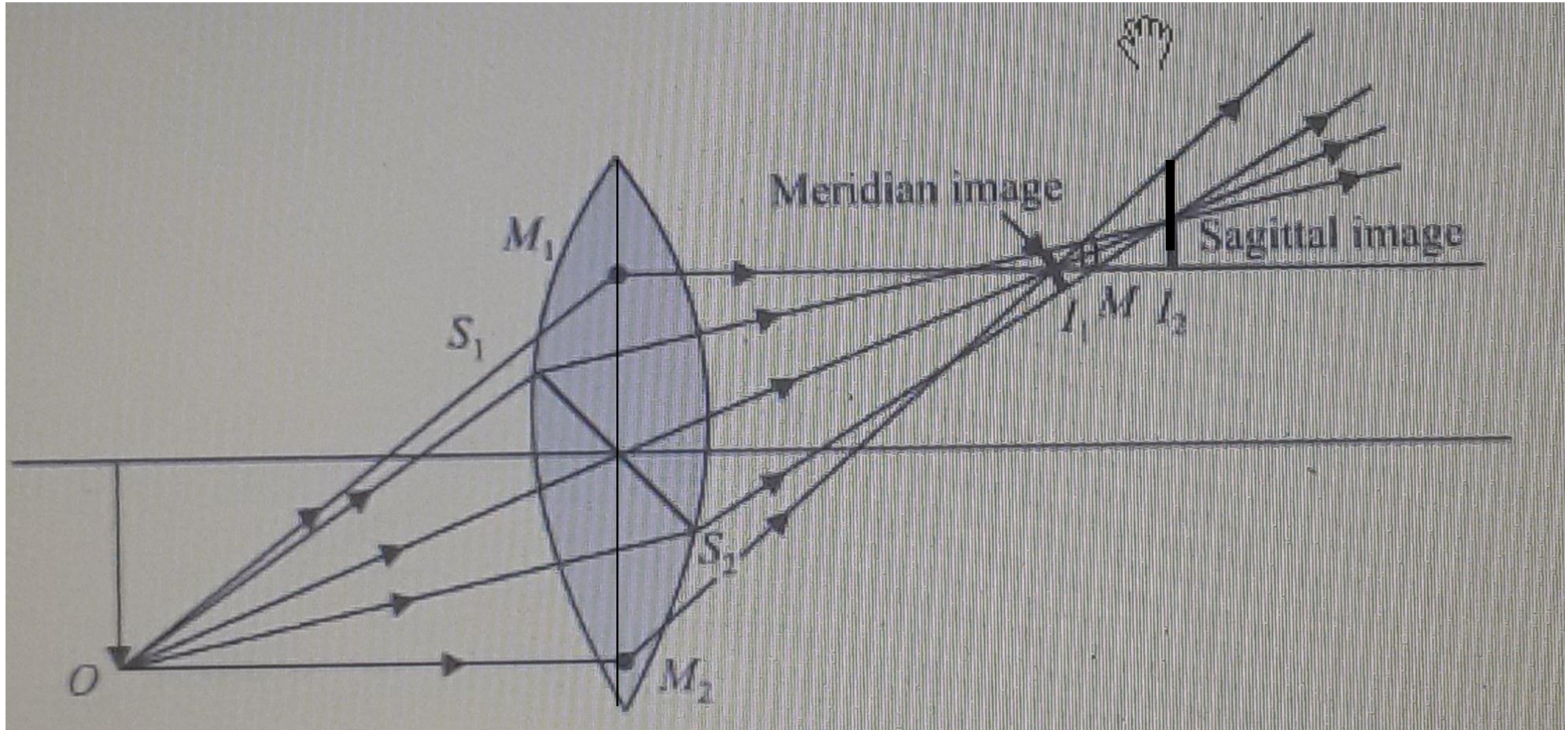


# Astigmatism

In astigmatism, a lens or mirror has different focal lengths across different diameters and focuses off axis, rays on two times instead of a single point

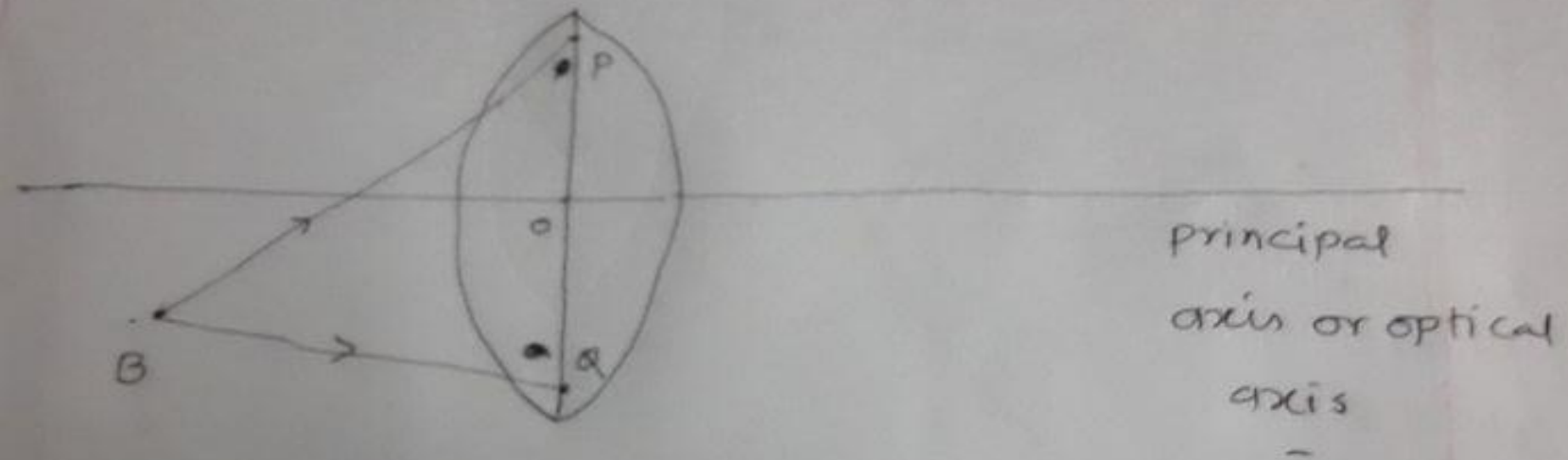
(Fig. 1)



When a point object is situated far-off the axis of a lens, the image formed by lens is not in a perfect focus. The image consists of two mutually perpendicular lines separated by a finite distance. Moreover, the two lines lie in perpendicular planes. The defect of the image is called astigmatism.

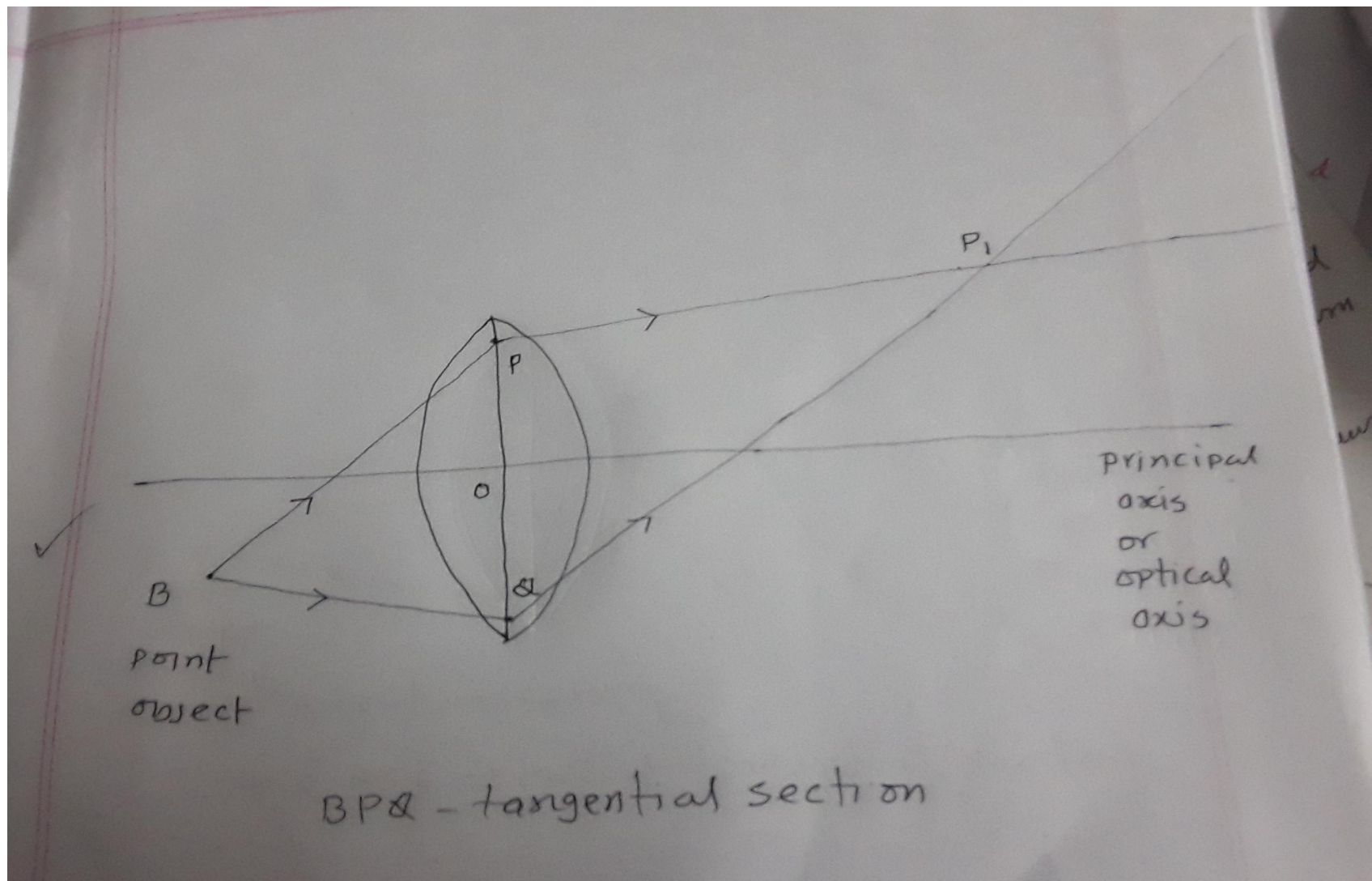
### **Meridian plane, Vertical or tangential plane**

A plane passing through the point object  $O$  and principal axis is known as meridian plane, i. e.  $OM_1M_2$ .

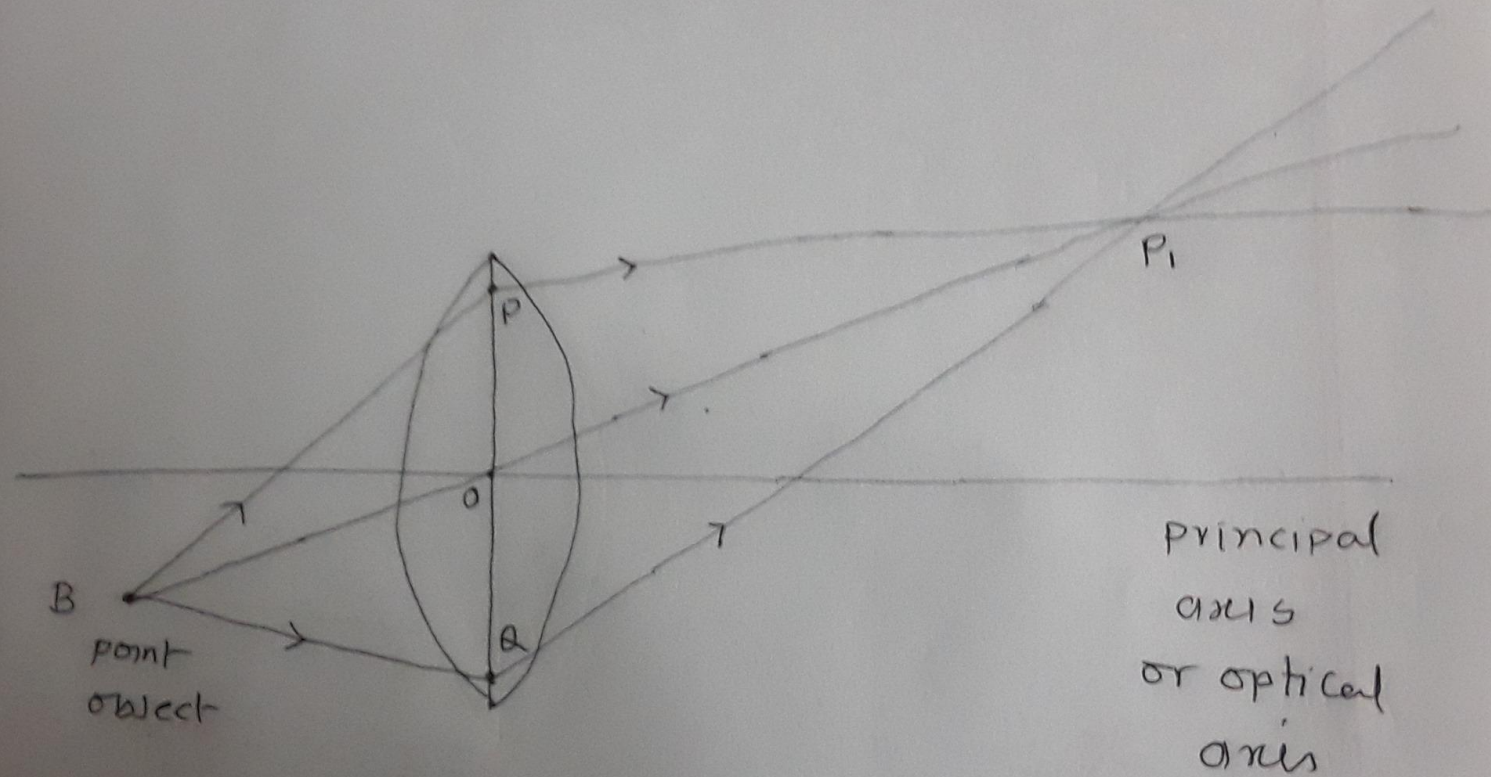


(i) Tangential section

BPA section is called tangential section

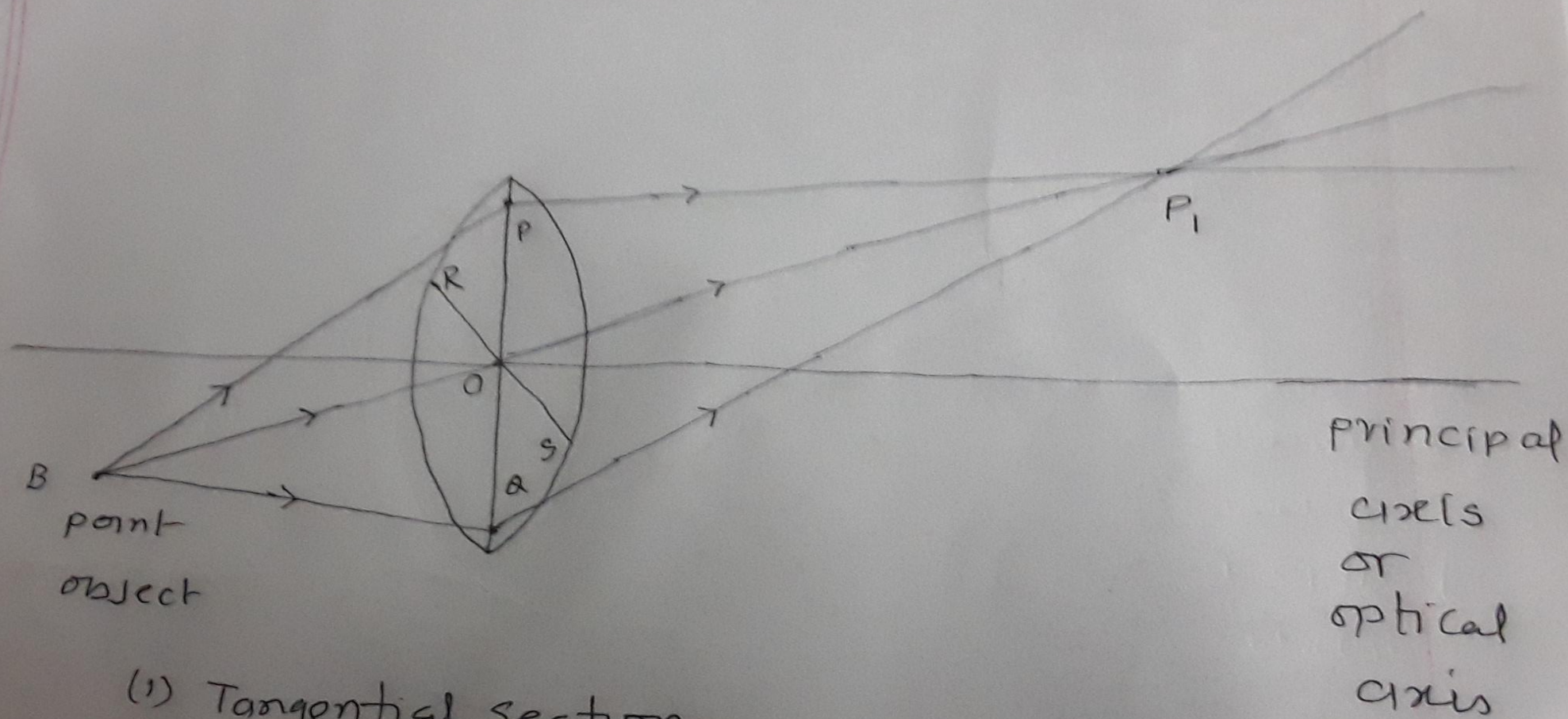






(i) Tangential section

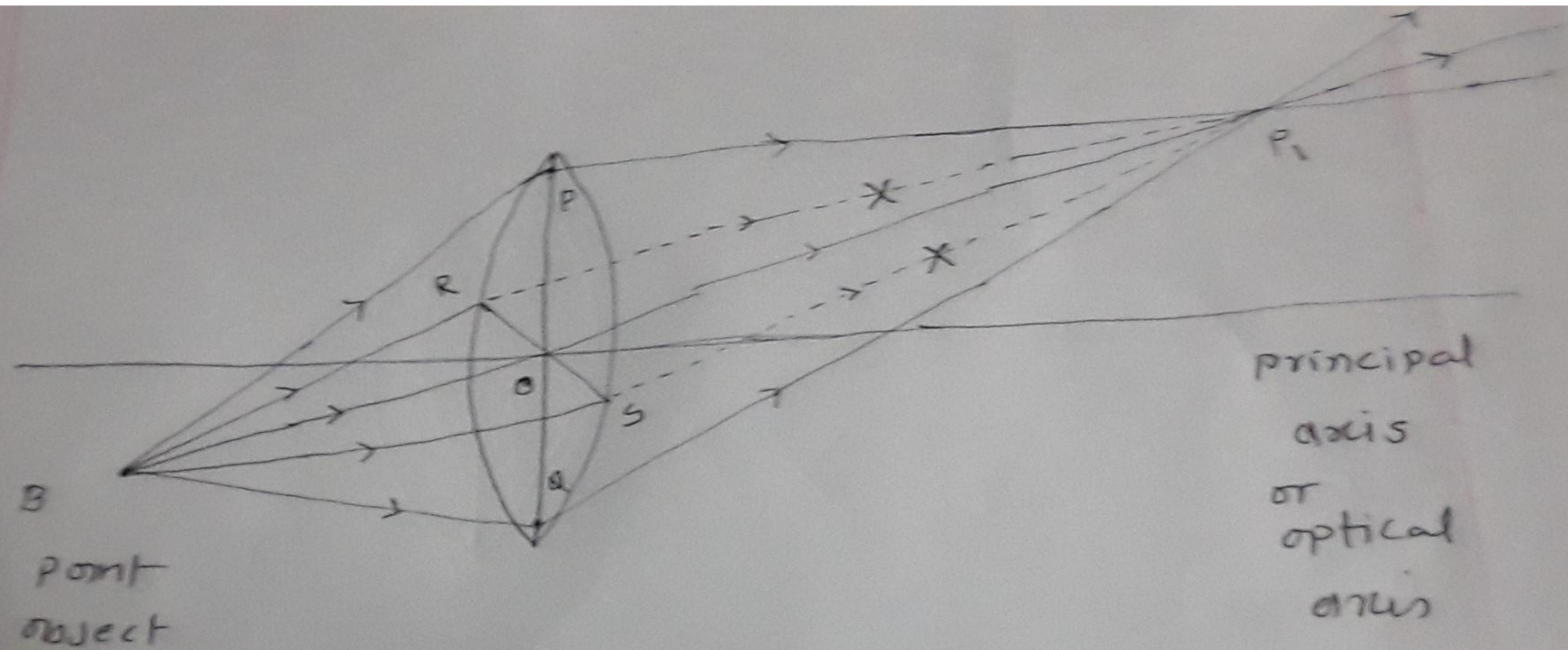
cone BPAQ is called tangential section.



(1) Tangential section

cone BPQ is called tangential section





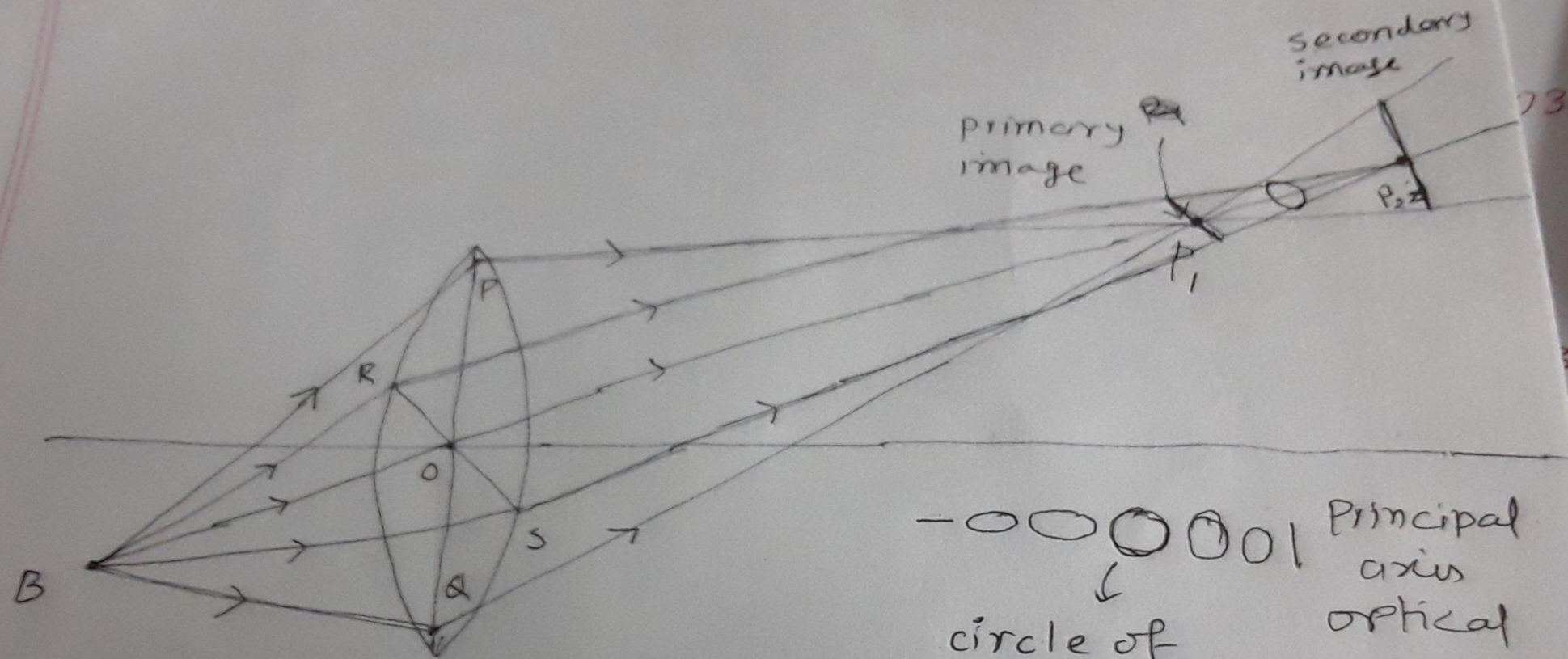
$O \rightarrow$  optical centre

(i) Tangential section  
 $\text{cone}_{\text{light}} B P Q$  is called tangential section

(ii) Sagittal section  
 $\text{cone}_{\text{light}} B R S$  is called sagittal section

$B R S$  is perpendicular to  $B P Q$

Point-  
object



Principal  
axis  
optical  
axis  
circle of  
least confusion

Best possible  
image of point  
object B.

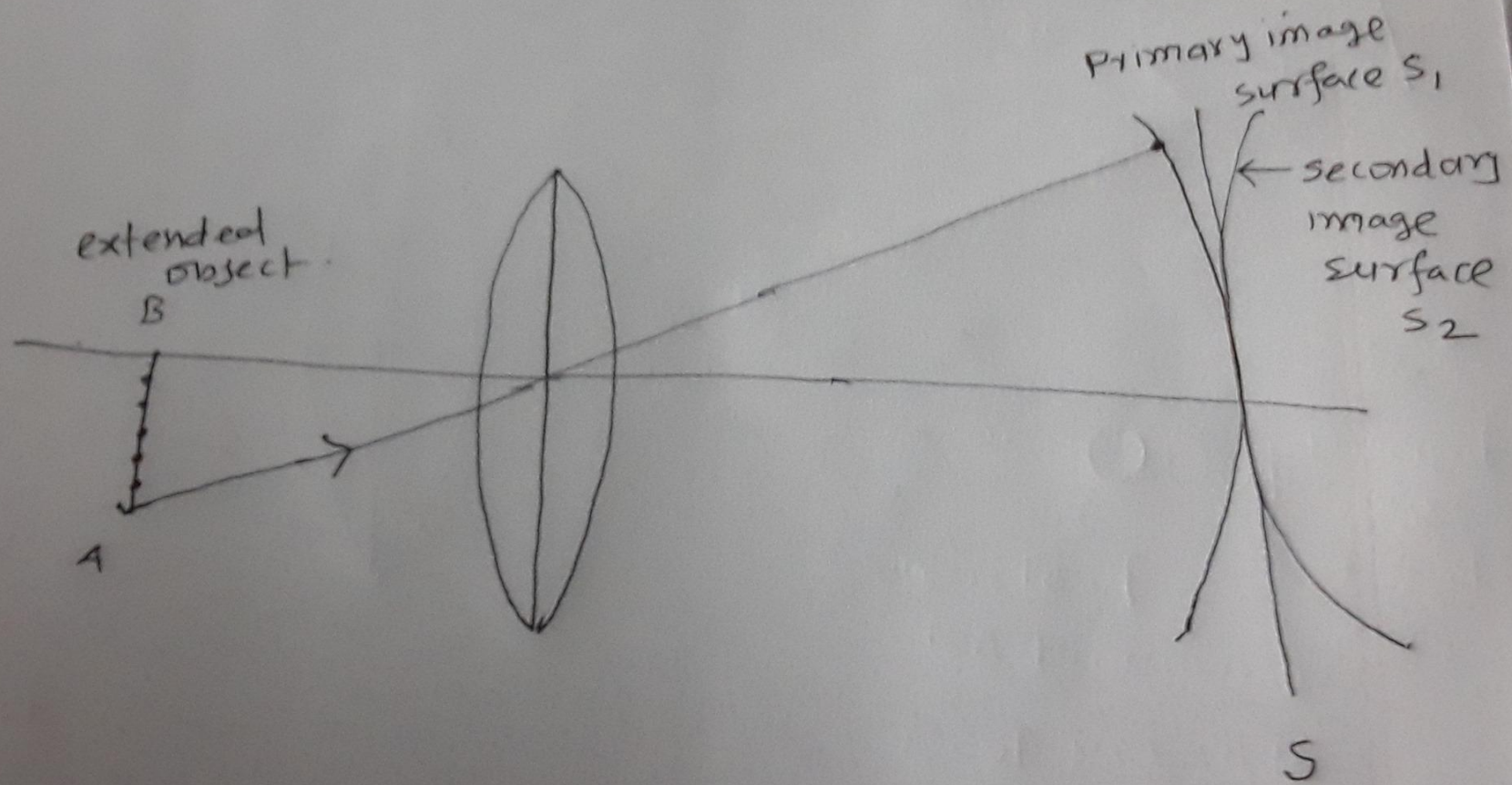


## Sagittal or Horizontal plane

A plane passing through the point object  $O$  and perpendicular to meridian plane is known as sagittal plane, i.e.,  $OS_1S_2$ , if  $O$  is the object point situated away from the principal axis.

The rays passing through the meridian plane do not meet at the same point, but a line image is formed passing through  $I_1$ . Similarly, another line image is obtained for sagittal plane through  $I_2$ .

These two lines are known as first and second focal lines. These two lines are perpendicular to each other separated by a distance. The difference between these two lines are said to be astigmatic difference or amount of astigmatism.



## Removal of astigmatism

- (i) **Using stops:** The astigmatism can be minimized by using stops in case of a single lens. Stops are placed such that only less oblique rays pass through the lens to form image.
- (ii) **Anastigmat:** Since astigmatism may be positive or negative depending on the nature of the lens, therefore, using a convex and concave lenses of suitable focal length and separated by a distance, the astigmatism can be minimized. Such a lens combination is called **anastigmat**.