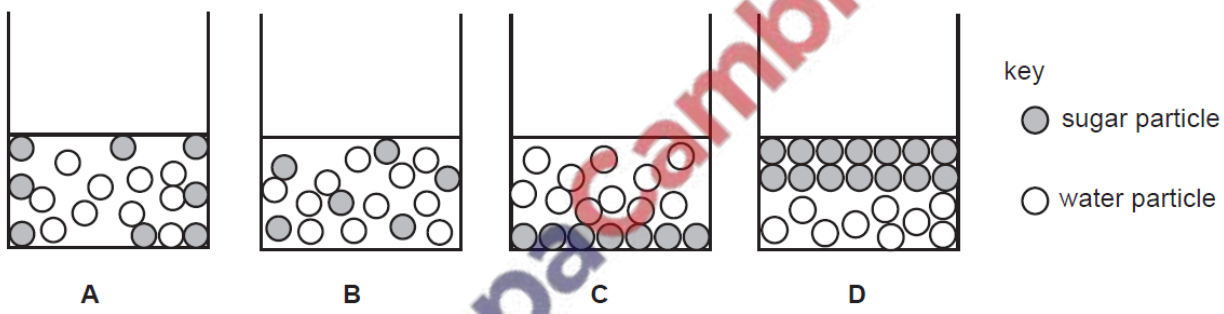
	the molecules become bigger	the molecules move further apart
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

0620_w/02/qp1

---

2 Some sugar is dissolved in water.

Which diagram shows how the particles are arranged in the solution?



0620_w/02/qp1

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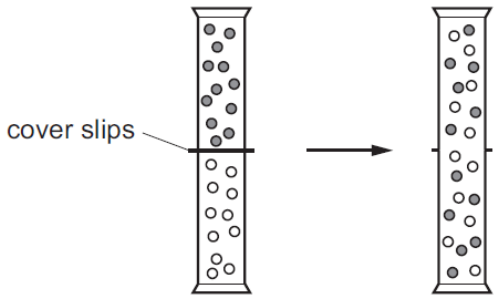
1 Two gas jars each contain a different gas. The gas jars are connected and the cover slips are removed.

The diagram shows what happens to the particles of the gases.



Which process has occurred?

A chemical reaction

B condensation

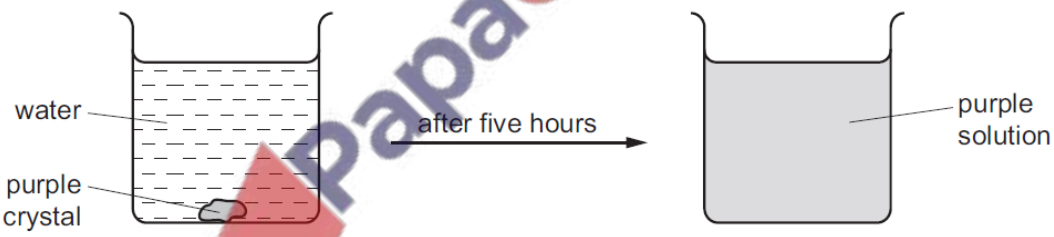
C diffusion

D evaporation

0620_s/14/qp12

---

1 The diagram shows the result of dropping a purple crystal into water.



Which processes take place in this experiment?

	chemical reaction	diffusing	dissolving
A	✓	✓	✓
B	✓	✗	✓
C	✗	✗	✓
D	✗	✓	✓

0620_s/14/qp11

1 The diagram shows a cup of tea.

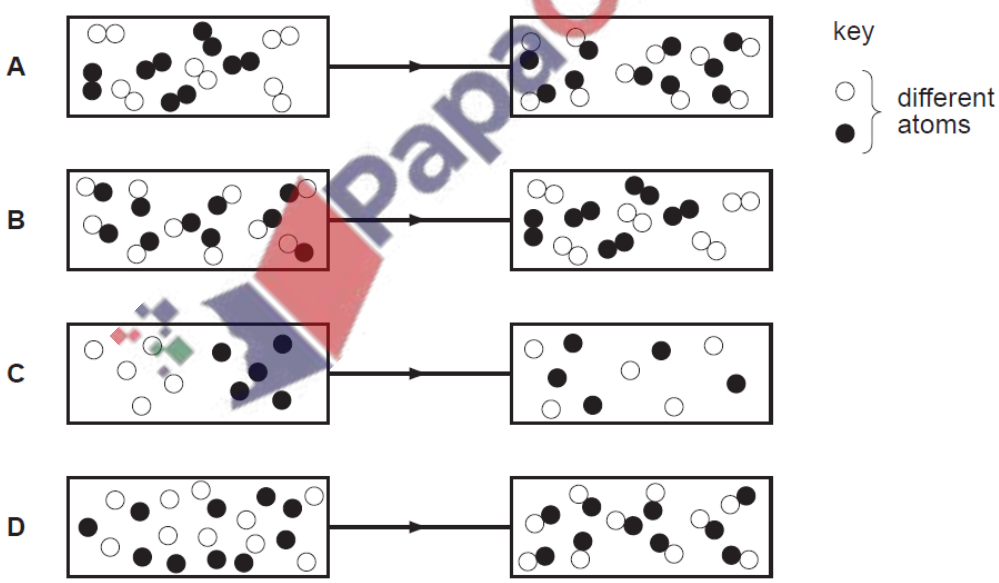
Which row describes the water particles in the air above the cup compared with the water particles in the cup?

	moving faster	closer together
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

0620_s/13/qp12

---

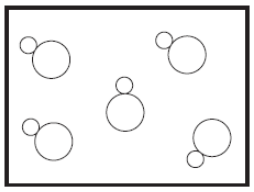
1 Which diagram shows the process of diffusion?

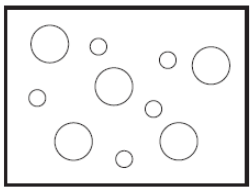


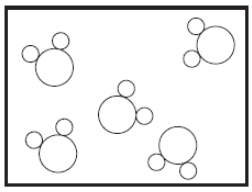
0620_s/12/qp11

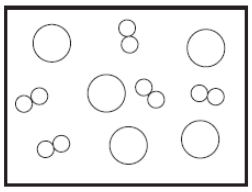
6 In the diagrams, circles of different sizes represent atoms of different elements.

Which diagram represents hydrogen chloride gas?

A 

B 

C 

D 

0620_s/11/qp11

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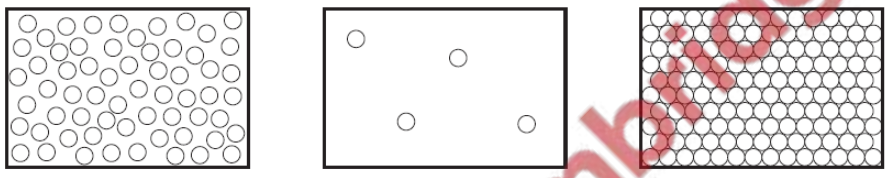
1 The diagrams show the arrangement of particles in three different physical states of substance X.



state 1 state 2 state 3

Which statement about the physical states of substance X is correct?

A Particles in state 1 vibrate about fixed positions.

B State 1 changes to state 2 by diffusion.

C State 2 changes directly to state 3 by condensation.

D The substance in stage 3 has a fixed volume.

0620_s/11/qp11

---

1 The diagram shows a cup of tea.

Which row describes the water particles in the air above the cup compared with the water particles in the cup?

	moving faster	closer together
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

0620_s/10/qp11

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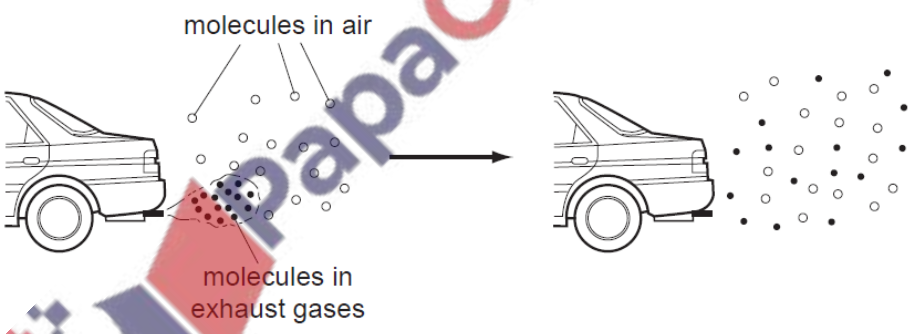
1 The diagram shows how the molecules in the exhaust gases diffuse into the air.



Which statement describes what happens to these molecules next?

A The molecules fall to the ground because they are heavier than air molecules.

B The molecules go back together as they cool.

C The molecules spread further into the air.

D The molecules stay where they are.

0620_s/09/qp11

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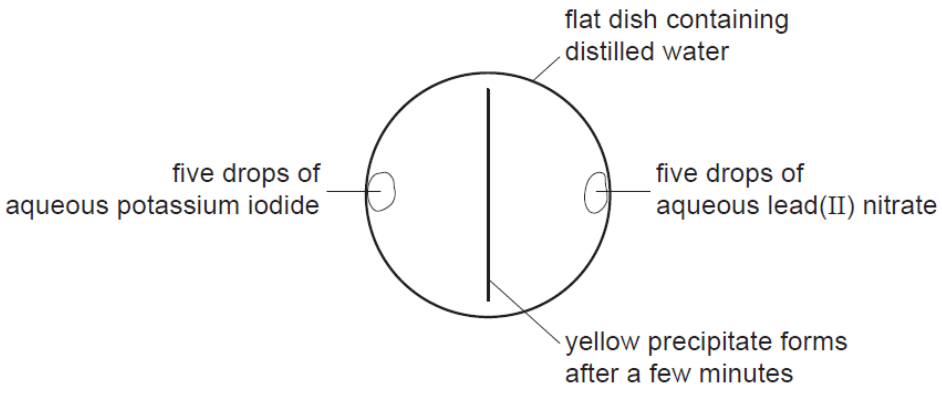
1 A yellow precipitate is formed in the experiment shown.



How is the precipitate formed?

A Particles collide, diffuse and then react.

B Particles collide, react and then diffuse.

C Particles diffuse, collide and then react.

D Particles diffuse, react and then collide

0620_s/08/qp1

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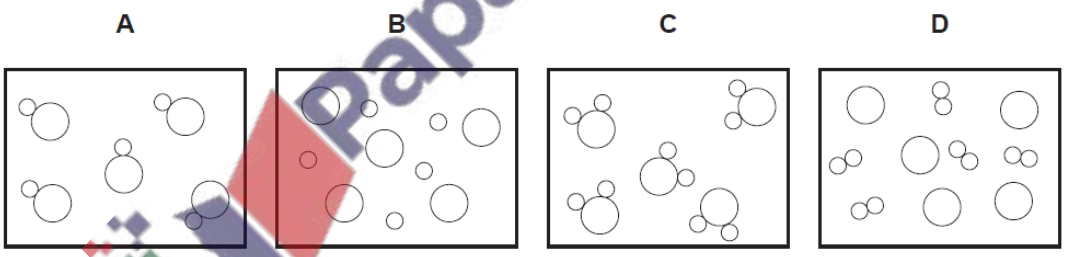
9 In the diagrams, circles of different sizes represent atoms of different elements.

Which diagram can represent hydrogen chloride gas?



0620_s/07/qp1

1 When there is no wind, the scent of flowers can be detected more easily on a warm evening than on a cold evening.

This is because the molecules of the scent ……1…… ……2…… than in colder conditions.

Which words correctly complete gaps 1 and 2?

	gap 1	gap 2
A	condense	nearer to the flowers
B	condense	further from the flowers
C	diffuse	nearer to the flowers
D	diffuse	further from the flowers

0620_s/07/qp1

1 At room temperature, in which substance are the particles furthest apart?

A H_2 **B** H_2O **C** Mg **D** MgO

0620_s/06/qp1

---

1 In which of the following are the particles arranged in a regular pattern?

A a gas

B a liquid

C a metal

D a solution

0620_s/05/qp1

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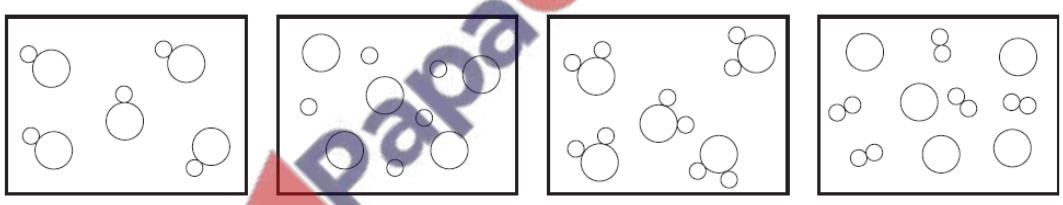
7 In the diagrams, circles of different sizes represent atoms of different elements.

Which diagram can represent hydrogen chloride gas?

A **B** **C** **D**



0620_s/04/qp1

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1 Some students are asked to describe differences between gases and liquids.

Three of their suggestions are:

1	gas molecules are further apart;
2	gas molecules are smaller;
3	liquid molecules vibrate around fixed positions.

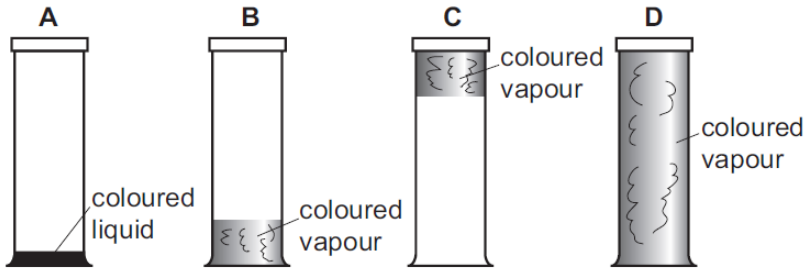
Which suggestions are correct?

A 1 only **B** 2 only **C** 3 only **D** 1, 2 and 3

0620_s/04/qp1

2 A coloured liquid vaporises easily at room temperature. Some of the liquid is placed at the bottom of a sealed gas jar.

Which diagram shows the appearance of the jar after several hours?



0620_s/04/qp1

3 Measurements are made on some pure water.

its boiling point, b.p.

its freezing point, f.p.

its pH

Sodium chloride is now dissolved in the water and the measurements repeated.

Which measured values change?

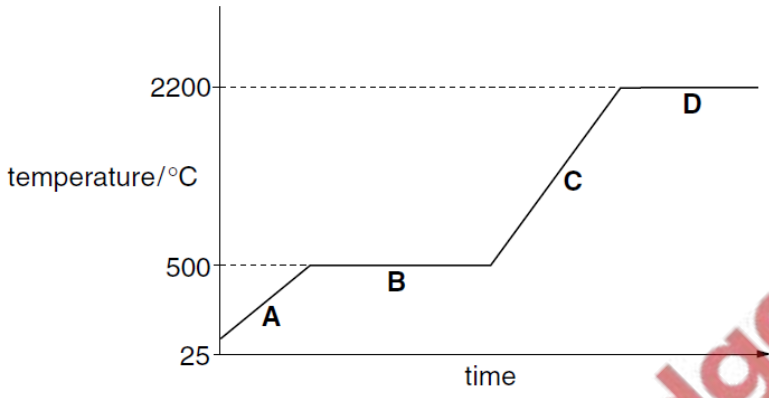
	b.p.	f.p.	pH
A	✓	✓	✓
B	✓	✓	✗
C	✗	✗	✓
D	✗	✗	✗

0620_s/04/qp1

2 A solid metal is heated until it turns to vapour.

The graph shows the temperature of the metal during this process.

Which part of the graph shows the melting of the metal?



0620_s/03/qp1

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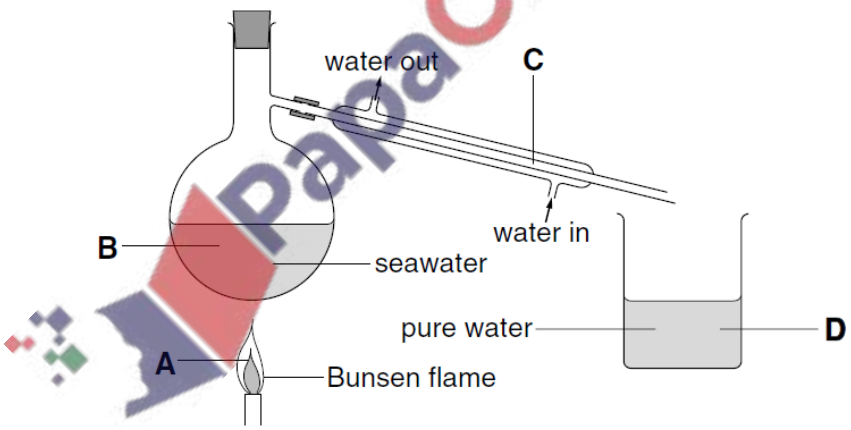
1 The diagram shows how to obtain pure water from seawater.

Where do water molecules lose energy?



0620_s/03/qp1

(c) When liquid nitrogen boils the following change occurs.

$$N_2(l) \rightarrow N_2(g)$$

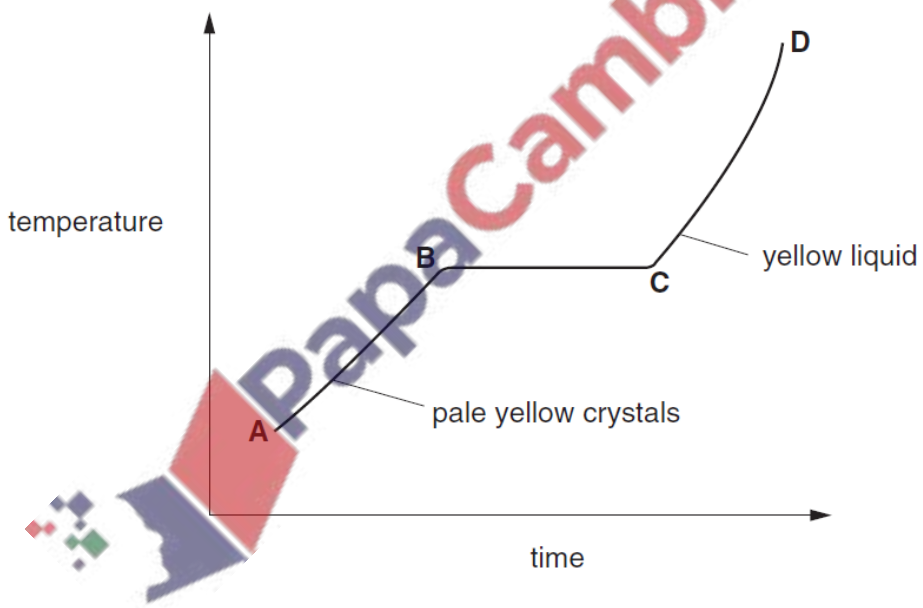
The boiling point of nitrogen is very low even though the bond between the atoms in a nitrogen molecule is very strong. Suggest an explanation.

.....

..... [2]

0620/s12/qp32

(b) When nitrogen dioxide is cooled, it forms a yellow liquid and then pale yellow crystals. These crystals are heated and the temperature is measured every minute. The following graph can be drawn.



(i) Describe the arrangement and movement of the molecules in the region **A–B**.

.....

.....

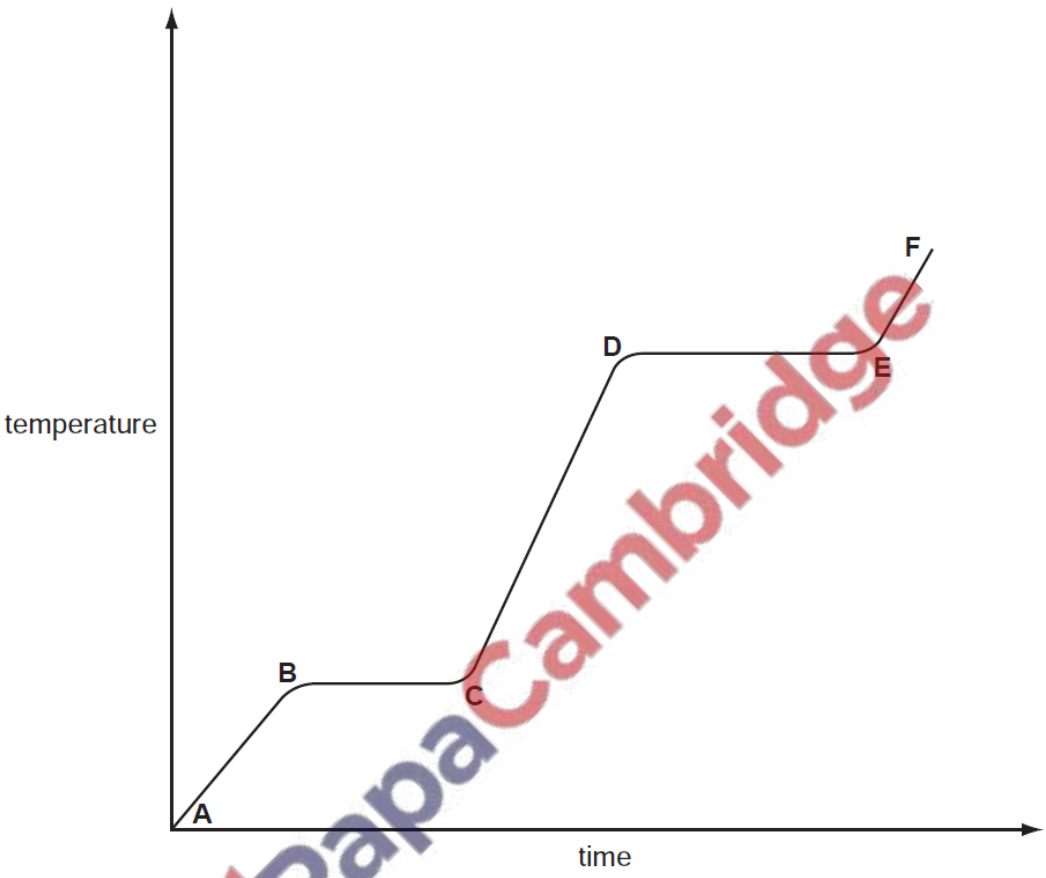
(ii) Name the change that occurs in the region **B–C**

.....[4]

0620/s03/qp3

2 Ethanoic acid is a colourless liquid at room temperature. It has the typical acid properties and forms compounds called ethanoates.

(a) A pure sample of ethanoic acid is slowly heated from 0°C to 150°C and its temperature is measured every minute. The results are represented on the graph below.



(i) Name the change that occurs in the region **D** to **E**.

..... [1]

(ii) What would be the difference in the region **B** to **C** if an impure sample had been used?

..... [1]

(iii) Sketch on the graph how the line would continue if the acid was heated to a higher temperature. [1]

(iv) Complete the following table that compares the separation and movement of the molecules in regions **C** to **D** with those in **E** to **F**.

	C to **D**	**E** to **F**
separation (distance between particles)	.....	.....
movement of particles	random and slow	....
Can particles move apart to fill any volume?	.....	.....

[5]

0620/w05/qp3

---

2 Ozone is a form of oxygen. Ozone is present in the upper atmosphere and it prevents dangerous solar radiation from reaching the Earth's surface. Some of the chemicals that diffuse into the upper atmosphere decompose ozone. Chemicals that have this effect are methane (CH_4), chloromethane (CH_3Cl) and an oxide of nitrogen (NO_2).

(i) Which of these three chemicals diffuses the most slowly? Give a reason for your choice.

.....

.....

..... [2]

0620/s10/qp31

2 Explain each of the following in terms of the kinetic particle theory.

(a) The rate of most reactions increases at higher temperatures.

.....

.....

.....

..... [3]

(b) A liquid has a fixed volume but takes up the shape of the container. A gas takes up the shape of the container but it does not have a fixed volume.

.....

.....

.....

.....

..... [3]

[Total: 6]

3 **(a)** Different gases diffuse at different speeds.

(i) What is meant by the term *diffusion*?

.....

..... [1]

(ii) What property of a gas molecule affects the speed at which it diffuses?

..... [1]

(b) Helium is a gas used to fill balloons. It is present in the air in very small quantities. Diffusion can be used to separate it from the air.

Air at 1000 °C is on one side of a porous barrier. The air which passes through the barrier has a larger amount of helium in it.

(i) Why does the air on the other side of the barrier contain more helium?

..... [1]

(ii) Why is it an advantage to have the air at a high temperature?

.....

..... [1]

0620/s14/qp31

(ii) How does the movement and arrangement of the molecules in a crystal of nitrogen differ from those in gaseous nitrogen?

.....

.....

..... [3]

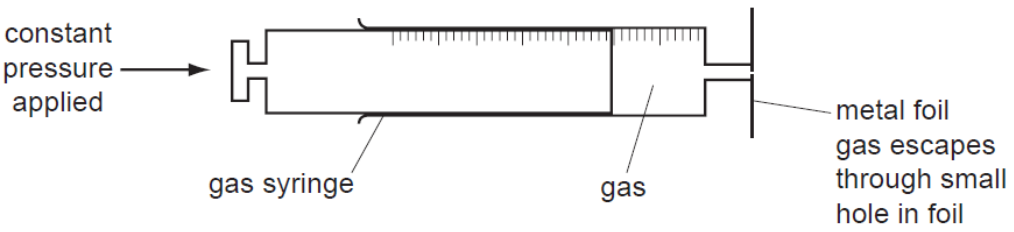
(b) Use the ideas of the Kinetic Theory to explain the following.

(i) A sealed container contains nitrogen gas. The pressure of a gas is due to the molecules of the gas hitting the walls of the container.
Explain why the pressure inside the container increases when the temperature is increased.

.....

..... [2]

(ii) The following apparatus can be used to measure the rate of diffusion of a gas.



The following results were obtained.

gas	temperature / °C	rate of diffusion in cm^3 / min
nitrogen	25	1.00
chlorine	25	0.63
nitrogen	50	1.05

Explain why nitrogen diffuses faster than chlorine.

.....

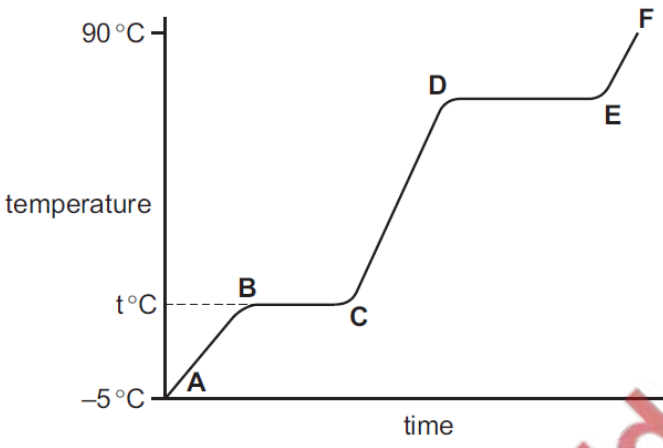
..... [2]

Explain why the nitrogen diffuses faster at the higher temperature.

..... [1]

2 Compound X is a colourless liquid at room temperature.

(a) A sample of pure X was slowly heated from –5.0 °C, which is below its melting point, to 90 °C, which is above its boiling point. Its temperature is measured every minute and the results are represented on the graph.



(i) Complete the equation for the equilibrium present in the region **BC**.

X(s) ⇌ ..... [1]

(ii) What is the significance of temperature t °C?

..... [1]

(iii) What is the physical state of compound X in the region **EF**?

..... [1]

(iv) What would be the difference in the region **BC** if an impure sample of X had been used?

..... [1]

3 **(a)** A small amount of liquid bromine is added to a container which is then sealed.

$$Br_2(l) \rightarrow Br_2(g)$$

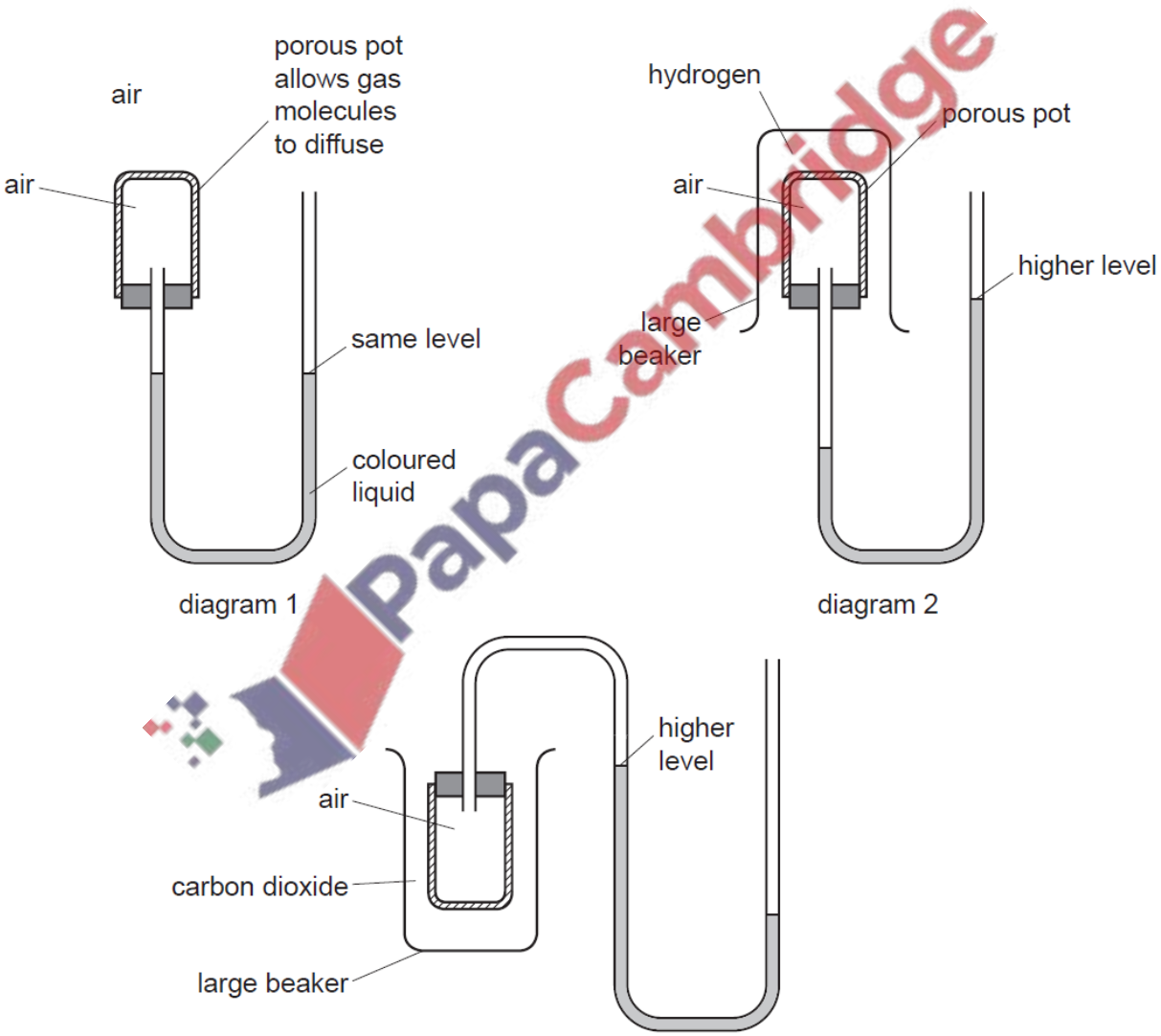
Use the ideas of the Kinetic Theory to explain why, after about an hour, the bromine molecules have spread uniformly to occupy the whole container.

.....

.....

..... [3]

(b) The diagrams below show simple experiments on the speed of diffusion of gases.



Complete the following explanations. Diagram 1 has been done for you.

Diagram 1

There is air inside and outside the porous pot so the rate of diffusion of air into the pot is the same as the rate of diffusion of air out of the pot. The pressure inside and outside the pot is the same so the coloured liquid is at the same level on each side of the tube.

Diagram 2

.....

.....

.....

..... [3]

Diagram 3

.....

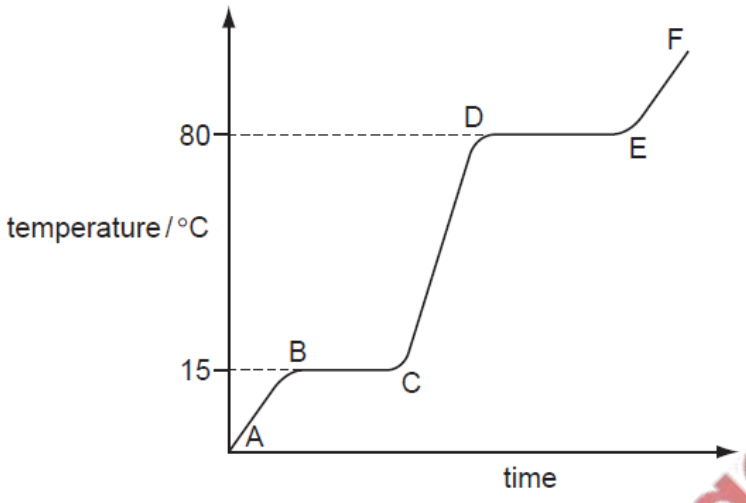
.....

.....

..... [3]

[Total: 9]

2 The diagram shows a heating curve for a sample of compound X.



(a) Is X a solid, a liquid or a gas at room temperature, 20 °C?

.....[1]

(b) Write an equation for the equilibrium which exists in region BC.

.....[2]

(c) Name the change of state which occurs in region DE.

.....[1]

(d) Explain how the curve shows that a pure sample of compound X was used.

.....

.....[2]

[Total: 6]

A2 The table shows some properties of the Group 0 elements (noble gases).

element	density of liquid element in g/cm^3	boiling point /°C
helium	0.15	–269
neon	1.20	–246
argon	1.40	–186
krypton		–152
xenon	3.52	

(a) Predict

(i) the density of liquid krypton, ...[1]

(ii) the boiling point of xenon. .....[1]

(b) Argon is a gas at room temperature.

(i) Describe the arrangement and motion of the particles in a gas.

arrangement .....

motion .....
[2]

(ii) State one use of argon.

.....[1]

(c) The noble gases are unreactive.
Explain why.

.....[1]

(d) Several compounds of the noble gases have been made in recent years.

Xenon(IV) fluoride, XeF_4, reacts with water to form a mixture which contains xenon, xenon(VI) oxide, XeO_3, and hydrogen fluoride, HF.

Complete the equation for the reaction of xenon(IV) fluoride with water.

$$\ldots\ldots XeF_4 + \ldots\ldots H_2O \rightarrow Xe + 2XeO_3 + 12HF$$ [1]

(e) The noble gases make up about 1% of the air.
Describe and explain how fractional distillation can be used to separate the gases in the air.

.....

.....

.....

.....[3]

[Total: 10]

(b) At room temperature iodine is a solid and bromine is a liquid.

Describe the difference between both the arrangement and the motion of particles in a solid and a liquid.

.....

.....

..... [2]

s/13/qp22

(d) The volume of a gas changes if the pressure is increased or the temperature is increased.

(i) Describe and explain qualitatively the effect of increasing the pressure on the volume of a gas if the temperature remains constant.

.....

.....

..... [2]

(ii) Describe and explain qualitatively the effect of increasing the temperature on the volume of a gas if the pressure remains constant.

.....

.....

..... [2]

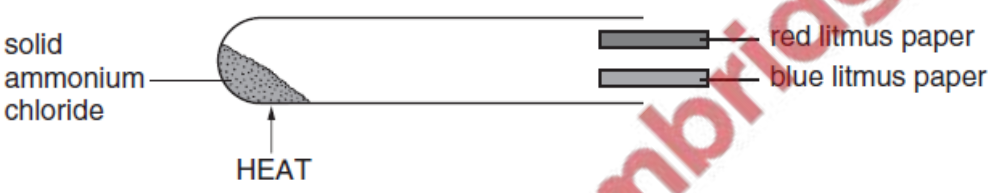
s/14/qp21

A2 The table shows some information about three gases.

name of gas	formula	relative molecular mass
chlorine	Cl_2	71
ammonia		17
	HCl	

(a) Complete the table by filling in the boxes. [3]

A student heated some solid ammonium chloride, NH_4Cl, in a test-tube.
Ammonia and one other gas were formed.
He tested the gases coming out of the tube with litmus paper.



The red litmus quickly turned blue.
A few seconds later, both pieces of litmus paper turned red

(b) Name the process which causes the gases to move along the tube.

.....[1]

(c) Which gas turned the red litmus paper blue?

.....[1]

(d) Which gas turned the litmus paper red?

.....[1]

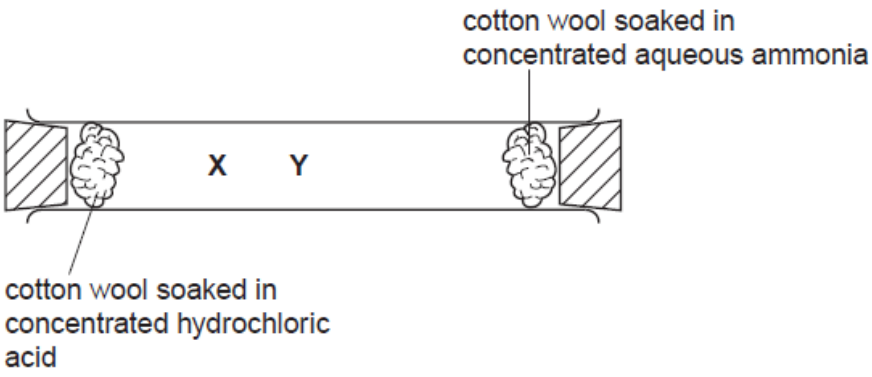
(e) Explain why the two gases travelled along the test-tube at different speeds.
Use information from the table.

.....

.....

.....[2]

A2 A student set up the apparatus shown below.



Colourless fumes of hydrogen chloride are given off by the hydrochloric acid.
Colourless fumes of ammonia are given off by the aqueous ammonia.

(a) After a few seconds, white fumes were seen at point **X** in the tube.
Name the compound formed at point **X**.

.....[1]

(b) Use the kinetic particle theory to explain this observation.

.....

.....

.....[3]

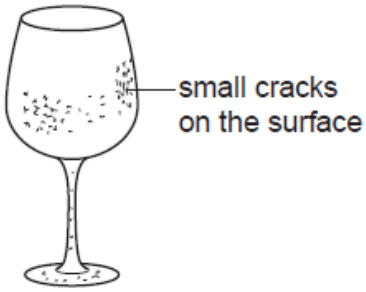
(c) The student repeated the experiment using a solution of methylamine, CH_3NH_2, in place of ammonia, NH_3.
The white fumes were seen at point **Y** in the tube, rather than at point **X**.
Explain this difference.

.....

.....[2]

[Total: 6]

(b) Old wine glasses often appear cloudy because they have many small cracks on their surface.



The cracks are caused by differences in the rate of diffusion of sodium ions and hydrogen ions in the glass.

(i) Explain the meaning of the term *diffusion*.

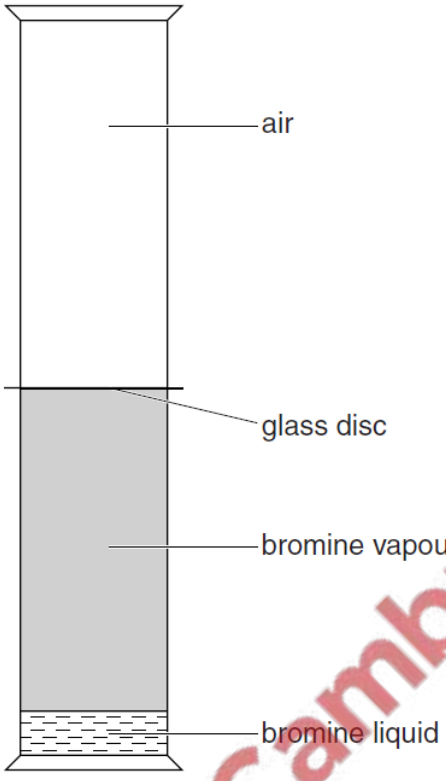
.....

.....[1]

(ii) Suggest why sodium and hydrogen ions do not diffuse at the same rate.

.....[1]

2 A student does an experiment as shown in the diagram below.



(a) What colour is bromine vapour?

..... [1]

(b) He carefully removes the glass disc to allow the contents to mix.

(i) What change, if any, is seen in the apparatus immediately after the disc is removed?

.....[1]

(ii) Describe the appearance of the contents of the gas jars after a few minutes.

.....[1]

(iii) Name the process taking place in the apparatus.

..... [1]

s/13/qp41