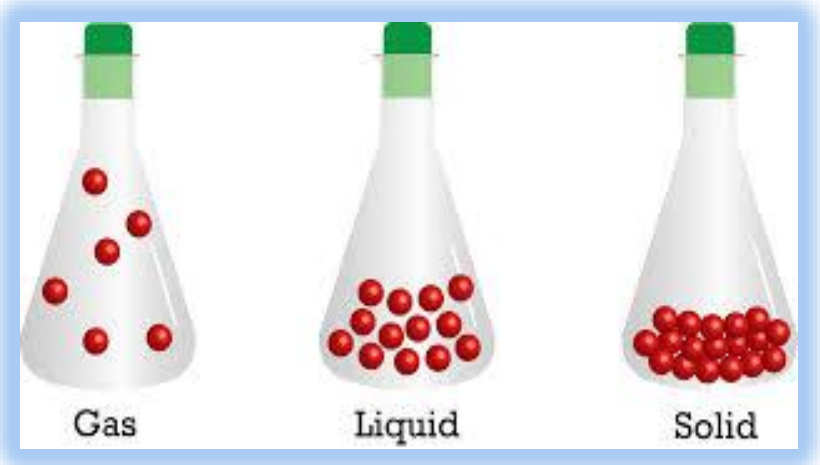
2020

PARTICULATE NATURE OF MATTER



TEACHERS OF PHYSICS
www.teachersofphysics.com
10/6/2020

1. What do you understand by the term "particulate nature of matter?" (1mk)

This is the existence of matter in very tiny particles.

2. State the evidence to show that matter is made up of very small particles. (2mk)

Use of a Piece of Paper.
A piece of paper can be cut continuously until when the small pieces cannot be cut into pieces any further. This suggests that the sheet of paper is made of tiny pieces of paper. Hence matter is made up of tiny particles.
Diluting Potassium Permanganate Solution
The process of diluting purple potassium manganese(VII) Can continue until the solution appears colorless. This suggests that the particles of potassium Permanganate are spread evenly in water and each dilution Process spread them further. This is a proof that matter is Made up of tiny particles which can be separated.

3. State the reason why it is easier to separate water into drops than to separate a solid into smaller pieces. (1mk)

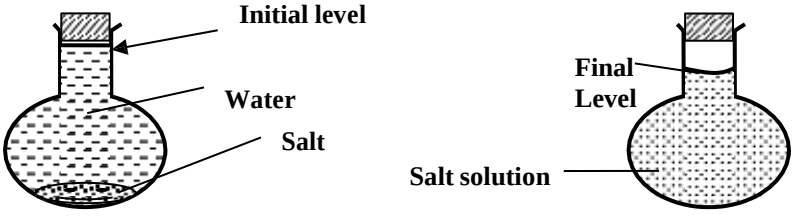
The force of attraction between solid particles is stronger that in liquids thus it's easier to separate liquid particles than solid particles.

4. You are provided with a beaker, a crystal of potassium permanganate and water. Describe a simple experiment how you can verify that matter is made up of small particles. ***Pour water into the beaker to half full. Dissolve the potassium permanganate crystals until the solution is purple. Transfer half of the solution to another beaker and add water. Continue the process with other beakers, comparing the colour to each other. The process of dilution can continue until the solution appears colourless. This suggests that the particles of potassium permanganate are spread evenly on water. As water particles increase the particles of potassium permanganate are spread further, making the purple colourless and less until it appears colourless. Thus it can be concluded that Potassium permanganate is made up of tiny particles.***

5. Fifteen grams of common salt were added to **1000cm^3** of water. After all the salt had dissolved the volume of solution was found to be **998cm^3**. Account for the decrease in volume of the solution. (2mk)

The salt particles occupy the small intermolecular spaces of the water molecules. This behavior of salt suggests that matter is made of very tiny particles.

6. Water was added to fill a flask containing some mass of salt. The container was sealed with a cork and shaken thoroughly to dissolve the salt. It was noticed that the level of the liquid dropped.



Explain the observation made above. (1mk)

Particles of salt are able to occupy some spaces between the water particles. The particles of the solution pack more closely in the available space, thus reducing the volume.

BROWNIAN MOTION

1. What is Brownian motion?

Brownian motion refers to the continuous random movement of liquid and gas particles.

2. Explain the reason why a dropping dust particle in a still room does not trace a straight vertical path.(1mark)

The particle is hit continually by the movement of small invisible particles of air. The movement is random, suggesting that the particles of air are in constant random movement.

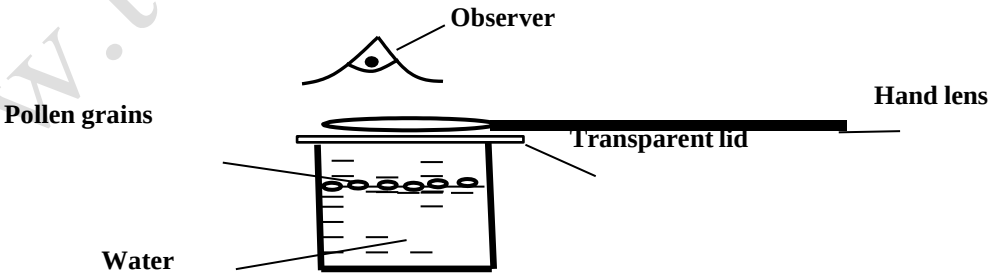
3. In the Brownian motion experiment, smoke particles are observed to move randomly. Explain how this motion is caused. (2mk)

The Smoke Particles Are Continuously Colliding With The Invisible Air Particle.

4. Name **one** state of matter in which Brownian motion occurs. (1mk)

***Solid*.**

5. A student observed some pollen grains on the surface of water in a beaker as shown below.



(i) State the observation made. (**1mk)**

The pollen grains are observed to be in a continuous random motion.

(ii) Explain the observation in **(i)** above. **(1mk)**

The pollen grains are colliding continuously and randomly with the invisible water particles.

(iii) State the changes observed when the temperature of the water above is increased. **(1mk)**

The continuous random motion will be increased.

6. Explain the cause of random motion of smoke particles as observed in

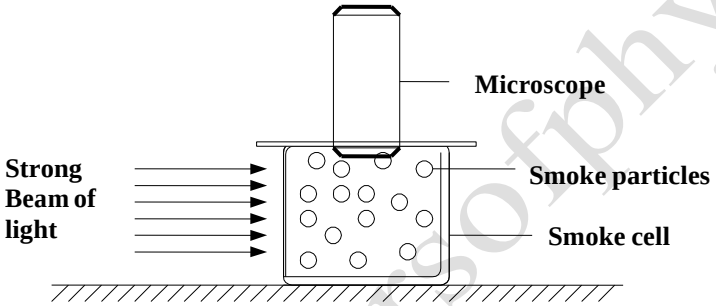
Brownian motion experiment using smoke cell.

The smoke particles collide continuous and randomly with invisible air particles. This causes their continuous random motion.

7. In an experiment to demonstrate Brownian motion, smoke was placed in a smoke cell and observed using a microscope. Bright specks were seen moving randomly in a cell. Explain the observation. (1mark)

The smoke particles in the smoke cell collide continuous and randomly with invisible air particles. This causes their continuous random motion.

8. The figure below shows apparatus used to observe the behaviour of smoke particles in a smoke cell.



(a) State and explain what was observed. (2mk)

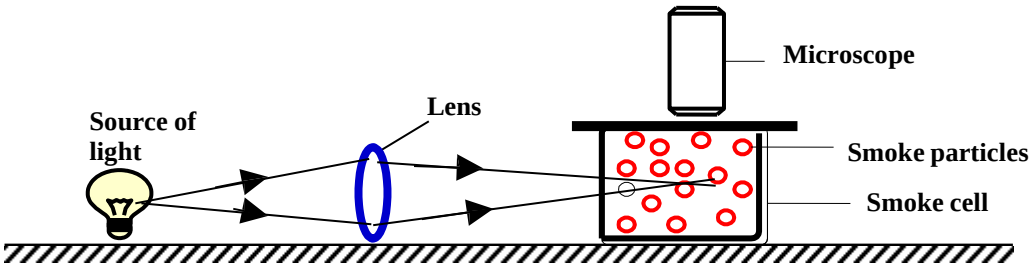
Bright sparks are observed to be in a continuous random motion.

The bright sparks are smoke particles that are being bombarded continuously and randomly by invisible air particles.

(b) Explain what would be happen if the temperature was raised. (1mk)

The observed continuous random motion would increase because increasing the temperature would increase the kinetic energy of the particles.

9. Brownian motion of smoke particles can be studied by using the apparatus shown below. To observe the motion, some smoke is enclosed in the smoke cell and then observed through the microscope.



(a) State and explain the observation made. (2mk)

Bright sparks are observed to be in a continuous random motion.

The bright sparks are smoke particles that are being bombarded continuously and randomly by invisible air particles.

(b) State what will be observed if the temperature surrounding the smoke cell is increased. (1mk)

The observed continuous random motion would increase.

(c) What is the function of the following in the experiment above.

(i) Microscope. (1mk)

Enlarge the smoke cell for easy observation.

(ii) The Lens. (1mk)

Focus the light into the smoke cell for easy illumination.

10. When smoke particles are observed through a microscope in a smoke cell which is illuminated from the side.

(a) What observation is made? (1mk)

Bright sparks are observed to be in a continuous random motion.

(b) How can you tell which particles are larger? (1mk)

The smoke particle are the only ones seen though air particles are also in the smoke cell but can't be seen since are very tiny to be observed.

(c) What change on their motion would be observed if the temperature of the smoke cell is increased?

Their motion would be observed to increase.

11. Smoke was trapped in a smoke cell and viewed through a lens. State the change in movement of the smoke particles when the temperature of the room was lowered.

The smoke particles would move slower.

12. Smoke particles in an air cell is suitably illuminated and viewed through a microscope.

a) State and explain what is observed.

Bright sparks are observed to be in a continuous random motion.

The bright sparks are smoke particles that are being bombarded continuously and randomly by invisible air particles.

b) What change is expected in the observations as the contents in the air cell were warmed?

The smoke particles would move faster and more randomly.

13. In the smoke cell experiment to show Brownian motion in gases, white specks in constant random motion are seen in the cell. What changes would be observed if the same set up is viewed at room temperature of about **25^0C** and the then at a temperature of **14^0C**. Explain your observation. (3mk)

The continuous random motion at the temperature of 25^0C will be faster and more randomly compared to the temperature of 14^0C. This is because at higher temperature the particles have more kinetic energy than at a lower temperature thus particles move faster at 25^0C than 14^0C.

14. What happens to the motion of smoke particles in the smoke cell experiment when the set up is Moved from an environment at 27^0c to an environment at **47^0C**.

There would be an increase in the continuous random motion.

KINETIC THEORY

1. State the kinetic theory of matter.

Matter is made up of very tiny particles which are in a continuous random motion.

2. Use kinetic theory of matter to differentiate between solids and liquids.

The particles of solids are closely packed together in an organised way. In their fixed positions, they vibrate to and fro, while in liquids, the particles are further apart. They are not fixed as in solids but move about in Brownian motion.

3. Distinguish between solid, gas and liquid states of matter in terms of intermolecular forces.

The particles of solids are closely packed together in an organised way and have a strong attractive forces (cohesive forces) between the particles while in liquids the cohesive forces between the particles are weaker compared to those in solids. Due to this liquid can flow and take up the shape of the container in which they are put and in gases the cohesive force between the particles is extremely small and as the particles move they collide with each other and with the walls of the container in which they are trapped.

4. Distinguish between solid, gas and liquid states of matter in terms of intermolecular distances.

The particles of solids are closely packed together in an organised way while the those in liquids are further apart. They are not fixed as in solids but move about in Brownian motion.Those in gases are further apart and have increased random motion compared to those in the liquid state.

5. Using the kinetic theory of matter, explain why liquids expand more than solids when heated through the same temperature.

Solid particles are closely packed together and strongly knitted together compared to liquids which are loosely packed, when heated the liquids particles easily gain kinetic energy and expand. At the temperature the solid would require more energy to weaken the strong cohesive bond before expanding.

6. In terms of intermolecular distances, explain why it is easier to compress a gas than a solid.

The liquids have larger intermolecular distance compared to solids thus it's easier to compress liquids than solids.

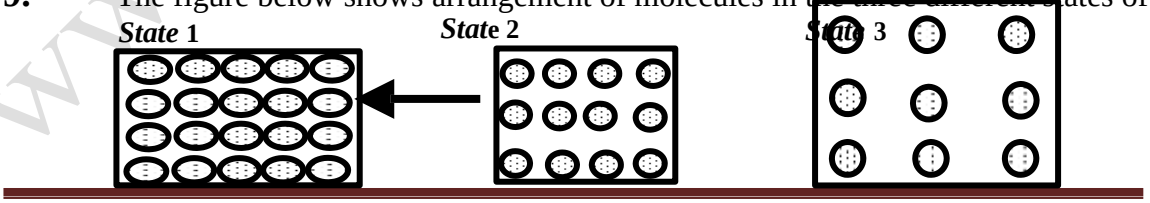
7. Use the kinetic theory of matter to explain thermal expansion in liquids.

When liquids are heated the particles gain more kinetic thus more randomly and also cover a longer distance increasing the volume thus expanding.

8. Using kinetic theory of matter, explain why solids expand when heated.

When solids are heated their particles gain more kinetic energy thus start vibrating more vigorously thus increasing their intermolecular distance thus increasing in size(expanding).

9. The figure below shows arrangement of molecules in the three different states of matter.



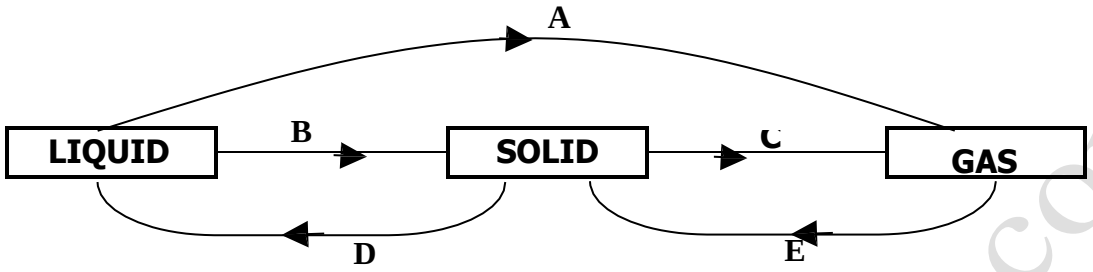
a) Name the process represented by the arrow. (1mk)

Freezing

(b) State the reason for the arrangement of molecules in state **3.** (1mk)

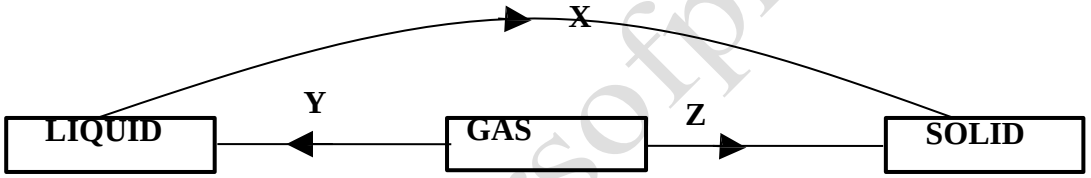
The cohesive force between the particles is extremely small thus particles are further apart.

10. Name the processes **A, B, C, D** and **E** taking place below.



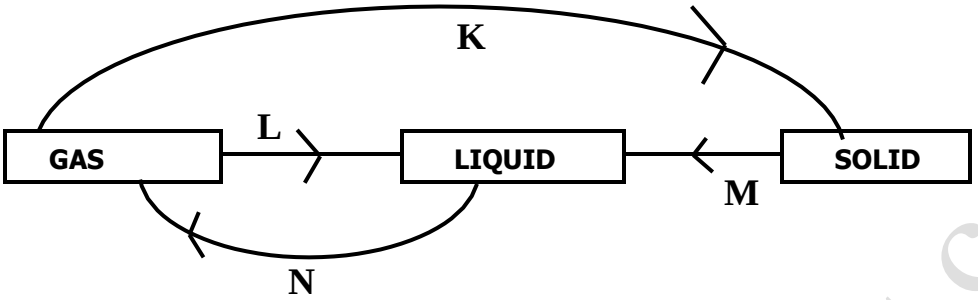
A-VAPORISATION.
B- FREEZING.
C- SUBLIMATION.
D- MELTING.
E- DEPOSITION.

11. Name the processes **X, Y,** and **Z** taking place below. **(4mk)**



X- FREEZING.
Y- CONDESATION.
Z – DEPOSITION.

12. Name the processes **K, L, M** and **N** taking place below. **(4mk)**



K-DEPOSITION.
L – CONDESATION.
M – MELTING.
N – VAPORISATION.

DIFFUSION

1. Define the term diffusion.

This is the process by which particles spread from regions of high concentration to those of low concentration. Diffusion takes place in solids, liquids and gases.

2. State and explain **two** factors that affect the rate of diffusion.

The temperature of the substance. Change in temperature of a substance changes the kinetic energy in the particles of the substance thus amount of kinetic energy will determine fast a substance diffuses.

Density of the substance, a substance of high density has heavier particles hence moves more slowly than lighter one.

3. A drop of blue ink is introduced at the bottom of a beaker containing water. It is observed that after some time all the water in the beaker turn blue. Name the process that takes place.

Diffusion.

4. A crystal of potassium permanganate was carefully introduced at the bottom of water column held in a gas jar. After sometimes the whole volume of water was coloured.

i) Explain this observation. 1mk

The particles of potassium permanganate moved from region of high concentration (point of introduction) to other parts of the water occupying the spaces within the water molecules.

ii) State the effect of using warm water on the observation above. 1mk

The process would take place faster (within a short time).

5. Two identical containers **X** and **Y** are filled with water. **X** is filled with cold water while **Y** is filled with hot water. A crystal of potassium permanganate is then put in both containers at the same time. In which container did the potassium permanganate spread fastest? Explain

Y- high temperature implies high kinetic energy in the particles thus particles move faster than in the colder water X

6. Two samples of bromine vapour are allowed to diffuse separately under different conditions, one in a vacuum and the other in air. State with reasons the conditions in which bromine diffuse slower. (2mk)

In air, due to collision with air particles

7. A bottle containing a smelling gas is opened at the front bench of a Classroom in the afternoon. State the reason why the gas is detected throughout the room shortly. (2mk)

Because of diffusion, the gas particles tend to move from a region of high concentration to region of low concentration.

8. State one reason why diffusion in gases is faster than diffusion in liquids. (2mks)

Diffusion in gases is faster due to their low density, high kinetic energy and weak cohesive forces.

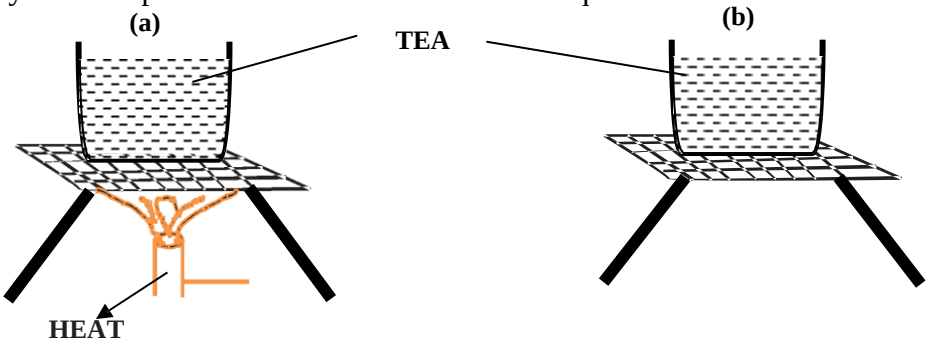
9. Two beakers contain equal volumes of water and ethanol. A crystal of potassium permanganate is placed in the liquids at the bottom of each of
the beakers. In which beaker will the diffusion be faster given that the two liquids are at the same temperature? Explain. **(2mks)**

In ethanol, ethanol is less dense than water thus less number of particle per volume thus the particles of potassium permanganate will experience less collision in ethanol thus in water thus diffusing faster

10. Two identical tubes A and B held horizontally contain air and water respectively. A small quantity of coloured gas is introduced at one end of A while a small quantity of coloured water is introduced at one end of B. State with reason the tube in which the colour will reach the other end faster. (2mk)

A, diffusion in gases is faster due to their low density, high kinetic energy and weak cohesive forces.

11. Study the set-ups below and use it to answer the questions that follow:



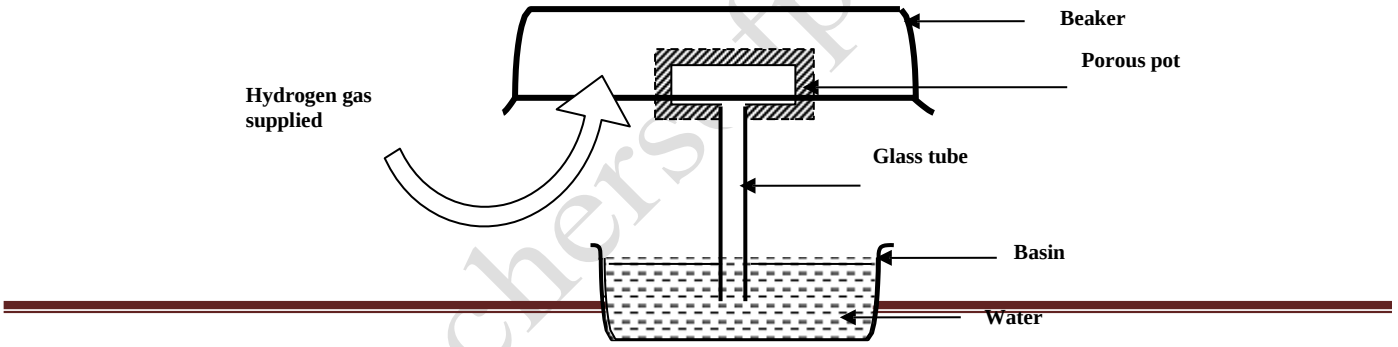
A student placed one teaspoonful of sugar in each of the identical cups with equal volume of tea as shown above. With a reason which cup of tea will taste sugary after 2 minutes?
(2mks)

(a), the sugar particles gain more kinetic energy thus spread and occupy the spaces between the particles of the heated liquid faster than in the colder liquid.

12. A bottle containing ammonia solution is placed at the back of the laboratory. **Give a reason** why its smell may not be detected in other parts of the laboratory if the temperature of the solution is kept very low.

Ammonia gas has lower density thus its particles are lighter thus diffuse easily even at low temperature.

13. The figure below shows an arrangement to demonstrate diffusion through solids:-

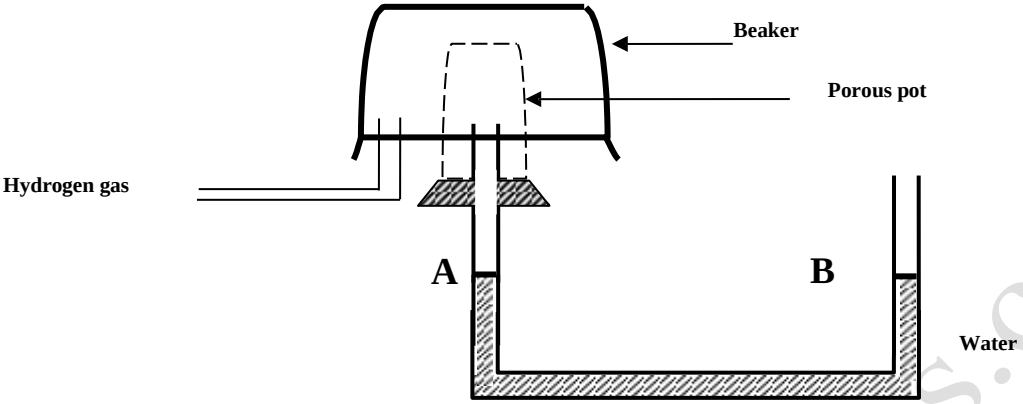


The hydrogen gas is supplied for sometimes then stopped and the beaker removed. State and explain what is likely to be observed when the hydrogen gas supply is stopped.

The water will rise in the glass tube.

As hydrogen diffuses out of the porous pot water rises to occupy space initial occupied by the hydrogen gas.

14. Use the diagram below to answer the question **below**.



(i) State the aim of this experiment. (1 mark)

To show diffusion through a porous pot.

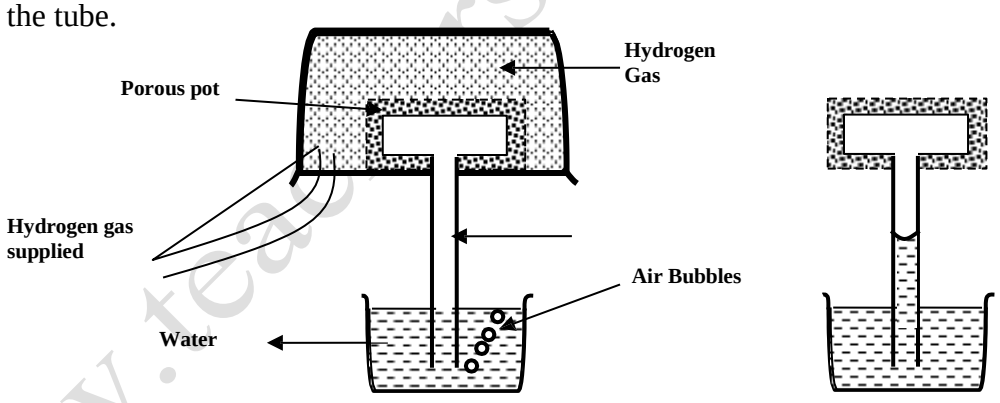
(ii) At the start of the experiment, the region below the beaker had no hydrogen gas. The hydrogen gas from a gas generator is now introduced for sometime.
State the observation made. (1 mark)

The water level in A lowers while it rises in B.

(iii) Give a reason for your answer. (1 mark)

Hydrogen gas diffuses into the porous pot thus pushing in arm A of the manometer downward.

15. The set up in figure below shows some observation made by a form two student in their school laboratory during a physics class. In fig (a) bubbles were coming out of water when hydrogen gas was allowed to flow over the porous pot whereas, fig (b) shows water having risen through the tube.



(i) What was the lesson investigating ? (1mk)

Diffusion through porous materials

(ii) Briefly explain each observation made in:

I Fig (a). (1mk)

Hydrogen gas is diffusing into the porous pot thus expelling the air initially occupying the porous pot.

II Fig (b) (1mk)

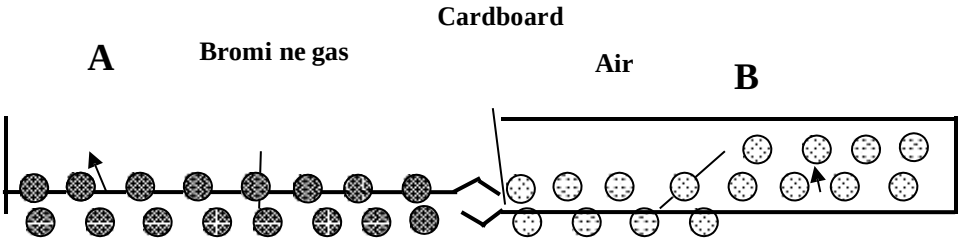
Hydrogen gas is diffusing out of the porous pot thus water rises to occupy the space left by the diffusing hydrogen gas.

(ii) Name two factors that would affect the observation made in the experiment set up, in figure above. (2mks)

Temperature of the surrounding.

Size of the pores on the porous pot.

16. Bromine (Reddish brown vapour) and air were trapped in gas jars A and B and the apparatus arranged as shown in figure 4 below.

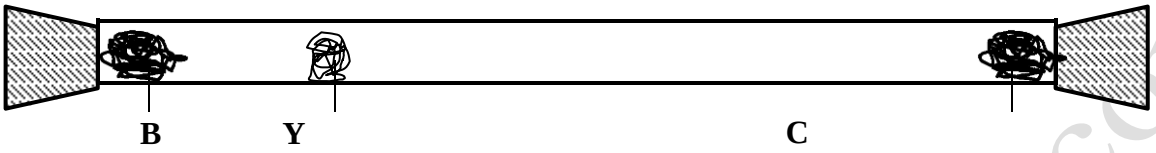


Explain what is observed if the jars are left for some time. (2mk)

A pale brown mixture forms in the two jars.

This because bromine gas diffused into jar B while air diffused into jar A forming a homogenous pale brown mixture.

17. The set-up shown in the figure below is used to investigate the rate of diffusion of two gases. **B** and **C** are cotton wools soaked in hydrochloric acid and ammonia solution respectively.



A white deposit **Y** is formed between **B** and **C**. Compare the densities of the two gases. (2mk)

Gas B is denser than gas C.

A gas of high density has heavier particles hence moves more slowly than lighter one.

18. The figure below shows two gases **A** and **B** put in a tube at the same time.

If gas **B** is heavier than gas **A,** indicate on the diagram where the two gases are likely to meet

The gases are likely to meet near gas B.