

Physics 214

Quiz 2-2 [20 points]

- a) [5 points] The largest astronomical telescopes have mirrors about 10 meters in diameter. What angular separation of visible objects (use $\lambda = 550 \text{ nm}$) can they resolve if diffraction is the limiting factor?

- $\delta\theta = 1.22 \lambda/d = 6.7 \times 10^{-8} \text{ rad}$

- b) [6 points] Could such a telescope resolve the pitchers mound from home plate on a lunar baseball field (*i.e.*, separated by 18.4 m) on the moon? Assume the moon is $3.8 \times 10^8 \text{ m}$ away.

- Need to resolve $\delta\theta = 18.4 \text{ m} / (3.8 \times 10^8 \text{ m}) = 4.8 \times 10^{-8}$ which is smaller than resolution
- So by Rayleigh's criterion one cannot resolve

- c) [5 points] A laser has an aperture of 0.25 cm. It sends its light ($\lambda = 550 \text{ nm}$) to the moon. What is the diameter of the beam that hits the moon?

- $2 L \delta\theta = 2 * 3.8 \times 10^8 \text{ m} (1.22) 550 \text{ nm} / 0.25 \text{ cm} = 2.04 \times 10^5 \text{ m}$

- d) [4 points] To decrease the spot size on the moon, we could do which of the following (check all that apply):

- ☐ decrease the aperture size
- ☒ increase the aperture size
- ☒ decrease the wavelength
- ☐ increase the wavelength