

JEE PHYSICS / RAY OPTICS

Telescope

Magnification and Aperture



Core Components: Objective vs. Eyepiece



Objective Lens

1. Aperture:

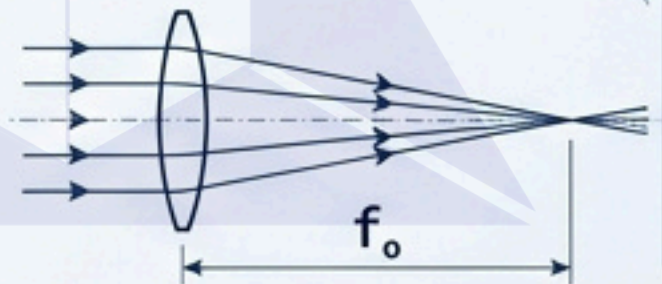
Large (designed to gather maximum light from faint, distant objects).



2. Focal Length:

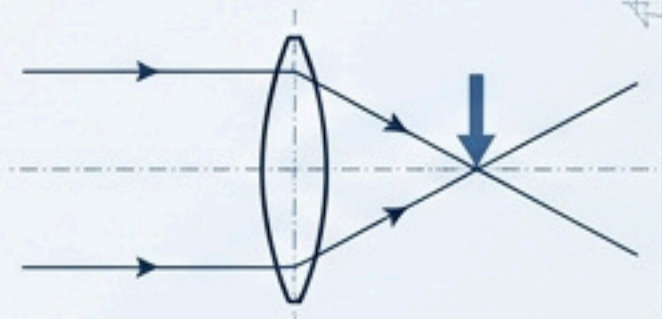
f_o

Large focal length.



3. Optical Role:

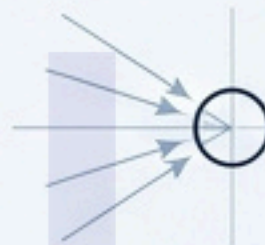
Forms the intermediate real, inverted image at its second focal point.



Eyepiece Lens

1. Aperture:

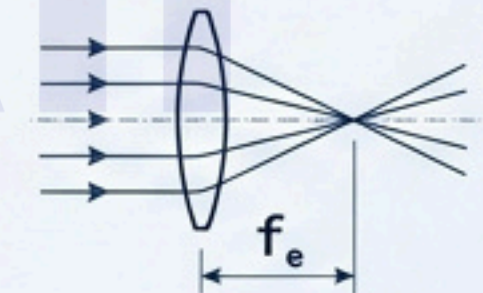
Small.



2. Focal Length:

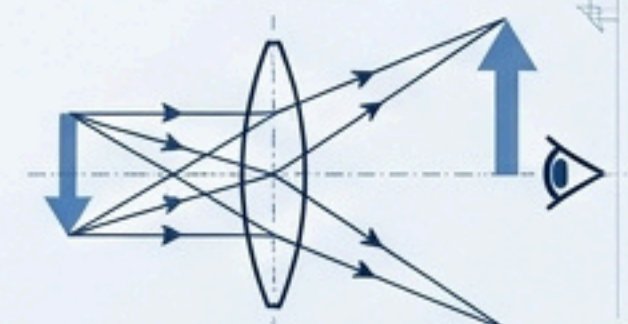
f_e

Small focal length.

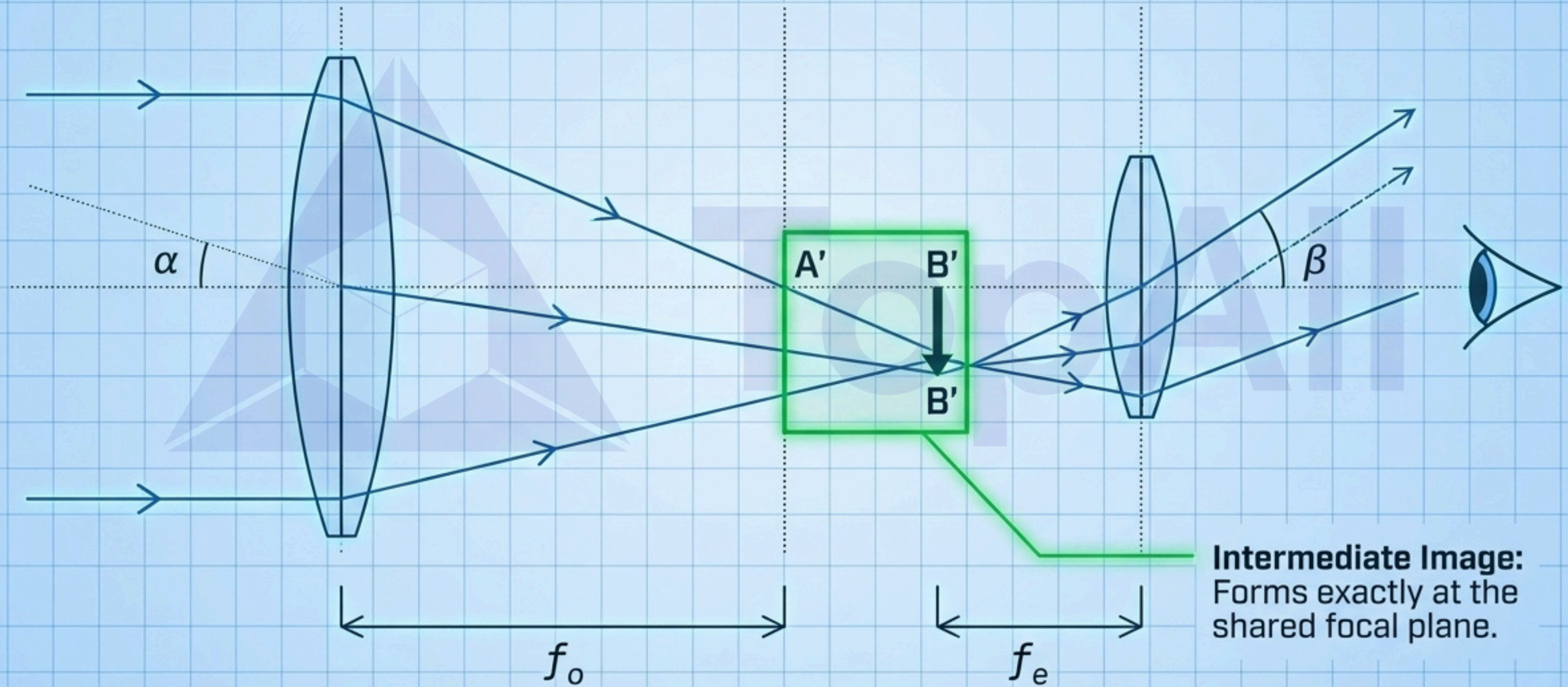


3. Optical Role:

Acts as a simple magnifier, producing the final highly magnified, inverted virtual image.



The Refracting Telescope System





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$$E=mc^2$$



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Formula Bank: Normal Adjustment

MAGNIFICATION

$$m = \frac{\beta}{\alpha} = \frac{f_o}{f_e}$$

β = angle subtended by final image,
 α = angle subtended by object

TUBE LENGTH

$$L = f_o + f_e$$



Key Takeaway: To achieve maximum magnification, the objective focal length (f_o) must be very large and the eyepiece focal length (f_e) very small.

System Constraints: Aperture Limits

JEE TRAP ALERT

Assuming a larger objective diameter increases the magnifying power (m) of the telescope.

Reality: Magnification is solely determined by the focal length ratio (f_o / f_e).

The Real Role of Aperture (Diameter)

Light Gathering Power:

Larger area captures more light, making faint, distant stars visible.

Resolving Power:

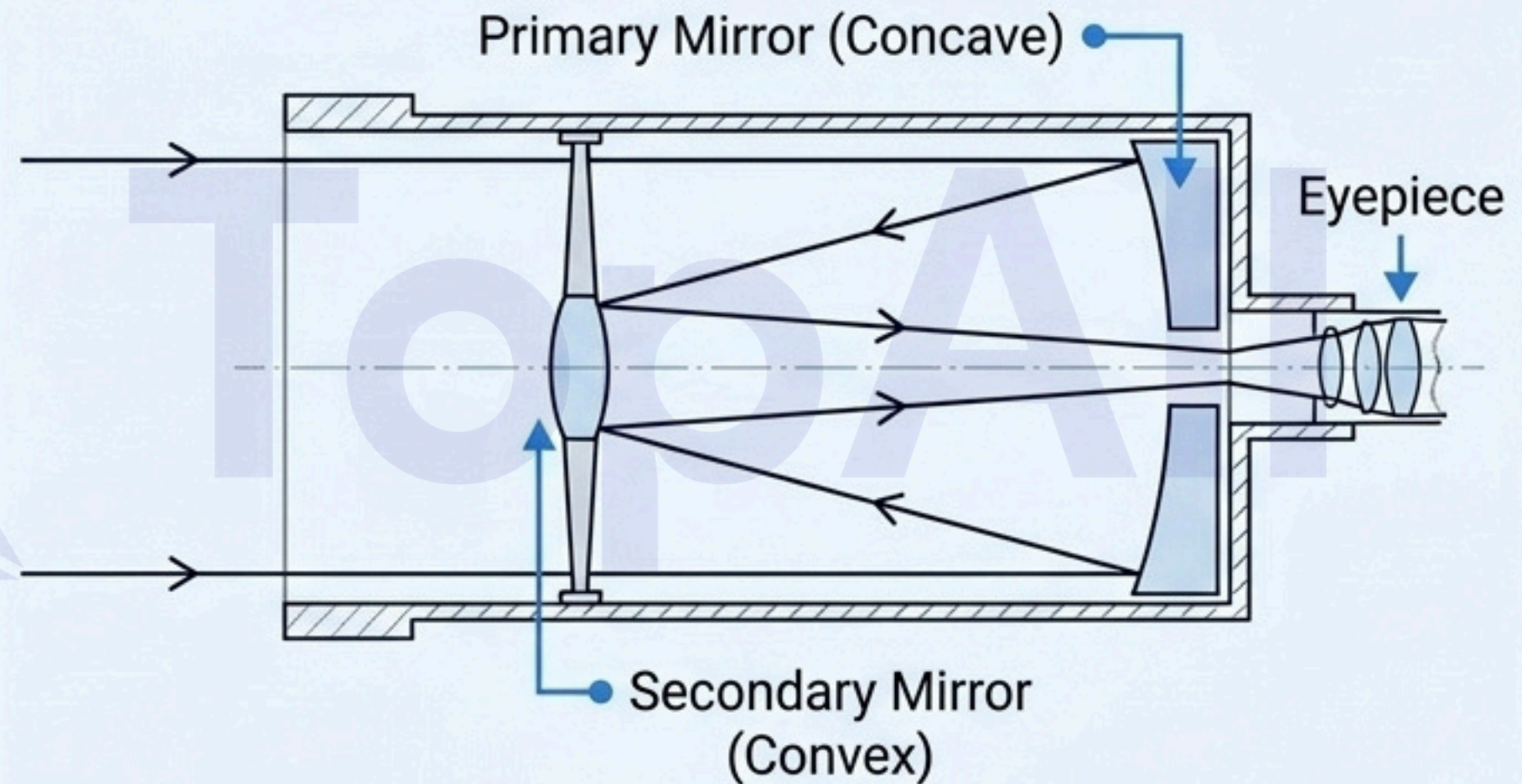
Larger diameter improves the ability to observe two closely spaced objects distinctly (resolution).

Evolution: The Cassegrain Reflector

Limits of Large Lenses

- Extremely heavy (difficult to support by edges)
- Inherently suffer from chromatic aberration
- Expensive to manufacture

The Mirror Advantage



Info Blue: Mirrors eliminate chromatic aberration and can be fully supported from the back.

Revision Card: Telescope Parameters

Optical Power

Focal-Length Ratio
 (f_o / f_e)



Controls **Magnification**
& **Tube Length**

Physical Scale

Objective Diameter
(Area)



Controls **Visibility** (Light
Gathering) & **Resolution**



End of Module



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