



PHYSICS CLASS XII

CHAPTER – 9 RAY OPTICS AND OPTICAL INSTRUMENTS

Q.1. What are the factors on which angular dispersive power of a prism depend?

Ans. Nature of material of the prism.

Q.2. Why should objective of a telescope have larger focal length?

Ans. To obtain larger magnifying power and better intensity of image.

Q.3. What do you understand by normal adjustment of a telescope?

Ans. In normal adjustment, the final image is formed at infinity.

Q.4. Why does the sky appear blue?

Ans. Due to large scattering of visible light of smaller wavelength (blue colour) as intensity of scattered light $\propto \frac{1}{\lambda^4}$.

Q.5. Which one, crown glass or flint glass has a larger refractive index?

Ans. Flint glass has larger refractive index.

Q.6. A hypermetropic person has problem in driving without specs. Justify the statement.

Ans. No, the statement is false, A hypermetropic person can observe far off objects without any problem.



Q.7. Why does the sun appear to us a small disc?

Ans. The sun appears to us a small disc because of small angle θ subtended at our eye by the diameter of sun

$$\theta = \frac{\text{diameter of sun } (l)}{\text{distance of sun from earth } (r)} = \frac{10^9}{10^{11}} = 10^{-2} \text{ radian.}$$

Q.8. Find the angular dispersion produced by a thin prism of 5° having refractive index for red light 1.50 and for violet 1.60.

Ans. Here, $A = 5^\circ$; $\mu_r = 1.50$; $\mu_v = 1.60$

$$\begin{aligned} \text{Angular dispersion} &= \delta_v - \delta_r = (\mu_v - \mu_r)A \\ &= (1.60 - 1.50) \times 5 = 0.5 \end{aligned}$$

Q.9. You are given prisms made of crown glass and flint glass with a wide variety of angles. Suggest a combination of prisms which will

(i) deviate a pencil of white light without much dispersion.

(ii) disperse (and displace) a pencil of white light without much deviation.

Ans. (i) When a beam of white light is incident on a prism, the emergent beam is dispersed and is deviated from the original path. When two prisms of different dispersion without deviation then such a combination is called direct vision prism. If the two prisms combined produce deviation without dispersion, then such a combination is called a chromatic prism. For the deviation without dispersion, the angular dispersion produced by two prisms should be zero.

i.e., $(\mu_b - \mu_r)A + (\mu'_b - \mu'_r)A' = 0$



As $(\mu'_b - \mu'_r)$ for flint glass is more than that for crown glass. So, $A' < A$ i.e., the prism of flint glass is suitable with crown glass prism of larger angle.

(ii) For dispersion without deviation,

$$(\mu_y - 1)A + (\mu'_y - 1)A' = 0$$

As μ'_y for flint glass is more than μ_y for crown glass. So, $A' < A$, i.e., we use a flint glass prism of smaller angle with crown glass prism of larger angle.

Q.10. A teacher has given three lenses of power 0.5 D, 4 D, 10 D to a student. He is not sure as to which lenses would he use for constructing a good astronomical telescope. So he consults his seniors and the teachers and then constructs a telescope to the junior classes and explain about the choice of lenses.

(i) What values has he show by doing these?

(ii) Which lenses are used as objective and which one as eyepiece?

Ans. (i) The values shown by him are

- (a) Consulting others in case of need.
- (b) Curocity
- (c) Sharing knowledge.

(ii) From these three lenses, he will use a lens of power 0.5 D for objective and lens of power 10 D as eyepiece.

Q.11. A student X sitting in the last row in the class have difficulty reading the matter written on the blackboard. The teacher requests the student sitting in



the front row to volunteer for exchange of seat to help X. Student Y sitting in the front row to volunteer for exchange of seat to help X. Student y sitting in the front row to volunteer for exchange of seat to help X. Student Y sitting in the front row volunteer herself to exchange the seat with X. Now X was able to read the matter on blackboard clearly and Y also did not face any difficulty. The teacher also advised X to get his eyes checked – up.

- (i) Which eye defect of vision X is suffering from?
- (ii) Which values is the teacher displaying through her actions and advice?
- (iii) Which values is Y displaying through volunteering?
- (iv) In what possible ways can X respond and reciprocate the help rendered by Y?

Ans. (i) Myopia/Shortsightedness

(ii) Concern for students

Helpfulness

Duty/role as a guide

Counseling

(iii) Empathy

Helpfulness

Cooperation

(iv) Friendship, sharing and caring, thanks and gratefulness.



Q.12. Rekha and Preethi were classmates. Preethi was a bright girl and had a quick grasping power. However Rekha noticed that preethi was not her usual self for the past few days. Rekha found out that Preethi was not able to see the letters on the board properly and also complained of frequent headaches. Rekha suggested to Preethi to get her eye checked. Preethi followed Rekha's suggestion and thanked her saying she felt very comfortable after wearing the spectacles.

(i) What was the eye defect that Preethi had?

(ii) How can it be corrected?

(iii) Rekha was a true friend. Justify?

Ans. (i) Myopia

(ii) Wearing spectacles of concave lens

(iii) Sympathy, kind, helpful, caring nature and concern about her friend.

Q.13. Mr. Viswanathan, a retired professor of physics was walking with his grandson. It was last week of December and so it was dark around 5.30 pm. The streetlights were on and the yellow light flooded the area around. The boy asked professor why yellow lights were used when white light were brighter. The professor answered that during foggy days the tiny droplets act as prisms splitting white light into its constituent colours and thus reducing the clarity.

(i) What phenomena was the professor referring to? Why does it happen?

(ii) Give one application of prism.



(iii) What values of the boy reflect from the conversation?

Ans. (i) Dispersion occurs due to speed of each colour is different when they enter glass.

(ii) Studying and analysing the spectrum of distant light sources.

(iii) Curiosity, research mindedness and awareness.

Q.14. Two convex lenses of same focal length but of aperture A_1 and A_2 ($A_2 < A_1$) are used as the objective lenses in two astronomical telescopes having identical eyepieces. What is the ratio of their resolving power? Which telescope will you prefer and why? Give reason.

Ans. Resolving power of telescope (R_p) = $\frac{A}{1.22\lambda}$

where A = aperture or diameter of the telescope objective.

λ = the wavelength of the objective.

$\Rightarrow R \propto A$

\therefore Ratio of resolving powers of two telescopes

$$\frac{R_1}{R_2} = \frac{A_1}{A_2}$$

$\therefore A_1 > A_2$

$\therefore R_1 > R_2$

The larger the aperture of objective, higher the resolving power of telescope. As well more gathering of light to form the image and hence, brighter image would be obtained. Thus, we prefer telescope having aperture A_1 .