optical instrument-CBSE

## 2 Marks Questions

1. Draw the ray diagram of an astronomical telescope showing image formation in the normal adjustment position. Write the expression for its magnifying power.

2. Draw a labelled ray diagram to show image formation by a compound microscope and write the expression for its resolving power.

3. Define the magnifying power of a compound microscope when the final image is formed at infinity. Why must both the objective and the eyepiece of a compound microscope has short focal lengths? Explain

4. A small telescope has an objective lens of focal length 150 cm and eyepiece of focal length 5 cm. What is the magnifying power of the telescope for viewing distance objects in normal adjustments.

   If this telescope is used to view a 100 m tall tower 3 km away, then what is the height of the tower formed by the objective lens

5. You are given two converging lenses of focal lengths 1.25 cm and 5 cm to design to compound microscope. If it is desired to have a magnification of 30, find out the separation between the objective and the eyepiece.

6. Draw a schematic diagram of refracting telescope. Write its two important limitations.

7. Draw a ray diagram for the formation of image by a compound microscope. Write the expression for total magnification when the image is formed at infinity

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

9. Draw a schematic arrangement of a reflecting telescope (Cassegrain) showing how rays coming from a distant object are received at the eyepiece. Write its two important advantages over a refracting telescope.

10. Two convex lenses of same focal length but of apertures $A_1$ 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.

11. Define the resolving power of a telescope. Write any two advantages of a reflecting telescope over a refracting telescope.

12. Define the magnifying power of a compound microscope. Why should both the objective and the eyepiece have small focal lengths in a microscope?

## 3 Marks Questions

13. Draw a labelled ray diagram of an astronomical telescope in the near point adjustment position. A giant refracting telescope at an observatory has an objective lens of focal length 15 m and an eyepiece of focal length 1.0 cm. If this telescope is used to view the Moon, find the diameter of the image of the Moon formed by the objective lens. The diameter of the Moon is $3.48 \times 10^6$ m and the radius of lunar orbit is $3.8 \times 10^8$ m.

**14.** (i) Draw a ray diagram depicting the formation of the image by an astronomical telescope in normal adjustment.

(ii) You are given the following three lenses. Which two lenses will you use as an eyepiece and as an objective to construct an astronomical telescope? Give reason.

| Lenses | Power (D) | Aperture (cm) |
|---|---|---|
| $L_1$ | 3 | 8 |
| $L_2$ | 6 | 1 |
| $L_3$ | 10 | 1 |

**15.** Draw a schematic ray diagram of reflecting telescope showing how rays coming from a distant object are received at the eyepiece. Write its two important advantages over a refracting telescope.

**16.** (i) A giant refracting telescope has an objective lens of focal length 15 m. If an eyepiece of focal length 1.0 cm is used, what is the angular magnification of the telescope?

(ii) If this telescope is used to view the moon, what is the diameter of the image of the moon formed by the objective lens? The diameter of the moon is $3.48 \times 10^6$ m and the radius of lunar orbit is $3.8 \times 10^8$ m.

**17.** Which two of the following lenses $L_1$, $L_2$ and $L_3$ will you select as objective and eyepiece for constructing best possible (i) telescope (ii) microscope? Give reason to support your answer. **Delhi 2015C**

| Lens | Power ($P$) | Aperture ($A$) |
|---|---|---|
| $L_1$ | 6D | 1 cm |
| $L_2$ | 3D | 8 cm |
| $L_3$ | 10D | 1 cm |

**18.** (i) Draw a labelled ray diagram showing the formation of a final image by a compound microscope at least distance of distinct vision.

(ii) The total magnification produced by a compound microscope is 20. The magnification produced by the eyepiece is 5. The microscope is focused on a certain object. The distance between the objective and eyepiece is observed to be 14 cm. If least distance of distinct vision is 20 cm. Calculate the focal length of the objective and the eyepiece.

**19.** Draw a labelled ray diagram of a refracting telescope. Define its magnifying power and write the expression for it.
Write two important limitations of a refracting telescope over a reflecting type telescope.

**20.** Draw a ray diagram showing the image formation by a compound microscope. Hence, obtain expression for total magnification when the image is formed at the infinity.

**21.** A compound microscope uses an objective lens of focal length 4 cm and eyepiece lens of focal length 10 cm. An object is placed at 6 cm from the objective lens. Calculate the magnifying power of the compound microscope. Also, calculate the length of the microscope

**22.** Two convex lenses of focal length 20 cm and 1 cm constitute a telescope. The telescope is focused on a point which is
1 m away from the objective. Calculate the magnification produced and the length of the tube if the final image is formed at a distance 25 cm from the eyepiece

**23.** The objective of an astronomical telescope has a diameter of 150 mm and a focal length of 4.00 m. The eyepiece has a focal length of 25.00 mm. Calculate the magnifying and resolving power of telescope. ($\lambda$ = 6000 Å for yellow colour).

24. (i) Draw a neat labelled ray diagram of an astronomical telescope in normal adjustment. Explain briefly its working.

(ii) An astronomical telescope uses two lenses of powers 10D and 1D. What is its magnifying power in normal adjustment?

25. (i) Draw a neat labelled ray diagram of a compound microscope. Explain briefly its working.

(ii) Why must both the objective and the eyepiece of a compound microscope have short focal lengths?

26. Draw a schematic diagram of a reflecting telescope (Cassegrain). Write two important advantages that the reflecting telescope has over a refracting type.

27. Explain with the help of a ray diagram, the working of an astronomical telescope. The magnifying power of a telescope in its normal adjustment is 20. If the length of the telescope is 105 cm in this adjustment, find the focal lengths of the two lenses.

## 5 Marks Questions

28. (i) Draw a labelled ray diagram showing the image formation of a distant object by refracting telescope.

Deduce the expression for its magnifying power when the final image is formed at infinity.

(ii) The sum of focal lengths of the two lenses of a refracting telescope is 105 cm. The focal length of one lens is 20 times that of the other. Determine the total magnification of the telescope when the final image is formed at infinity.

29. (i) Draw a labelled ray diagram to obtain the real image formed by an astronomical telescope in normal adjustment position. Define its magnifying power.

(ii) You are given three lenses of power 0.5 D, 4 D and 10 D to design a telescope.

(a) Which lenses should be used as objective and eyepiece? Justify your answer.

(b) Why is the aperture of the objective preferred to be large?

30. Define magnifying power of a telescope. Write its expression.

A small telescope has an objective lens of focal length 150 cm and an eyepiece of focal length 5 cm. If this telescope is used to view a 100 m high tower 3 km away, find the height of the final image when it is formed 25 cm away from the eyepiece.

31. How is the working of a telescope different from that of a microscope?

The focal lengths of the objective and eyepiece of a microscope are 1.25 cm and 5 cm, respectively. Find the position of the object relative to the objective in order to obtain an angular magnification of 30 in normal adjustment.

32. Draw a ray diagram to show the working of a compound microscope. Deduce an expression for the total magnification when the final image is formed at the near point.

In a compound microscope, an object is placed at a distance of 1.5 cm from the objective of focal length 1.25 cm. If the eyepiece has a focal length of 5 cm and the final image is formed at the near point. Estimate the magnifying power of the microscope.