Wave Optics - 01

Introduction :- Huygens Wave theory of light
Wavefront

Newton's Corpuscular theory :- (1675)

→ Every light source emits tiny corpuscles (elastic, rigid & massless particles of different shapes & sizes)

→ Corpuscles travel in straight line with different speed in different medium

→ Different colours of light have different sizes of corpuscles

→ The theory explained
i) Rectilinear propogation of light
ii) Reflection
iii) Refraction
but failed to explain
i) Interference
ii) Diffraction
iii) Polarisation
& predicted that light travels faster in water or glass than air, which proved to be false later (Foucault, 1850 → experiment → speed of light in water less than that in air)

In the same era, Huygen gave Wave theory of light.

Huygens Wave theory :- (1678)

→ Light is a mechanical wave
(requires a medium)

→ Q) How does light travels from Sun to Earth in vacuum?

Answer)

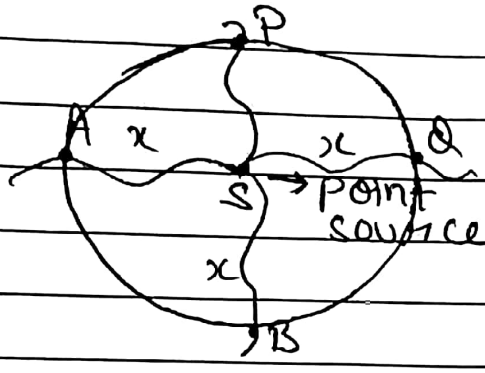
Ether Hypothesis :- A very dilute & highly elastic medium is spread everywhere in space, called ether.
(untouchable, undetectable)

*** Later Ether theory failed.

→ It explained i) Rectilinear propogation of light
ii) Reflection iii) Refraction
iv) Interference v) Diffraction
But Not Polarisation & photoelectric effect

Huygens Principle

① **Wavefront:** Wavefront is the Locus of all points of the medium which are vibrating in the same phase.



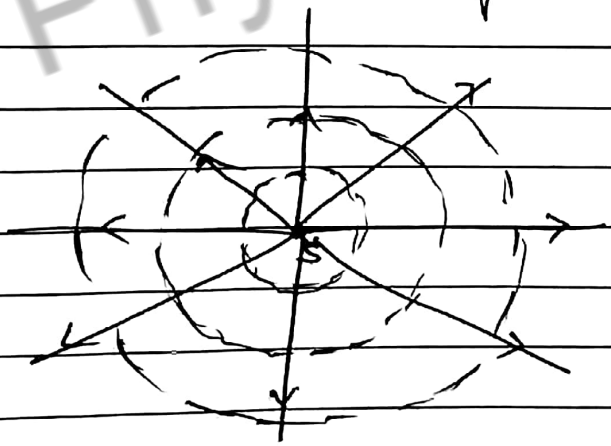
$y = A \sin(\omega t + kx)$

(phase)

at $t = t$

P, Q, A, B have same phase

Point source → Spherical wavefront



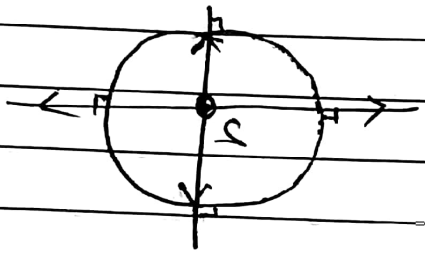
spherical wavefronts

Like we see ripples in water when a stone is dropped.

② The direction of wave propogation is always ⊥ to wavefront.

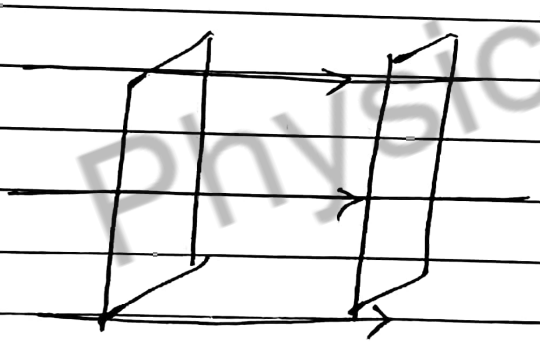
③ Types of wavefront :-

(i) Point Source → spherical wavefront

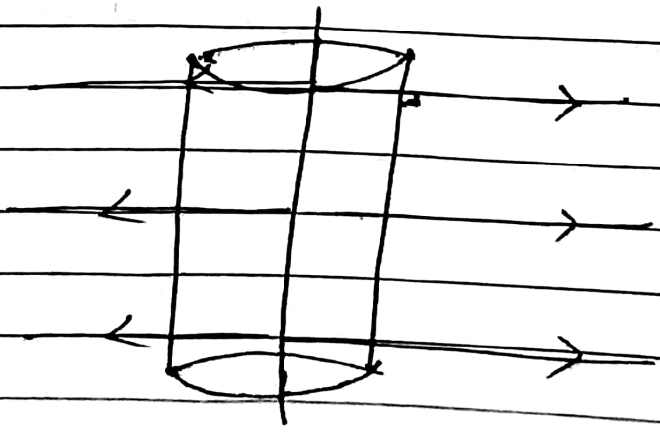


(ii) for Source at ∞

Plane wavefront

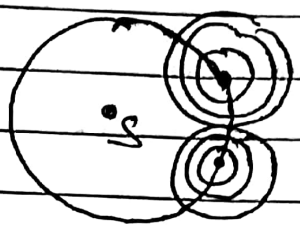


(iii) For Linear Source

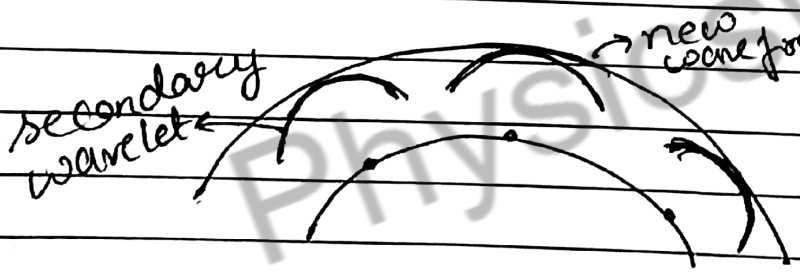


Cyclindrical wavefront

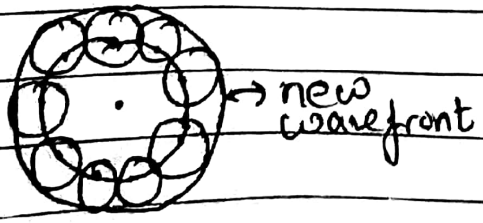
④ Each point of the wavefront acts as source of secondary disturbance & wavelets from these points are called secondary wavelets. These wavelets travels with speed of wave. Secondary wavelets spread in all directions



⑤ A common tangent on the secondary wavelets in forward direction gives new wavefront.

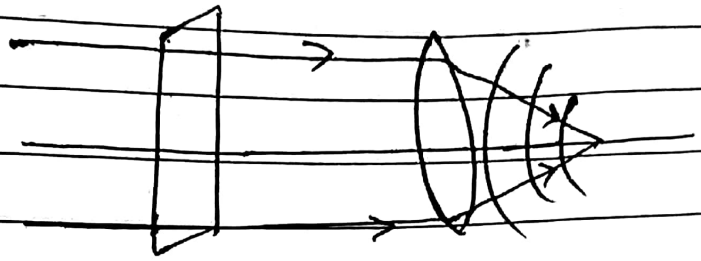


If we want to determine shape of wavefront after $t = 2$, draw sphere of radius $r = v2$ from each point on wavefront. & then draw tangent enveloping forward wavelet

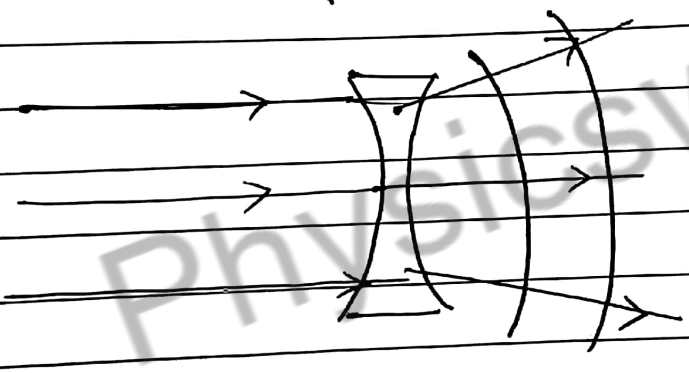


⑥ Huygens assumed that intensity of secondary wavelet in backward direction is Zero.

Q) Draw wavefronts for rays of light incident on convex lens from infinity.



Q) Draw wavefronts



Q) Draw wavefronts