f) The angle of incidence on the cladding is greater than critical angle of the core with respect to the cladding. Hence total internal reflection takes place several times at the cladding and finally emerges out.

g) To form the image of an object a bundle of fibres of 72 in number is used in general. It is called an optical pipe.

h) **Uses :**

i) The optical fibres are used in the filed of communication since they are thin, light weight, flexible and interference free.

ii) Different telephone signals by superposing on the optical beam can be transmitted simultaneously through fibres without any interference. The response time reduces since the velocity of transmission is high.

iii) The optical fibres are used for medical investigations. Optical fibres are used in laproscope, endoscope for visual examination of inaccessible regions in the human body.

iv) The optical fibres in the form of photometric sensors are used for measuring the blood flow in the heart.

v) The optical fibre sensors have been used to measure temperature and pressure.

vi) The optical fibres in the form refractometers are used to determine the refractive indices of liquids.

27. **Expression for glancing angle (or) launching angle :**

a) The maximum angle of incidence in air for which all the light is totally reflected at the core-cladding interface of an optical fibre is called glancing angle.

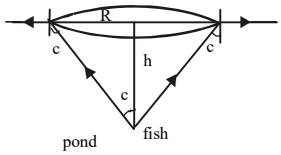
b) If μ_1 and μ_2 are the refractive indices of cladding and core respectively ($\mu_2 > \mu_1$) and θ is the glancing angle in air then $\sin\theta = \sqrt{\mu_2^2 - \mu_1^2}$.

c) The factor $\sqrt{\mu_2^2 - \mu_1^2}$ is called numerical aperture, denoted by NA.

$\therefore$ $NA = \sqrt{\mu_2^2 - \mu_1^2}$.

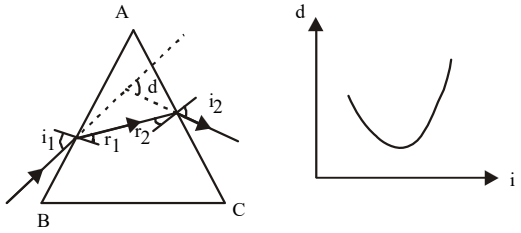
28. The apparent altitude of a star is more than the real altitude because of atmospheric refraction.
29. A person under water observes the setting or rising sun at an angle of $41°25^I$ i.e., (90°–C) with the horizontal.
30. The sun is seen before it actually rises above the horizon due to atmospheric refraction. If there were no atmosphere, then the length of the day on earth would decrease by four minutes.
31. The rising sun appears to be bigger or oval in shape when it is at the horizon due to atmospheric refraction.
32. If light travels a distance x in a medium of refractive index μ, the equivalent path in vacuum it would cover in the same time is μx and it is called **optical path**.
33. For a fish or diver under water, the outside world appears to be within a cone of vertex angle 2C (= 98°).
34. If h is the depth of the fish from the surface of water of refractive index μ, the radius of the circle R on the surface of water through which it can see the outside world is

R = htanC or $R = \frac{h}{\sqrt{\mu^2 - 1}}$.



35. **PRISM :**

a) A prism is a piece of gas or any other transparent material, bounded by two triangular and three rectangular surfaces.



b) When a light ray passes through a prism it bends towards the base of the prism.

c) The angle made by emergent ray with incident ray is called angle of deviation (d).

d) $d=i_1+i_2-A$, $A=r_1+r_2$ where i_1 – angle of incidence,
i_2 – angle of emergence, A – angle of prism,
r_1 – angle of refraction at first retracing face,
r_2 – angle of refraction at second refracting face.

e) As the angle of incidence increases, angle of deviation first decreases to a minimum value (D) and then increases.

f) If d=D, then $i_1=i_2=i$ and $r_1=r_2=r$

$\Rightarrow D = 2i - A,\ A = 2r$

g) $\mu = \dfrac{\sin\left(\dfrac{A+D}{2}\right)}{\sin\dfrac{A}{2}}$

h) As refractive index (μ) of material of prism increases the angle of deviation increases.

i) As angle of prism (A) increases, the angle of deviation increases.

j) As wavelength of light increases, the angle of deviation decreases. Ex : The angle of deviation for red is minimum as it has maximum wavelength. The angle of deviation of violet is maximum as it has minimum wavelength.

k) If D=A, then $\mu = 2\cos\dfrac{A}{2}$

l) The prism whose angle is very small is called thin prism.

m) For a thin prism $D=(\mu-1)A$.

36. **Refraction through a prism :**

A → angle of the prism or refracting angle

D → angle of deviation

i_1, i_2 → are the angles of refraction

i) Angle of prism, $A=r_1+r_2$

ii) Angle of deviation $D=i_1+i_2-A$

iii) Refractive index of the prism, $\mu = \dfrac{\sin i_1}{\sin r_1} = \dfrac{\sin i_2}{\sin r_2}$

37. **Limiting angle of the prism :**

a) It is the angle of the prism for which a ray grazing on one of the face of the prism after refraction grazes out from the second face.