Assignment 1

Submission Deadline

May 27, 2023

Problem 1:

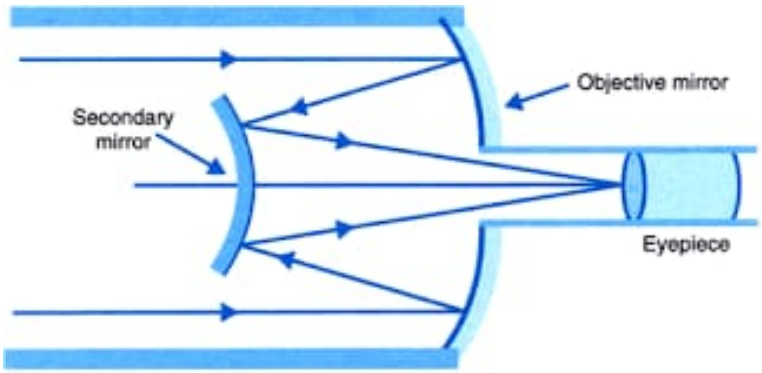
Find out the magnification of the refracting telescope having two convex lens where the distance between the lens is less than the sum of their focal distances.

Problem 2:

What is the resolving power of a telescope with diameter 200cm when observing at a wavelength of 450 nm?

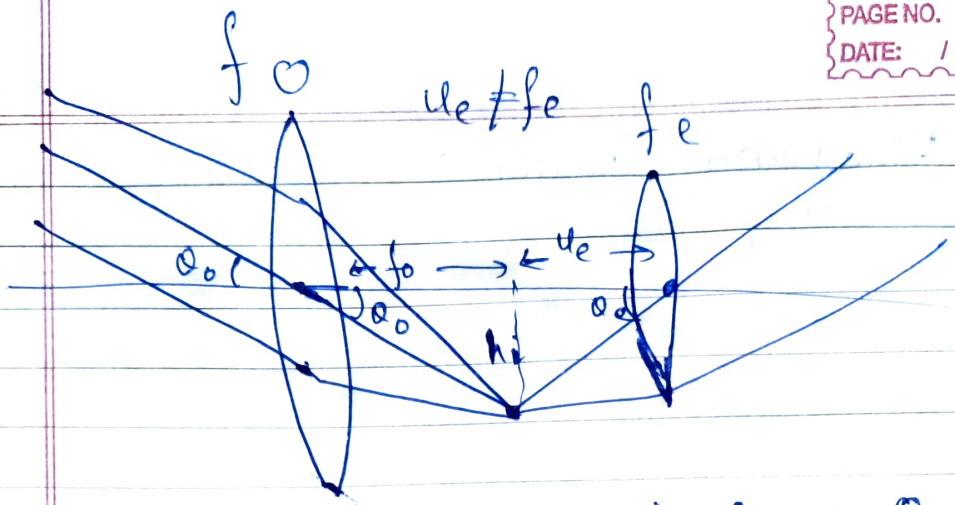
Problem 3:

A Cassegrain telescope uses two mirrors as shown in figure. Such a telescope is built with the mirrors 18 mm apart. If the radius of curvature of the large mirror is 210 m and the small mirror is 132mm, where will the final image of an object at infinity be?



Problem 4:

Find out what you mean by the angular resolution of a telescope. Two radio telescopes, Telescope A and Telescope B, are positioned 340 meters apart. The telescopes are observing a distant radio source. If the wavelength of the radio waves is 9.8 centimeters, what is the maximum angular resolution achieved by the interferometer?



Ang size from Objective lens = θ_o

$$\theta_o = \frac{h_i}{f_o}$$

" " " Eyepiece lens = θ_e

$$\theta_e = \frac{h_i}{u_e}$$

$$u_e = \frac{v f_e}{v + f_e}$$

$$\theta_e = \frac{h_i}{v f_e}(v + f_e)$$

$$m = \frac{\theta_e}{\theta_o} = \frac{h_i}{v f_e}(v + f_e) \times \frac{f_o}{h_i}$$

$$m = \frac{f_o}{f_e}\left(\frac{v + f_e}{v}\right)$$

$$m = \frac{f_o}{f_e}\left(1 + \frac{f_e}{v}\right)$$

$v \approx 25$ cm for human eye

Q2

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Resolving power (Telescope) $= \frac{1}{\theta}$

$$\theta = \frac{1.22\lambda}{D}$$

$$\frac{1}{\theta} = R_p = \frac{D}{1.22\lambda}$$

$$R_p = \frac{200 \text{ cm}}{1.22 \times 450 \text{ nm}}$$

$$R_p = \frac{200 \times 10^{-2}}{1.22 \times}$$

$$R_p = \frac{2 \text{ m}^{-1}}{1.22 \times 450 \times 10^{-9} \text{ m}}$$

$$R_p = 0.0364 \times 10^{8}$$

$$\boxed{R_p = 3.64 \times 10^{6}}$$

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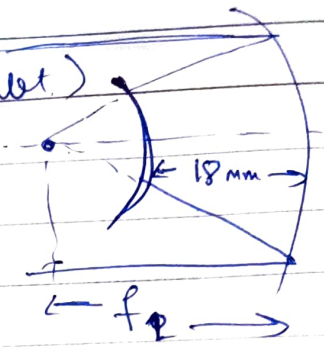
Q3

Dist^n b/w mirrors = 18 mm

R_1 (large) = 210 m (Doubt)

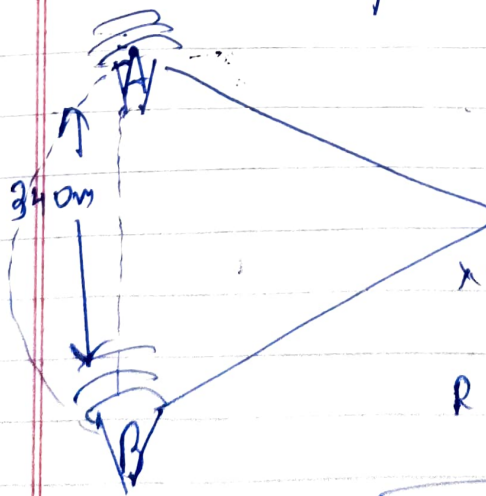
R_2 (small) = 132 mm



$$f_1 = \frac{R_1}{2} = 105 \text{ m}$$

Q4

- The smallest angular separation for which two distant and distinct objects are JUST resolved is called limit of resolution and it's reciprocal is called angular resolution.
- It varies for different devices.



$$R = \frac{1}{\theta}$$ (θ = Min^m Angle for just resolved distinct image)

$$R = \frac{D}{1.22\lambda}$$

$$R = \frac{340 \text{ m}}{1.22 \times 9.8 \times 10^{-2} \text{ m}}$$

$$R = 2.008 \times 10^3$$

Max^m. Ang. Resolution