CBSE

Matter in Our Surroundings

for Class- IX

Super Short Tricky Chemistry By
Er. Jitendra Gupta Sir

Conceptual Notes for NTSE/KVPY/Olympiad/Boards

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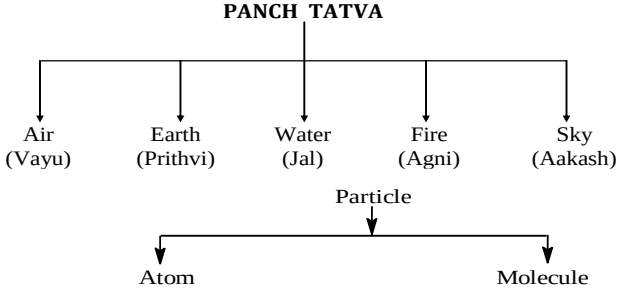
Introduction:

➢ **Matter :**

- Everything in this universe is made of materials which scientist has names 'matter'.
- Early Indian philosopher classified matter into five basic elements. the "Panch Tatva"– air, earth, fire, sky and water. According to them, living as well as non living things are made up of these elements.
- The matter is anything that occupies space & has mass.
- Particles of matter attract each other.
- For example : The air we breathe, the food we eat, stones, clouds, stars, plants and animals, even a small drop of water or a particle of sand everything is matter.



➢ **Physical Nature of Matter :** Is matter continuous or particulate ? - Matter is particulate in nature.

➢ **What is the size of these particles?**

- The matter is made up of very small tiny <u>particles</u>. It is not continuous but is particulate .
- These particles of matter are too small so they cannot be seen by naked eyes or simple microscope.
- Particles of matter are continuously moving as they posses kinetic energy, with the increase of temperature kinetic energy of particles also increases so particle moves faster.

➢ **Brownian Motion(By Robert Brown) :** The zig-zag or random path travelled by the particles of matter is called Brownian motion. For example - dust moves randomly because the random moving particles of air collide with dust particles.

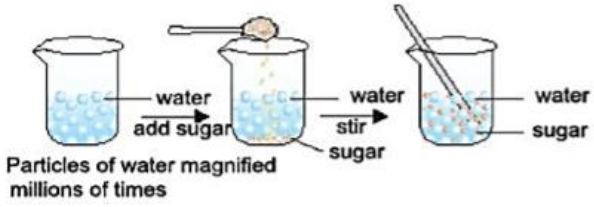
➢ **Characteristics of matter :** All matter consists of small particles of matter. These particles have some common characteristics. These characteristics are laid down in a theory called **Kinetic Theory of Matter**.

- Matter is made up of small particles called atoms.
- These particles are too small to be observed with naked eye.
- These particles are constantly moving constantly.
- These particles have spaces between them.
- Particles of matter attract each other because of the force of attraction.

1. Particles of Matter have spaces between them : Matter is made up of small particles. These particles have small spaces between them. These spaces are invisible to the naked eye, But particles of other matter can get between these spaces without increase in volume.

Have you ever wondered what causes salt to get dissolved in water ?

Salt gets dissolved in water because their particles have spaces between them. The particles of the salt get in between the spaces between the particles of water and a mixture is formed.



2. Particles of Matter are continuously moving :

Particles of matter are in **motion** all the time. Hence, they possess **kinetic energy.**

Particles present in matter move continuously. The particles of matter shown **three types** of **motion.**

- **Translatory Motion –** When particles move in straight lines, changing direction without loss of energy on colliding with another particle or the wall of the container, the motion is called translatory motion.

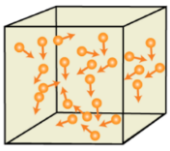
Translatory motion is maximum in gases & the least in solids when compared to liquids.

- **Rotational Motion –** When particles move around their own axis, the motion is called rotational motion. This motion is similar to the rotation of earth around its axis.

Rotational motion will be high in gases and in liquids.

- **Vibrational Motion** – When particles have a to and fro motion about a mean position, the motion is called Vibrational motion.

This motion is maximum in solids as the particles are held in a rigid structure.



Kinetic Energy – Energy due to motion.

The particles of a matter intermix on their own with other particles of a matter.

For Example- Salt in water, Various gases in the air, Ink in water.

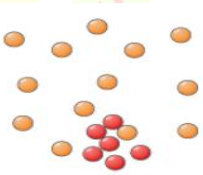
Diffusion – The process of mixing two different types of particles together is called diffusion.

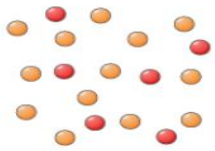
Diffusion becomes faster on heating.

Activity/Examples :Applications of Diffusion -

(i) 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.
- This shows that the particles have spaces between them and are continuously moving on their own.


Before diffusion


After diffusion

(ii) Mixing of two gases:

- Fragrance of an incense stick (agarbatti) lightened in one corner of a room, spreads in the whole room quickly.
- The particles of gases (or vapours) produced by burning the incense stick move rapidly in all directions and mix with the moving particles of air in the room.
- This also shows that the particles of matter are constantly moving.

(iii) Diffusion in Solids: Diffusion in solids is a very, very slow process.

Examples–: The smell of food being cooked in the kitchen reaches us even from a considerable distance.

Note : Gases diffuse very rapidly. The rate of diffusion of a gas varies inversely as the square root of its density.

3. Particles of Matter attract each other :

- The particles of matter are always held together because of a force of attraction between them.
- The force with which they attract each other varies from matter to matter. In some kinds of matter the force is small. In other kinds of mater the force is large.
- Solids have the highest force of attraction. That is why we cannot move our hands through a solid object. The particles are so tightly bound.
- Similarly, particles of gases have the least force of attraction in them. We can move our hands easily in the air, can't we? This is because the particles of air are loosely bound.
- We can also move our hands through water or liquid matter but not as freely as we can in the air. This means that they are also loosely bound to some extent.
- The force of attraction between particles of solid, liquid and gas can be arranged in decreasing order as follows- Solid > Liquid > Gas

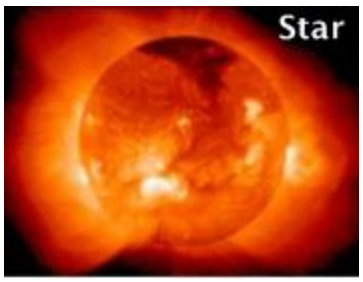
➢ **Force of Attraction (or Cohesion):** There is some force of attraction between the particles of the matter which bind them together. This force of attraction between the particles of same substance is known as force of attraction (or cohesion).

States Of Matter : The Five States of Matter -

- we have discussed the three states of matter – Solid, Liquid, Gas.
- But, scientists have discovered that there are two more states of matter – Plasma & Bose-Einstein Condensate

➢ **Plasma :** It is a state of matter in which the particles are super excited and super energetic. They are in the form of ionized gases.

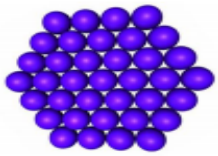
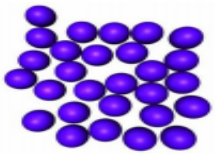
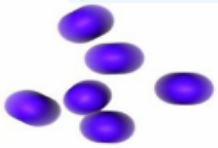
- Plasma state is a ionic state of matter that is present at very high temperatures 10^7 K.
- A plasma is a very good conductor of electricity and is affected by magnetic fields.
- **For Example** – Fluorescent tubes and neon light bulbs consist of plasma.
- In fact, the Sun and the stars glow because they plasma is present in them.



➢ **Bose-Einstein Condensate (BEC):**

- It is the fifth state of matter discovered by Albert Einstein on the basis of the studies conducted by an Indian scientist *Satyendra Nath Bose* .
- BEC is formed by cooling a gas of extremely low density to super low temperatures.
- Particles are less energetic than solids because Exist at very low temperature.
- BEC shows super fluidity because Particles can flow without friction.

➢ **Comparison of some important characteristics of solids, liquid and gas :**

S.N	Solid	Liquid	Gas
1.	Definite shape	Indefinite shape	Indefinite shape
2.	Definite volume	Definite volume	Indefinite volume
3.	Maximum force of attraction between particles	Less forces of attraction between particles compare to solid	Negligible force of attraction between particles
4.	Cannot be compressed	Cannot be compressed	Can be compressed
5.	Kinetic energy of particles is minimum	Kinetic energy of particles is more than solid	Kinetic energy of particles is maximum
6.	Particles cannot move rather they vibrate only at their fixed position	Particles can slide over one another	Particles can move freely
7.	Highest density	Density is lower than solid	Lowest denisty
8.	Cannot flow	Flow	Flow
9.	Solids show only slight expansion on heating.	Liquids show slight expansion on heating but more than solids.	Gases expand considerably on heating.
10.			

➢ **Rigid And Fluid:**

Rigid : Rigid means 'unbending' or 'inflexible'. A stone is rigid because it is unbending or inflexible.

Fluids : Fluid means 'a material which can flow easily' and requires a vessel to keep it.

- A solid is a rigid form of matter. Due to their rigidity, solids have a tendency to maintain their shape when subjected to outside force. Thus, the main identifying characteristic of solids is their rigidity. Solids do not require a container to keep them. A brick and a log of wood are two common solids.
- A liquid is a fluid form of matter which occupies the lower part of the container. Being fluids, liquids require a container to keep them. A liquid has a well-defined surface, so a liquid can be kept in an open container. The liquid will not escape from the open container by itself. Water and milk are two common liquids around us.
- A gas is a fluid from of matter which fills the whole container in which it is kept. Being fluids, gases also require a container to keep them. A gas does not have a free surface, so a gas has to be kept in a closed container. A gas will escape if kept in an open container. This is why gases are usually kept in air-tight gas cylinders. For example, cooking gas (LPG) is kept in air-tight metal cylinders.
- From this discussion we conclude that both, liquids and gases are known as fluids. Characteristic of liquids and gases of 'flowing' easily is called 'fluidity'. Due to fluidity, liquids and gases change their shapes readily when subjected to outside force.

✍ *Change of State of Matter* **:**Water exists in three states :

(i) Ice – solid
(ii) Water – liquid
(iii) Water Vapour – Gas

$$\text{solid} \underset{\text{freeze}}{\overset{\text{heat}}{\rightleftharpoons}} \text{liquid} \underset{\text{cool}}{\overset{\text{heat}}{\rightleftharpoons}} \text{gas}$$

Physical states of matter can be interconvert into each other by following two ways:

1. By changing the temperature **2.** By changing the pressure

➢ **Effect of Change of Temperature : What happens to matter when we heat it ?**

1. Solids :

- As we heat solids, the kinetic energy between the particles of solids increases which decreases the force of attraction between them.
- They start vibrating and changing their positions. Slowly, due to heat the particles become free and a solid converts into liquid.
- **Melting Point –** The temperature at which solid melts to become a liquid at atmospheric pressure. For Example - the melting point of ice is 273.16 Kelvin.
- **Melting (Fusion) –** The process of melting of a solid into liquid is called Fusion.
- **Latent Heat of Fusion –** The amount of heat energy required to change 1 kg of a solid into liquid at atmospheric pressure at its melting point is known as the Latent Heat of Fusion.
- **Atmospheric Pressure –** Pressure exerted by the weight of the atmosphere.

2. Liquids:

- Just like in solids, the kinetic energy of particles of liquid increases, the force of attraction among them decreases and they start moving freely.
- As we keep on supplying the heat, a point comes when the particles overcome the forces of attraction completely.
- This is when a liquid starts changing into gas.
- **Boiling Point -** The temperature at which a liquid starts boiling at the atmospheric pressure is known as its Boiling Point. For Example- The boiling point of water is 100° C = 273 + 100 = 373 K .

Boiling (Vaporization):

- The process in which a liquid substance changes into a gas rapidly on heating is called boiling.
- The temperature at which a liquid boils and changes rapidly into a gas at atmospheric pressure is known as boiling point of a liquid. **Or**
  Temperature at which vapour pressure of liquid is equal to the atmospheric pressure
- **Latent Heat of Vaporization –** the amount of heat energy required to change 1 kg of a liquid into a gas at atmospheric pressure at its boiling point is known as Latent Heat of Vaporization.

➢ **Difference b/w Latent Heat of Fusion & Vaporization -**

➢ **Latent Heat :** Heat which required by substance to change its state without rise of its temperature. It is called latent heat (hidden heat) because it becomes hidden in the substance undergoing the change of state and does not show its presence by raising the temperature.

"The hidden heat which breaks the force of attraction between the molecules during change of state."

Fusion	Vaporisation
Heat energy required to change 1kg of solid into liquid.	Heat energy required to change 1kg of liquid to gas at atmospheric pressure at its boiling point.

Example - It has been found by experiments that 3.34×10^5 **J** of heat is required to convert 1 kg of ice in water at same temperature (0°C). So, latent heat of fusion of ice is 3.34×10^5 **J/ Kg.**

Different substances have different *Latent Heat of Fusion* ***or*** *Latent Heat of vaporization.*

What happens when we decrease the temperature ?

1. Gases:

- The kinetic energy between the particles decreases and they turn into a liquid state.
- **Condensation / Liquefaction –** The process of converting a gas into a liquid by cooling down its temperature.
  I. It is the reverse of vaporization. (Boiling)
  II. For Example - The formation of clouds is due to condensation of water vapour from Earth.

2. Liquids:

- The kinetic energy between the particles decreases and they turn into a solid state. For Example -The formation of ice.
- **Sublimation : –** " The changing of a solid directly into vapours on heating, and of vapours into solid on cooling is known as sublimation." $\text{Solid} \underset{\text{Cooling}}{\overset{\text{Heating}}{\rightleftharpoons}} \text{Vapour (or Gas)}$

  The common substance which undergo sublimation are : Ammonium chloride, Iodine, Comphor, Naphthalene and Anthracene etc.
  Another example of sublimation is provided by solid carbon dioxide (which is commonly known as dry ice).
  Solid carbon dioxide (or dry ice) sublimes to form carbon dioxide gas.

Note : Evaporation Vs Boiling :-

Boiling is a bulk phenomenon. Particles from the bulk (whole) of the liquid change into vapour state.
Evaporation is a surface phenomenon. Particles from the surface gain enough energy to overcome the forces of attraction present in the liquid and change into the vapour state.

Effect of change of Pressure :

- By applying pressure, we can bring the particles of matter close to each other thereby, increasing the force of attraction among the particles.
- When we compress and decrease the temperature of a gas, the gas changes into a liquid.
- **Dry Ice –** Solid carbon dioxide (CO_2) is stored under high pressure. Solid CO_2 gets converted directly to gaseous state on decrease of pressure to 1 atmosphere without coming into liquid state. This is the reason that solid carbon dioxide is also known as dry ice.

Evaporation : – The phenomenon of change of a liquid into vapours at any given temperature below its boiling point is called Evaporation. Evaporation is different than boiling.

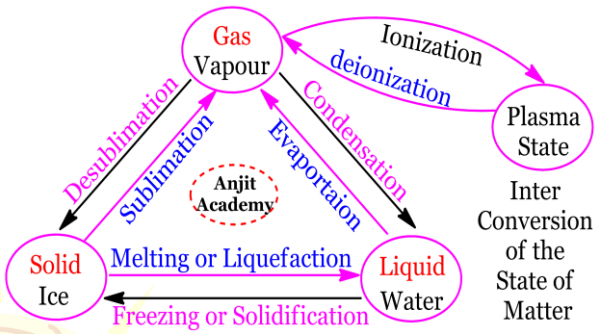
- Bubble cannot Form - If Atmospheric Pressure > Vapour Pressure
- Bubble can Form & Rise - If Atmospheric Pressure = Vapour Pressure

➢ **Factors Affecting Evaporation:**

S.N	Condition	Rate of Evaporation	Reason
1.	Increase in Surface Area	Increases	Particles have more space and thus can evaporate easily
2.	Increase in temperature	Increases	Kinetic energy among the particles increases
3.	Increase in humidity	Decreases	Water content in air increases and so evaporation decreases
4.	Increase in wind speed	Increases	Water vapours are blown away by winds allowing more evaporation

➢ **Inter Conversion of The State Of Matter : State of Matter change Triangle -**

The terms involved	Process of change from – (at particular temp.)
Melting	Solid state ⟶ liquid state
Vaporization	Liquid state ⟶ gaseous state
Liquefaction	Gaseous state ⟶ liquid state
Solidification	Liquid state ⟶ solid state
Sublimation	Solid state ⟶ gaseous state
Freezing	Liquid ⟶ solid
Boiling	Liquid state ⟶ gaseous state

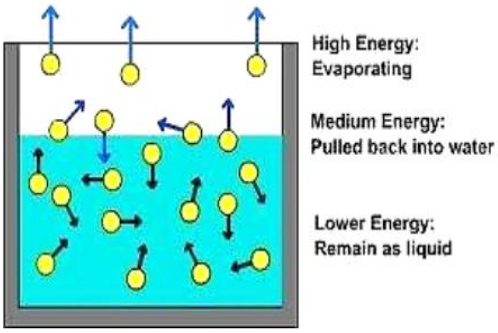


How does evaporation causes cooling ?

The process of evaporation uses the energy of the liquid particles. Therefore, the particles absorb energy from the surroundings in order to compensate the energy that is being lost in the process of evaporation. This results in cooling of the surrounding area.

For Example :

- Our palms feel cool when we put some acetone (nail paint remover) on it.
- People sprinkle water on their roofs or ground on sunny days to cool the area.
- We are able to sip hot tea faster in a saucer than in a cup.



➢ **Why people wear cotton clothes in summer ?**

We perspire more in summer. As the sweat evaporates it takes energy from our body surface and keeps our body cool. Cotton can absorb the sweat easily and exposes it to the atmosphere causing evaporation to take place easily. This, in turn, keeps us cool in summer days.

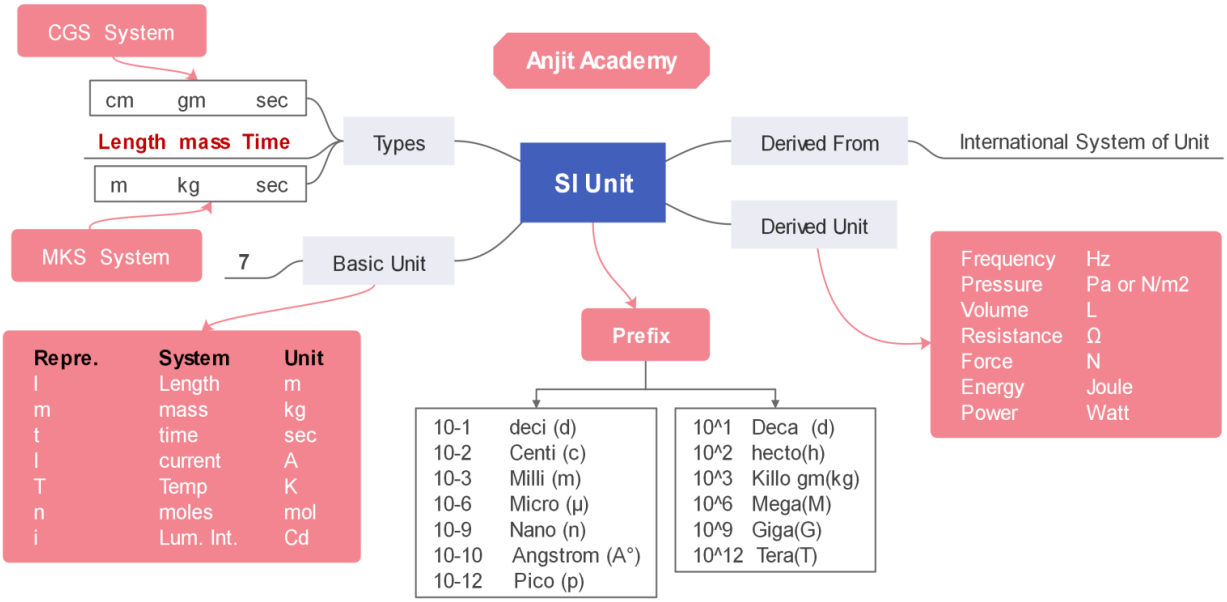
➢ **Why water droplets appear on the surroundings of a glass with ice-cold water ?**

There are water vapours present in the air. When they come in contact with the walls of the glass that has ice-cold water in it they condense. As a result, their state changes from gaseous state to liquid state thus forming tiny water droplets on the walls of the glass.

Important Measurement Units :

S.N	SI Unit of Mass	Kg (Kilogram)
1.	SI unit of Volume	m^3 (cubic meters)
2.	Common unit of Volume	L (Litters)
3.	SI unit of **Temperature**	Kelvin ; 0^O C = 273.16 K or 273 K (approximately) Kelvin = Celsius + 273
4.	Si unit of Pressure	Pa (Pascal)
5.	For measuring pressure exerted by Gas	Atmosphere (atm.) ∵ 1 atm = 1.01 x 10^5 Pa Normal Atmospheric Pressure = 1 atm. (at sea level)

Some Important Measurements & SI Units :



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Very Short Answer Type Questions - 1 Mark

1. What is matter?
2. What is the composition of matter?
3. What is the inter particle space?
4. How many states of matter are there?
5. Rate of diffusion depends on?
6. Why rate of diffusion is maximum in gas in comparison to sold & liquid?
7. What is rigid substance?
8. What is condensation?
9. What is sublimation?
10. Conversion of solid to gas is called?
11. Give two reasons for saying that wood is a solid.
12. 'A substance has a definite volume but no definite shape'. State whether this substance is a solid, a liquid or a gas.
13. Name the physical state of matter which can be easily compressed.
14. 'A substance has a definite shape as well as a definite volume'. Which physical state is represented by this statement?
15. A substance has neither a fixed shape nor a fixed volume. State whether it is a solid, a liquid or a gas.
16. Mention the CGS unit of mass.
17. Define diffusion.
18. Which states of matter are called fluids?
19. Give the CGS unit of density.
20. What is the physical state of water at 37^0 C ?

Short Answer Type Questions - 2 Marks

1. Why do gases have neither a fixed shape nor a fixed volume?
2. Why the wet clothes dry up very slowly in a humid air?
3. Why does our palm feel cold when we put some acetone (or perfume) on it?
4. Why does the temperature remain constant during the melting of ice even though heat is supplied continuously?
5. 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, Aluminum, Oxygen
6. Define diffusion with example?
7. Write some differences between rigid and fluid
8. How evaporization cause cooling?
9. In which state of matter, particles exert more pressure and why?
10. (a) What happens when camphor is subjected to heating? (b) Name the process.
11. Solids are rigid while liquids and gases are fluids. Explain.
    (a) Express the freezing point and boiling point of water in Kelvin scale.
    (b) Which state of matter possesses more heat energy at boiling point of water?
12. What happens when dry ice is stored in a closed container ? Give reason.
13. Two person X and Y working in kitchen got burns due to boiling water and steam respectively.
    (a) Which person gets affected more? (b) Explain with reason
14. (i) The diffusibility of which physical state of matter is greater?
    (ii) While Anu's mother was cooking a food item, Anu could get the smell even when she was quite far away. Why?
    (iii) When the same food item was packed in a lunch box, Anu could get only a faint smell when she opened the box during lunch time. How do you explain this? ❖❖❖

CBSE

Matter in our Surroundings

For Class - IX

Super Short Tricky Chemistry By
Er. Jitendra Gupta sir

Marks = 24 | Date : 20/05/2020 | Time = 45 Min.

General Instructions-

- Every question is compulsory.
- Keep answer copy neat and clean.
- use of calculator, slide rule, graph paper & trigonometric tables is Not Permitted.

Section-'A' Each Quetions-1 Mark

1. Define Latent heat of vaporisation.
2. Explain why temperature remain constant during the change of state of any substance?
3. Define Sublimation with examples.
4. Do we sweat more on a dry day or humid day ? Justify your reason.
5. Why do we see water droplets on the outer surface of a glass containing ice cold water?
6. Convert the following temperature to the Kelvin scale (a) 25°C (b) 373°C
7. List two properties that liquids have in common with solids.
8. List two properties that liquids have in common with gases.
9. What will happen to the melting point temperature of ice if some common salt is added to it? Justify your answer.
10. How will you show that air has maximum compressibility?

Section-'B' Each Questions 2-Mark.

1. Define the term (a) Latent heat of fusion (b) Latent heat of vaporization
2. State the effect of (i) surface area (ii) nature of the liquid on the rate of evaporation.
3. Liquids generally have lower density as compared to solids. But you must have observed that ice floats on water. Why?
4. What is the physical state of water at 250°C, 100°C, 0°C ?
5. Give reasons :
(i) A sponge can be pressed easily; still it is called a solid.
(ii) Water vapours have more energy than water at same temperature.
6 . What are intermolecular forces ? How are these related to the three states of matter ?
7. Is it possible to liquefy atmospheric gases ? If yes, suggest a method.

High Order Thinking (HOT) Problems
(For Home Work ONLY)

Q1. What is the common name of solid carbon dioxide?
Q2. What is meant by saying that the latent heat of ice is 3.34 × 105 J/kg?
Q3. State two conditions necessary to liquefy a gas.
Q4. Why does temperature remain constant during the boiling of water even though heat is being supplied continuously?
Q5. Why does desert cooler cool better on a hot, dry day?
Q6. Why does the naphthalene balls kept in stored clothes in our home disappear over a period of time?
Q7. Why do gases neither have fixed volume nor fixed shape?
Q8. How does the smell of food being cooked in the kitchen reaches us even from a considerable distance?
Q9. Explain why does diffusion occurs more quickly in gases than in liquids?

*** *With Best Wishes* ***

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☎आपका परिश्रम + हमारा मार्गदर्शन = निश्चित सफलता ☎
❖❖❖