DEPARTMENT OF PHYSICS

II B.Sc Physics SEMESTER III
PAPER – IV – OPTICS

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PREAMBLE

This paper gives a sound knowledge about Physical optics

UNIT – I –LENSES AND ABBRATIONS:

Lens – Refraction through lenses – Aberration – Chromatic aberration – Spherical aberration – Minimization of aberrations – Coma – Astigmatism.

UNIT- II - EYEPIECES, DISPERSION AND RAINBOWS

Ramsden's eyepiece – Huygen's eyepiece – Oil immersion objective – Dispersion – Dispersion through a prism – Cauchy's dispersion formula – Theory of Rainbows – Primary and Secondary Rainbow.

UNIT – V– POLARISATION

Double refraction – Nicol prism construction and working - Huygen's explanation – Production, Detection and Analysis of Plane, Circularly and elliptically polarized light – Quarter and Half wave plates – Optical rotation – Fresnel's theory of optical rotation - Biot's laws – Laurent's half shade Polari meter.

BOOK FOR REFERENCE:

Optics – S.P. Singh and J.P. Agarwal
Optics– Sathya prakash
Optics & Spectroscopy – R. Murugeshan

BOOK FOR STUDY:

Optics – Brijlal and Subramaniam

Optics is a branch of Physics which deals with the behavior of light rays, their sources and their interaction with matter.

Optics is of two categories:

1. Geometrical optics & 2. Physical optics

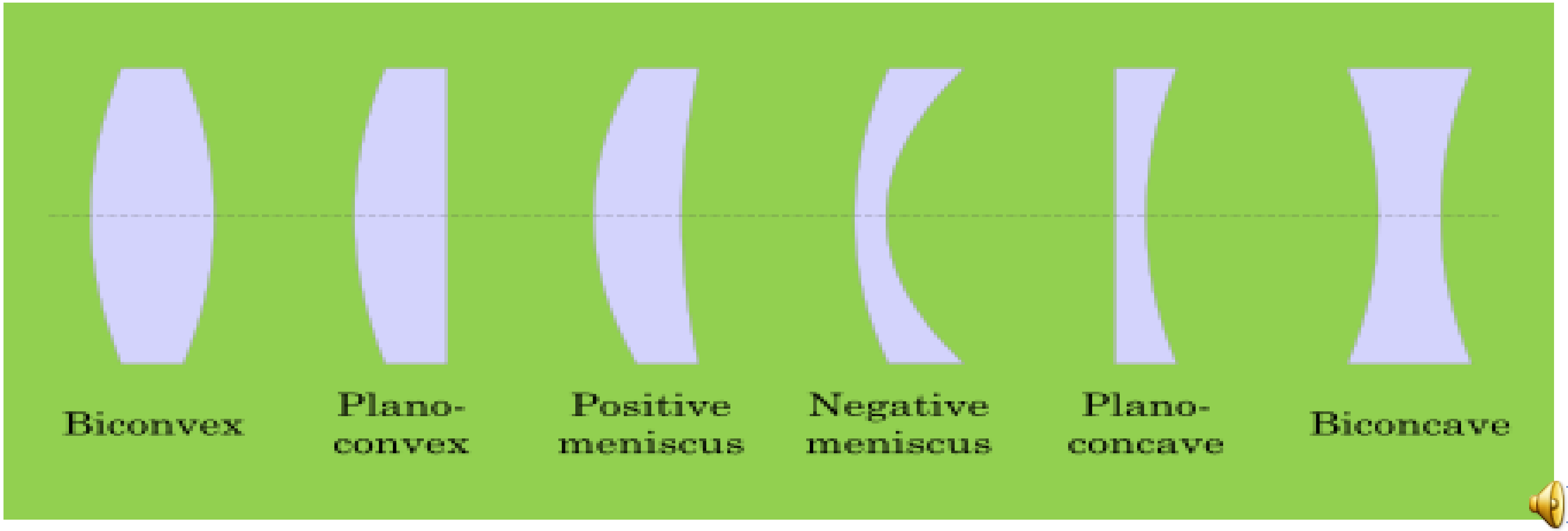
In Geometrical optics we will study (a) the refraction through lenses and prisms, (b) Aberrations (the defects in lenses and prisms) and the methods of removal of aberrations (c) eyepieces & (d) formation of rainbows

UNIT – I –LENSES AND ABBRATIONS:

What is a lens?

A **lens** is a transmissive optical device that focuses or disperses a light beam by means of refraction. A simple **lens** consists of a single piece of transparent material, while a compound **lens** consists of several simple **lenses** (elements), usually arranged along a common axis.

Types of Lenses



Lenses are classified by the curvature of the two optical surfaces. A lens is *biconvex* (or *double convex*, or just *convex*) if both surfaces are convex. If both surfaces have the same radius of curvature, the lens is *equiconvex*.

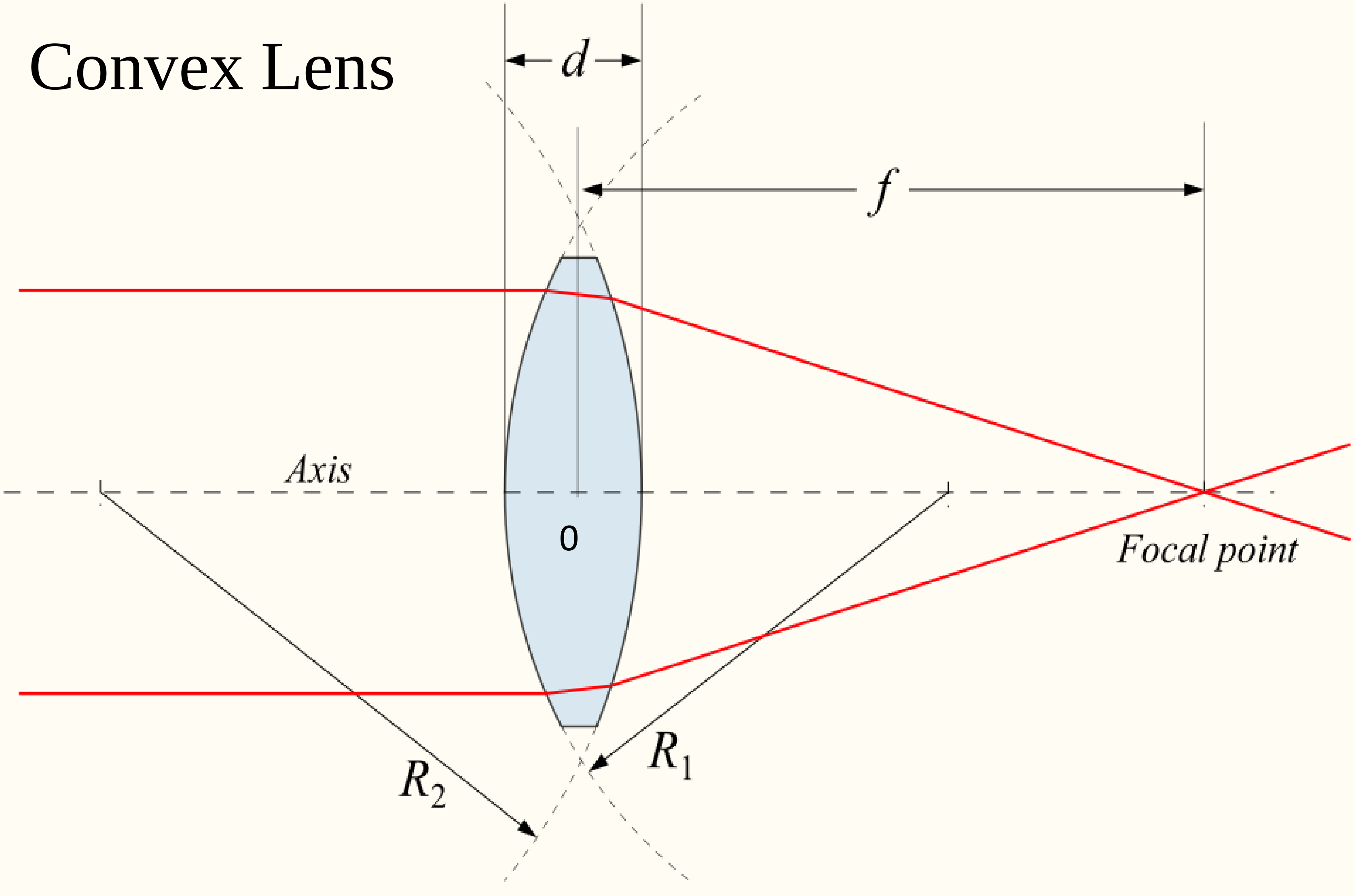
A lens with two concave surfaces is *biconcave* (or just *concave*). If one of the surfaces is flat, the lens is *plano-convex* or *plano-concave* depending on the curvature of the other surface.

A lens with one convex and one concave side is *convex-concave* or *meniscus*. It is this type of lens that is most commonly used in corrective lenses.

If the lens is biconvex or plano-convex, a collimated beam of light passing through the lens converges to a spot (a *focus*) behind the lens. In this case, the lens is called a *positive* or *converging* lens.

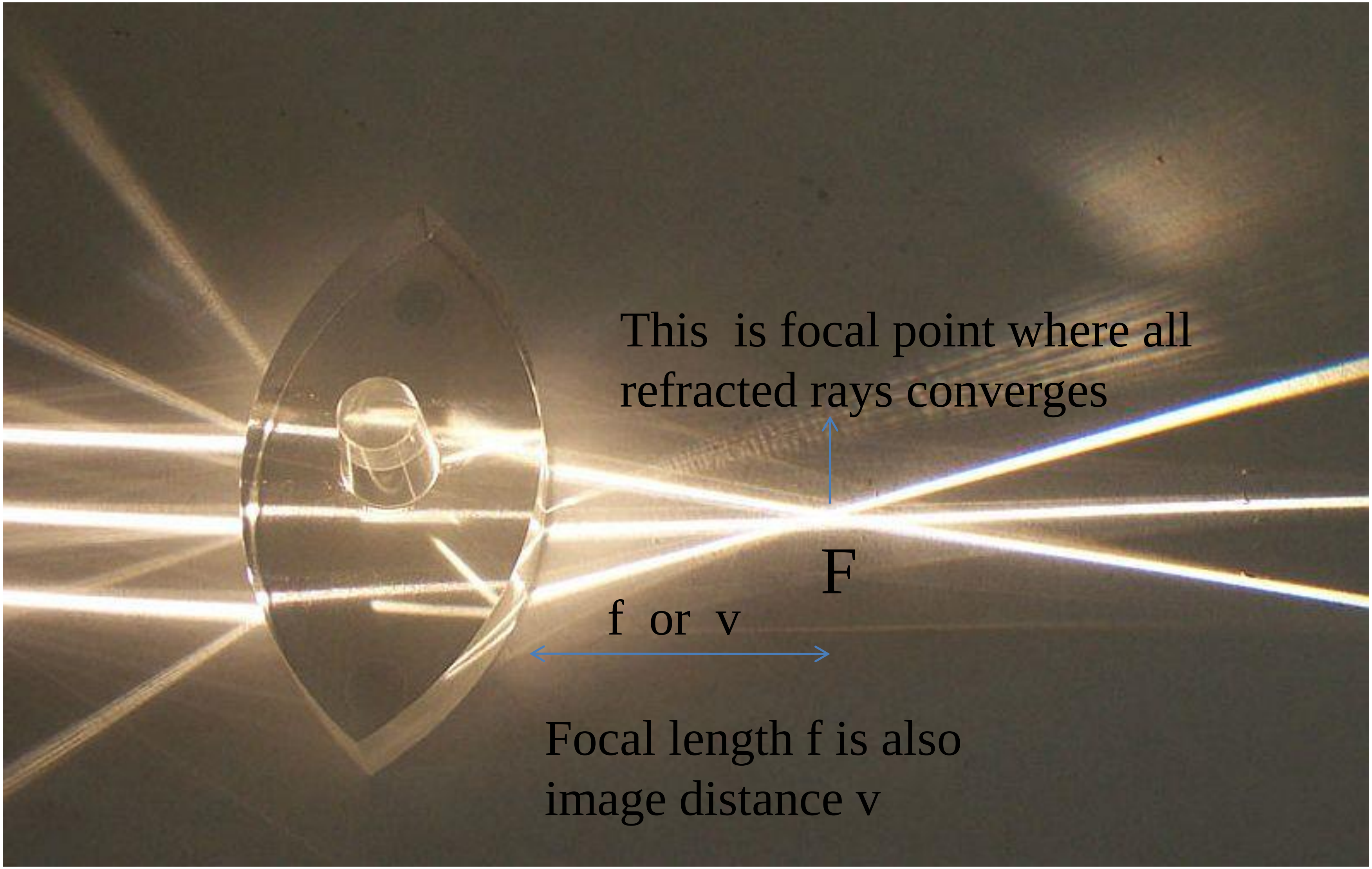
For a thin lens in air, the distance from the lens to the spot is the focal length of the lens, which is commonly represented by *f* in diagrams and equations.

Convex Lens

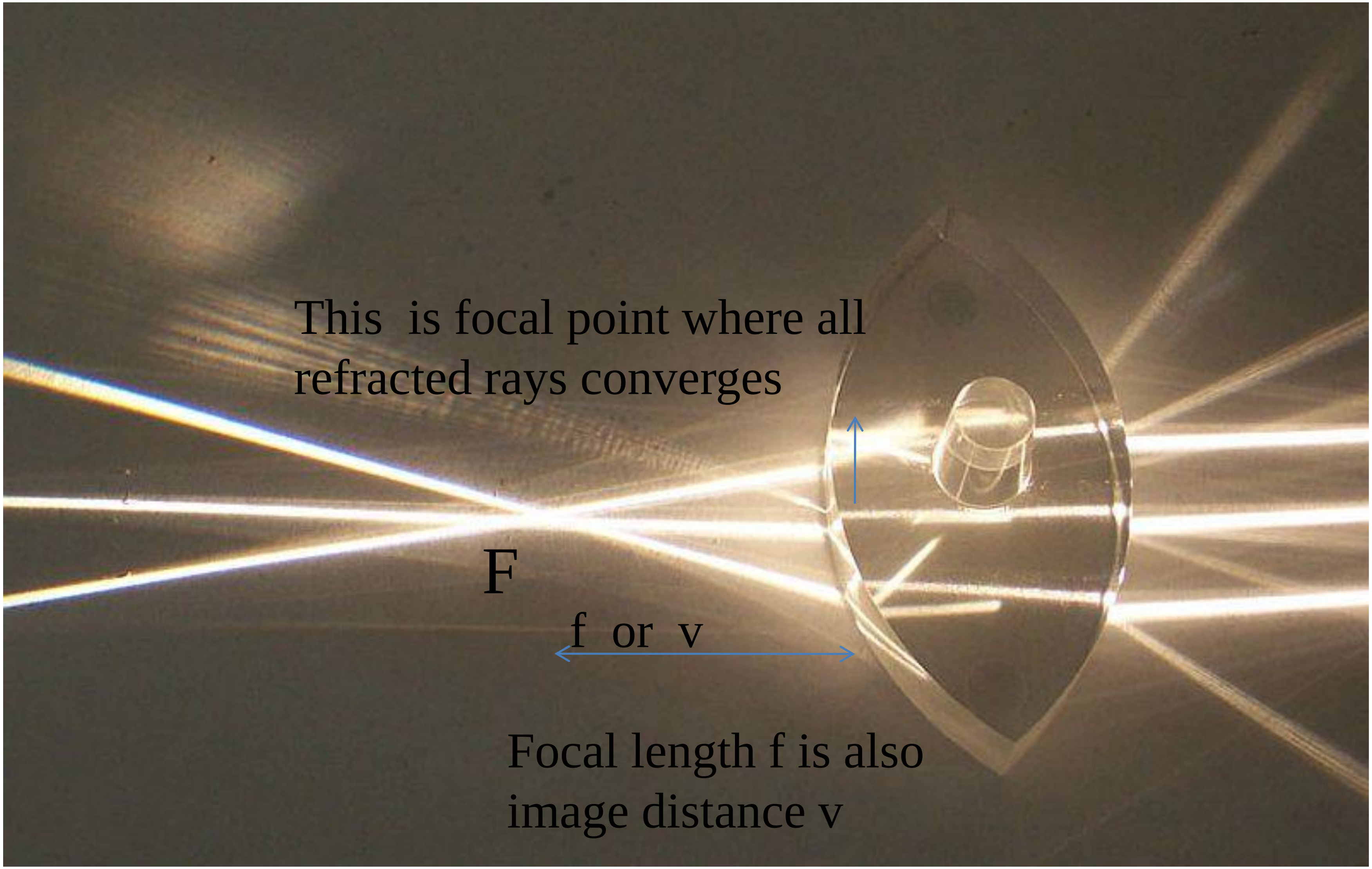


Positive (converging) lens

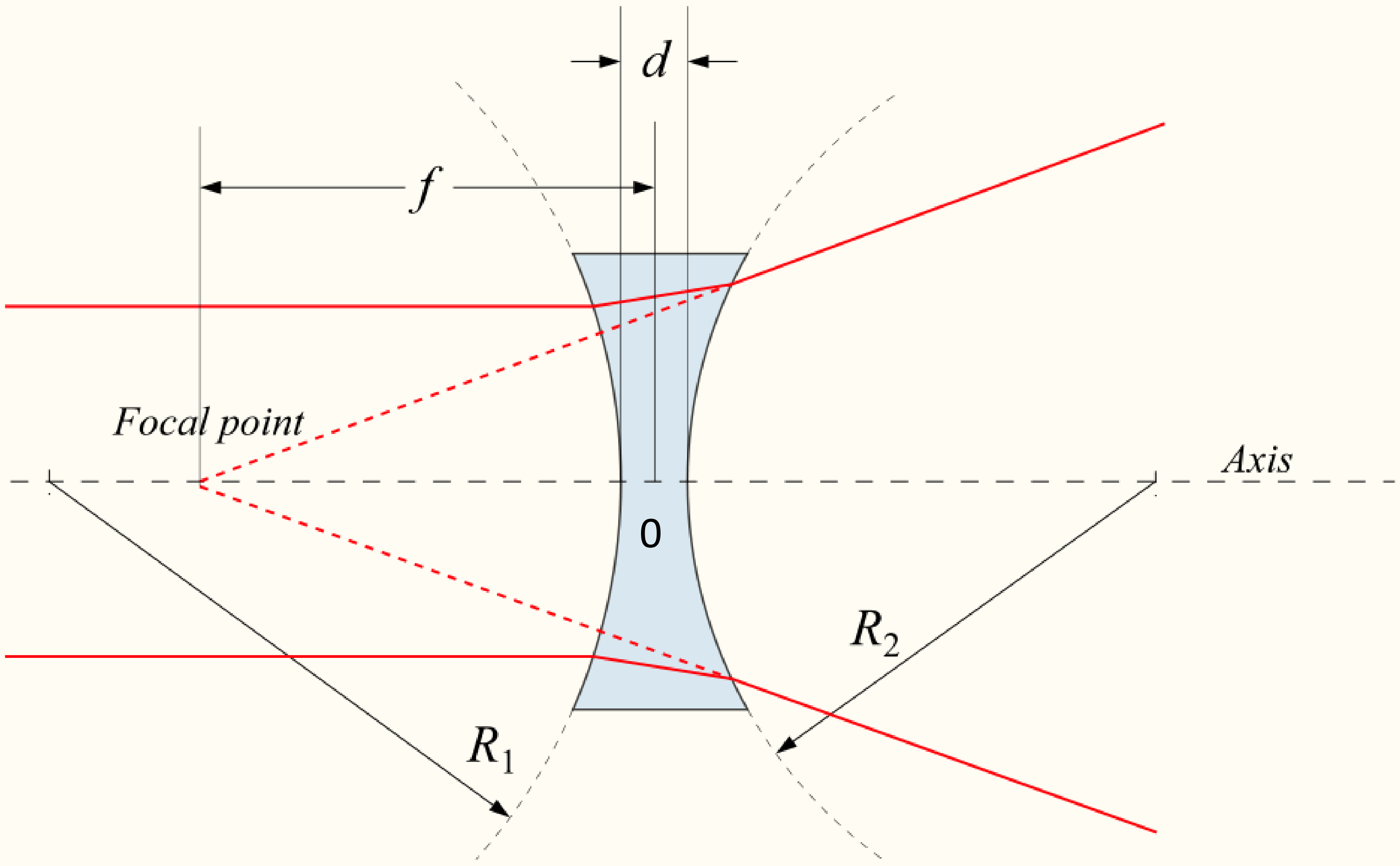
Refraction through Convex lens incident rays are from left to right



Refraction through Convex lens incident rays are from right to left



Concave Lens



Negative (diverging) lens

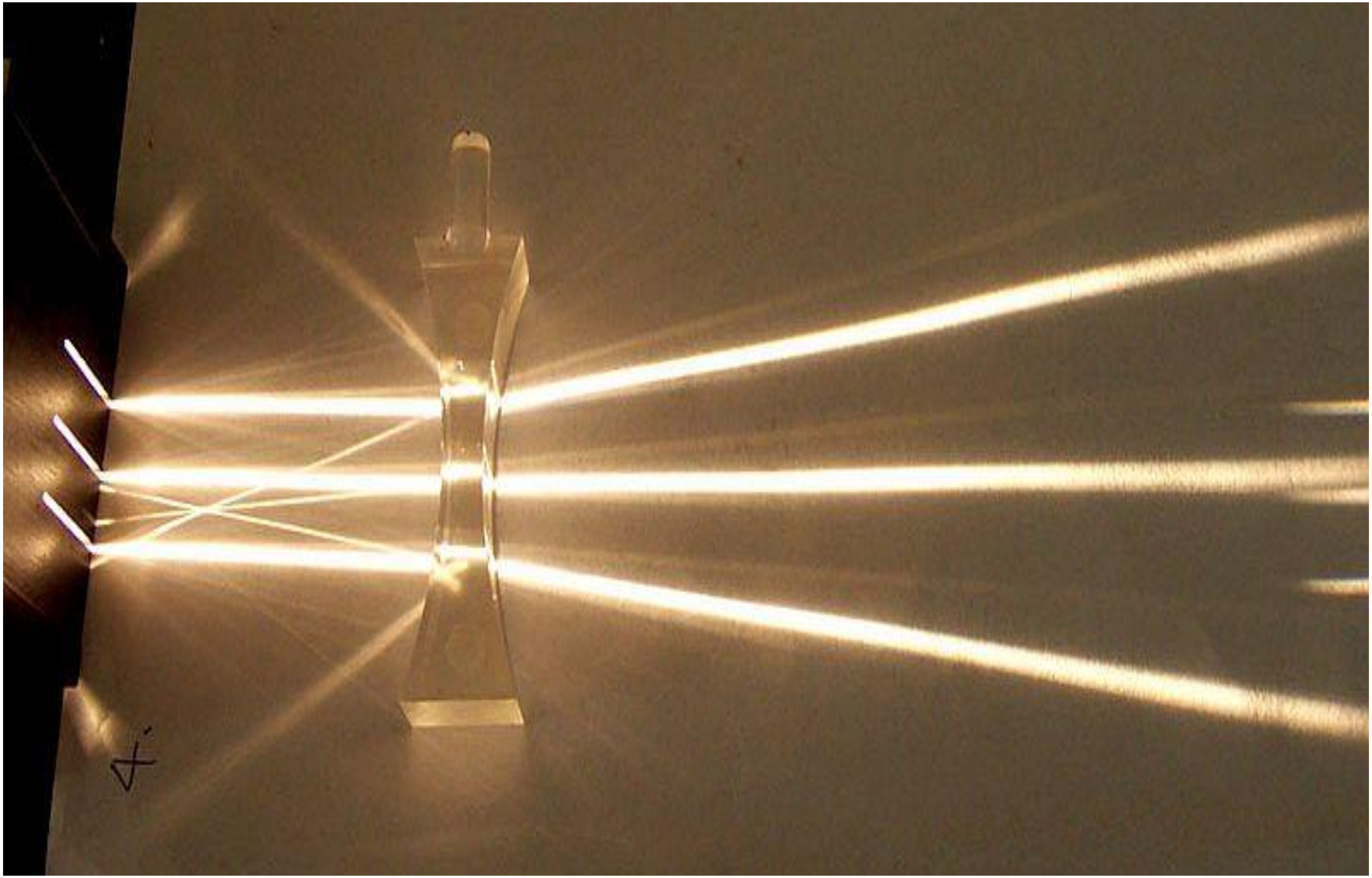
The **concave lens is a *diverging lens***, because it causes the light rays to bend away (diverge) from its axis.

In this case, the lens has been shaped so that all light rays entering it parallel to its axis appear to originate from the same point, F, defined to be the focal point of a diverging lens.

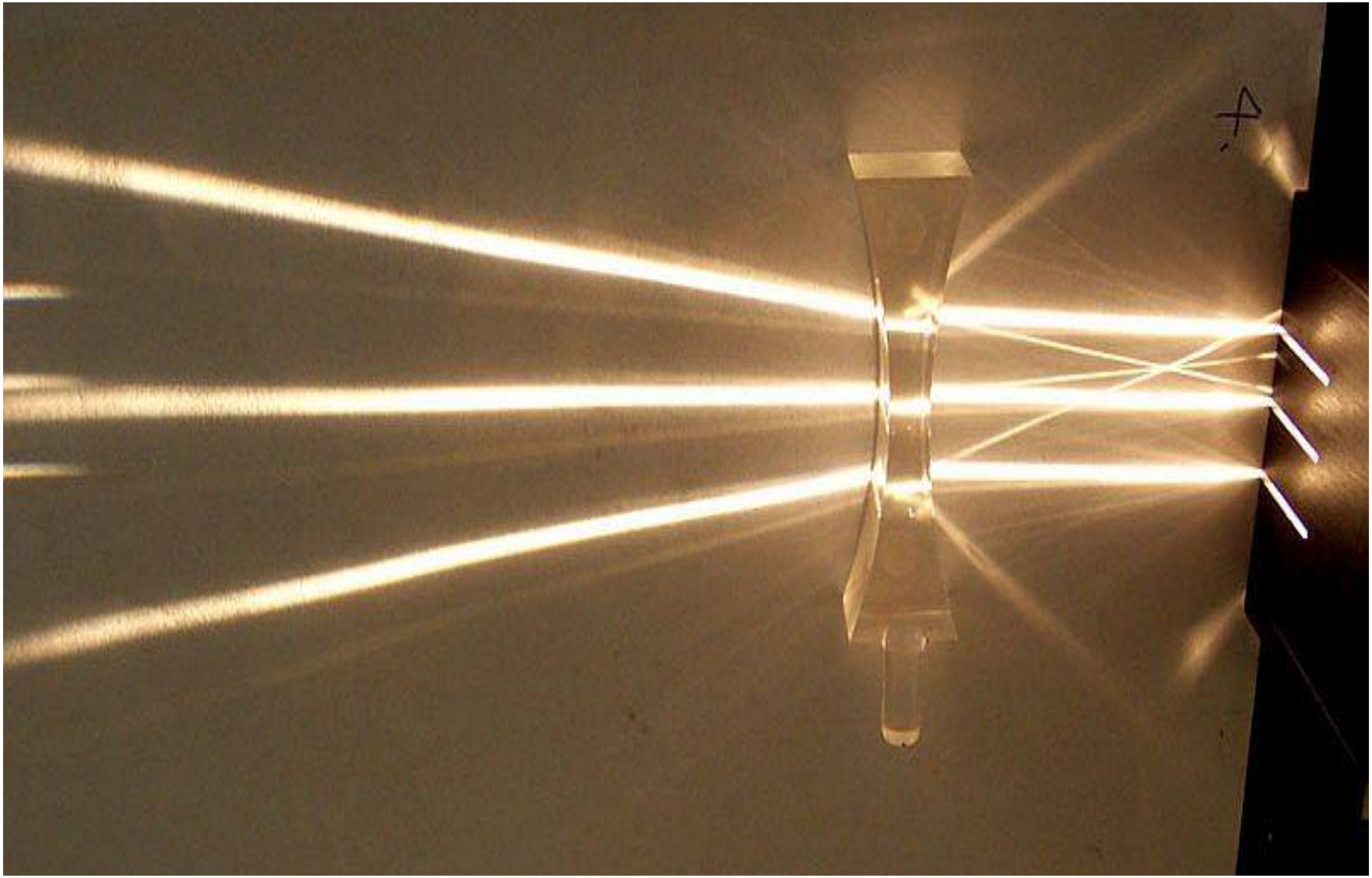
The distance from the center of the lens to the focal point is again called the focal length *f* of the lens.

Note that the focal length and power of a diverging lens are defined to be **negative**.

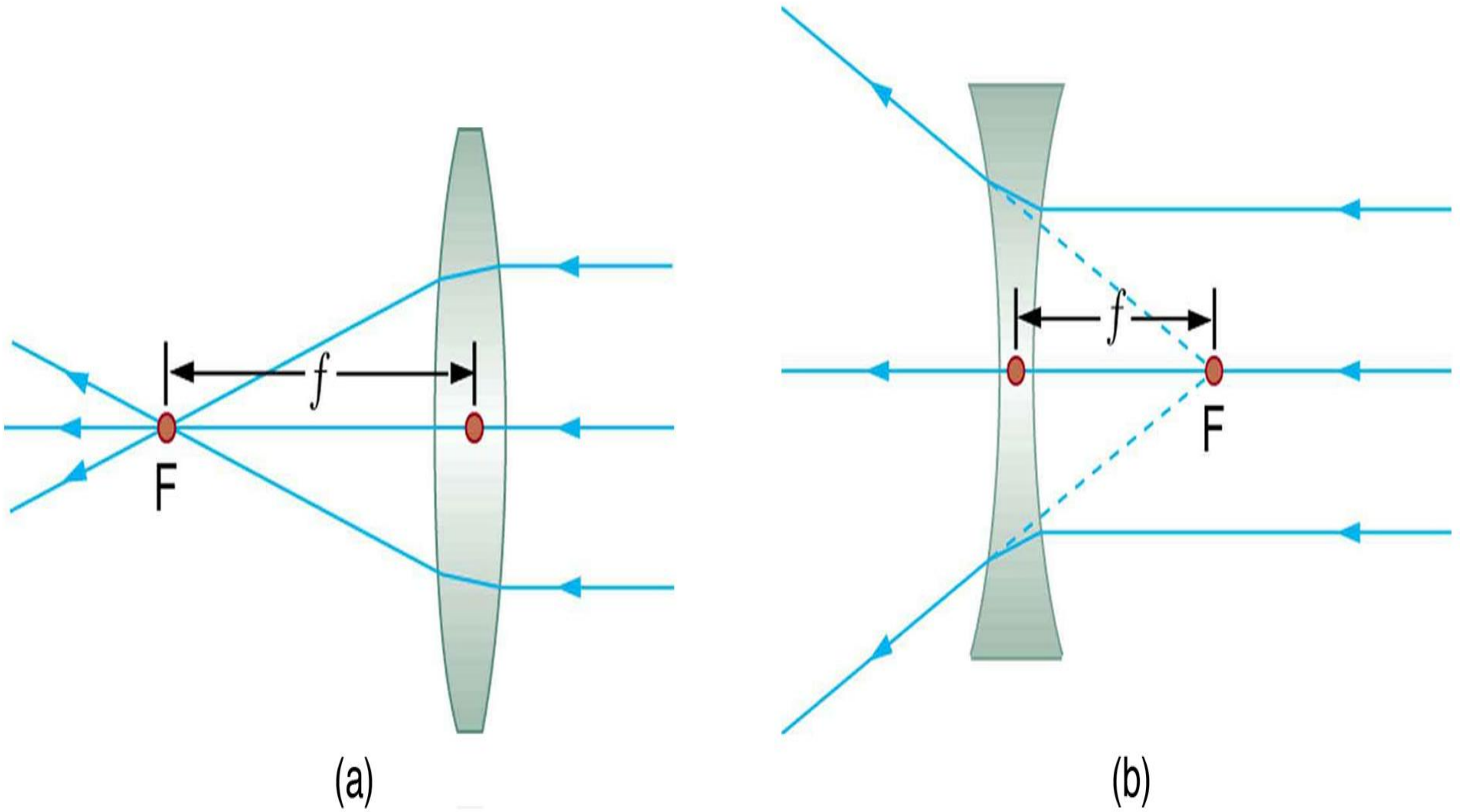
In concave lens, light rays diverge after refraction



In concave lens, light rays diverge after refraction



Incident and refracted rays in convex and concave lenses



F is the focal point and f is the focal length

- A ray entering a converging lens parallel to its axis passes through the focal point F of the lens on the other side.
- A ray entering a diverging lens parallel to its axis seems to come from the focal point F.
- A ray passing through the center of either a converging or a diverging lens does not change direction.
- A ray entering a converging lens through its focal point exits parallel to its axis.
- A ray that enters a diverging lens by heading toward the focal point on the opposite side exits parallel to the axis.