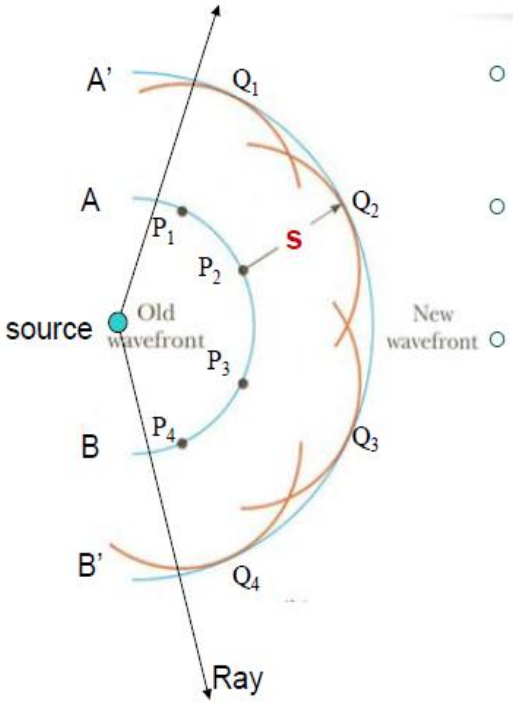
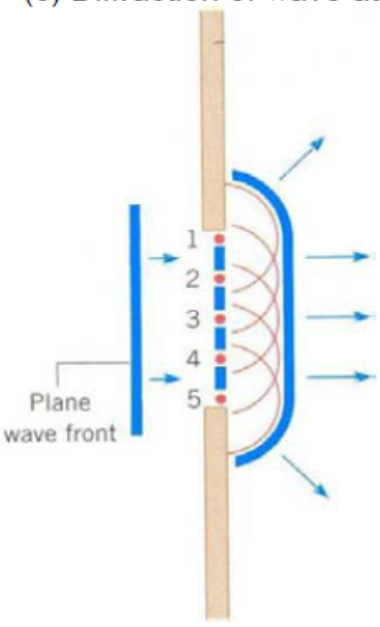
(b) Construction of new wavefront for a circular wave



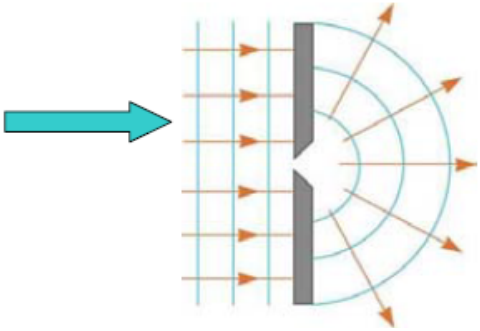
- Explanation as in the construction of new wavefront for a plane wavefront
- But the wavefront A'B' is a curve touching points Q_1,Q_2,Q_3 and Q_4.
- The curve A'B' is the new (circular) wavefront after *t* second.

(c) Diffraction of wave at a single slit



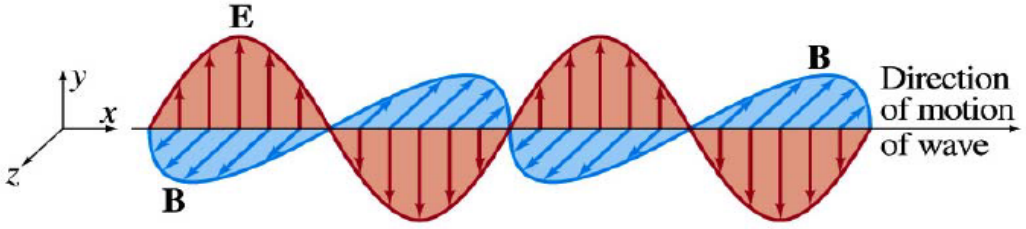
- Huygens' principle can be used to explain the diffraction of wave.
- Each of the point in figure shown, acts as a secondary source of wavelets (red circular arc)
- The tangent to the wavelets from points 2, 3 and 4 is a plane wavefront.
- But at the edges, points 1 and 5 are the last points that produce wavelets.
- Huygens' principle suggest that in conforming to the curved shape of the wavelets near the edges, the new wavefront bends or diffracts around the edges - applied to all kinds of waves.

If the size of the slit is small ($a << \lambda$), then diffraction will occur as shown in figure .



1.3. Interference of Light Waves

- Light waves are electromagnet waves.
- Consists of varying electric field E and varying magnetic field B which are perpendicular to each other



Electric field: $E = E_o \sin(\omega t - kx)$

Magnetic field: $B = B_o \sin(\omega t - kx)$

- **Interference**

  When two light waves meet at a point, a bright or a dark region will be produced in accordance to the *Principle of Superposition.*

- ***Principle of Superposition***:

  The resultant displacement at any point is the vector sum of the displacements due to the two light waves. 10

- **Constructive interference**
  - Reinforcement of amplitudes of light waves that will produce a bright fringe (maximum).
- **Destructive interference**
  - Total cancellation of amplitudes of light waves that will produce a dark fringe (minimum).

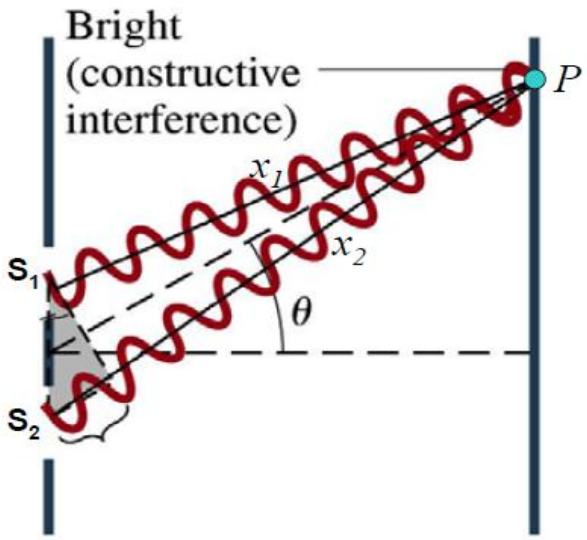
1.4. Condition for Fixed Interference

(a) Two coherent sources,
- The sources must have the same wavelength (monochromatic).
- the sources must have a constant phase difference between them.

(b) The waves that are interfering must have the same or approximately the same amplitude to obtain total cancellation at minimum or to obtain a good contrast at maximum.

1.5. Path difference

- Definition – is defined as *the difference in distance from each source to a particular point.*



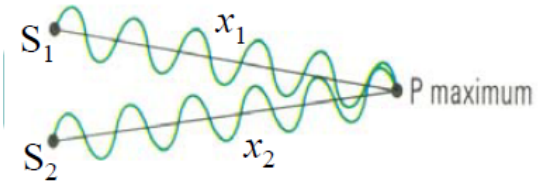
Path Difference, $\Delta L = |S_2P - S_1P|$

$= |x_2 - x_1|$

1.6. Interference of Two Coherent Sources in phase

- **Path difference for constructive interference**

S_1 and S_2 are coherent sources in phase



- A bright fringe at P if

$\Delta\Phi = 2m\pi$ where $m = 0,1,2,...$

- At P,

$E_{1P} = E_0 \sin(\omega t - kx_1)$

$E_{2P} = E_0 \sin(\omega t - kx_2)$

then

$\Delta\Phi = (\omega t - kx_2) - (\omega t - kx_1)$

$\Delta\Phi = k(x_1 - x_2)$ since $k = \frac{2\pi}{\lambda}$ and

$\Delta\Phi = \frac{2\pi}{\lambda}\Delta L$ $(x_1 - x_2) = \Delta L$

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- Therefore

$$2m\pi = \frac{2\pi}{\lambda}\Delta L$$

$$\boxed{\Delta L = m\lambda}$$

where $m = 0,1,2,.....$

λ : wavelength

- Note

When

$m = 0$ ⇒ Central bright fring

$m = 1$ ⇒ 1st bright fringe

$m = 2$ ⇒ 2nd bright fringe

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