

# LIQUID STATE

For  
B.Sc Chemistry(Part-II)  
Physical Chemistry  
Paper-III  
Lecture-04



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# Liquid State

## Contents:

- **Refractive index**
- **Idea of liquid crystals**

# Refractive index

- The refractive index is determined by measuring the deviation of a laser beam passed through a cylindrical cuvette containing the test liquid.

## Factors affecting refractive index depends:

- Refractive index of a medium depends upon the refractive index of the surroundings when you consider the light ray passing from the surrounding into the medium, optical density, wavelength of the light and temperature

## How do you measure refractive index?

- Using the Refractometer to **measure Refractive Index**
- As a ray of light passes from air into a block of glass, the direction in which it is travelling is changed. The path is bent. The amount of bending that takes place depends on the nature of the glass and the wavelength of the light being used.

# Refractive index

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## Measurement of refractive index :

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# Refractive index

## Relation between Refractive index and density

Refractive index is directly proportional to density.

- If the density of the medium increases then refractive index of that medium also increases. However, of course there are some exceptions like water.
- Velocity of the light in a medium is inversely proportional to the refractive index of that medium.
- The index of refraction value of a material is a number that indicates the number of times slower that a light wave would be in that material than it is in a vacuum.
- The index of refraction value increases, the optical density increases, and the speed of light in that material decreases.

# Refractive index

- The higher the refractive index the slower the light travels, which causes a correspondingly increased change in the direction of the light within the material. What this means for lenses is that a higher refractive index material can bend the light more and allow the profile of the lens to be lower.

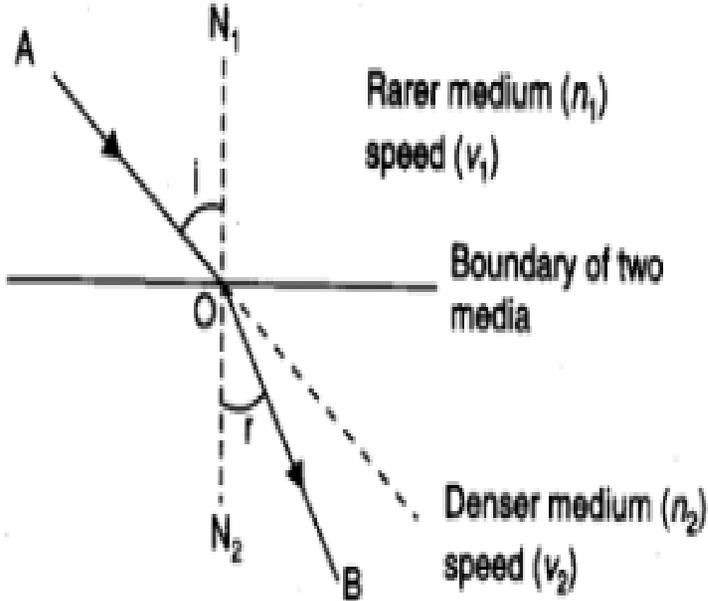
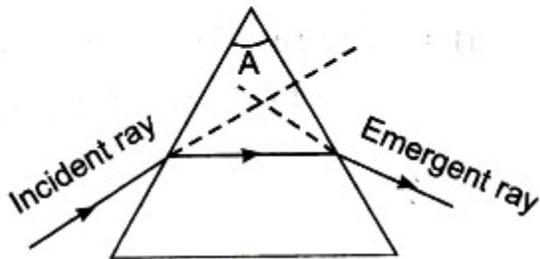
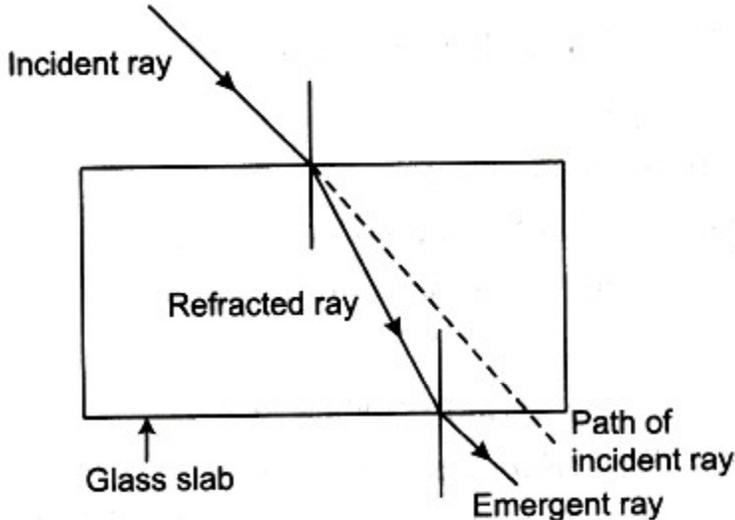
Index of Refraction for common Liquids

| <b>Fluid</b>               | <b>Refractive Index</b> |
|----------------------------|-------------------------|
| Alcohol, methyl (methanol) | 1.33                    |
| Alcohol, propyl            | 1.38                    |
| Aniline                    | 1.586                   |
| Benzene                    | 1.501                   |

## Index of Refraction in Various media

| Media              | Index of Refraction |
|--------------------|---------------------|
| Vacuum             | 1.00                |
| Air                | 1.0003              |
| Carbon dioxide gas | 1.0005              |
| Ice                | 1.31                |
| Pure water         | 1.33                |
| Ethyl alcohol      | 1.36                |
| Quartz             | 1.46                |
| Vegetable oil      | 1.47                |
| Olive oil          | 1.48                |
| Acrylic            | 1.49                |
| Table salt         | 1.51                |
| Glass              | 1.52                |
| Sapphire           | 1.77                |
| Zircon             | 1.92                |
| Cubic zirconia     | 2.16                |
| Diamond            | 2.42                |
| Gallium phosphide  | 3.50                |

# Refractive index



# Refractive index



The effect can be seen just by poking a stick into the water; at the water surface, the light changes its direction, the stick appears to be bent. Materials with a negative refractive index bend light the "wrong" way.

# Idea of liquid crystals

- Liquid crystals (LCs) are a state of matter which has properties between those of conventional liquids and those of solid crystals. For instance, a liquid crystal may flow like a liquid, but its molecules may be oriented in a crystal-like way.
- A liquid crystal is a state of matter between liquid and solid (a "mesophase").
- Liquid crystals are composed of organic, rod-shaped molecules that align in parallel, and the common types used in electronic displays are nematic, cholesteric and smectic. See LCD, LCD types and LCD categories.

## Important application of liquid crystals

- Display devices like Liquid crystal displays (LCDs) are used in watches, calculators, and laptop computer screens
- For instrumentation in cars, ships, and airplanes

# Idea of liquid crystals

Liquid crystals are made of polymeric organic compounds.

Many liquid crystals are simple polymeric organic compounds because Polymers are flexible.

For example, many proteins and cell membranes are liquid crystals.

Other well-known examples of liquid crystals are solutions of soap and various related detergents, as well as the tobacco mosaic virus, and some clays.

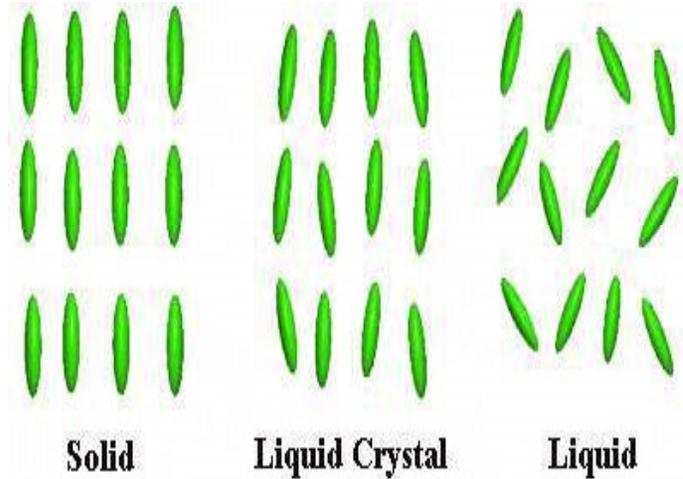
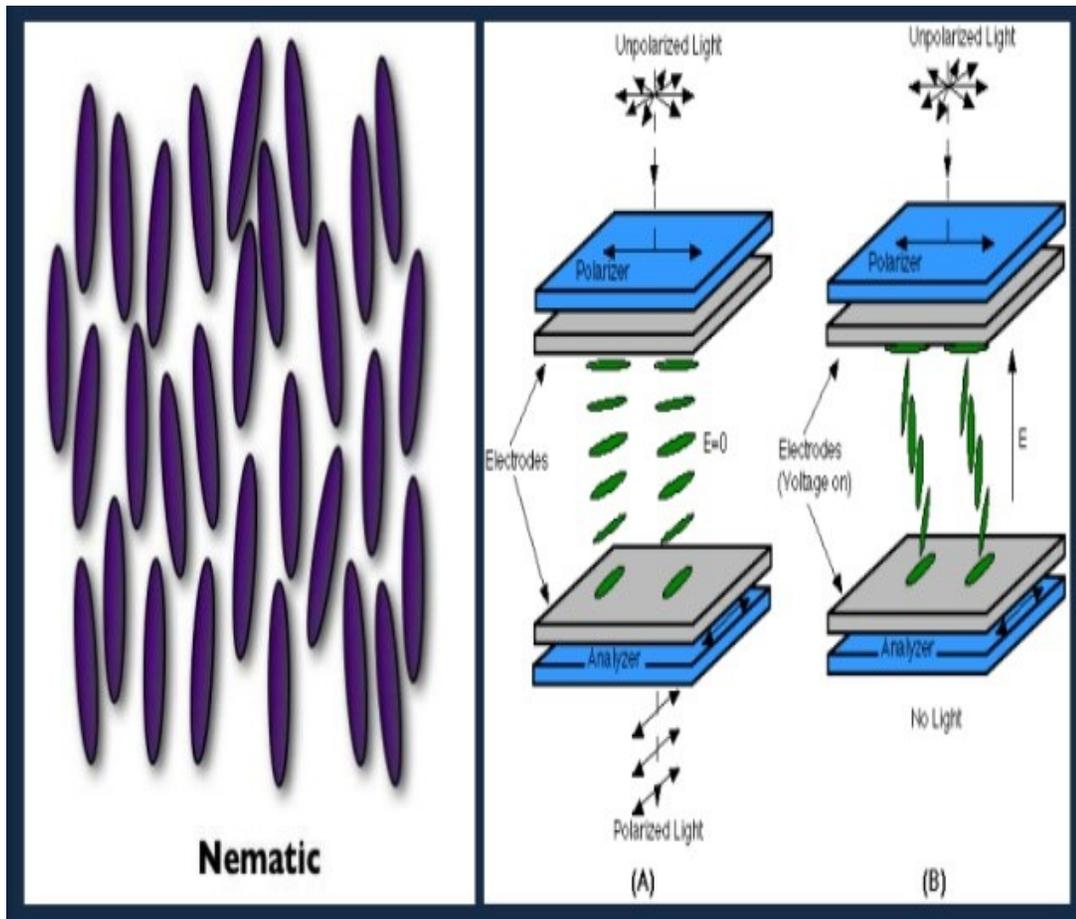
How do liquid crystals work?

Liquid crystal display technology works by blocking light.

Electrical currents cause the liquid crystal molecules to align to allow varying levels of light to pass through to the second substrate and create the colors and images that we see.

**Note:**Liquid crystal materials can be skin irritants

# Liquid Crystal Concept



Questions for practice:

Q1. On what factors refractive index depends?

Q2. Is a higher refractive index better?

Q3. What is liquid crystal with example?

Q4. What are liquid crystals made of?