Physics

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Board -	Class - 12	Topic - Ray Optics and optical Instruments

Level-I

1. One half of the reflecting surface of a concave mirror is coated with black paint. How will the image be affected?

Ans: Brightness decreases

2. Why a concave mirror is preferred for shaving?

Ans: Because image is enlarged and virtual

3. Mirrors in search lights are parabolic and not spherical. Why?

Ans: They produce intense parallel beam eliminating spherical aberration

4. Using the mirror formula show that a virtual image is obtained when an object is placed in between the principal focus and pole of the concave mirror.

5. Using the mirror formula show that for a concave mirror, when the object is placed at the centre of curvature, the image is formed at the centre of curvature.

6. Find the position of an object, which when placed in front of a concave mirror of focal length 20cm, produces a virtual image which is twice the size of the object.

Ans: 10cm

7. Plot a graph between $1/u$ and $1/v$ for a concave mirror. What does the slope of the graph yield?

Ans: Straight line, slope $= \frac{u}{v} = \frac{1}{m}$

8. Which of the following properties of light: velocity, wavelength and frequency, changes during the phenomenon (i) reflection (ii) refraction

Ans: (i) No change (ii) velocity, wavelength change

9. A convex lens is combined with a concave lens. Draw a ray diagram to show the image formed by the combination, for an object placed in between f and 2f of the convex lens. Compare the Power of the convex and concave lenses so that the image formed is real.

Ans: f of convex lens must be less than f of concave lens to produce real image. So power of convex greater than that of concave lens

10. Derive a relation between the focal length and radius of curvature of a plano-convex lens made of glass. Compare the relation with that of a concave mirror. What can you conclude? Justify your answer.

Ans: ($f = 2R$) both are same. But applicable always in mirrors, but for lenses only in specific cases, the relation can be applied.

11. In the given figure an object is placed at 0 in a medium ($n_2 > n_1$). Draw a ray diagram for the image formation and hence deduce a relation between u, v and R

$$\frac{n_1}{v} - \frac{n_2}{u} = \frac{n_1 - n_2}{R}$$

12. Show that a concave lens always produces a virtual image, irrespective of the position of the object.

13. Sun glasses are made up of curved surfaces. But the power of the sun glass is zero. Why?

Ans: It is convex concave combination of same powers. So net power zero

14. A convex lens is differentiated to n regions with different refractive indices. How many images will be formed by the lens?

Ans: n images but less sharp.

15. A convex lens has focal length f in air. What happens to the focal length of the lens, if it is immersed in (i) water ($n = \frac{4}{3}$) (ii) a medium whose refractive index is twice that of glass.

Ans: 4f, $-$f

16. Calculate the critical angle for glass air surface, if a ray falling on the surface from air, suffers a deviation of 15° when the angle of incidence is 40°.

Ans: Find n by Snell's law and then find $\theta_C = 41.14°$

17. Two thin lenses when in contact produce a net power of +10D. If they are at 0.25m apart, the net power falls to +6 D. Find the focal lengths of the two lenses

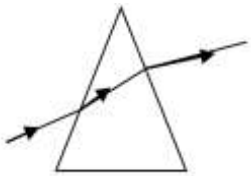
Ans: 0.125m, 0.5m

18. A glass prism has an angle of minimum deviation D in air. What happens to the value of D if the prism is immersed in water?

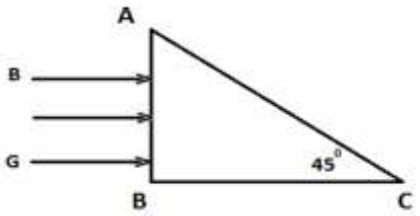
Ans: Decreases

19. Draw a ray diagram for the pat followed by the ray of light passing through a glass prism immersed in a liquid with refractive index greater than glass.

Ans:



20. Three rays of light red (R) green (G) and blue (B) are incident on the surface of a right-angled prism as shown in figure. The refractive indices for the material of the prism for red green and blue are 1.39, 1.43 and 47 respectively. Trace the path of the rays through the prism. How will the situation change if the rays were falling normally on one of the faces of an equilateral prism?

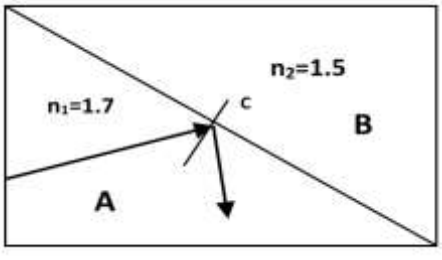


(Hint Calculate the critical angle for each and if the angle of incidence on the surface AC is greater, then TIR will take place.)

21. Show that the angle of deviation for a small angled prism is directly proportional to the refractive index of the material of the prism. One of the glass prisms used in Fresnel's bi-prism experiment has refractive index 1.5. Find the angle of minimum deviation if the angle of the prism is 30.

Ans: $D = (n - 1)A$, 1.5°

22. In the given diagram, a ray of light undergoes total internal reflection at the point C which is on the interface of two different media A and B with refractive indices 1.7 and 1.5 respectively. What is the minimum value of angle of incidence? Can you expect the ray of light to undergo total internal reflection when it falls at C at the same angle of incidence while entering from B to A. Justify your answer?



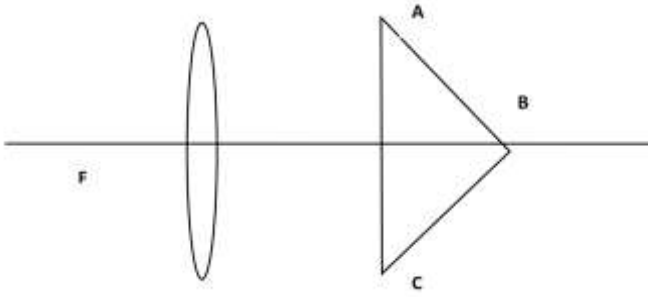
Hint: Use $\sin\theta_C = \frac{n_r}{n_d} = 0.88$ and $\theta_C = 61.8°$

Ans: No, for TIR ray of light must travel from denser to rarer (from B to A)

23. The velocity of light in flint glass for wavelengths 400nm and 700nm are 1.80×10^8 m/s and 1.86×10^8 m/s respectively. Find the minimum angle of deviation of an equilateral prism made of flint glass for the given wavelengths

Ans: For 400nm, $D = 52°$ and for 700nm, $D = 48°$

24. In the given diagram a point object is kept at the Focus F of the convex lens. The ray of light from the lens falls on the surfaces AB and BC of a right angled glass prism of refractive index 1.5 at an angle 42°.Where will be the final image formed? Draw a ray diagram to show the position of the final image formed. What change do you expect in your answer if the prism is replaced by a plane mirror?



Level-II

You are given following three lenses. Which two lenses will you use as an eyepiece and as an objective to construct an astronomical telescope? 2

Lens	Power (P)	Aperture (A)
L1	3D	8 cm
L2	6D	1 cm
L3	10D	1 cm

Ans- The objective of an astronomical telescope should have the maximum diameter and its eyepiece should have maximum power. Hence, L1 could be used as an objective and L3 could be used as eyepiece.

Draw a ray diagram of a reflecting type telescope. State two advantages of this telescope over a refracting telescope. 2

Draw a ray diagram of an astronomical telescope in the normal adjustment position, state two drawbacks of this type of telescope. 2

4. Draw a ray diagram of a compound microscope. Write the expression for its magnifying power. 2

5. The magnifying power of an astronomical telescope in the normal adjustment position is 100. The distance between the objective and the eyepiece is 101 cm. Calculate the focal lengths of the objective and of
the eye-piece. 2

6. How does the 'resolving power' of an astronomical telescope get affected on (i) Increasing the aperture of the objective lens? (ii) Increasing the wavelength of the light used? 2

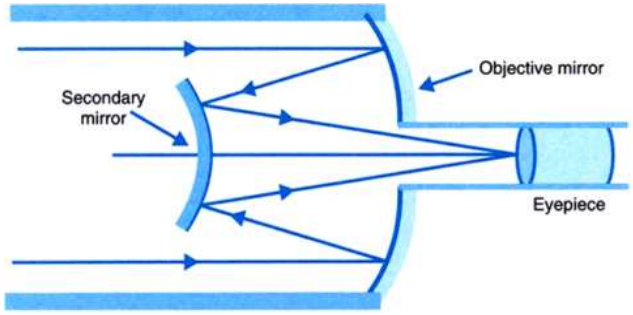
7. What are the two ways of adjusting the position of the eyepiece while observing the final image in a compound microscope? Which of these is usually preferred and why?
Obtain an expression for the magnifying power of a compound microscope. Hence explain why
a) we prefer both the 'objective' and the 'eye-piece' to have small focal length? and

b) we regard the 'length' of the microscope tube to be nearly equal to be separation between the focal points of its objective and its eye-piece?

c) Calculate the magnification obtained by a compound microscope having an objective of focal length 1.5 cm and an eyepiece of focal length 2.5 cm and a tube length of 30.

Hint- observed angular separation = 0.75′ ×200 = 150′

8. Cassegranian telescope uses two mirrors as shown in figure. Such a telescope is built with the mirrors20 mm apart. If the radius of curvature of the large mirror is 220mm and the small mirror is 140mm, where will the final image of an object at infinity be? The following figure shows a Cassegranian telescope consisting of a concave mirror and a convex mirror.



Ans: 315 mm