**Q. What is wave front?**

 Answer

**Wave Fronts**

 The surface on which all the points of waves have same phase of vibration is known as wave front

**Explanation** Suppose the light emitted from a point source propagates outward in all direction with speed c After time t the waves reach the surface of an imaginary sphere with center as S and radius as ct As the distance of all these points from the source is same so all the points on the surface of the sphere have the same phase of vibration Such as surface is known as wave front

**Note** The wave front from a point source are spherical Thus wave propagates in space by the motion of wave fronts

 The distance between two consecutive wave fronts is one wave length

**Ray of Light**

 The line normal to the wave front which shows the direction of propagation of light is called a ray of light

**Spherical wave front**

 The wave front in which the light waves are propagated in spherical form with the source is called spherical wave front

 For appoint source of light in a homogeneous medium, the wave fronts are the concentric sphere of increasing radii.

**Plane wave front**

 At very large distance (ie at infinity) from the source, a small portion of spherical wave front will become very nearly plane Such a wave front is known plane wave front

**For example,**the sun light reaches the earth in plane wave fronts points they cancel the effect of each other destructive interference) Such phenomenon is called interference of light

**Types of Interference**

 There are two types of interference

**1) Constructive Interference**

 2) If crest of one wave falls on the crest of other or through of one wave falls on trough of other waves

3) they support each other. This phenomenon is called constructive interference 4) Whenever the path difference between the two waves is an integral multiple of wavelength, then the

5) both waves reinforce each other. This effect is called constructive interference

2)**Destructive Interference**

If crest of one wave fall on the trough of the other wave, then they cancel each other. Such an Interference is known as destructive interference

Whenever the path difference between the two waves is an odd integral multiple of half of wavelength, then the both waves cancel each other's effect This effect is called constructive interference

**Conditions for detectable interference pattern**

 The following condition must be met, in order to observe the interference phenomenon

1) The interfering beams mu be monochromatic

 2)The interfering beams of light must be coherent

 3) The sources should be narrow and very close to each other

 4) The intensity of the two sources be comparable

**Monochromatic Source**

 The sources which should emit the light of single wave length are called monochromatic sources

**Coherent sources**

monochromatic sources of light which emit waves, having a constant phase difference are called coherent source

**How to obtain coherent sources**

 A common method to obtain the coherent light beam is to use a monochromatic source to illuminate a screen containing two small closely speed holes, usually in the shape of slits The light emerging from the two slits is coherent because a single source produces the original beam and two slits serve only to split it into two parts The points on a Huygens wave front which send out secondary wavelength are also coherent sources of light

**Q. Describe the Young' double slit experiment for demonstration for interference of light Derive an expression for fringe spacing.**

 Answer

**Young's double Slit Experiment**

 In 1801. Thomas Young performed the interference experiment to prove the wave nature of light A screen having two narrow slits is illuminated by a beam of monochromatic light The portion of wave front incident on the slit behaves like the source of secondary wavelets Tn wavelets leaving the slits are coherent Superposition of these wavelets results into the senses of baht and dark bands which are observed on the second screen placed at some distance parallel to the first screen

**Q. Discuss the formation of Newton's rings. Why does the central spot of Newton's ring look dark?**

 Answer

**Newton's Ring**

 When a plano-convex lens of long focal length is placed in contact with a plane glass plate a thin air film is enclosed between them to form circular dark and bright fringes known as Newton's rings

**Experimental arrangement**

The thickness of the air film between plano-convex lens and glass slit is almost zero at the point of contact "O and t increases gradually as we proceed towards the periphery of the lens Thus the point where the thickness of the air film is constant will lie on the circle with O as center Light beam from a monochromatic source S' becomes parallel after passing through the convex lens 'L this beam of light falls on the glass plate G Some rays are partly reflected normally towards the air film and partly refracted through G when light rays fall normally on the lens, these rays are reflected by the top and bottom surfaces of the air film As these rays are coherent and interfere each other constructively or destructively

 When the light reflected upward is observed through a microscope M focused at the glass plate G a series of dark and bright circular rings are observed as shown in figure These concentric rings are called Newtons rings

**Dark Central Spot:**

 At the point of contact of the lens and the glass plate, the thickness of the film is effectively zero but due to reflection at the lower surface of air film from denser medium, an additional path difference of is (or phase change of 180) introduced Consequently the center of Newton rings is dark due to destructive interference

**Q. Explain the phenomenon of polarization. How plane polarized light is produced and detected?**

 Answer

**Polarization**

 The phenomenon of interference and diffraction have proved that light has wave nature, but these phenomenon do not show whether light waves are longitudinal transverse In transverse mechanical waves, the vibration can be oriented along vertical, horizontal or any other direction In each of these cases, the wave is said to be polarized The plane of polarization is the plane containing the direction of vibration of the particles of the medium and the direction of propagation of wave

A light wave produced by oscillating charge consists of a periodic variation of electric field vector along with magnetic field vector at right angle to each other.

The direction of polarization in a plane polarized light wave is taken as the direction of electric field vector Unpolarized light A beam of ordinary light consisting of large number of planes of vibration is called unpolarized light Polarized light The beam of light in which all vibrations are confined to a single plane of vibration is called polarized light Production and Detection of plane polarized light The light emitted by an ordinary incandescent bulb is un-polarized, because its vibrations are randomly oriented in space It is possible to obtain plane polarized beam of light from unpolarized light by removing all waves from the beam except those having vibrations along one particular direction This can be achieved by various method as given below

 1) Selective absorption

 2) Reflection from different surfaces

 3) Scattering by small particles

 4) Refraction through crystals

**Selective absorption method**

 Selective absorption method is the most common method to obtain plane polarized light by using certain types of materials called dichotic substances These transmit only those waves whose vibrations are parallel to the particular direction and will absorb those waves whose vibration are in other directions One such commercial polarizing material is Polaroid

If the un-polarized light is made incident on the sheet of Polaroid, the transmitted light will be plane polarized If a second sheet of Polaroid is placed in such a way that the axes of the Polaroid as shown by the straight lines drawn on them are parallel the light is transmitted through the second Polaroid also If the second Polaroid is slowly rotated about the beam of light, as axis o rotation, the light emerging out of the second Polaroid gets dimmer and dimmer and disappears when the axes become mutually perpendicular. The light appears on further rotation and become brightest when the axes re again parallel to each other

**Transverse Nature of Light**

 This experiment proves that light waves are transverse waves of the light waves were longitudinal they would never disappear even if the two Polaroids were mutually perpendicular Sunlight also becomes partially polarized because of scattering by air molecules of the Earth's atmosphere or by reflection we can obtain the partially polarized light instead of glare of light

**Reflection from different surfaces:**

 Reflection of light from water, glass snow and rough road surfaces for larger angles of incidences produces glare Since the reflected light is partially polarized, glare can considerably be reduced by using polarized sunglasses

**Scattering by small particles**

 Reflection of light from water glass snow and rough road surfaces for larger angles of incidence produces glare Since the reflected light is partially Polarized glare can considerably be reduce by using polarized sunglasses

**Scattering by small particles:**

 Sunlight also becomes partially polarized due to scattering by air molecules of earth's atmosphere This effect can be observed by looking directly up through a pair of sunglasses made of polarizing glass A certain direction of the lens. less light passes through it than at others Polaroid.

 A synthetic doubly refracting substance, that strongly absorbs polarized light in one plane while easily passing polarized light in another plane of right angles

**Q. What is meant by optical rotation?**

 Answer

**Optical Rotation**

 When a plane polarized light is passed through certain crystals They rotate the plane of polarization Quartz and sodium chlorate crystals are typical examples, which are termed optically active crystals

 A few millimeter thicknesses of such crystals will rotate the plane of polarization by many degrees Certain organic substances, such as sugar and tartaric acid show optical rotation when they are in solution this property of optical active substances can be used to determine the concentration in the solutions