PROPERTIES OF MATTER

1. Define deforming force and restoring force?

The phenomenon of change in shape (or) size of a body under the action of force is called deformation .this force required for the deformation of a body is knows as deformation force.

The force which develops inside the body against a deforming force and tries to bring the body back to its original size and shape is called Restoring force.

2. Define the terms Elasticity and plasticity?

The property of certain materials of returning back to their original size and shape after removing the deforming force is called "Elasticity".
The bodies which exhibit the property of elasticity is known as elastic bodies
Ex: rubber, crystals, quartz etc....

A body which cannot regain its original state when the deforming force is removed is called plastic body. This property is called plasticity.
Ex: wax, chewing gum, lead solder etc.....

3. Define the terms stress and strain?

Stress: The restoring force per unit area develops inside the body is called stress.

$$\text{Stress} = \frac{force}{Area}$$

Unit: N/m^2 (or) Pascal

DF: $ML^{-1}T^{-2}$

Strain: The change produced per unit magnitude a body is called strain

$$\text{Strain} = \frac{change\ in\ dimenson}{original\ dimension}$$

It is the ratio. So it has no units and dimensions.

4. Define different types of stress?

There are three types of stress

Longitudinal stress (or) Tensile stress:

The stress which increases (or) decreases the length of a rod is called longitudinal stress.

$$\text{Longitudinal stress} = \frac{force}{Area} = \frac{F}{A}$$

Volume stress (or) Bulk stress:

The stress which increases (or) decreases the volume of a body is called volume stress

$$\text{Volume stress} = \frac{force}{Area} = \frac{F}{A}$$

Shearing stress (or) tangential stress:

Force per unit area applied parallel to the surface and shearing to displace the appear layers of the body is called shearing stress

$$\text{Shearing stress} = \frac{force}{Area} = \frac{F}{A}$$

5. Define different types of strain?

There are three types of strain.

Longitudinal strain (or) Tensile strain:

The ratio of change in length to original length is called longitudinal strain.

$$\text{Longitudinal strain} = \frac{\Delta l}{l}$$

Volume strain (or) Bulk strain:

The ratio of change in volume to original volume is called volume strain.

$$\text{Volume strain} = \frac{\Delta v}{v}$$

Shearing strain (or) tangential strain:

The ratio of relative displacement between two layers under the action of a tangential force to the perpendicular distance between the two layers is called shearing strain (θ)

$$\theta = \frac{\text{Relative displacement of a layer}}{perpendicular\ \ distance\ between\ the\ layer}$$

6. **W hat is elastic limit? State and explain Hooke's law?**

Elastic limit: The maximum stress up to which the body exhibits the property of elasticity is called elastic limit.

Within elastic limit, the stress is directly proportional to strain.

Stress $\propto$ strain

Stress = (E) strain

E= stress/strain

Here E is called as modules of elasticity.

It's Unit: N/m^2

Dimensional Formula: $ML^{-1}T^{-2}$

7. **Define different types of modulus of elasticity?**

Modulus of elasticity is three types:

Young's modulus (Y): Within elastic limit, the ratio between longitudinal stress to the longitudinal strain is called Young's modulus.

$$\text{Young's modulus} = \frac{\text{longitudinal stress}}{\text{longitudinal strain}}$$

$$Y = \frac{F/A}{\Delta l/l} = \frac{Fl}{A\Delta l}$$

Bulk modulus (k): Within elastic limit the ratio between bulk stress to the bulk strain is called bulk modulus (k).

$$\text{Bulk modulus (k)} = \frac{Bulk\ \ stress}{bulk\ \ strain}$$

$$K = \frac{F/A}{\Delta v/v} = \frac{Fv}{A\Delta v}$$

Rigidity modulus (n): Within elastic limit, the ratio between shearing stress to the shearing strain is called Rigidity modulus.

$$\text{Rigidity modulus (n)} = \frac{shearing\ \ stress}{shearing\ \ strain}$$

$$n = \frac{F/A}{\theta} = \frac{F}{A\theta}$$

8. **Define compressibility and write its unit and dimensional formula?**

The reciprocal of bulk modulus is called compressibility.

$$\text{Compressibility} = \frac{1}{K}$$

Units: m^2/N (or) $pascal^{-1}$

Dimensional Formula: $M^{-1}LT^{-2}$

9. **Define surface tension and state examples?**

The normal force acting per unit length on either side of the imaginary line drawn on the surface of a liquid at rest is defined as the surface tension of the liquid .It is denoted by **T.**

Ex: 1. some insects are capable of walking on the surface of water due to surface tension.

2. Rain drops are spherical in shape due to surface tension.
3. Drops of water on certain leaves are spherical.

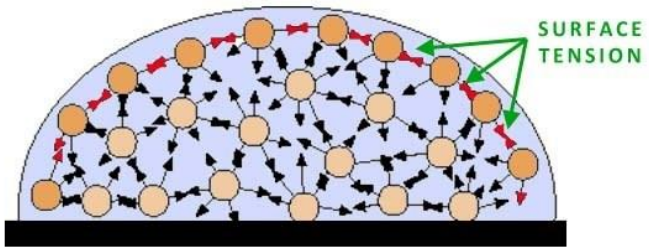
$$\text{Surface tension (T)} = \frac{force}{length}$$

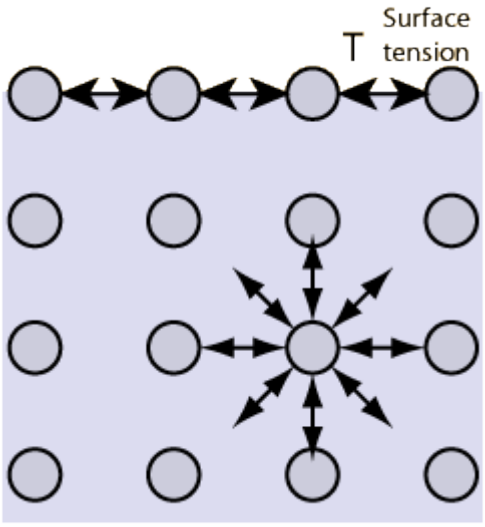
Unit: Nm^{-1}

Dimensional formula :

surface tension = $\frac{f}{L} = \frac{M\ L\ T^{-2}}{L}$

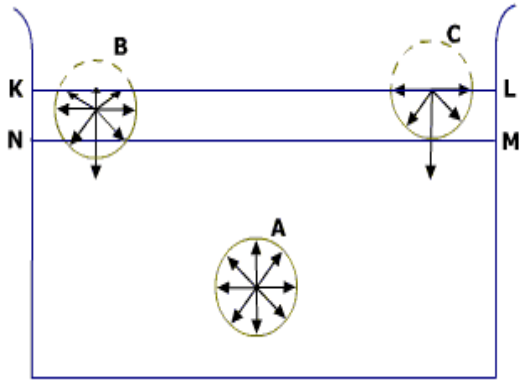
$= M\ L^0\ T^{-2}$





10. Explain Surface tension with reference to molecular theory?

Liquids, according to the Molecular theory, are made up of molecules. Let KLMN represent a surface film of thickness LM, which is same as the molecular range. Consider three molecules A, B, C at different positions.



The molecule 'A' is deep inside the liquid . The molecule A experiences force of attraction equally in all directions, due to its neighbouring molecules. The solid circle represents its sphere of influence (whose radius is equal to the molecular range). Therefore, the net force acting on A is zero.

The molecule at B (till below the surface). Like A, even B experiences a force of attraction due to its neighbouring molecules. But unlike A, B is not pulled equally on all sides and experiences a net pull downward. This is because; it experiences more attraction due to number of molecules inside the liquid.

The molecule 'C', we find that it experiences a greater downward pull because it is attracted by even fewer number of molecules.

The downward force or pull experienced by molecules B and C, is called the force of cohesion. In other words, the force of cohesion represents the attractive force of two similar molecules.

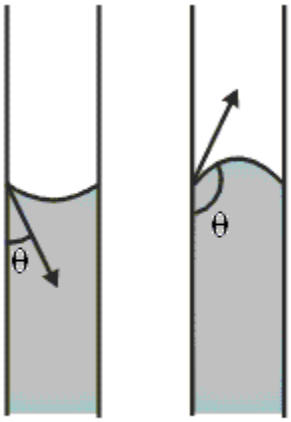
The process of cohesion is responsible for phenomenon of surface tension.

11. What is temperature effect on the surface tension of a liquid?

With increase in temperature, molecular distance in a liquid will be increases. As a result the force of cohesion becomes weak. Hence surface tension of a liquid decreases with rise in temperature.

The surface tension of a gas increases with rise in temperature.

12.Define angle of contact



The angle between the tangent of the liquid surface at the point of contact and the solid surface, inside the liquid is called the angle of contact (θ).

If the angle of contact is acute(less than 90^0), the liquids wets the solids. These liquids are called wetting liquids.

If the angle of contact is obtuse (greater than 90^0), the liquids wets the solids. These liquids are called wetting liquids.

13.Define capillarity and give examples?

The phenomenon of rise or fall of a liquid in a capillary tube due to surface tension is called capillarity.

Ex: 1.In a wax candle the molten wax rises up the wick by capillary action.

2. In plants, water and sap rises into the stem and leaves by capillary action.

3. In a kerosene lamp, kerosene rises to the top of the wick through narrow spaces between the threads.

14.Write the formula for surface tension based on capillarity and name the parameters?

$$T = \frac{hrdg}{2cos\theta}$$

T - Surface tension of liquid.
r - Radius of capillary tube.
d - Density of liquid.
h - Rise of liquid in capillary tube.
g - Acceleration due to gravity.
θ - Angle of contact.

15.Explain the concept of Viscosity?

The property of a liquid to oppose the relative motion between its different layers is called viscosity. It is also called as fluid friction.

Ex: 1.The tides of water are subsided due to viscosity of water.

2. Rain drops are slowed by the viscosity of air

3. Honey runs slower than water because of high viscosity

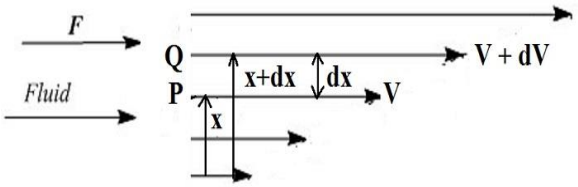
16. What is the cause of viscosity of a fluid?

Viscosity is due to the internal frictional force that develops between different layers of fluids as they are forced to move relative to each other .

viscosity is caused by the cohesive forces between the molecules in liquids and by the molecular collisions i gases

17. State Newton's formula for viscous force and explain?

Consider two adjacent layers P & Q having equal areas and separated by a distance dx in the laminar flow of a liquid.



According to Newton's law of viscous flow the magnitude of the viscous force F on a certain layer of liquid is proportional to

(i) The area A of the liquid

(ii) The velocity gradient $\frac{dv}{dx}$ which is perpendicular to the direction of flow

F α A and $F \ \alpha \ \frac{dv}{dx}$

$F \ \alpha \ A\frac{dv}{dx}$ => F = η A $\frac{dv}{dx}$

Where 'η' is constant of proportionality and is known as coefficient of viscosity.

18. Define co-efficient of viscosity and write its units and dimensional formula?

Newton's formula for viscous force is F = η A $\frac{dv}{dx}$

=> $\eta = \frac{F}{A\left(\frac{dv}{dx}\right)}$

If A = 1 and $\frac{dv}{dx}$ = 1, then n = F.

The viscous force acting per unit area when there is unit velocity gradient in flow of liquid is called coefficient of viscosity(η).

SI Unit : N m^2 s

dimensional formula : $M^1 L^{-1} T^{-1}$

19. Explain the effect of temperature on viscosity of liquids and gases

As temperature increases the distance between the molecules increases. Hence, a cohesive force decreases. So, the viscosity of liquids decreases as the temperature increases.

As temperature increases, the exchange of momentum increases. So the viscosity of gases increases as the temperature increases.

20. State Poiseulle's equation for Co-efficient of viscosity and name the physical quantities involved?

The coefficient of viscosity of the liquid flowing through the capillary tube is given by

$$\eta = \frac{\pi p r^4}{8lv}$$

Where

P - Pressure difference between the ends of the capillary tube.

r - Radius of capillary tube.

l - Length of capillary tube

v - Volume of the liquid flowing per unit time through the capillary tube.

11.MODERN PHYSICS

1. Define Photo-electric effect?

When light of sufficient energy is incident on a metal surface, electrons are ejected from the metal. This phenomenon is called as 'photoelectric effect' and the ejected electrons are called as 'photoelectrons'.

2. Write Einstein's photoelectric equation and explain?

Einstein in 1905 explained photo electric effect on the basis of Planck's quantum theory of radiation.
According to quantum theory electromagnetic radiation (light) consists of a quanta or photons. The energy of each photon is

$$\mathbf{E = h\upsilon.}$$

Here, **h** is Planck's constant.
υ is the frequency of the incident photon.

According to Einstein When a photon is striking the metal surface,the total energy of the photon(hυ) is transferred to the single electon in the metal surface.
The energy of photon =Work Function ($W_o = h\upsilon_0$) + kinetic energy of the emitted electron.

$$\therefore \mathbf{E = W_o + KE}$$

$$\mathbf{h\upsilon = h\upsilon_0 + \frac{1}{2} mv^2}$$

υ_0 is the threshold frequency for the photoelectric effect.
m is the rest mass of the ejected electron.
v is the speed of the ejected electron.

If $E < W_0$, no photo electric effect will take place.
If $E = W_0$, photoelectric effect will take place but kinetic energy of ejected photo electron is zero.
If $E > W_0$, photo electric effect will take place along with possession of kinetic energy by ejected electron.

3. Define the terms work function, threshold frequency and stopping potential?

The minimum amount of energy necessary for the photo electric emission to start is called Work Function(W_o).

The minimum frequency of incident light required for the photo electric emission is called Threshold Frequency(υ_o).

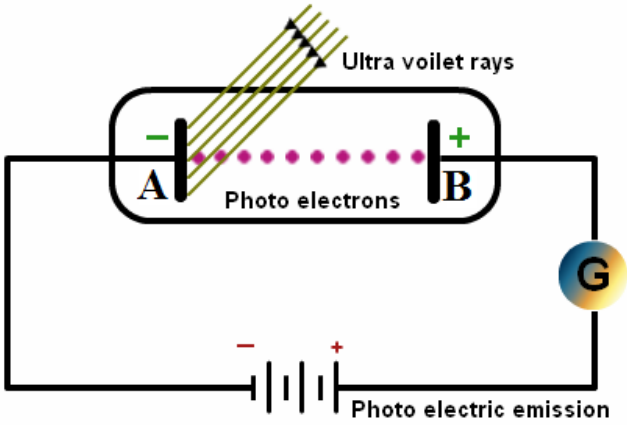
The potential difference applied to stop the electrons from being ejected from the surface when the light falls on it is called Stopping Potential

4. State laws of photoelectric effect?

1. The photoelectric emission is an instantaneous process.
2. The photo electrons are emitted only when the frequency of incident light is more than. threshold frequency.
3. The stopping potential of photo electrons increases when the frequency of the incident light increases.
4. The maximum kinetic energy of the photo electrons is directly proportional to the frequency of incident radiation, but is independent of its intensity.
5. The strength of photo electric current (number of photo electrons) is directly proportional to the intensity of incident light.

5. Explain the Working of photoelectric cell ?

1. The phenomenon is basically about light energy (photo) converting into electrical energy.



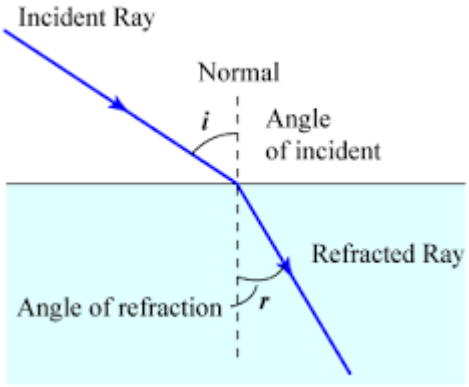
2. The apparatus consists of an evacuated quartz tube having photosensitive plate called emitter **A** and collector **B**.
3. Plate **A** is connected to the negative terminal and plate **B** is connected to the positive terminal of a battery via rheostat **R**.
4. The potential difference between the plates **AB** can be adjusted by changing the value of the rheostat.
5. When light of suitable wavelength is incident on the plate **A** then electrons are emitted and reaches plate **B**, thus measurable current flows through the circuit.
6. This is seen by deflection in galvanometer.

6. List the applications of photoelectric effect?

a) To compare the illuminating powers of two sources.
b) Counting systems.
c) Photo cells are used in automatic door openers and fire alarms.
d) Photocells are used in television camera to reproduce sound recorded on films.
e) In burglar and fire alarms.
f) To measure the temperature of stars.
g) To study the spectrum of heavy bodies.
h) To operate street light.
i) To determine the Planck's constant.

7. State the laws of refraction of light?

When light ray passes from one medium to another medium , the bending property of light ray at the surface, separating two different media is known as refraction.



Laws of refraction:

a) The incident ray, refracted ray and the normal at the point of incidence all lies in a same plane.
b) The angle of incidence and angle of refraction is constant which is also known as Snell's law.

$$\mu = \frac{\sin i}{\sin r}$$

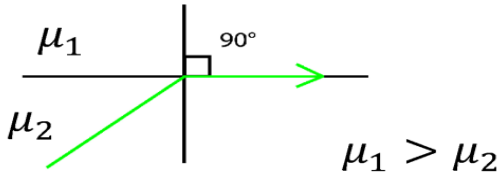
c) When light ray travels from rarer medium to denser medium it bends towards the normal.
d) When light ray travels from denser medium to rarer medium it bends away from the normal.

8. Define critical angle?

The angle of incidence in the denser medium for which the angle of refraction in the rarer medium becomes 90^0 is called critical angle. It is denoted by C.

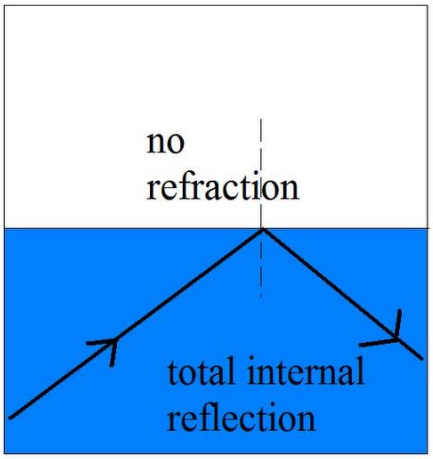
$$\mu = \frac{1}{\sin c}$$

Refractive index — Critical angle



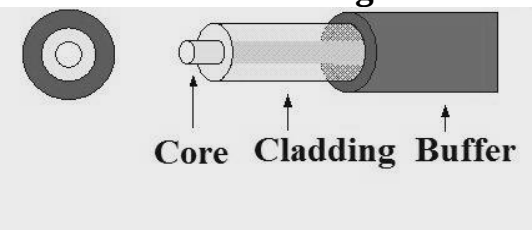
9. Explain the Total Internal Reflection?

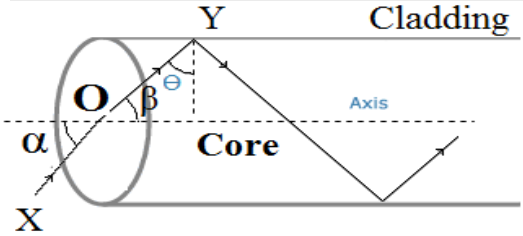
When a light ray passes through a denser medium to rarer medium and if the angle of incidence is greater than the critical angle (i > C) then the light ray reflects into the same medium. This phenomenon is called "Total internal reflection".



10. Explain the principle and working of Optical Fiber?

An optical fiber is a dielectric wave guide that transports light signals from one place to another.
The optical fiber works on the principle of total internal reflection.
Construction and working:





It consists of a central core within which the propagating light is confined and which is surrounded by a cladding layer, which is itself surrounded by a buffer.
The refractive index of core, cladding and buffer is as follows:

$$\mu_{core} > \mu_{cladding} > \mu_{buffer}$$

The difference in refractive index of the cladding and the core allows total internal reflection.
If light is incident on a cable end with an angle of incidence greater than the critical angle then the light will remain trapped inside the glass strand.
In this way, light travels very quickly down the length of the cable over a very long distance (tens of kilometres).

11. Define acceptance angle, emission angle and numerical aperture?

Acceptance angle: The angle at which the light enters fiber is called "acceptance angle".
Emission Angle: The angle with which light leaves fiber is called "emission angle".
Numerical Aperture: The ability of an optical fiber to allow light through it is called "Numerical Aperture".
It is essential for the selection of optical fiber for different applications.It is given by the formula

$$NA = \sqrt{\mu_{core} - \mu_{cladding}}$$

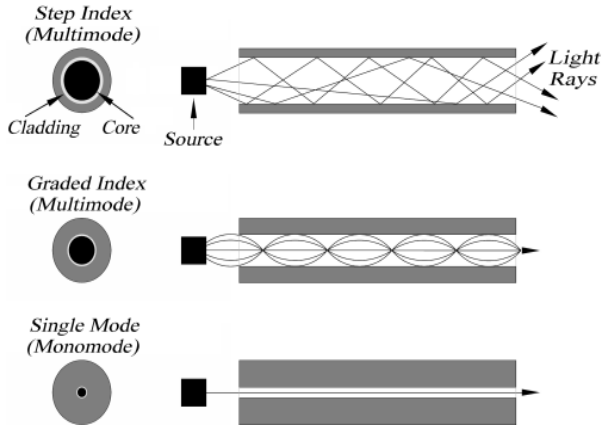
12. Mention types of optical fibbers?

Basically there are two types of optical fibers .They are
(i) Step index optical fiber.
(ii) Graded index optical fiber.

In step index optical fiber the refractive index of the core and cladding is different. There is a step or abrupt change in refractive index takes place at the interface of core and cladding.These fibers are used in illumination purpose.

In graded index optical fiber, there is a gradual change of refractive index.It is gradually decreases from the core to cladding.These fibers are used in tele

communications and other uses with LASER.



13.List the applications of Optical Fiber?

The optical fibers are used in :

1. In military communications
2. Inter linking of computers
3. Cable television transmission
4. In decorating flower vases
5. In sensors industry (such as to measure the number of revolutions of a motor)

14.Define super conductor and give examples?

A material whose resistance is zero is called "Super conductor"
That means that electrons can flow very easily through the material.
This can be achieved only at very low temperatures.
Ex: Mercury at a temperature of 4.22 k
Lead at a temperature of 7. 18K etc...

15. Define Super conductivity and transition temperature?

Super conductivity : The property of a material by which it exhibits zero resistance is called super conductivity

Transition temperature (or) critical temperature (T_c):

The temperature at which resistance of a material disappear in zero magnetic field is called the transition temperature or critical temperature.

16.Sate the factors influencing super conductivity of materials?

The factors influencing super conductivity of materials are:

1. Temperature
2. Magnetic field
3. Impurities
4. Atomic Structure
5. Magnetic stress

17.State the properties of superconducting materials ?

In D.C Measurements.

1. The resistivity of the superconductors is zero
2. Perfect diamagnetism is an essential property of super conducting state
3. Thermal conductivity is low in superconducting state
4. At transition all magnetic flux is ejected out by the super conductor and behaves as a dia magnetic substance.
5. All thermoelectric effects disappear in the superconducting state

18.List the applications of superconductors?

Super conducting materials used:

1. For producing very strong magnetic fields of about 50 Tesla.
2. To perform logic and storage functions in computers.
3. Power transmission without loss
4. As ultrafast computer switches.
5. Magnetic energy can be stored in large Super conductors.