

Quiz #6

2021.05.17

Name:

Assume that the pupil diameter of a normal eye typically can vary from 2 mm to 7 mm in response to ambient light variations. The center wavelength of light is 550 nm.

- (a) What is the corresponding range of distances over which such an eye can detect the separation of objects 1.5 mm apart?
- (b) Experiment to find the range of distances over which you can detect the separation of lines placed 1.5 mm apart. Use the results of your experiment to estimate the diameter range of your own pupils.

Sol.)

$$\Delta \theta = \frac{s}{L} = \frac{1.22 \lambda}{D} \rightarrow L = \frac{SD}{1.22 \lambda}$$

$$D_{\min} = 2 \text{ mm}$$

$$D_{\max} = 7 \text{ mm}$$

$$(i) L_{\min} = \frac{(1.5 \times 10^{-3})(2 \times 10^{-3})}{(1.22)(5.5 \times 10^{-7})} = \boxed{4.8 \text{ (m)}}$$

$$(ii) L_{\max} = \frac{(1.5 \times 10^{-3})(7 \times 10^{-3})}{(1.22)(5.5 \times 10^{-7})} = \boxed{15.6 \text{ (m)}}$$

$$(b) D = \frac{1.22 \lambda L}{s} = \frac{(1.22)(5.5 \times 10^{-7})}{1.5 \times 10^{-3}} L = \boxed{4.5 L \times 10^{-4}}$$