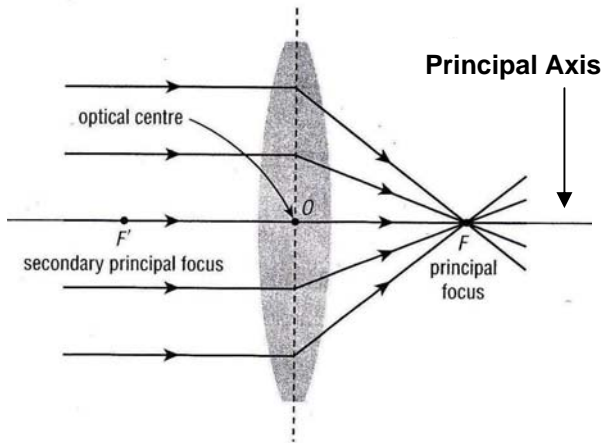


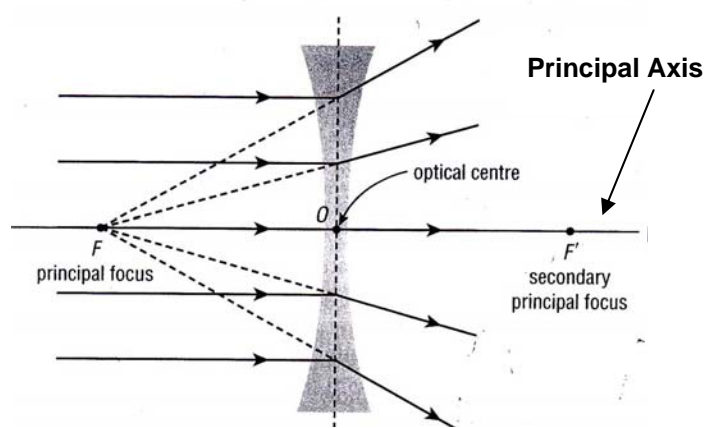
# Lenses

They are transparent materials that have curved sides. Lenses are optical instruments that “bend” light. The bend happens at the boundary between glass and air.

## Convex or Converging (Thickest at the middle)

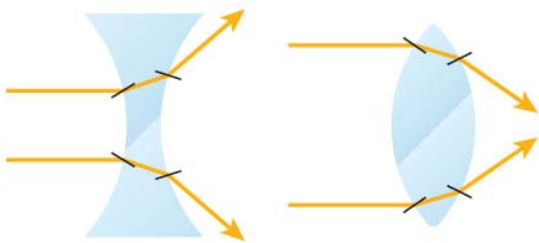


## Concave or Diverging (Thinnest at the middle)

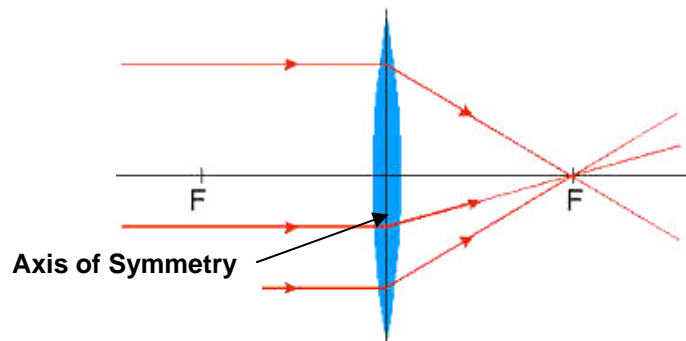


## Simplifying the Path through a Lens

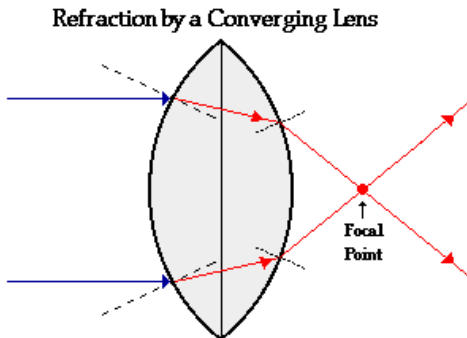
Light is refracted at two spots in a lens: When it hits the glass from the air; and leaving the glass entering the air. To simplify ray diagrams in this section, it is assumed that all lenses are thin and that all refraction takes place at the axis of symmetry of for lens



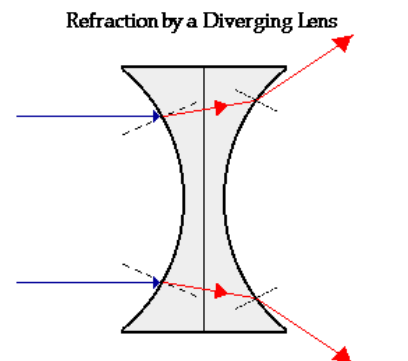
**Actual Path**



**Shortcut**



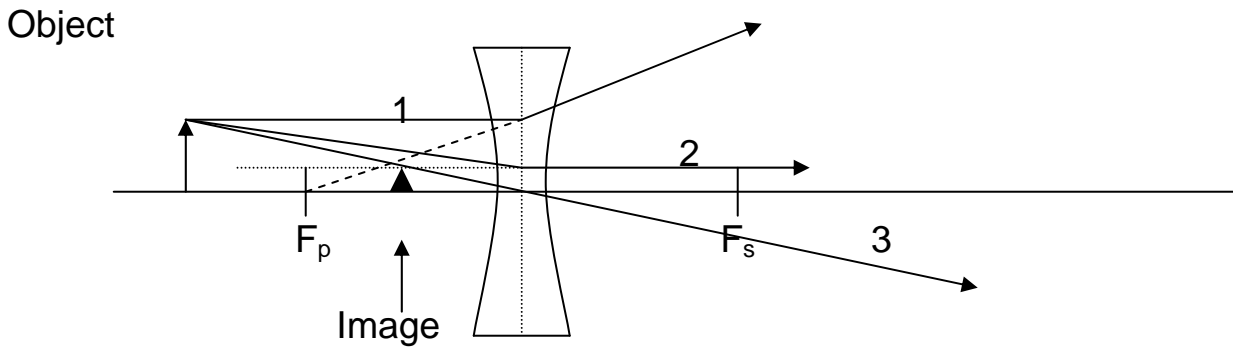
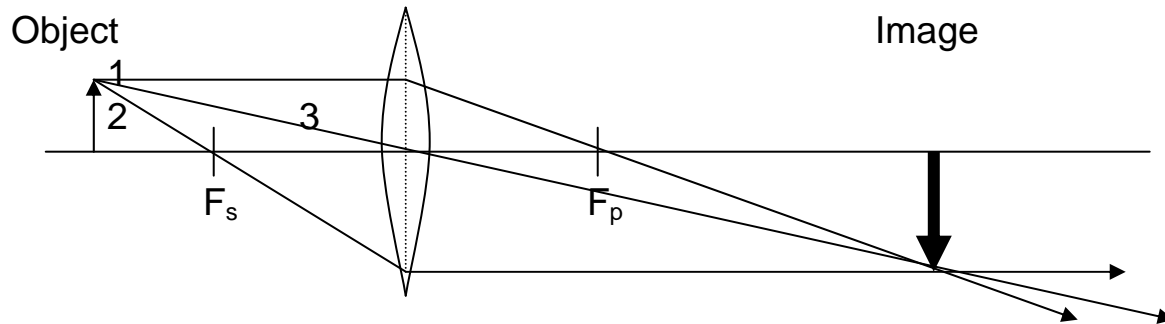
Incident rays which travel parallel to the principal axis will refract through the lens and converge to a point.



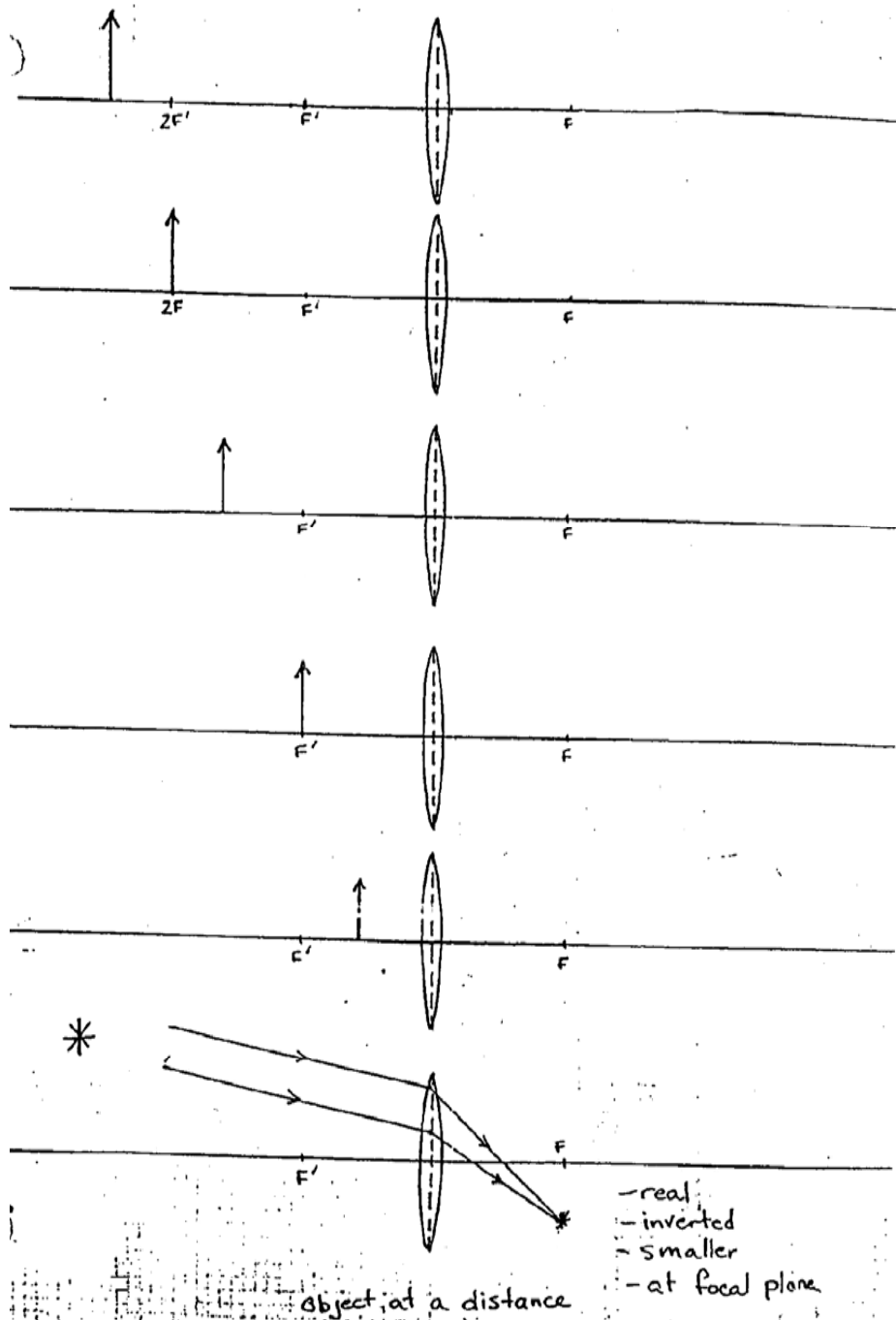
Incident rays traveling parallel to the principal axis will refract through the lens and diverge, never intersecting.

## Rules

1. A ray parallel to P.A. is refracted through (or appears to come from)  $F_p$  (primary focal point)
2. A ray that passes through (or is pointed at) the  $F_s$  or  $F'$  (secondary focal point) refracts parallel to P.A.
3. A ray through the exact center of the lens goes straight through.



## Homework Sheet



# IMAGES FORMED BY DIVERGING LENSES

