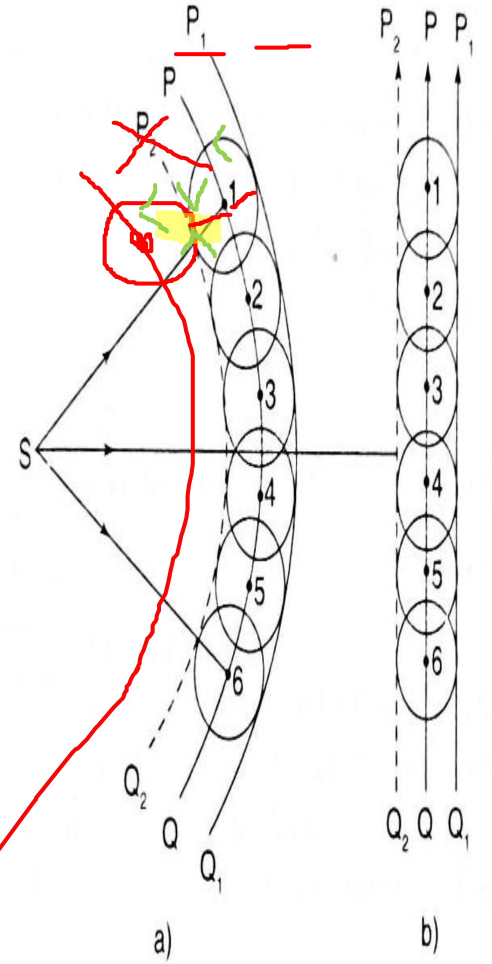
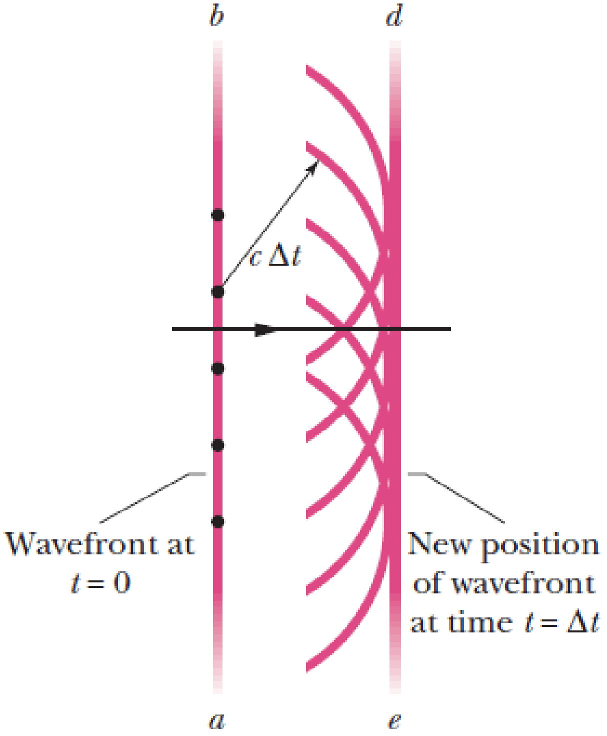
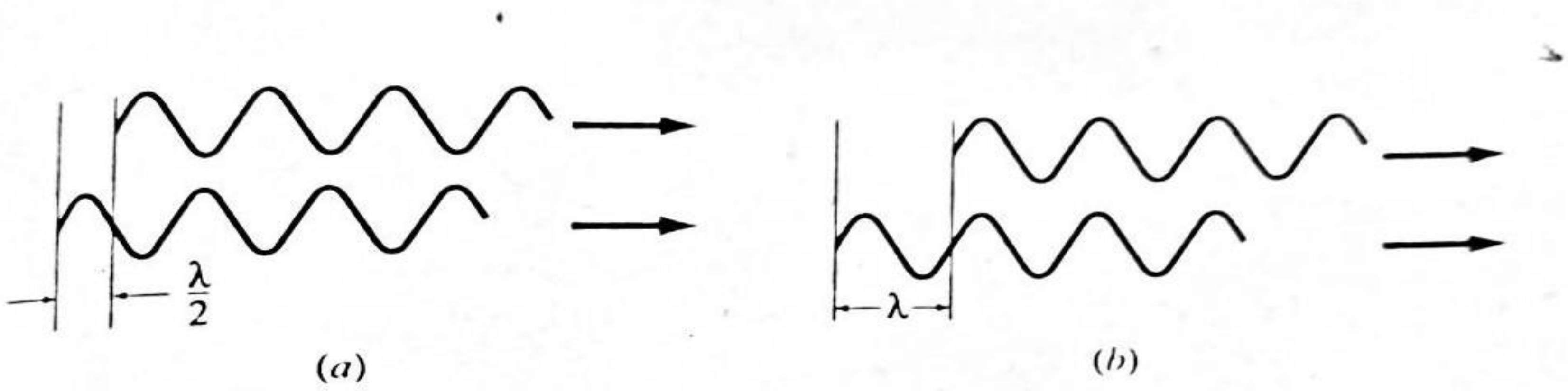
- Huygens hypothesis is related to geometrical construction of position of common wave front at any instant when waves propagate in medium.
- Huygens’ principle tells the way in which the wave fronts propagated in medium.
- **Assumptions of Huygens’ principle:**
- On the given wave front, every point acts as a source of secondary wavelets.
- Secondary wavelets from each point travel through space in all direction with speed of light.
- Third assumption defines secondary wave front. At any given time , a surface touching the secondary wavelets tangentially in forward direction constructs the new wave front at that instant.

- Fig a) shows spherical wave fronts and Fig. b) shows plane wave fronts.
- Consider propagation of these wave fronts in an isotropic (uniform) medium emerging from light Source S. PQ is section of the primary Wave front. Take points 1,2,3.. On PQ, to find position of wave front after an interval t. Points 1,2,3 .. act as a source of secondary wavelets.
- Sphere radii is ct, where c is speed of light.
- Spherical surfaces show the position of secondary Wavelets. Further draw a surface P1Q1 that touches Tangentially all these secondary wave fronts.
- P1Q1 is secondary wave fronts.
- There is no backward movement of the energy during light propagation so P2Q2 are not secondary wave fronts.

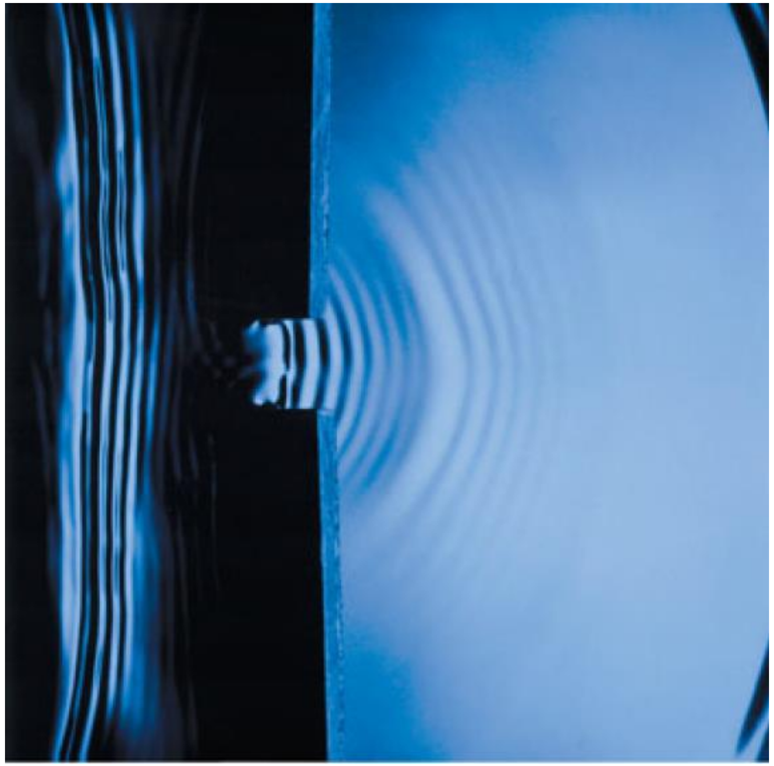




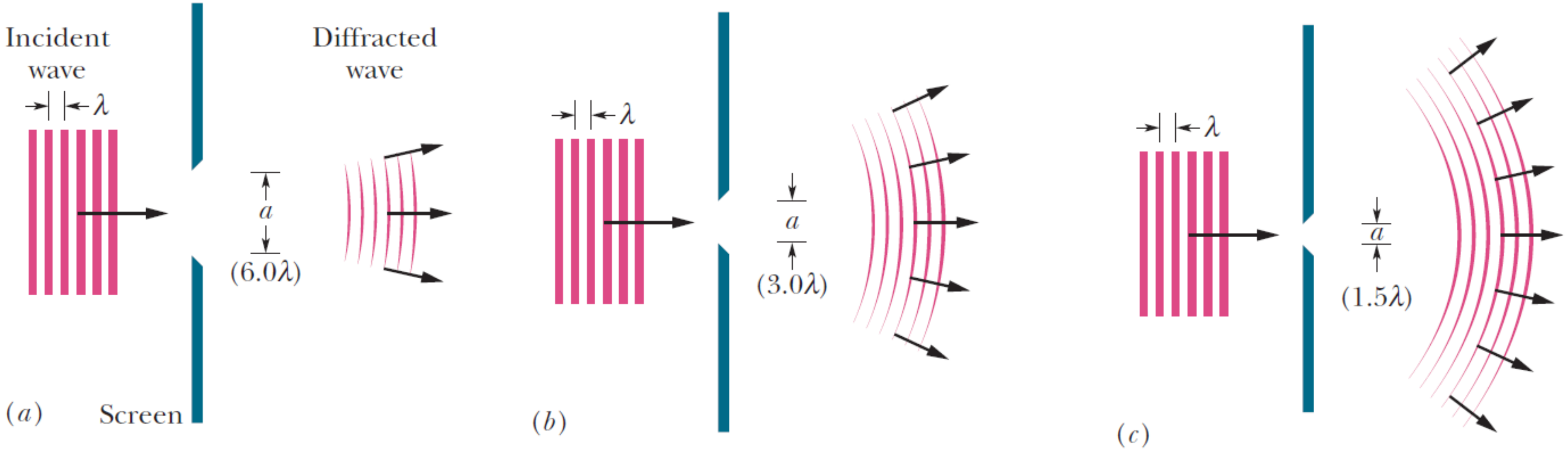
- **Constructive and destructive interference:** Fig. a shows bottom wave travels half a wavelength farther so both waves are 180 degree out of phase and know as destructive interference.
- Fig b shows lower wave travels a full wavelength farther, then resultant waves are in-phase and known as constructive interference
- Condition: paths differ by an odd integer multiple of a half wavelength like ½, 1 ½, 2 ½ wavelengths.
- For constructive interference, paths differ by an integer multiple of wavelength like 1,2,3…wavelengths.

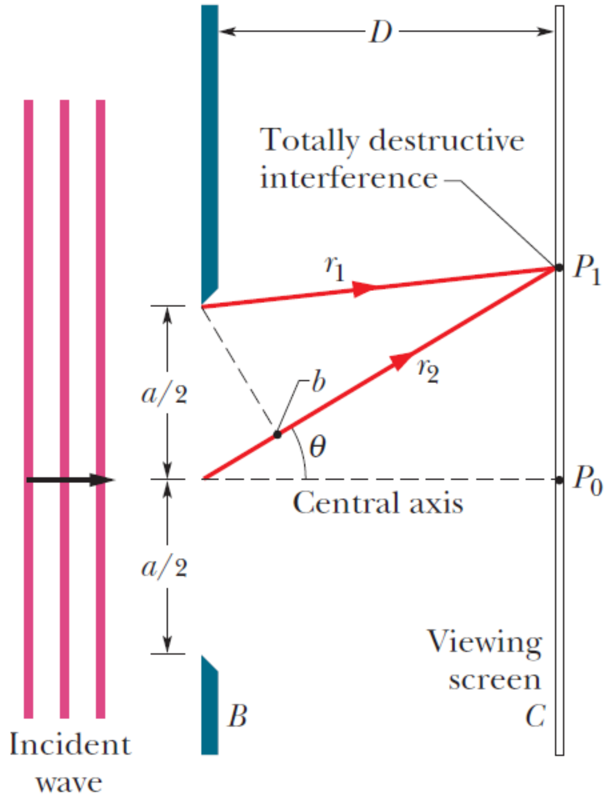


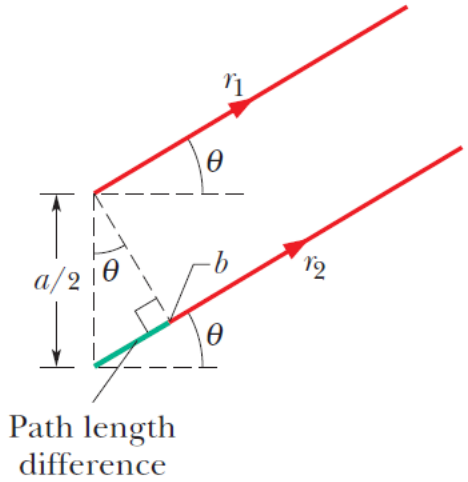
- **<u>Diffraction:</u>**
- The bending of waves around small obstacle.
- The effects of diffraction are generally prominent for waves when the size of the diffracting object is of the order of the wavelength
- Diffraction is bending of light around an obstacle, whereas interference is the meeting of two waves.



A wave passing through a slit flares (diffracts)

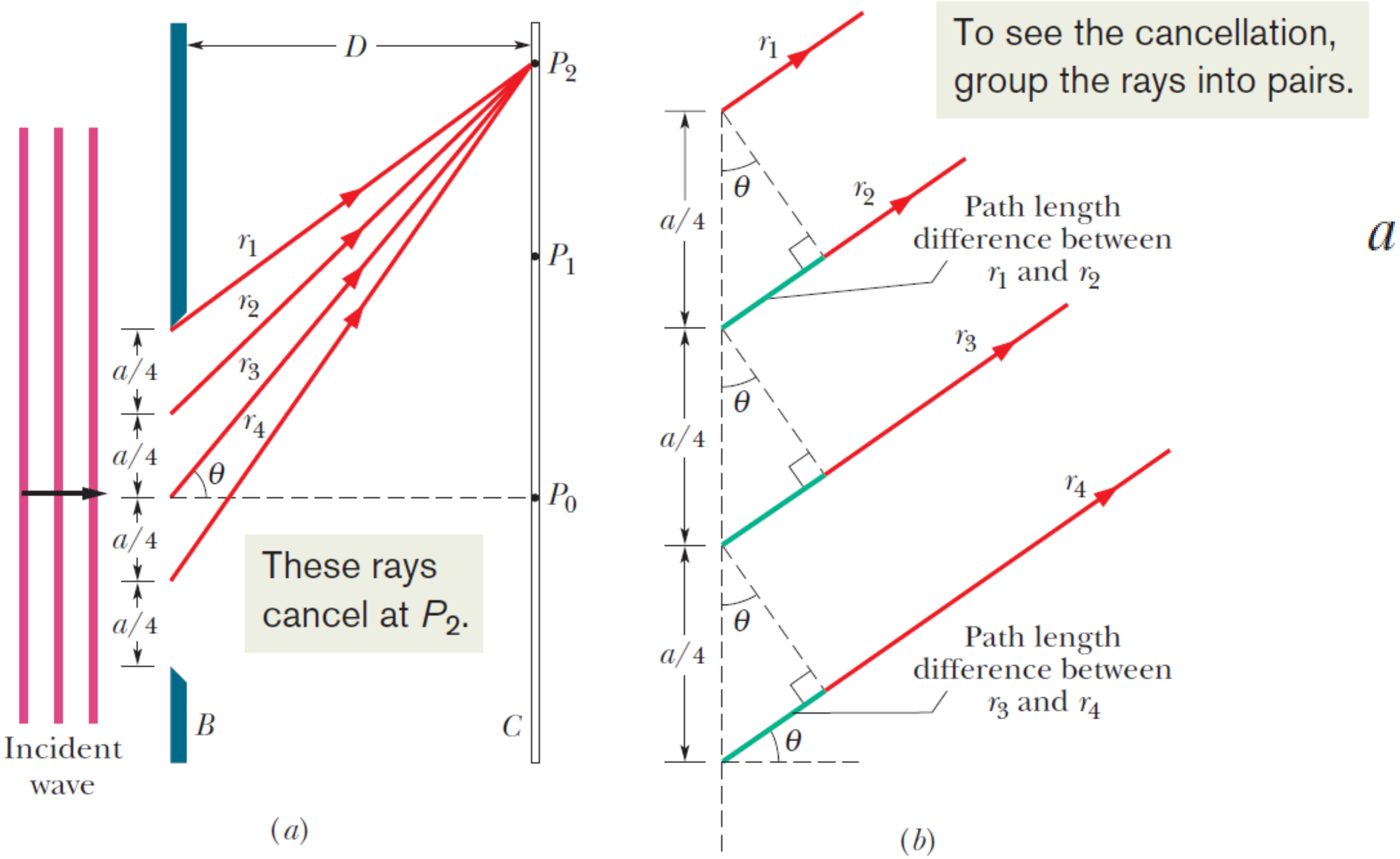






$$\frac{a}{2}\sin\theta = \frac{\lambda}{2}$$

$$a\sin\theta = \lambda \qquad \text{(first minimum)}$$



$$\frac{a}{4}\sin\theta = \frac{\lambda}{2}$$

$$a\sin\theta = 2\lambda \qquad \text{(second minimum)}$$

$$a\sin\theta = m\lambda, \qquad \text{for } m = 1, 2, 3, \ldots \quad \text{(minima—dark fringes)}$$

A slit of width a is illuminated by white light.

(a) For what value of a will the first minimum for red light of wavelength $\lambda = 650$ nm appear at $\theta = 15°$?

(b) What is the wavelength λ' of the light whose first side diffraction maximum is at 15°, thus coinciding with the first minimum for the red light?

$$a = \frac{m\lambda}{\sin\theta} = \frac{(1)(650\text{ nm})}{\sin 15°}$$
$$= 2511\text{ nm} \approx 2.5\ \mu\text{m}.$$

$$a \sin\theta = 1.5\lambda'.$$

$$\lambda' = \frac{a\sin\theta}{1.5} = \frac{(2511\text{ nm})(\sin 15°)}{1.5}$$
$$= 430\text{ nm}.$$