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Chapter-1 Matter in our Surroundings

Matter :-

Anything which occupies space & has mass is called matter. Modern day scientist classify matter in two ways :-

- i) Physical Properties :- solid, liquid & gas.
- ii) Chemical Properties :- element, compound & mixture.

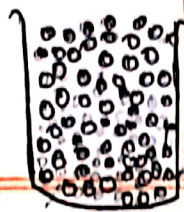
Matter is made up of particles, a small rain drop contains about 10^{21} particles of water in it. The particles which make up matter are atom & molecules.

Evidence for Particles in Matter :-

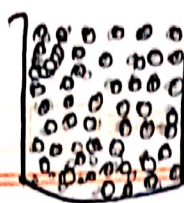
The evidence for the existence of particles in matter & their motion comes from the experiment on diffusion & brownian motion. Now, we will describe some experiment which can only be explained by assuming that all matter is made up of particles.

Dissolving a solid in a liquid :-

When a crystal of potassium permanganate is placed in a beaker of water. The water slowly turns purple on its own even without stirring. The particles of potassium permanganate get into the space between the particles



Potassium permanganate crystal made of particles



Particles separate from crystal

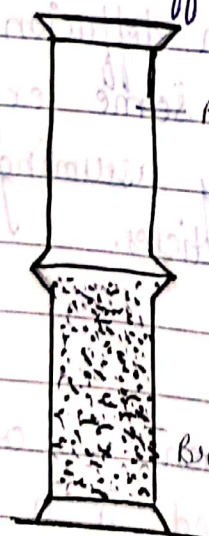


Potassium permanganate particles spread through the water particles

Water made of the water. The particles of potassium permanganate & particles of water spread into each other & mix up in their own. It is concluded that they are in moving or they are in motion.

Mixing of two gases:-

Air is a colourless gas. Bromine is a red-brown liquid. A gas jar containing air is placed upside down on a gas jar of Bromine vapour. The red brown bromine vapour from the lower gas jar spread up into air in the upper gas jar. The gas jar containing air also becomes completely red brown in colour. This is diffusion.



(a) Before

After some time



Red Brown colour

(b) After

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Air present in the upper gas jar also diffused downward into bromine vapour in the lower gas jar but since air is colourless, we can not notice its presence in the lower gas jar.

Pollen :-

Pollen is a powdery substance discharged from the male part of a flower called stamen. Pollen is actually present in the top part of a stamen called anther. Pollen contains microscopic particles called pollen grains.

Movement of Pollen grains in water :-

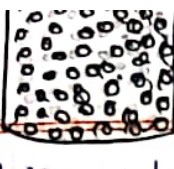
The best evidence for the present & movement of particles in liquid was given by Robert Brown in 1827. Robert Brown suspended extremely small pollen grains in water. It was found that the pollen grains were moving rapidly throughout water in a very zigzag way. The pollen grains move on the surface of water, constantly being



Potassium permanganate crystal particles



particles separate from crystal



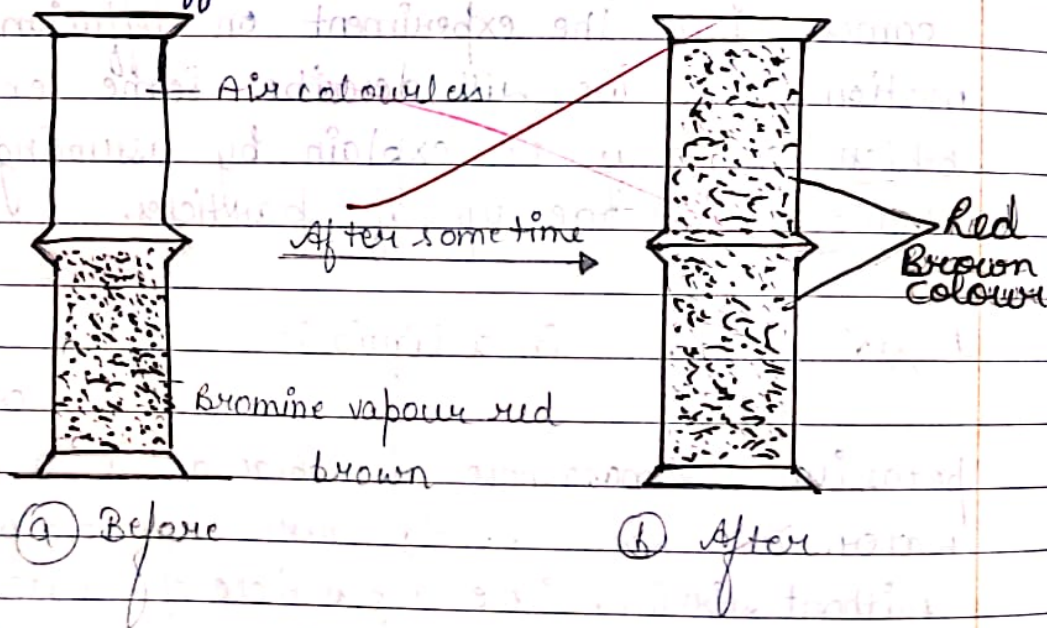
the water particles

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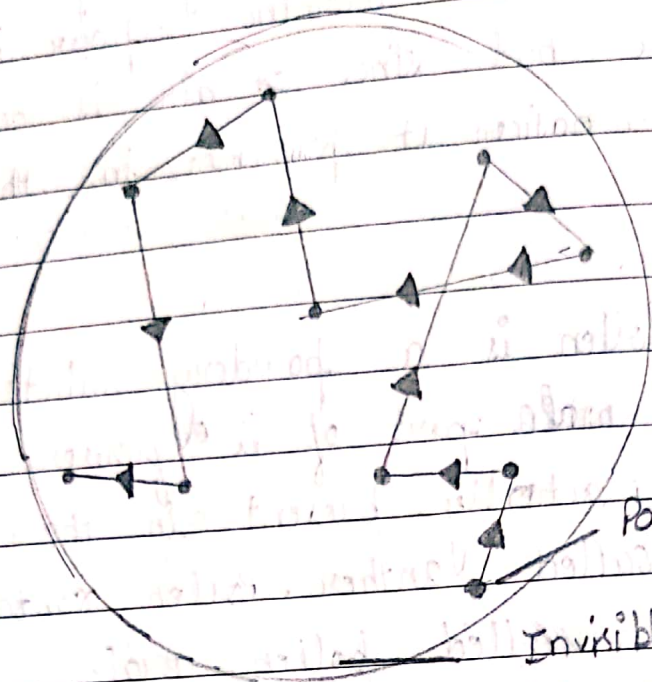
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Movement of Pollen grains in water :-

The best evidence for the present & movement of particles in liquid was given by Robert Brown in 1827. Robert Brown suspended extremely small pollen grains in water. It was found that the pollen grains were moving rapidly throughout water in a very zigzag way. The pollen grains move on the surface of water because they are constantly being hit by fast moving particles of water. It is an example of Brownian Motion. Brownian Motion can also be observed in gases. The zig-zag movement of the small particles suspended in a liquid or gas is

called Brownian Motion.



Pollen grain

Invisible moving particles of water which continuously hit

The existence of brownian motion gives us two conclusion about the nature of matter:

- i) That matter is made up of tiny particles.
- ii) That the particles of matter are constantly moving?

Characteristics of Particles of Matter:-

i) The Particles of matter are very very small.

ii) The Particles of matter are very very small:-

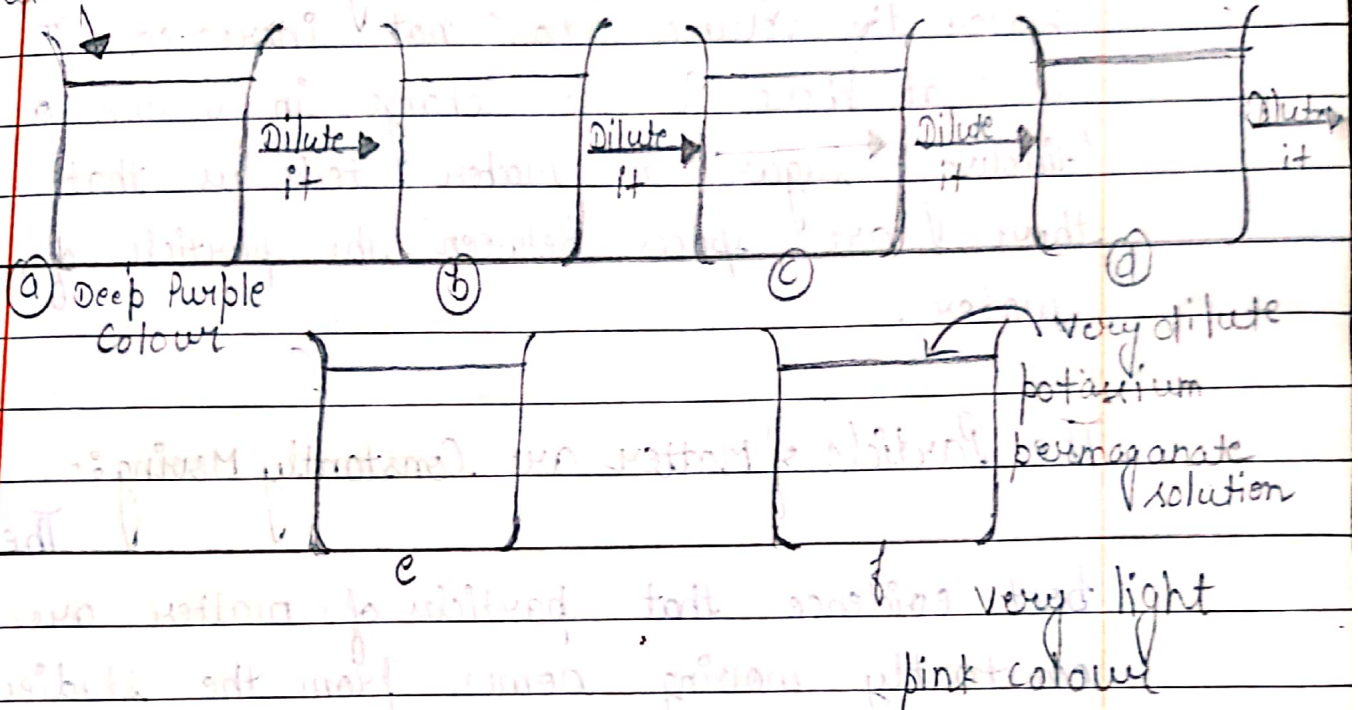
small size of particles of the matter

The very very

can be shown by ~~using~~ performing the experiment by using potassium permanganate.

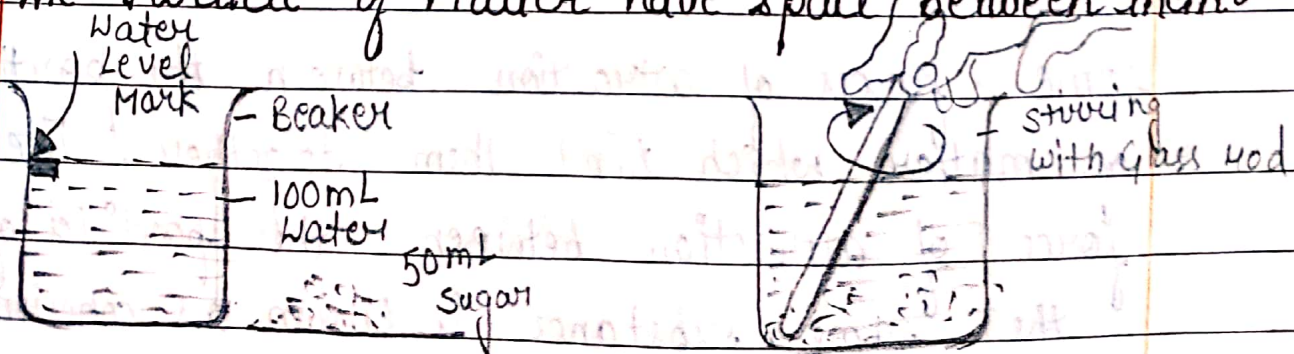
Concentrated potassium permanganate solution

Take 10 ml of potassium permanganate solution from previous beaker & mix with 90 ml of water in the next beaker



Each potassium permanganate crystal ~~itself~~ must be made up of millions of small particles which keep on spreading & ~~are~~ imparting colour to more & more water these particles must be very small

The Particle of Matter have space between them:-



The space between the particles of water can be shown by performing the following experiment.

We take 100ml of water in a beaker. Even after dissolving 50g of sugar in 100ml of water the volume has not increased. The fact that there is no change in volume on dissolving sugar in water tells us that there are spaces between the particles of water.

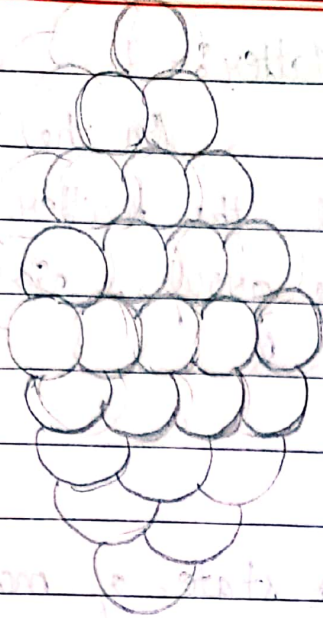
The Particles of Matter are Constantly Moving:-

The best evidence that particles of matter are constantly moving comes from the studies of diffusion & Brownian Motion.

The fragrance of a burning incense stick spread in the entire room very quickly tells us that the particles of matter are constantly moving.

The Particles of Matter Attract Each Other:-

There are some forces of attraction between the particles of matter which bind them together. The force of attraction between the particles of the same substance is known as cohesion.



The force of attraction is maximum in the particle of solid matter & minimum in the particle of gaseous matter.

Rigid & Fluid :-

Rigid means unbending or inflexible. Fluid means a material which can flow easily & requires a vessel to keep it. A solid is a rigid form of matter. A liquid is a fluid form of matter which occupies the lower part of the container in which it is kept. A liquid doesn't fill the whole container. A gas is a fluid form of matter which fills the whole container in which it is kept. Liquid & gases are known as fluid. The characteristic of liquid & gases of flowing easily is called fluidity.

per unit volume
many particles
lie density.

Classification of Matter:-

On the basis of physical states all the matter can be classified into three groups. solid, liquid and gases.

Solid:-

A solid is a state of matter characterized by particles arranged such that their shape & volume are relatively stable.

Properties of Solid:-

- i) Solid have a fixed shape & fixed volume.
- ii) Solid can not be compressed.
- iii) Solid have higher density.
- iv) Solid don't flow.

~~Solid &~~

Liquid:-

A liquid is a sample of matter that conforms to the shape of the container in which it is held & which acquires a free surface in the presence of gravity.

Properties of Liquid:-

- i) Liquids have a fixed volume but they have no fixed shape.
- ii) Like solids, liquid can't be compressed.
- iii) Liquid do not fill their container completely.

Gases:-

A gas is defined as a state of matter consisting of particles that have neither a defined volume or defined shape.

Properties of Gases:-

- i) Gases have neither a fixed shape nor a fixed volume.
- ① Gases can be compressed easily.
- ② Gases have very low density.
- ③ Gases fill their container completely.

Difference between solid, liquid & gases:-

The space between the particles are the minimum in solids, a little more in liquids & the maximum in gases.

The force of attraction between the particles are the strongest in solids, less strong in liquid & negligible in gas.

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③ The moment of particles is the minimum in solids, more in liquid & the maximum in gases.

Diffusion:-

The spreading out & mixing of a substance with another substance due to the motion of its particles is called diffusion. Diffusion is a property of matter which is based on the motion of its particles. Diffusion is fastest in gases & slowest in solids. The rate of diffusion increases on the increasing temperature of the diffusion substance. The phenomena of diffusion tells us that the particles of matter are constantly moving.

Diffusion in gases:-

Diffusion in gases is very fast, because the particles in gases move very quickly in all directions. The rate of diffusion of a gas depends on its density. Light gases diffuse faster than heavy gases.

Example:- (i) The smell of food being cooked in

the kitchen reaches us even from a considerable distance.

- (ii) The fragrance of burning incense stick of ~~burn~~ spread all around due to the diffusion of its smoke into the air.

Diffusion in liquids:-

Diffusion in liquid is slower than that in gases.

- Ex:- (i) The spreading of purple colour of potassium permanganate into water on its own is due to the diffusion of potassium permanganate particle into water.

Note:- Carbon Dioxide gas & oxygen gas present in the atmosphere diffused into water lakes, river and sea dissolve in it.

Diffusion in solid:-

Diffusion in solids is a very-very slow process.

- Ex:- (i) If two metals blocks are bound together tightly & kept undisturbed for a few year. Then, the particles of one metal are found to have diffused into the other metal.

- ✓ 1. What are the conditions for 'something' to be called 'matter'?
- ✓ 2. Name two processes which provide the best evidence for the motion of particles in matter.
- ✓ 3. Which single term is used to describe the mixing of copper sulphate and water kept in a beaker, on its own?
- ✓ 4. When sugar is dissolved in water, there is no increase in the volume. Which characteristic of matter is illustrated by this observation?
- ✓ 5. Even two or three crystals of potassium permanganate can impart colour to a very large volume of water. Which characteristic of particles of matter is illustrated by this observation?
- ✓ 6. When an incense stick (*agarbatti*) is lighted in one corner of a room, its fragrance spreads in the whole room quickly. Which characteristic of the particles of matter is illustrated by this observation?
- ✓ 7. A piece of chalk can be broken into small particles by hammering but a piece of iron cannot be broken into small particles by hammering. Which characteristic of the particles of matter is illustrated by these observations?

8. What is the scientific name of particles which make up matter ?
 9. Name the process by which a drop of ink spreads in a beaker of water.



At start

After an hour

After a day

These pictures show black ink diffusing through a beaker of water.

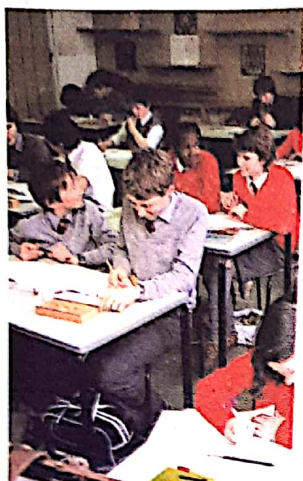
10. What is the general name of :
 (a) rigid form of matter ?
 (b) fluid forms of matter ?
11. Out of solids, liquids and gases, which one has :
 (a) maximum movement of particles ? *Gas*
 (b) maximum interparticle attractions ? *Solid*
 (c) minimum spaces between particles ? *Solid*
12. 'A substance has a definite volume but no definite shape'. State whether this substance is a solid, a liquid or a gas. *liquid*
13. Name the physical state of matter which can be easily compressed. *Gas*
14. 'A substance has a definite shape as well as a definite volume'. Which physical state is represented by this statement ? *Solid*
15. A substance has neither a fixed shape nor a fixed volume. State whether it is a solid, a liquid or a gas. *Gas*
16. Name two gases which are supplied in compressed form in homes and hospitals. *LPG and Oxygen*
17. Write the full forms of the following :
 (a) LPG (b) CNG (c) *Liquid Petroleum Gas* (d) *Compressed Natural Gas*
18. Which of the two diffuses faster : a liquid or a gas ? *Gas diffuses faster*
19. Which of the two diffuses slower : bromine vapour into air or copper sulphate into water ?
20. State whether the following statement is true or false ;
 Red-brown bromine vapour diffuse into air in a gas jar but the colourless air molecules do not diffuse into bromine vapour. *false*
21. A bottle of perfume was opened in a room. The smell of its vapours spread in the entire room. Name the property of gases which is responsible for this behaviour of perfume vapours. *diffusion*
22. If the fish is being fried in a neighbouring home, we can smell it sitting in our own home. Name the process which brings this smell to us. *diffusion*
23. Name one property of liquids and gases which tells us that their molecules are moving constantly. *Diffusion*
24. Fill in the following blanks with suitable words :
 (a) The best evidence that the particles of matter are constantly moving comes from the studies of and
 (b) The smell of perfume gradually spreads across a room due to.....
 (c) Solid, liquid and gas are the three.....of matter.
 (d) At room temperature, the forces of attraction between the particles of solid substances are.....than those which exist in the gaseous state.
 (e) The arrangement of particles is less ordered in the.....state. However, there is no order in the.....state.

Short Answer Type Questions

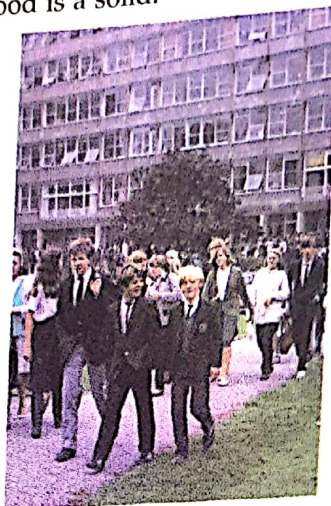
25. State two characteristics of matter demonstrated by :
 (a) diffusion.
 (b) Brownian motion.
26. Name the scientist who studied the movement of pollen grains suspended in water through a microscope. What is this phenomenon known as? *Brownian Motion*
27. When a crystal of potassium permanganate is placed in a beaker, its purple colour spreads throughout the water. What does this observation tell us about the nature of potassium permanganate and water?
28. When a gas jar containing air is inverted over a gas jar containing bromine vapour, the red-brown bromine vapour diffuse into air. Explain how bromine vapour diffuse into air.
29. Describe in your own words, what happens to the particles when salt dissolves in water.
30. Explain why, we can easily move our hand in air but to do the same through a plank of wood, we need a karate expert.
31. Give one example of the diffusion of a solid in another solid.
32. Explain why, the diffusion of a solid in another solid is a very slow process.
33. Which of the following diffuses fastest and which the slowest?
 Solid, Liquid, Gas
 Give reasons for your answer.
34. Explain the following :
 When an incense stick is lighted in the corner of a room, its fragrance spreads quickly in the entire room.
35. Name the three states of matter. Give one example of each. *The Solid state - Ice (35)*
The liquid II = Water
" Gas II - Air
36. State two characteristic properties each of :
 (a) a solid (b) a liquid (c) a gas
37. Why do gases have neither a fixed shape nor a fixed volume?
38. How do solids, liquids and gases differ in shape and volume?
39. Arrange the following substances in increasing order of force of attraction between their particles (keeping the substance having the minimum force of attraction first) :
 Water, Sugar, Oxygen *Water < Sugar < Oxygen*
40. Give two reasons to justify that :
 (a) Water is a liquid at room temperature.
 (b) An iron almirah is a solid.
41. (a) When an incense stick (*agarbatti*) is lighted in one corner of a room, its fragrance quickly spreads in the entire room. Name the process involved in this. *Diffusion*
 (b) A girl is cooking some food in the kitchen. *The* smell of food being cooked *soon* reaches her brother's room. Explain how the smell could have reached her brother's room. *the other room by the drift of gases released in to the during the cooking of*
42. (a) What does the diffusion of gases tell us about their particles?
 (b) Give one example of diffusion of gases in a liquid.
43. Give reason for the following observation :
 The smell of hot sizzling food reaches us even from a considerable distance but to get the smell from cold food, we have to go close to it.
44. Explain how, the smell of food being cooked in the kitchen reaches us even from a considerable distance.
45. Explain why, when a bottle of perfume is opened in a room, we can smell it even from a considerable distance.
46. When a crystal of copper sulphate is placed at the bottom of a beaker containing water, the water slowly turns blue. Why?
47. Honey is more viscous than water. Can you suggest why? *The force of attraction between particles of honey is much more than the of attraction between the particles of water.*
48. Explain why :
 (a) air is used to inflate tyres.
 (b) steel is used to make railway lines.
49. Explain why, diffusion occurs more quickly in a gas than in a liquid.

Long Answer Type Questions

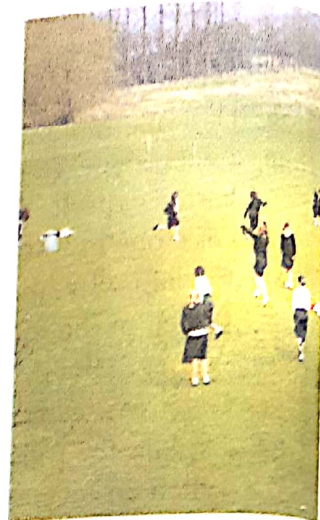
50. (a) What is meant by 'diffusion'? Give one example of diffusion in gases. *very quickly in all directions*
 (b) Why do gases diffuse very fast? *because the particles in gases move*
 (c) Name two gases of air which dissolve in water by diffusion. What is the importance of this process in nature?
51. (a) Compare the properties of solids, liquids and gases in tabular form.
 (b) Give two reasons for saying that wood is a solid.



During class, the students resemble molecules in a solid (because they are very close to one another)



While going from one classroom to another the students resemble molecules in a liquid (because they are a little more far apart from one another)



And in the playground students resemble molecules in a gas (because they are very, very far apart from one another)

52. (a) Why does a gas exert pressure?
 (b) Why does a gas fill a vessel completely?
 (c) Why are gases so easily compressible whereas it is almost impossible to compress a solid or a liquid?
53. (a) Define matter. Give four examples of matter.
 (b) What are the characteristics of matter?
54. (a) What is Brownian motion? Draw a diagram to show the movement of a particle (like a pollen grain) during Brownian motion.
 (b) In a beam of sunlight entering a room, we can sometimes see dust particles moving in a haphazard way in the air. Why do these dust particles move?

Multiple Choice Questions (MCQs)

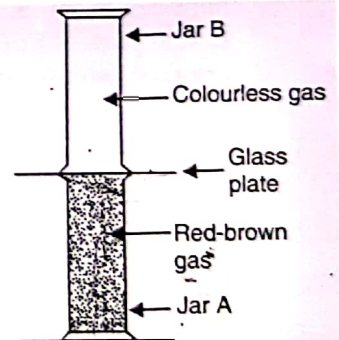
55. When a crystal of potassium permanganate is placed at the bottom of water in a beaker, the water in the whole beaker turns purple on its own, even without stirring. This is an example of :
 (a) distribution (b) intrusion (c) diffusion (d) effusion
56. Which one of the following statement is correct in respect of fluids?
 (a) only gases behave as fluids (b) gases and solids behave as fluids
 (c) gases and liquids behave as fluids (d) only liquids are fluids
57. A few substances are arranged in the increasing order of 'forces of attraction' between their particles. Which one of the following represents the correct arrangement?
 (a) water, air, wind (b) air, sugar, oil (c) oxygen, water, sugar (d) salt, juice, air
58. In which of the following conditions, the distance between the molecules of hydrogen gas would increase?
 (i) increasing pressure on hydrogen contained in a closed container
 (ii) some hydrogen gas leaking out of the container
 (iii) increasing the volume of the container of hydrogen gas
 (iv) adding more hydrogen gas to the container without increasing the volume of the container
 (a) (i) and (iii) (b) (i) and (iv) (c) (ii) and (iii) (d) (ii) and (iv)

MATTER IN OUR SURROUNDINGS

59. Out of the following, an example of matter which can be termed as fluid is :
 (a) carbon (b) sulphur (c) oxygen (d) phosphorus
60. The best evidence for the existence and movement of particles in liquids was provided by :
 (a) John Dalton (b) Ernest Rutherford (c) J.J. Thomson (d) Robert Brown
61. A form of matter has no fixed shape but it has a fixed volume. An example of this form of matter is :
 (a) krypton (b) kerosene (c) carbon steel (d) carbon dioxide
62. Which of the following statement is incorrect ?
 (a) the particles of matter are very, very small
 (b) the particles of matter attract one another
 (c) the particles of some of the matter are moving constantly
 (d) the particles of all the matter have spaces between them
63. When a gas jar full of air is placed upside down on a gas jar full of bromine vapours, the red-brown vapours of bromine from the lower jar go upward into the jar containing air. In this experiment :
 (a) air is heavier than bromine
 (b) both air and bromine have the same density
 (c) bromine is heavier than air
 (d) bromine cannot be heavier than air because it is going upwards against gravity
64. When a gas jar containing colourless air is kept upside down over a gas jar full of brown-coloured bromine vapour, then after some time, the brown colour of bromine vapour spreads into the upper gas jar making both the gas jars appear brown in colour. Which of the following conclusion obtained from these observations is incorrect ?
 (a) bromine vapour is made of tiny particles which are moving
 (b) air is made up of tiny particles which are moving
 (c) the particles of bromine are moving but those of air are not moving
 (d) even though bromine vapour is heavier than air, it can move up against gravity
65. Which one of the following statements is not true ?
 (a) the molecules in a solid vibrate about a fixed position
 (b) the molecules in a liquid are arranged in a regular pattern
 (c) the molecules in a gas exert negligibly small forces on each other, except during collisions
 (d) the molecules of a gas occupy all the space available

Questions Based on High Order Thinking Skills (HOTS)

66. Look at the diagram on the right side. Jar A contains a red-brown gas whereas jar B contains a colourless gas. The two gas jars are separated by a glass plate placed between them
 (a) What will happen when the glass plate between the two jars is pulled away?
 (b) What name is given to the phenomenon which takes place ?
 (c) Name the brown gas which could be in jar A.
 (d) Which is the colourless gas most likely to be present in jar B ?
 (e) Name one coloured solid and one colourless liquid which can show the same phenomenon.
67. Bromine and air take about 15 minutes to diffuse completely but bromine diffuses into a vacuum very rapidly. Why is this so ?
68. Bromine particles are almost twice as heavy as chlorine particles. Which gas will diffuse faster ; bromine (vapour) or chlorine ? Explain your answer.
69. Why is a liquid (the hydraulic fluid) used to operate the brakes in a car ?
70. Explain why, a small volume of water in a kettle can fill a kitchen with steam.
71. Explain why, osmosis can be considered to be a special kind of diffusion. Classify the following into (i) osmosis, and (ii) diffusion :
 (a) swelling up of a raisin on keeping in water
 (b) spreading of virus on sneezing



- (c) earthworm dying on coming in contact with common salt
 (d) shrinking of grapes kept in thick sugar syrup
 (e) preserving of pickles in salt
 (f) spreading of smell of cake being baked in the kitchen
 (g) aquatic animals using oxygen dissolved in water during respiration
72. A student placed a gas jar containing air in the upside down position over a gas jar full of red-brown bromine vapours. He observed that the red-brown colour spread upwards into the jar containing air. Based on this observation, the student concluded that it is only the bromine vapour which moves up and diffuses into air in the upper jar, the air from the upper jar does not move down by diffusion into the lower jar containing bromine vapours. Do you agree with this conclusion of the student? Give reason for your answer.
73. An inflated balloon full of air goes down slowly (becomes smaller and smaller slowly) even though the knot at the mouth of the balloon is airtight. And after a week all the air has escaped from the balloon. Explain how the air particles got out of the balloon.
74. When extremely small particles X derived from the anther of a flower were suspended in a liquid Y and observed through a microscope, it was found that the particles X were moving throughout the liquid Y in a very zig-zag way. It was also observed that warmer the liquid Y, faster the particles X moved on its surface.
- What could particles X be?
 - What do you think liquid Y is?
 - What is the zig-zag movement of X known as?
 - What is causing the zig-zag movement of particles X?
 - Name the scientist who discovered this phenomenon.
 - What does this experiment tell us about the nature of liquid Y?
75. When a beam of sunlight enters a room through a window, we can see tiny particles X suspended in a gas (or rather a mixture of gases) Y which are moving rapidly in a very haphazard manner.
- What could particles X be?
 - Name the gas (or mixture of gases) Y.
 - What is the phenomenon exhibited by particles X known as?
 - What is causing the movement of particles X?
 - What conclusion does the existence of this phenomenon give us about the nature of matter?

ANSWERS

2. Diffusion and Brownian motion 3. Diffusion 4. The particles of a liquid (here water) have spaces between them 5. Each crystal of potassium permanganate must be made up of millions of small particles 6. The particles of matter are constantly moving in all the directions 7. The particles of matter attract one another (some attract less as in the case of chalk but some attract much more as in the case of iron) 8. Atoms or Molecules 9. Diffusion 10. (a) Solid (b) Liquid and Gas 19. Copper sulphate into water 20. False 21. Diffusion 22. Diffusion 23. Diffusion 24. (a) diffusion; Brownian motion (b) diffusion (c) states (d) much more (e) liquid; gaseous 39. Oxygen < Water < Sugar 47. The force of attraction between the particles of honey is much more than the force of attraction between the particles of water 55. (c) 56. (c) 57. (c) 58. (c) 59. (c) 60. (d) 61. (b) 62. (c) 63. (c) 64. (c) 65. (b) 66. (a) The red-brown gas will diffuse from jar A into colourless gas in jar B due to which its red-brown colour will also spread into jar B (b) Diffusion (in gases) (c) Bromine vapour (d) Air (e) Potassium permanganate and Water 67. Bromine diffuses slowly into air because the motion of bromine molecules is obstructed due to the collisions with the moving molecules of air. Bromine diffuses very rapidly into vacuum because there is 'nothing' in the vacuum to oppose the motion of bromine molecules 68. Chlorine will diffuse faster than bromine vapour. This is because light molecules diffuse faster than heavy molecules 69. The particles in a liquid (the brake oil) can move freely without being compressed much and hence transmit the pressure applied on brake pedal to the brake drum (on moving wheel) efficiently 70. The steam is gaseous form of water. The molecules of water in steam move very rapidly in all directions and fill the whole kitchen space with steam. Gases (including steam) fill their container completely 71. In both, diffusion as well as osmosis, there is movement of particles from a region of higher concentration to a region of lower concentration. Diffusion can take place without there being a membrane or through a permeable membrane (which allows both solvent particles as well as solute particles to pass through it). Osmosis takes place only