

Lecture 6

1. Lenses. Types of lenses. Main characteristics of the lenses.
2. The imaging in the lenses
3. The formula of thin lens.
4. Application the lens. Camera. The eye as an optical system.

law of rectilinear distribution of light.

law of reflection and light refraction.

phenomenon of total reflection.

optic instruments.

Optics - the branch of physics that studies the properties and the physical nature of light and its interaction with substance.

The laws of geometrical optics:

- 1 The law of the rectilinear propagation of light.
- 2 The law of reflection of light.
- 3 The law of refraction of light.

1 Rectilinear Propagation of Light

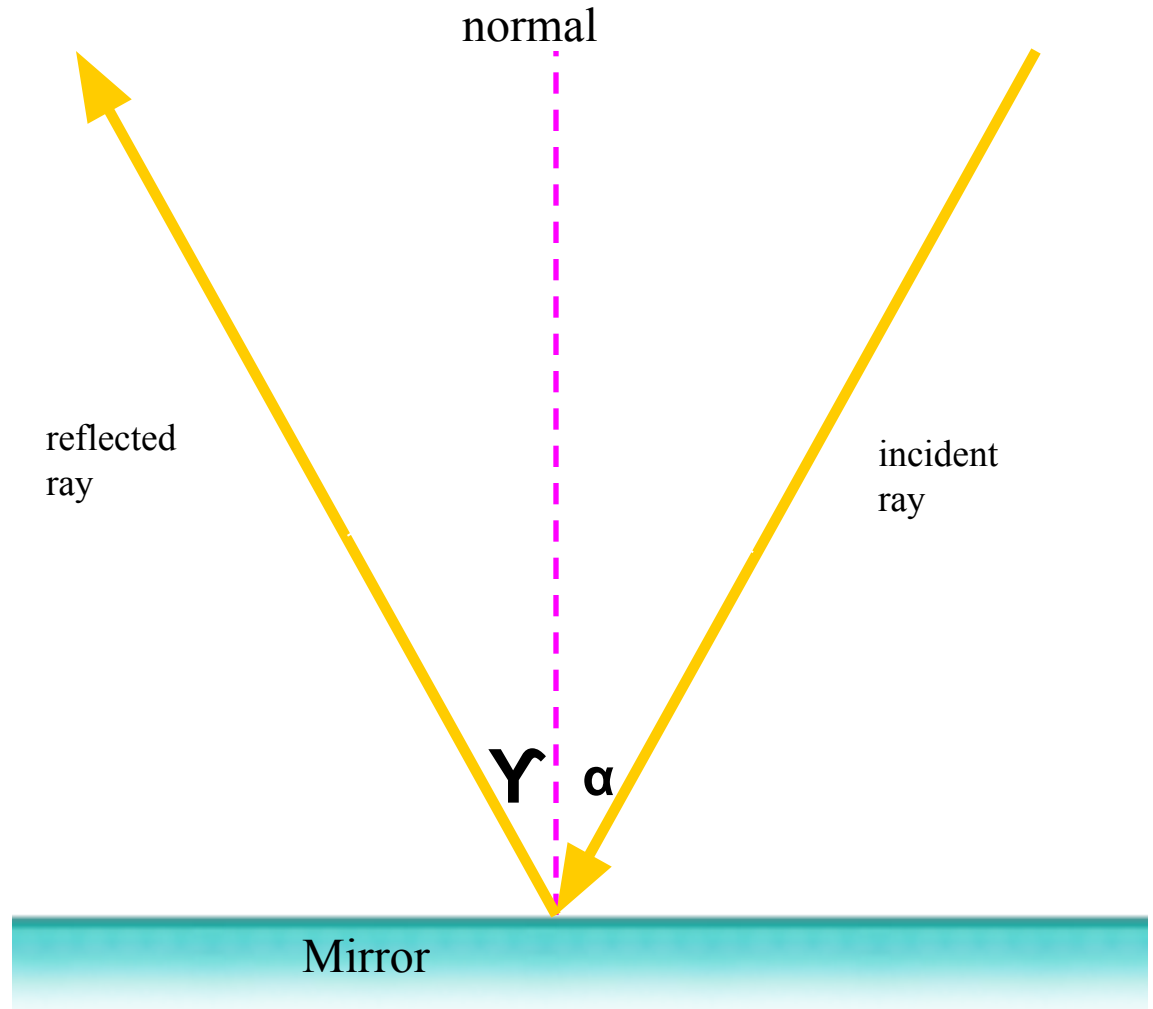
In a homogenous transparent medium light travels in a straight line and this is known as rectilinear propagation of light

2. Reflection (шағылу)

Reflection is when light changes direction by bouncing (подпрыгивать) off a surface.

When light is reflected off a mirror, it hits the mirror at the same angle (α , the incidence angle) as it reflects off the mirror (γ the reflection angle).

The normal is an imaginary line which lies at right angles to the mirror where the ray hits it.



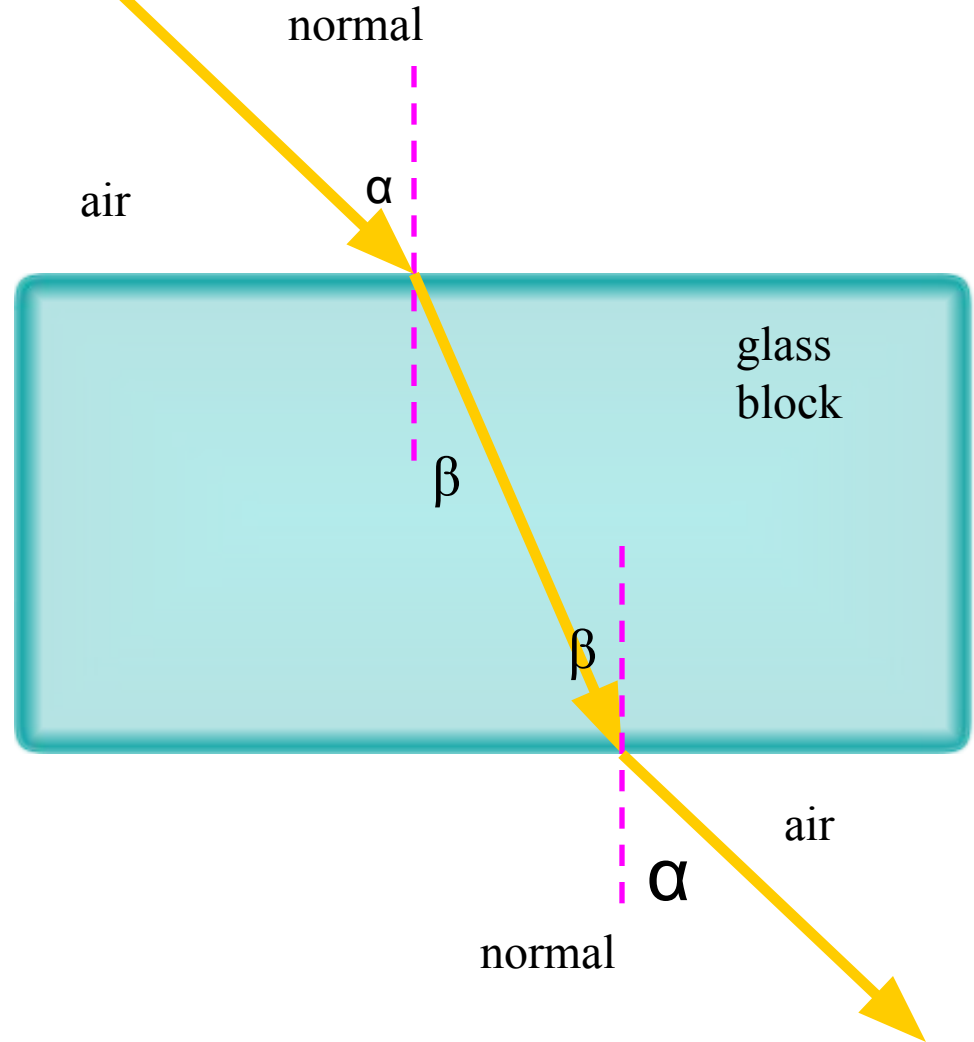
$$\alpha = \gamma$$

3. Refraction (сыну)

Refraction is when light bends as it passes from one medium into another.

When light traveling through air passes into the glass block it is refracted towards the normal.

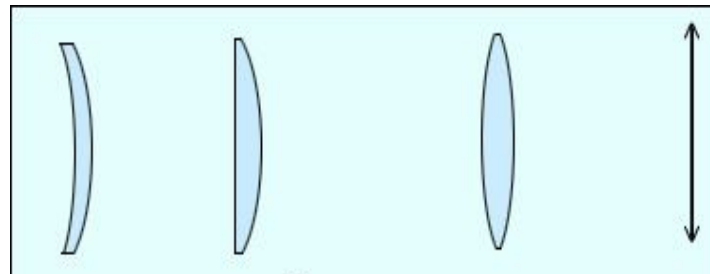
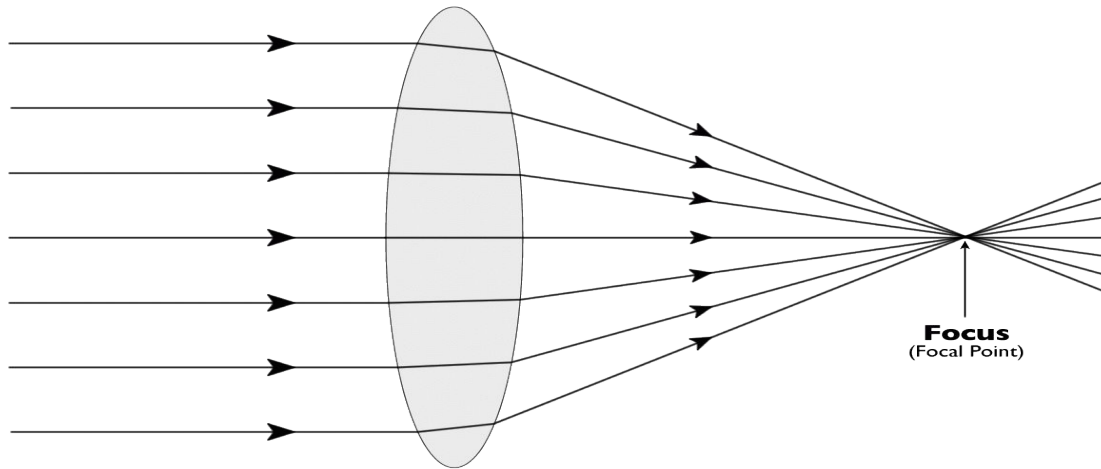
When light passes back out of the glass into the air, it is refracted away from the normal.



Lenses - a piece of transparent substance, usually glass, having two opposite surfaces either both curved or one curved and one plane, used in an optical device in changing the convergence of light rays, as for magnification, or in correcting defects of vision.

Convex Lenses (Дөңес линза)

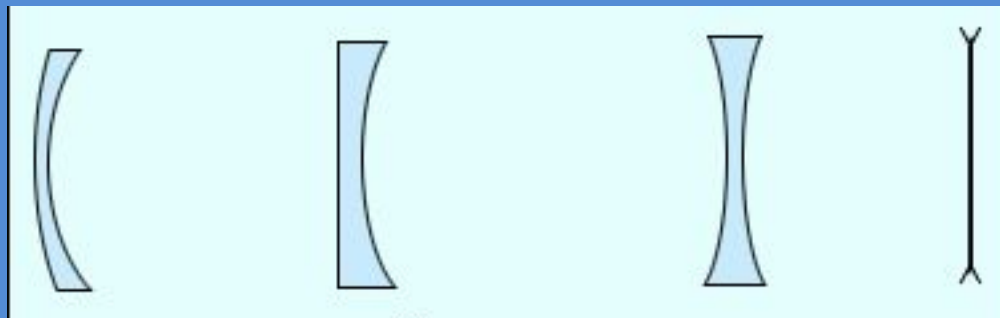
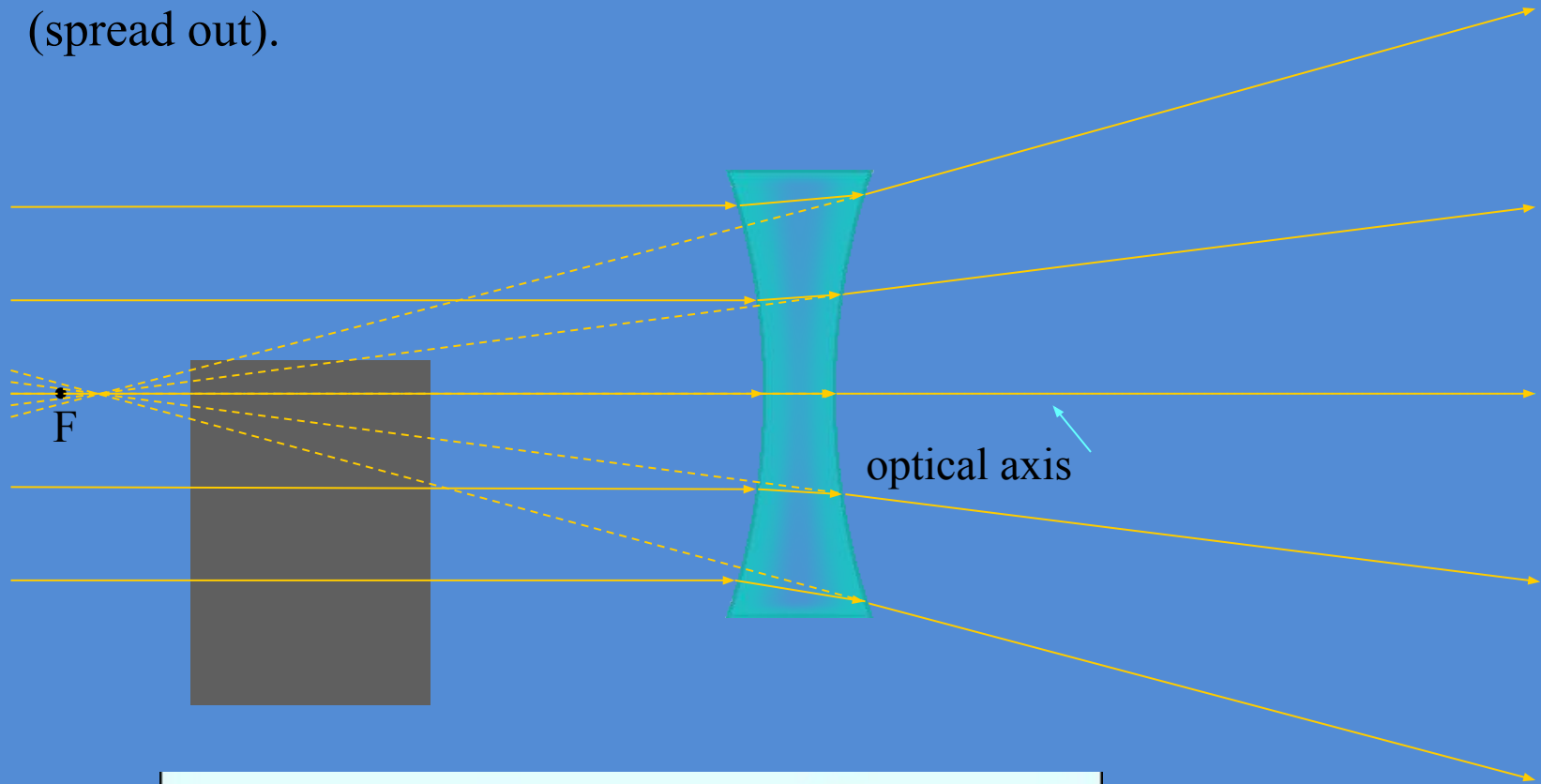
Convex lenses are thicker in the middle and focus light rays to a focal point in front of the lens.



The focal length of the lens is the distance between the center of the lens and the point where the light rays are focused.

Concave Lenses (Ойыс линза)

Concave lenses are thin in the middle and make light rays diverge (шашырату) (spread out).

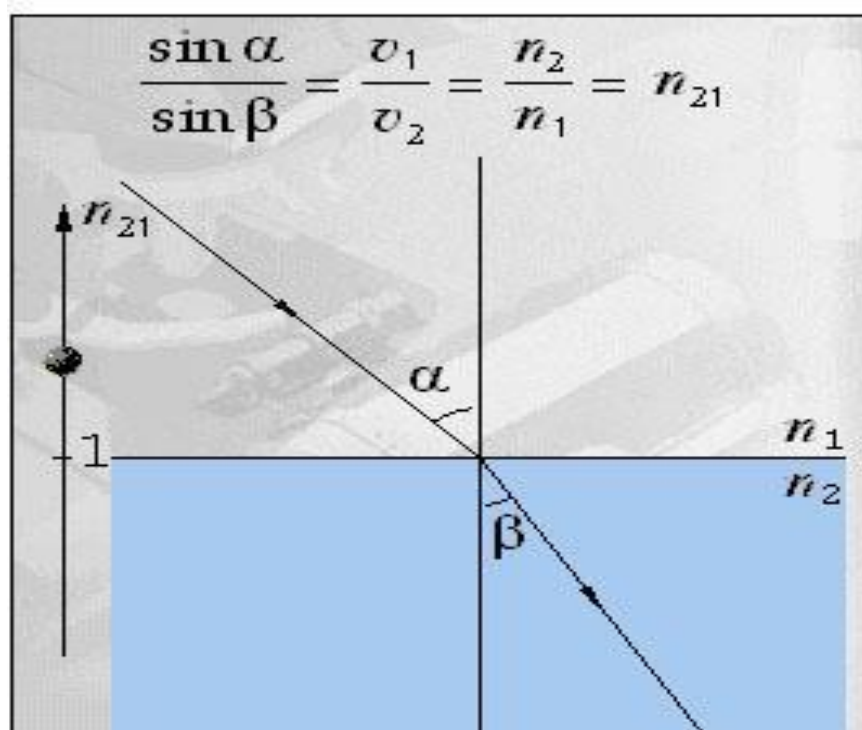


1. Index of refraction. The two transparent optical media that form an interface are distinguished from one another by a constant called the *index of refraction*, generally labeled with the symbol n . The index of refraction for any transparent optical medium is defined as the ratio of the speed of light in a vacuum to the speed of light in the medium, as given in Equation 3-1.

$$n = \frac{c}{v} \quad (3-1)$$

where c = speed of light in free space (vacuum)
 v = speed of light in the medium
 n = index of refraction of the medium

Закон Снеллиуса



Snell's Law

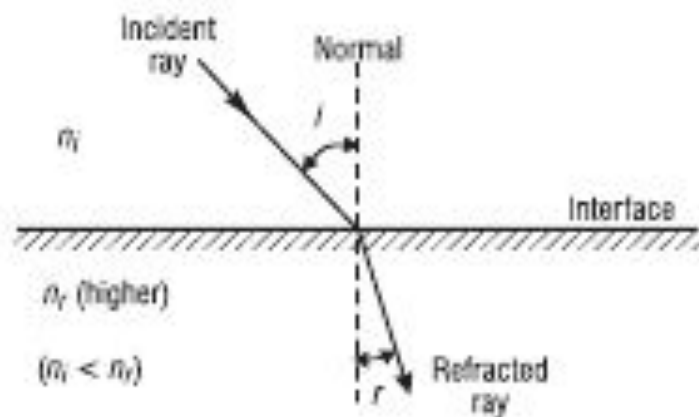
$$\frac{\sin i}{\sin r} = \frac{n_r}{n_i}, \text{ where}$$

i is the angle of incidence

r is the angle of refraction

n_i is the index in the incident medium

n_r is the index in the refracting medium



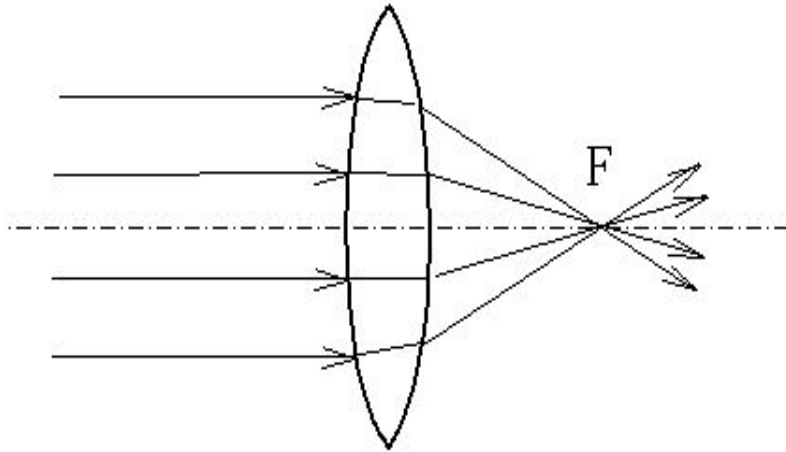
Note carefully that both the angle of incidence (i) and refraction (r) are measured with respect to the surface normal. Note also that the incident ray, normal, and refracted ray all lie in the same geometrical plane.

In practice Snell's law is often written simply as

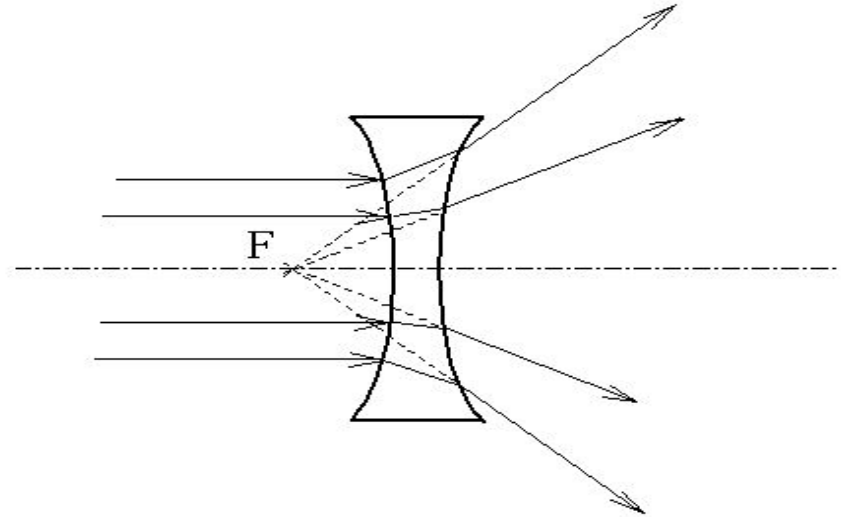
$$n_i \sin i = n_r \sin r$$

(3-2)

Now let's look at an example that make use of *Snell's law*.



F- the focus of lens (real)

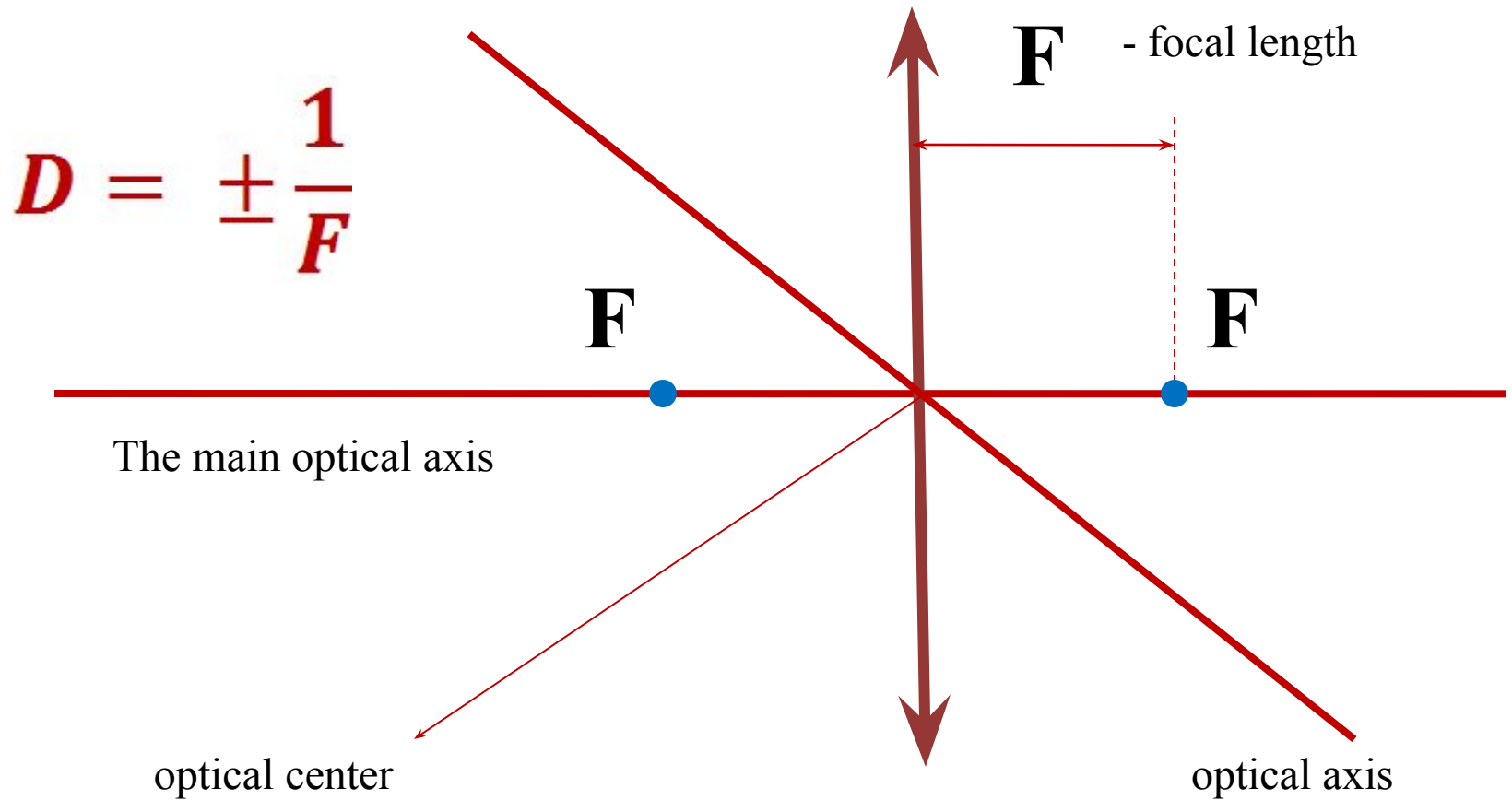


F –the focus of lenses (imaginary)

Images are:

- * real or imaginary,
- * direct and inverse,
- * increase or decrease.

The main characteristics of the lens



Constructing an image in the lenses

Construction image in **Convex lens**.

1. Object AB is between the focus and dual focus.

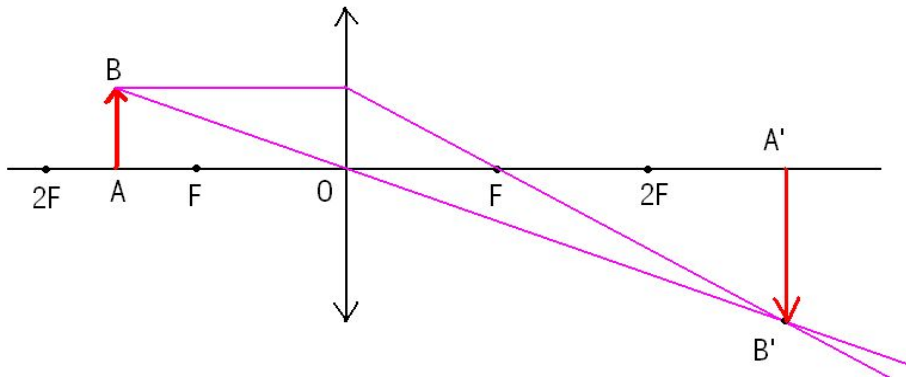


Image characteristics:

real

inverse

increased

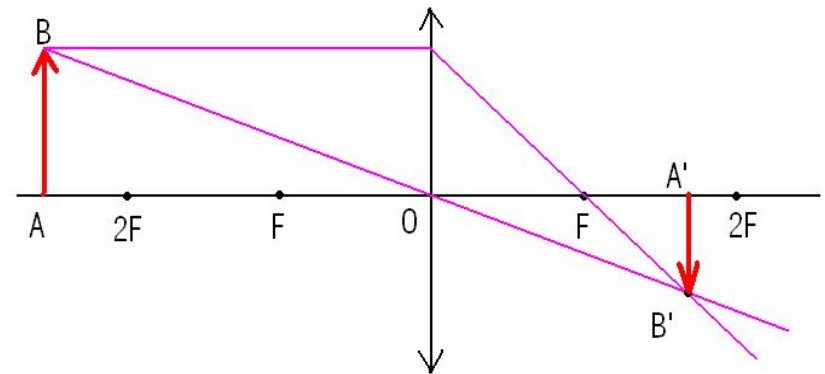


Image characteristics:

real

inverse

decreased

Construction image in **Concave lens**.

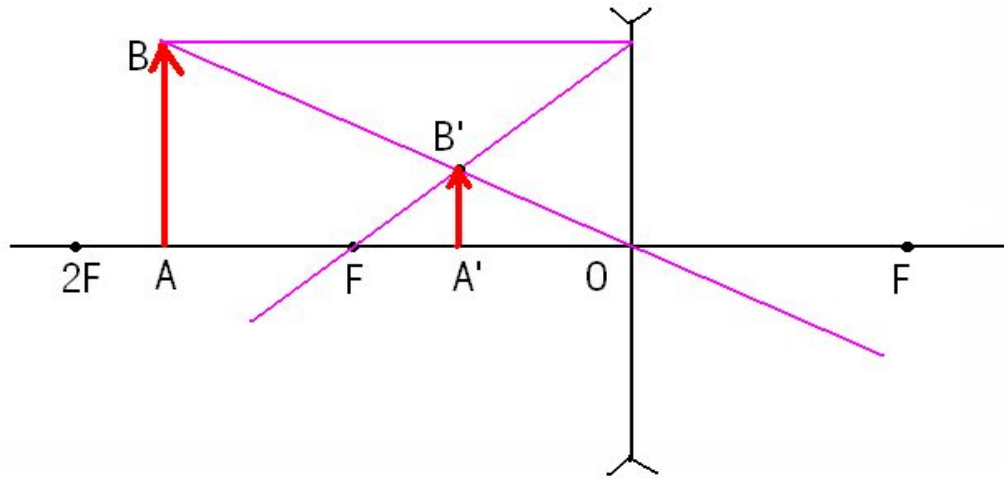
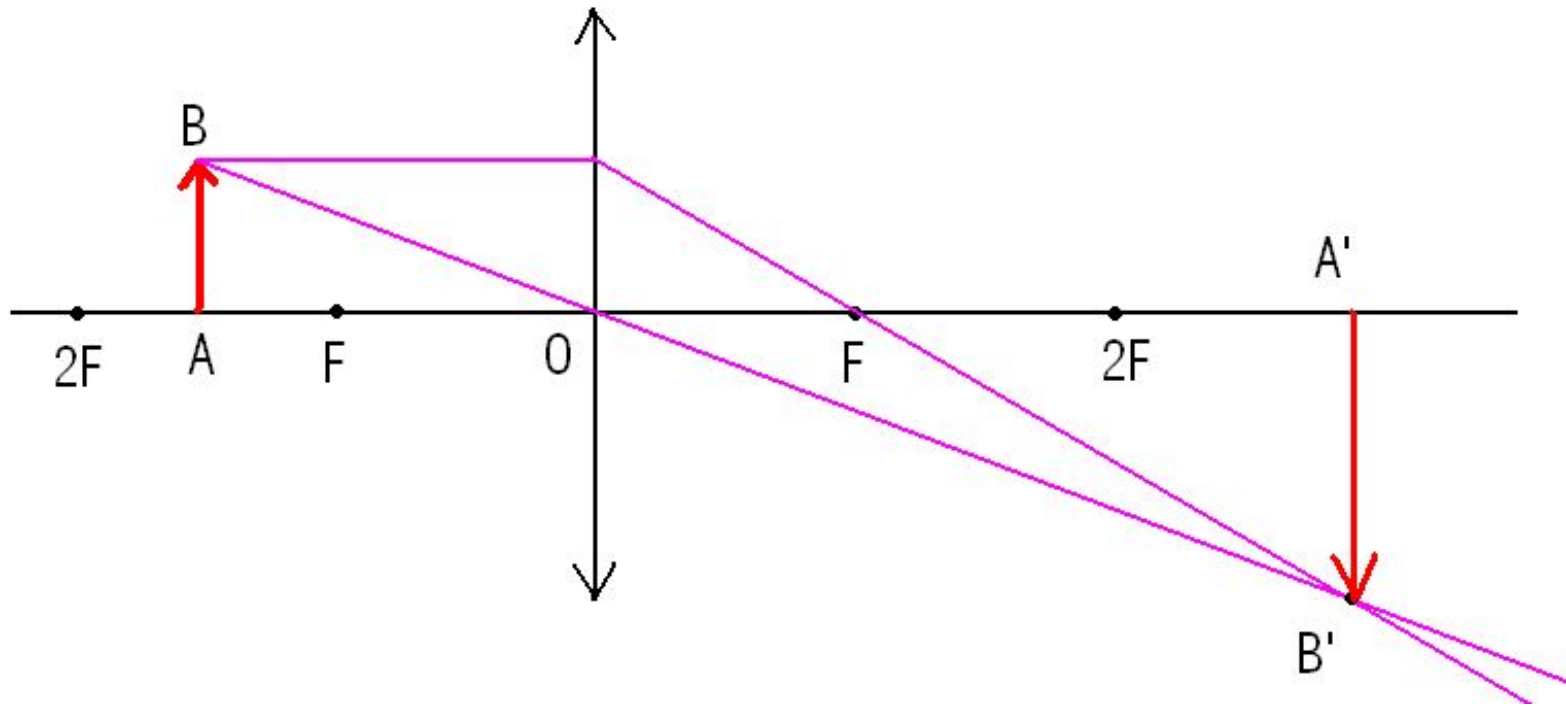


Image characteristics:
imaginary;
direct;
decreased.

The formula of thin lens.

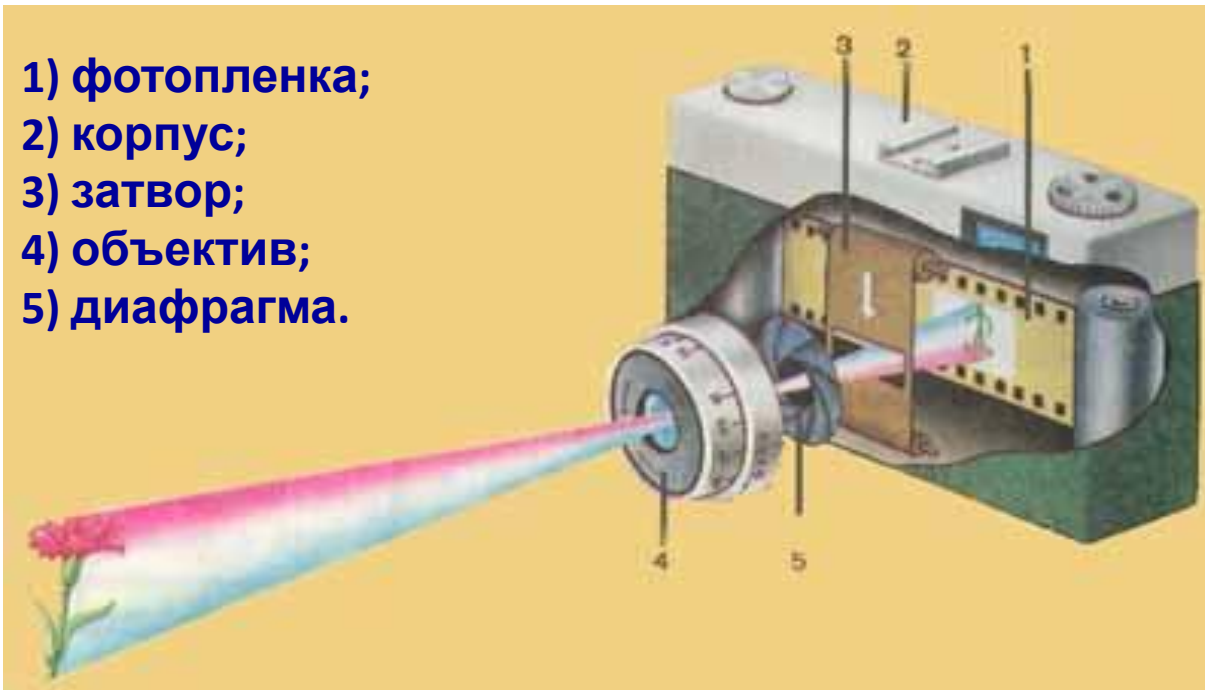


$$\frac{1}{d} \pm \frac{1}{f} = \pm \frac{1}{F} \quad \frac{1}{d} \pm \frac{1}{f} = D \quad \Gamma = \frac{f}{d} = \frac{H}{h}$$

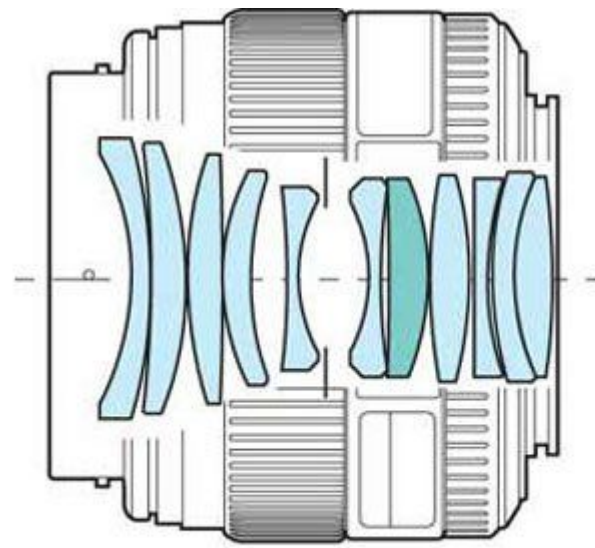
Application of lenses

The main part of the film camera

- 1) фотопленка;
- 2) корпус;
- 3) затвор;
- 4) объектив;
- 5) диафрагма.

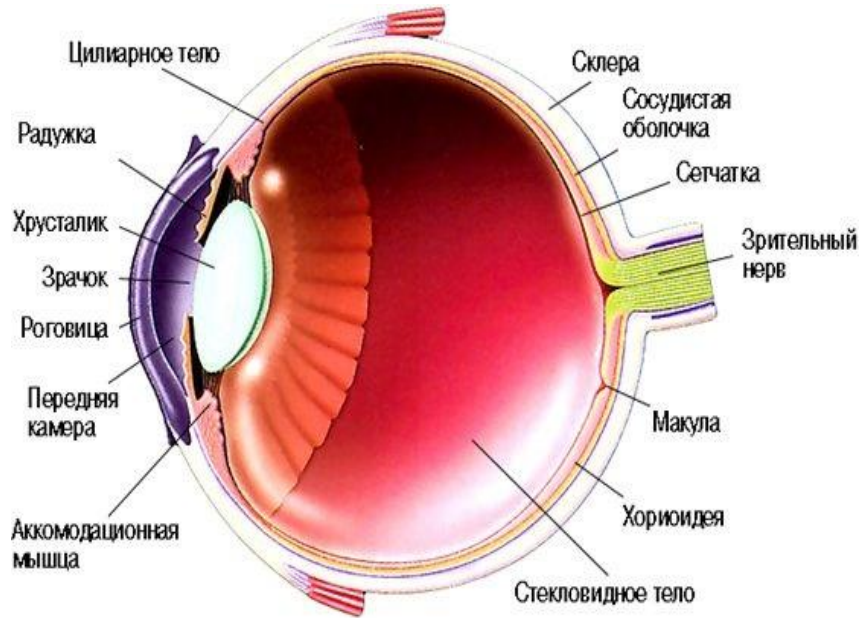


Objective

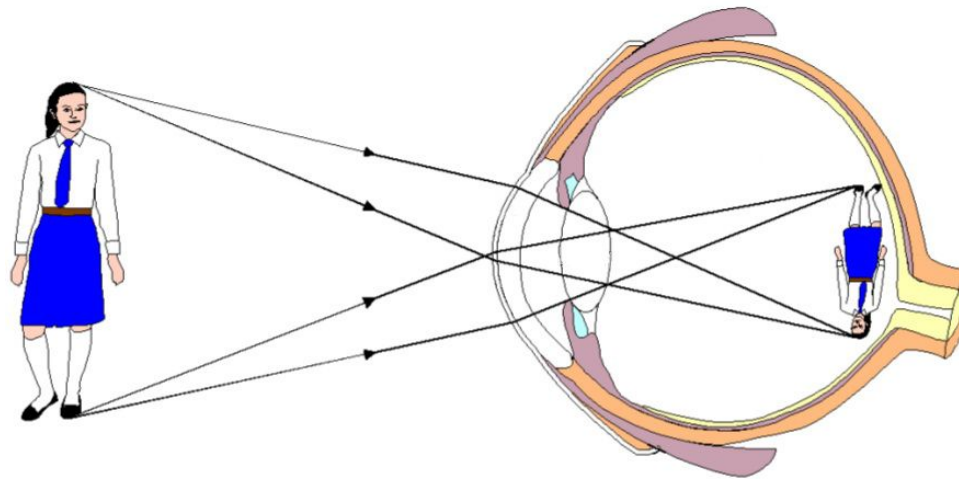
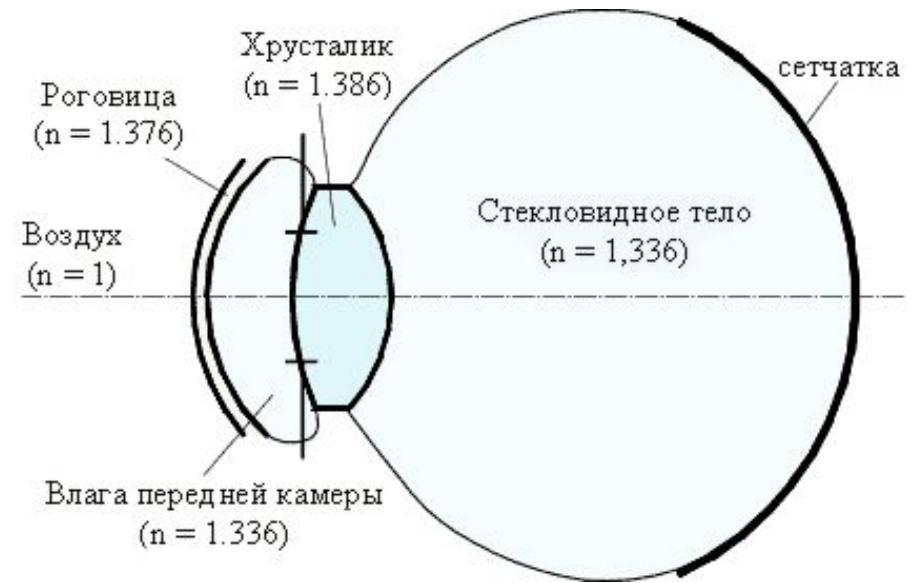


50mm F2.0 Macro 1:2
ED Glass Element

The structure of the eyeball



Simplified optical eye diagram



Diseases of the human eye and treatment



- 1.Нормальный глаз
- 2.Близорукий глаз
- 3.Дальнозорький глаз

The best distance to the normal eye is
equal of **25 cm.**

Eye diseases and treatment with glasses

