Plane mirror

Light sources – bodies that emit light

Optical medium:

Transparent medium: light travels without absorbtion

Non-transparent medium: light is absorbed or reflected

Translucent: light goes through with scattering

Homogeneous optical medium – same optical properties

In homogeneous optical medium light has a stright path.

Equiphase - line perpendicular to the direction of beam of light

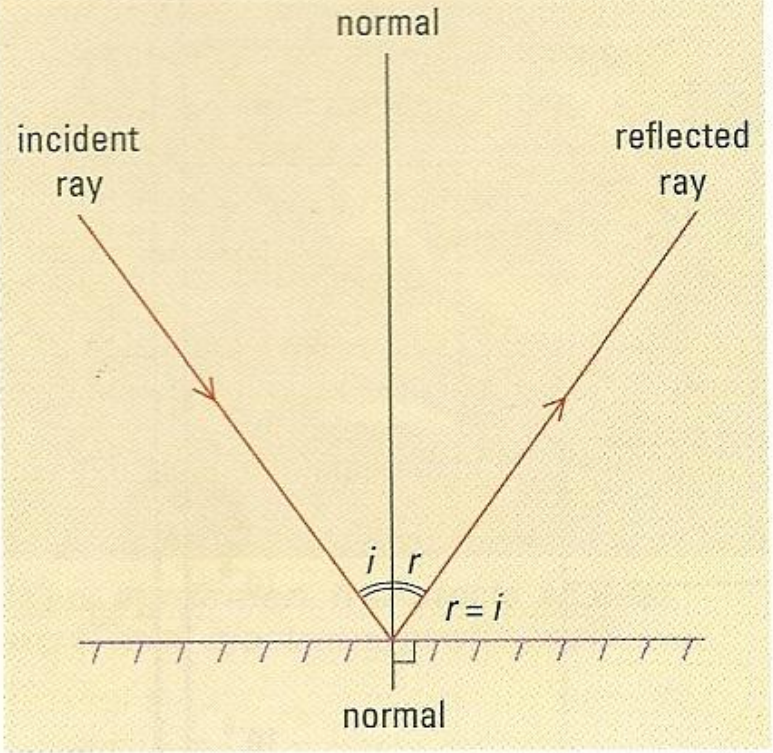
Speed of light in vacuum – $3 \times 10^{8}\ m.s^{-1}$

Reflection and refraction of light. Index of refraction

Law of reflection

The incident and reflected rays make equal angles to a normal to the surface at the reflection point α = α´, where α – incidence angle

α´- angle of reflection



*The **normal** is a line drawn perpendicular to the surface and is used in preference to the surface itself because it remains well defined even when the surface is curved.*

Question:

If a radar reflection takes 14 minutes to complete a return trip to mercury, how far is mercury from the earth at the time of experiment?

Law of refraction (Snell´s law):

The ratio of the sines of incident to refracted angles is equal to the ratio of velocities of the waves in the two media. This ratio is a conctant for a ray moving between a particular pair of media and is called the **relativeindex** n_{12}.

A ray travelling from medium 2 into medium 1 across this boundary would exactly retrace this path but in the opposite dirrection, with the incident and refracted rays swapped and a refractive index n_{21}, i.e. the reciprocal of n_{12}:

$\sin \Phi_1 / \sin \Phi_2 = c_1 / c_2 = n_2 / n_1$, $\quad n_1 \sin \Phi_1 = \sin \Phi_2 \, n_2$

If $c_1 > c_2$ the refractive index is greater than 1 and the wave moves towards the normal. This occurs whenever wave velocity reduces as the wave crosses the boundary, as with light travelling from air into glas or water waves approaching a beach. The waves then refract towards the normal. In optics the velocity of light depends on the electron density in the medium – the greater the density the slower the light.

Summary:

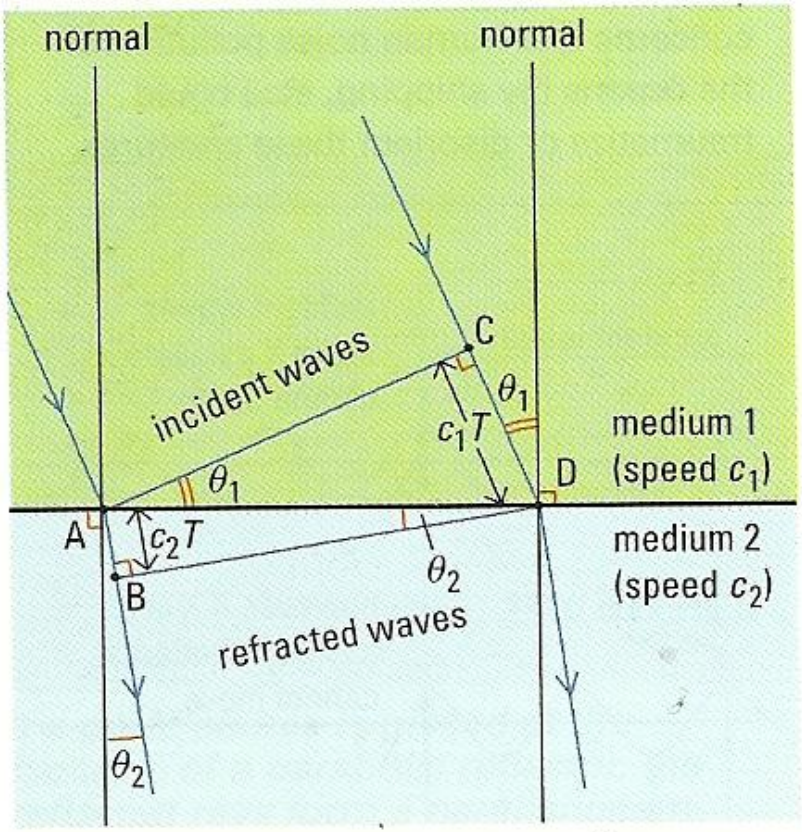
•Light rays bend toward the normal when light enters an optically denser medium.

•Light rays bend away the normal when leaving an optically denser medium.

Absolute refractive index - n:

$$\mathbf{n = n_{vac\ med} = c / c_{med}}$$

$$n_{12} = c_1 / c_2 = c_1 / c \times c / c_2 = n_2 / n_1$$



Light travelling from one medium to another.

Question:

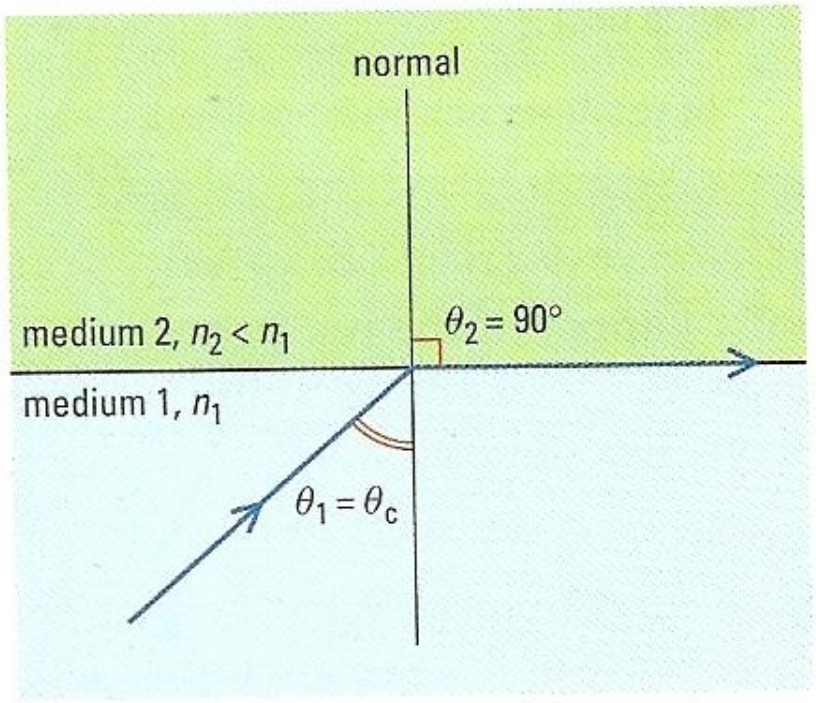
A ray of light travels from water into a glas block at an angle of 15° to the normal to the boundary between the two media. In what direction does it travel inside the glas? (take n_{water}=1.33 and n_{glas}=1.53)

What is the speed of light in diamond? (take $n_{diamond}$=2.42)

Total internal reflection:

The critical angle Φ_C is the angle of incidence for a ray crossing the boundary from a medium of higher refractive index into one of lower refractive index at which the law of refraction predicts a refracted angle of 90°. No refracted rays can form so the incident ray undergoes total internal reflection.

$$\sin \Phi_C = n_2 / n_1$$

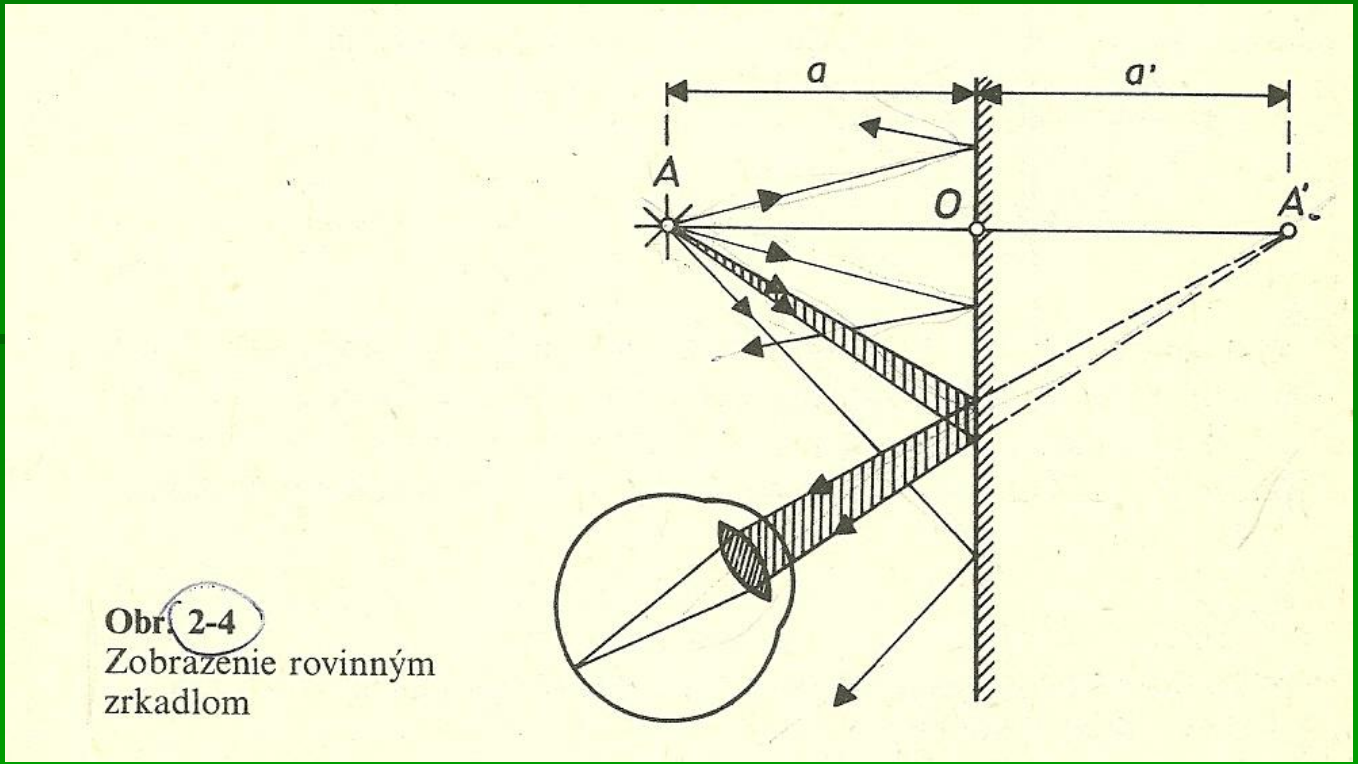


The critical angle.

Question:

Light is travelling along an optical fibre made of glas of relative index 1.52, What is the index of cladding material if the critical angle is 82°?

Plane mirror:



Obr. 2-4
Zobrazenie rovinným zrkadlom

Image is always:

- Unreal
- Of the same size
- Symetrical with the object according the mirror plane