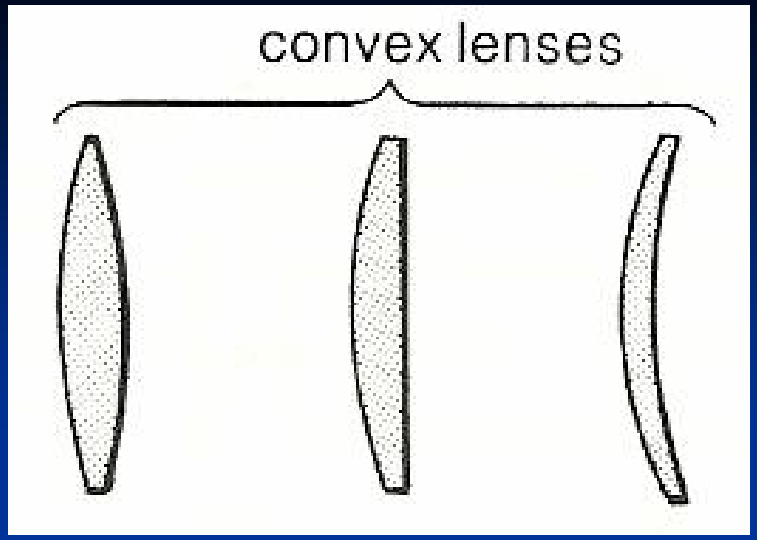
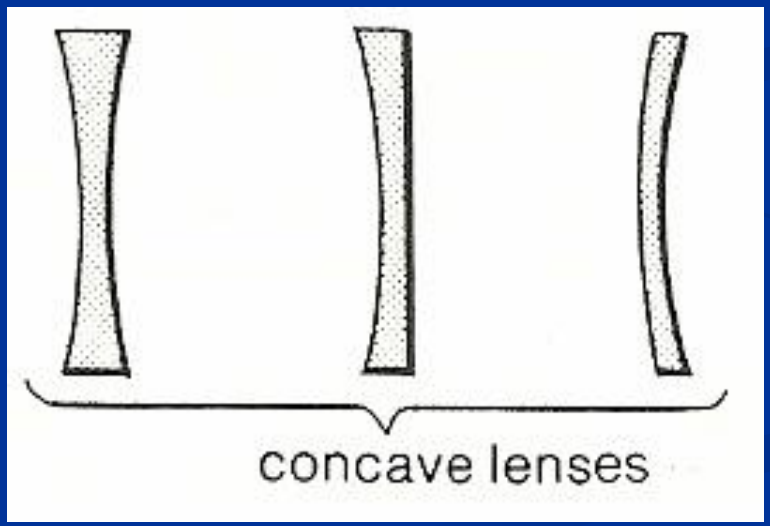
Lenses

•Convex lenses



•Concave lenses



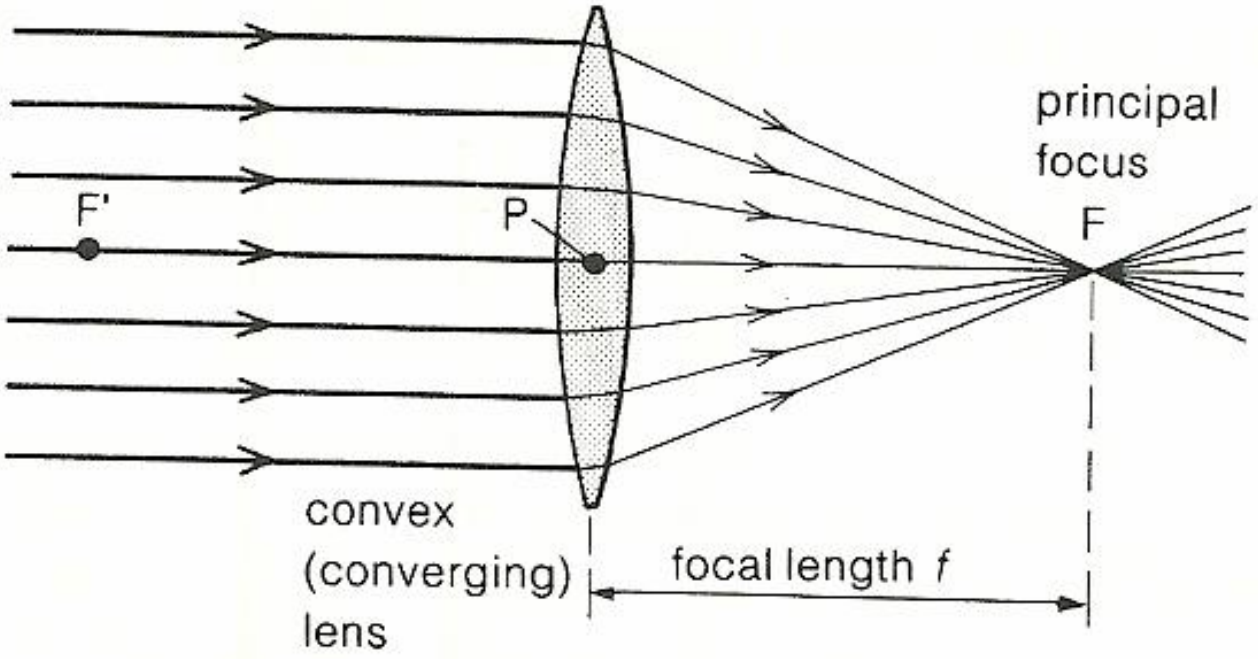
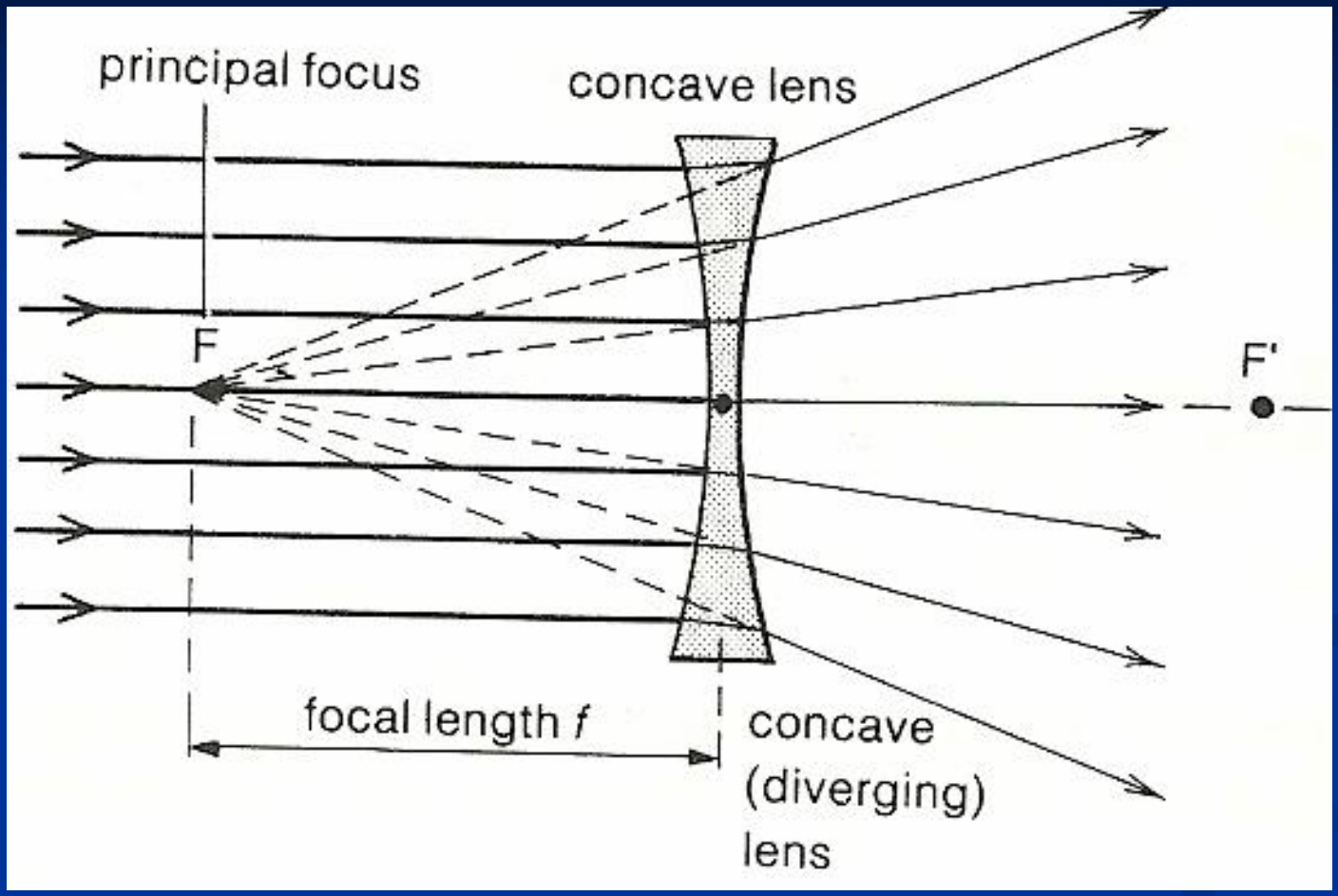
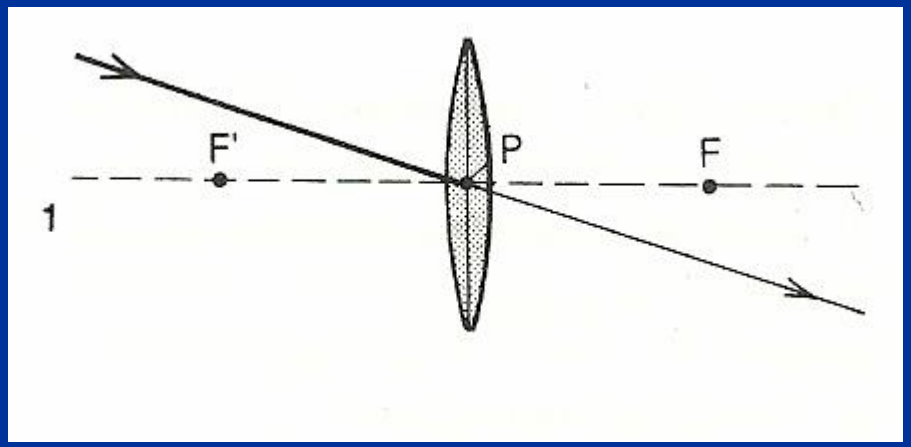


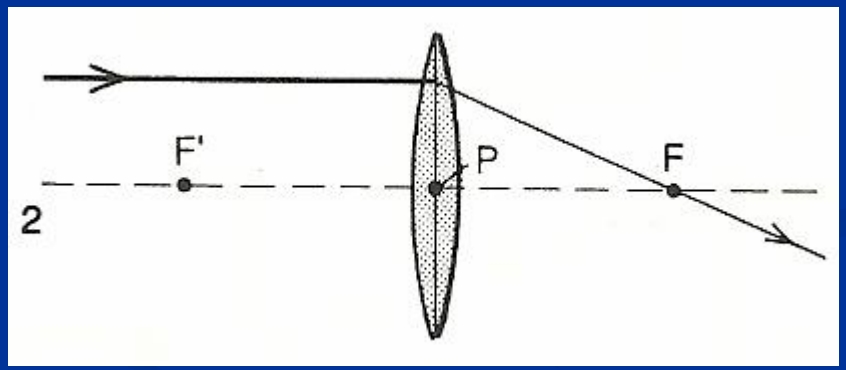
Figure 3a Parallel rays are brought to a focus on the far side of a convex lens

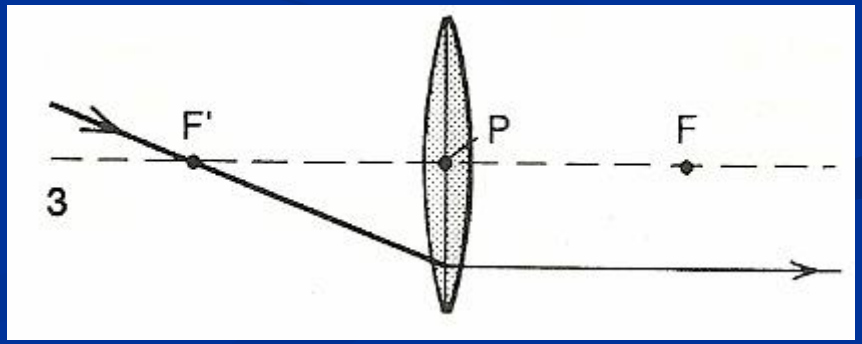

principal focus
concave lens
F
F'
focal length f
concave
(diverging)
lens

Images formed by convex lenses

1. A ray of light through the optical centre of the lens, P. This passes through the lens unbent.
2. A ray of light parallel to the principal axis. This passes through F when it leaves the lens.
3. A ray of light F´. This leaves the lens parallel to the principal axis. It is equivalent to ray number 2 in reverse.







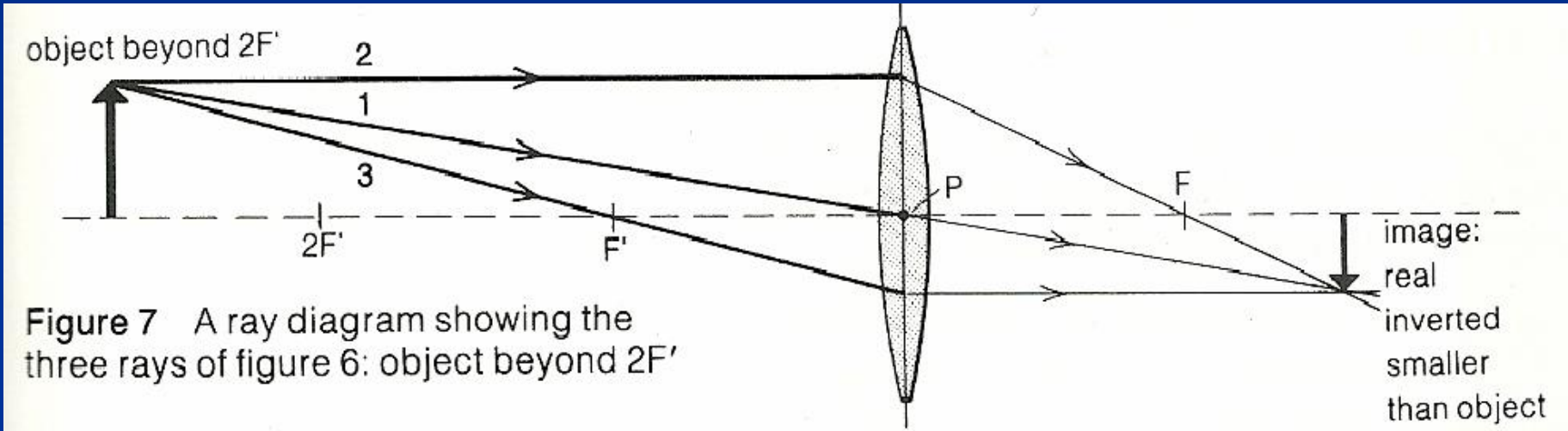


Figure 7 A ray diagram showing the three rays of figure 6: object beyond 2F′

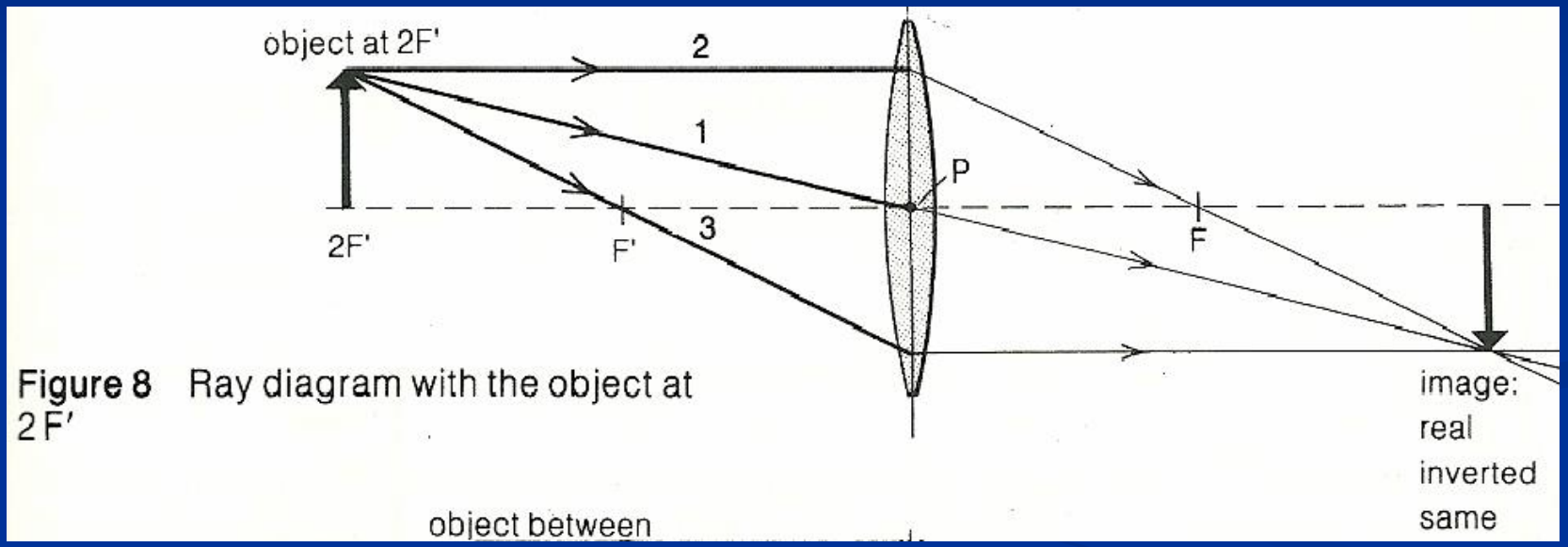


Figure 8 Ray diagram with the object at 2 F′

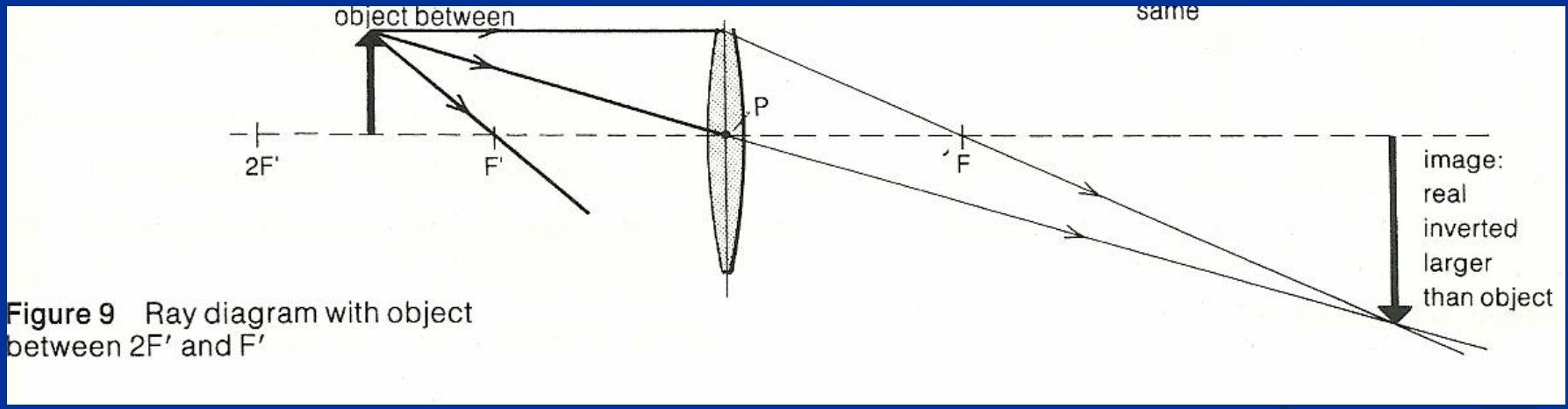


Figure 9 Ray diagram with object between 2F′ and F′

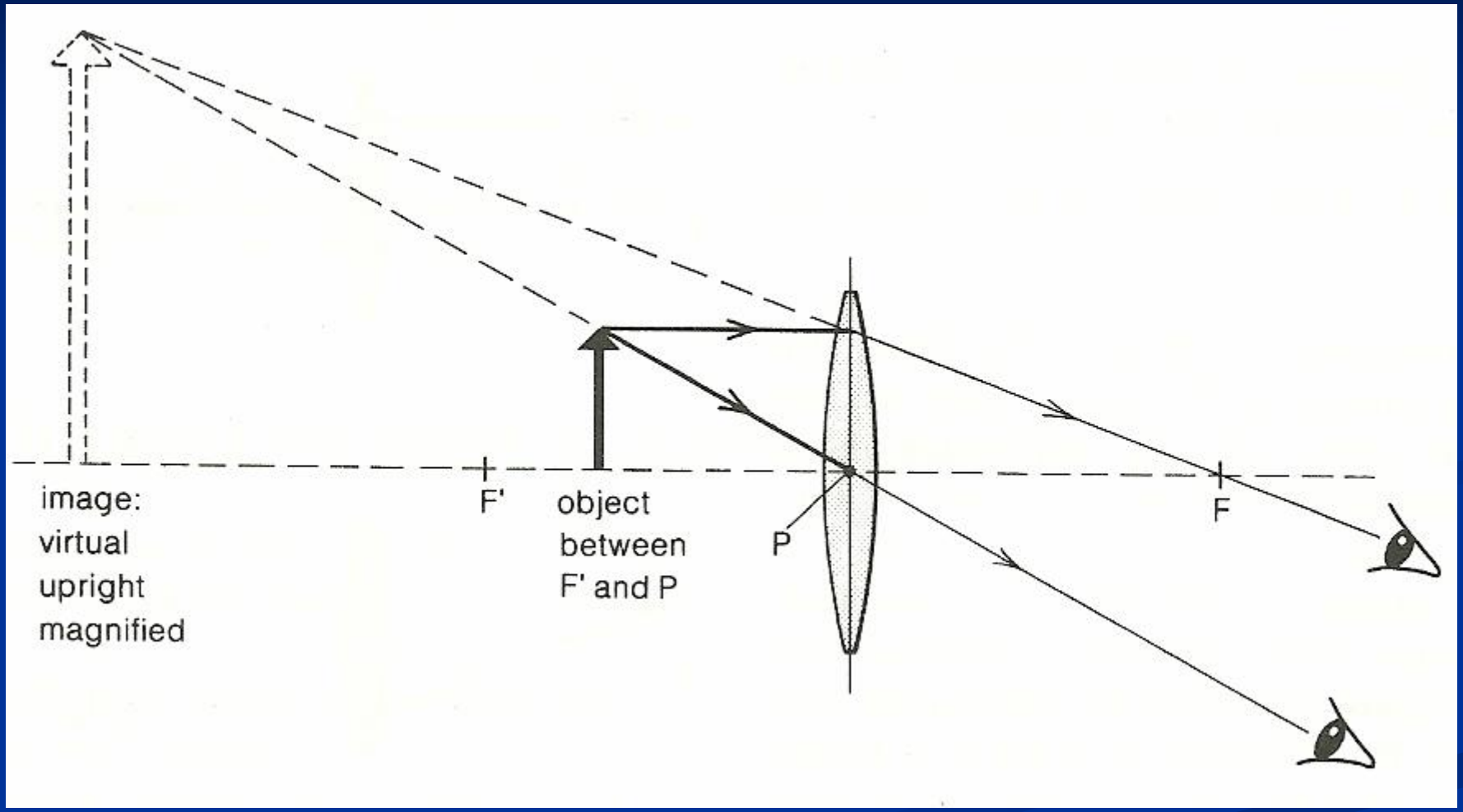
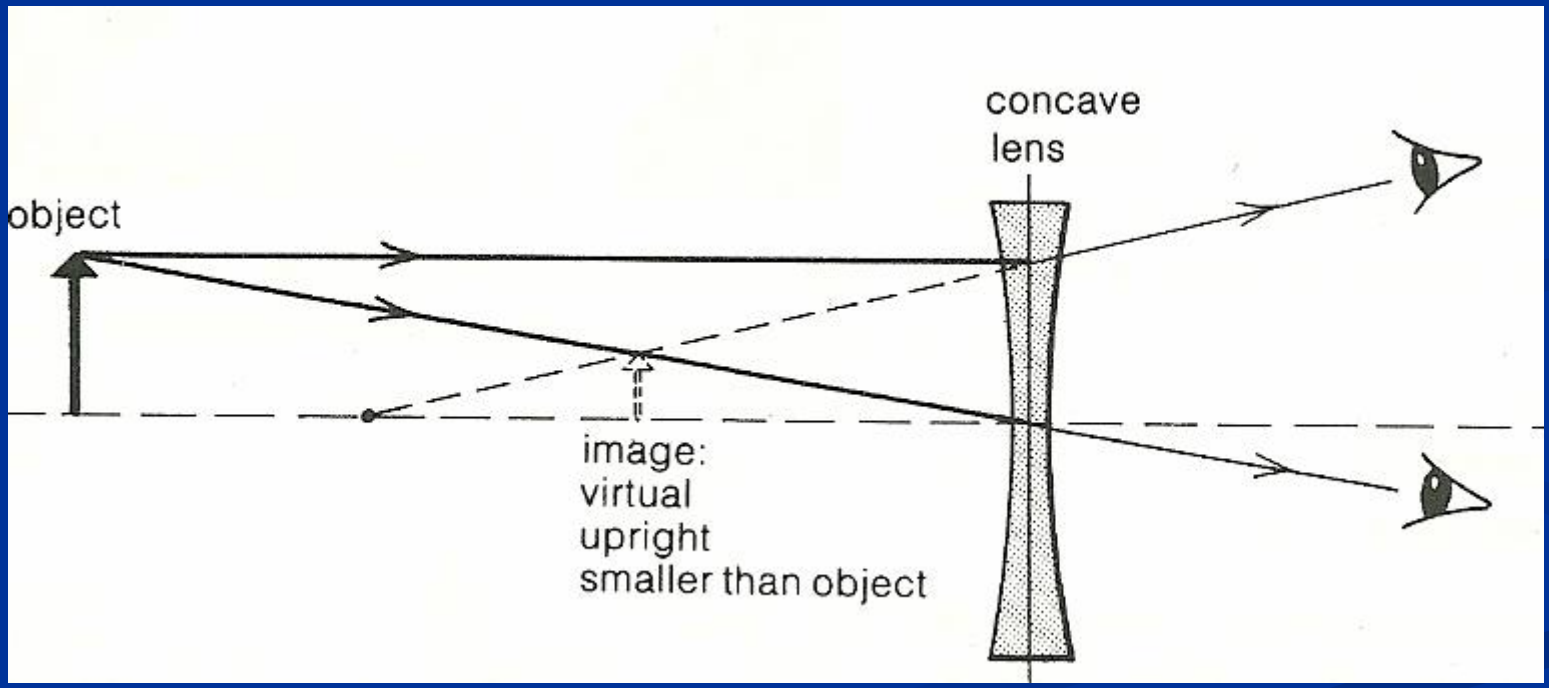


image:
virtual
upright
magnified
F'
object
between
F' and P
P
F

Image formed by concave lenses

A concave lens form an upright, virtual image of any object placed in front of it. The image is always smaller than the object and closer to the lens.

Changing the position of the object changes the position and size of the image, but the basic form of the diagram is unchanged.



Calculating image positions

The equation used to find the position and nature of th eimage:

$1/u + 1/v = 1/f$

u – distance from the object to the lens

v - distance from the image to the lens

Note the following

1. If the lens is convex, f is taken as positive.
2. If the lens is concave, f is taken as negative.
3. When v is positive, the image is real.
4. When v is negative, the image is virtual.

Z - linear magnification

$$Z = y'/y = v/u = -a'/a = -(a'-f)/f = -f/(a-f)$$

power of lens – $\Phi = 1/f$

An object 2cm high stands on the principal axis at a distance of 9 cm from a convex lens. If the focal length of the lens is 6cm, what is the position and nature of the image?