

## Viva voce on Nodal Slide

**Q. 1. What are you doing ?**

**Ans :** Sir, I am determining the focal length of a coaxial optical system of two thin convex lenses separated by a distance with the help of nodal slide.

**Q. 2. What is nodal slide ?**

**Ans :** Nodal slide is a small horizontal metal carriage having two lens holders. The separation between the lens placed in the lens holders can be changed and directly read on the linear scale provided with the carriage. The metal carriage as a whole can be moved back and forth in horizontal direction as well as can be rotated about a vertical axis.

**Q. 3. Why do you call it nodal slide ?**

**Ans :** It is so called because it is used to locate the nodal points of a lens system.

**Q. 4. What are nodal points ?**

**Ans :** A pair of conjugate points on the principal axis of the optical system having unit positive angular magnification are called nodal points of that optical system. It means that if a ray of light is incident on one of these points, after refraction through the optical system it emerges from the other nodal point parallel to the original direction.

**Q. 5. What is angular magnification ?**

**Ans :** If the incident ray and the conjugate emergent ray make angles  $\theta_1$  and  $\theta_2$  with the principal axis, then the ratio of tangent of  $\theta_2$  and  $\theta_1$  ( $\tan \theta_2 / \tan \theta_1$ ) is called the angular magnification of the lens.

**Q. 6. Do you know any other pairs of such points ?**

**Ans :** Yes, there are two other pairs of such points of an optical system, called focal points and principal points.

**Q. 7. What is the common name of all these three pairs of points of the coaxial optical system ?**

**Ans :** The common name of all these points of a coaxial system is called cardinal points.

**Q. 8. What do you mean by coaxial lens system ?**

**Ans :** A system of two or more lenses having common principal axis is called coaxial lens system.

**Q. 9. What are focal points of an optical system ?**

**Ans :** A pair of points lying on the principal axis of the coaxial optical system and conjugate to points at infinity are called focal points. The first focal point  $F_1$  is that point on the principal axis of the converging lens system, the rays starting from which, after refraction through the optical system, become parallel to the principal axis. The second focal point  $F_2$  of a converging optical system is defined as the image point on the principal axis for which the object point lies at infinity.

**Q. 10. What are principal points ?**

**Ans :** A pair of conjugate points on the principal axis of the coaxial optical system having unit positive linear or lateral magnification are called principal points of an optical system.

**Q. 11. What is lateral magnification ?**

**Ans :** The lateral magnification of a coaxial lens system is defined as the ratio of the length of the image to the length of the object. The lengths are measured perpendicular to the principle axis. For erect image the lateral magnification is positive. Conversely, it is negative for an inverted image.

$$m = \frac{\text{length of the image}}{\text{length of the object}} = \frac{I}{O}$$

## Viva voce on Nodal Slide

**Q. 12. What are principal planes ?**

**Ans :** A plane passing through the first principal point and perpendicular to the principal axis of the coaxial optical system is called first principal plane. Similarly a plane passing through second principal point and perpendicular to the principal axis of the lens system is called second principal plane.

**Q. 13. What are cardinal points of an optical system ?**

**Ans :** There are six cardinal points of an optical system, viz. (i) two focal points, (ii) two principal points, and (iii) two nodal points.

**Q. 14. What is the importance of the cardinal points of the coaxial optical system ?**

**Ans :** By the knowledge of cardinal points, we can treat the optical system of coaxial lenses as a single lens and the position and size of the image of an object may directly be obtained by using simple formulae developed for thin lenses without considering refraction through each component of the system separately.

**Q. 15. Under what condition the six cardinal points of an optical system reduce to four ?**

**Ans :** If the medium on either side of the optical system and also between the lenses is same (or air), the nodal points coincide with the principal points. Hence, the six cardinal points reduce to four.

**Q. 16. How will you mark the position of cardinal points of your lens system in optical diagram ?**

**Ans :** First of all the two lenses  $L_1$  and  $L_2$  at a known distance  $x$  are sketched, then the position of nodal points with respect to their corresponding lens are marked on the common principal axis of lenses. Since the medium on either side of the system is air nodal points coincide with the principal points. Now the focal points are marked at a distance equal to the combined focal length from their respective nodal points or principal points.

**Q. 17. What is the principle of your nodal slide ?**

**Ans :** Nodal slide is based on the principle based on the property of nodal points. If a beam of light parallel to the principal axis is incident on a coaxial converging lens system and after refraction through the system image is formed on a screen placed at the second focal plane, then the image of the object does not shift laterally when the system is slightly rotated (approximately  $5^\circ$ ) about a vertical axis passing through its second nodal point.

**Q. 18. What do you mean by focal planes ?**

**Ans :** The plane passing through the first focal point and perpendicular to the principal axis of the lens system is called first focal plane. Similarly, the plane passing through second focal point and perpendicular to the direction of the principal axis of the lens system is called second focal plane.

**Q. 19. What is the function of plane mirror in your experiment ?**

**Ans :** The plane mirror simply reflects the parallel beam of light falling on it.

**Q. 20. If the position of plane mirror is changed, how will the position of the final image be affected ?**

**Ans :** The position of the plane mirror does not affect the position of image, it is simply used to focus the image on the cross-slit itself.

**Q. 21. In your experiment, why more than one images of the cross-slit are appearing ?**

**Ans :** In addition to the actual image of the slit few false images are appearing due to partial reflections from the face of the lens.

**Q. 22. How will you locate the true image out of these false images ?**

**Ans :** It can be recognize by one of the following two ways : (i) By giving slight rotation to the plane mirror : if by giving slight rotation to the mirror the image moves on the screen then it is the true image otherwise the image is false. (ii) If we simply put our hand in front of the mirror, the true image will disappear and false images remain.

## Viva voce on Nodal Slide

**Q. 23. Is it necessary to rotate the lens combination by  $180^\circ$  ?**

**Ans :** Yes, because the nodal points are not symmetrical with respect to two lenses of different focal lengths. But if the focal lengths of the two lenses are same, there is no need to rotate the lens combination by  $180^\circ$ .

**Q. 24. How will you define nodal planes ?**

**Ans :** The planes passing through the nodal points and perpendicular to the principal axis are called nodal planes of the coaxial optical system. Corresponding to two nodal points, there are two nodal planes.

**Q. 25. Who discovered the nodal points ?**

**Ans :** The nodal points were discovered by Listing.

**Q. 26. Can you tell the relative positions of nodal and principal points of your lens system ?**

**Ans :** Since, the coaxial optical system is situated in air, nodal points coincide with the principal points.

**Q. 27. When the system is dipped in water, is the relative positions of nodal and principal points of your lens system changed ?**

**Ans :** No, because still the medium on either side of the system is same.

**Q. 28. What are equivalent points in an optical system ?**

**Ans :** When The medium on both the sides of the optical system is same, the principal points coincide with the nodal points and these points are then called equivalent points.

**Q. 29. What is longitudinal magnification ?**

**Ans :** The ratio of the extension of the image to the extension of the object along the principal axis is called the longitudinal magnification of the lens system.

**Q. 30. On what factors does the focal length of a thin lens depend ?**

**Ans :** The focal length  $f$  of a thin lens depends upon the refractive index  $\mu$  of its material and the radii of curvatures  $R_1$  and  $R_2$  of its two surfaces and is given by

$$\frac{1}{f} = (\mu - 1) \left( \frac{1}{R_1} - \frac{1}{R_2} \right)$$

**Q. 31. What is the focal length of a combination of two coaxial thin lenses of focal lengths  $f_1$  and  $f_2$  when they are separated by a distance  $x$ .**

**Ans :** The focal length  $f$  of the combination of two thin lenses of focal lengths  $f_1$  and  $f_2$ , when they are separated by a distance  $x$  is given as

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{x}{f_1 f_2}$$

**Q. 32. When they are in contact ?**

**Ans :** When two lenses are in contact, the combined focal length  $F$  is given by

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$$