Optics

Second year / First semester
Lecture 6

Assist .lec. Mena Luay

Human Eye

Light enters the eye through a curved front surface, the cornea. The light is further focused by the eye lens on the retina. The retina is a film of nerve fibers covering the curved back surface of the eye. The standard value for normal vision is taken as 25 cm. (Often the near point is given the symbol D.) This distance increases with age, because of the decreasing effectiveness of the ciliary muscle and the loss of flexibility of the lens. The near point may be as close as about 7 to 8 cm in a child ten years of age, and may increase to as much as 200 cm at 60 years of age. Thus, if an elderly person tries to read a book at about 25 cm from the eye, the image appears blurred. This condition (defect of the eye) is called presbyopia. It is corrected by using a converging lens for reading.

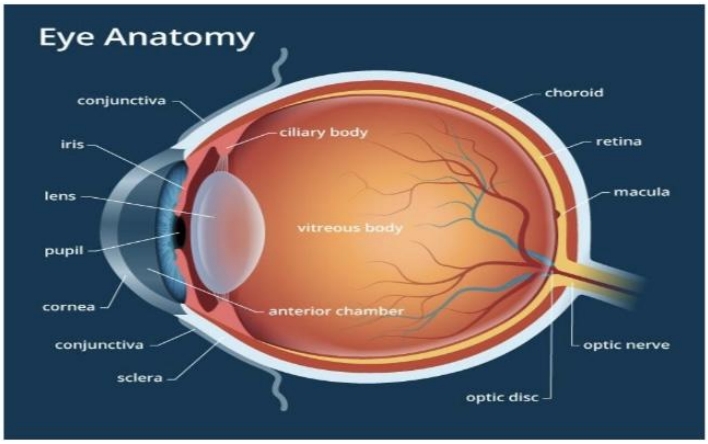


Figure 1: The human eye anatomy.

Myopia (nearsightedness)

Person suffering with Myopia can see the near distances comfortably but finds difficulty in seeing far off things. This is a defect of vision in which far objects appear blurred but near objects are seen clearly. The

image is focused in front of the retina rather than on it usually because the refractive power of the eye's lens too strong and the cornea is too steep. Myopia can be corrected by wearing glasses/contacts with concave lenses these help to focus the image on the retina as shown in figure 2. Hence it is also called as Near Nearsightedness.

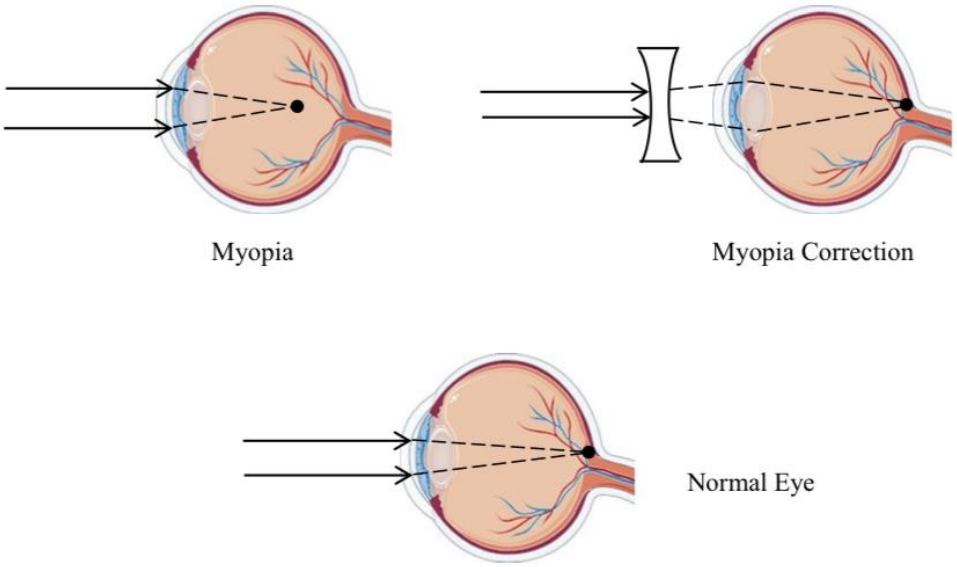


Figure 2: Myopia defect and corrected by wearing concave glass.

Hypermetropia (farsightedness)

This is a defect of vision in which there is difficulty with near vision but far objects can be seen easily. The image is focused behind the retina rather than upon it. This occurs when the eyeball is too short or the refractive power of the lens is too weak. Hyperopia can be corrected by wearing glasses/contacts that contain convex lenses as shown in figure .3. Hence it is also called as Farsightedness.

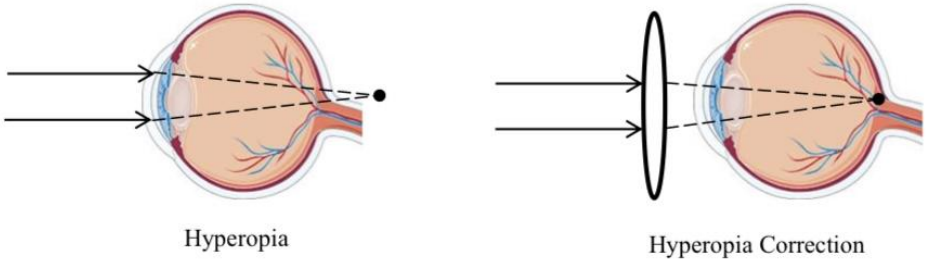


Figure 3: Hyperopia defect and corrected by wearing convex glass.

Presbyopia

Old age due to ciliary muscles becoming weak and eye lens becoming inflexible the eye loses its power of accommodation. Presbyopia is special kind of hypermetropia. It's possible that same person suffering hypermetropia can also suffer with myopia. In old age, person cannot see near as well as far. Corrective presbyopia by using a bifocal lens is used in spectacles in which upper part is concave and lower part of lens is convex as shown in figure .4.

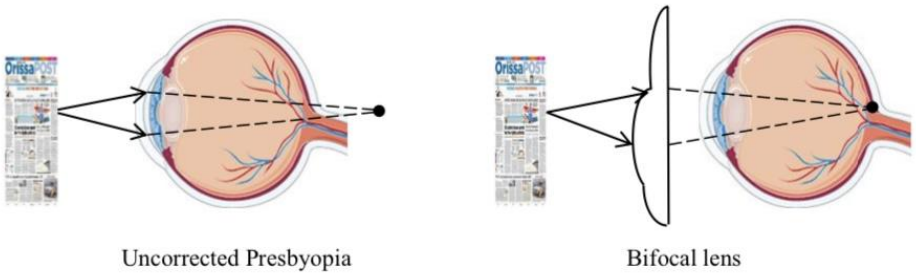
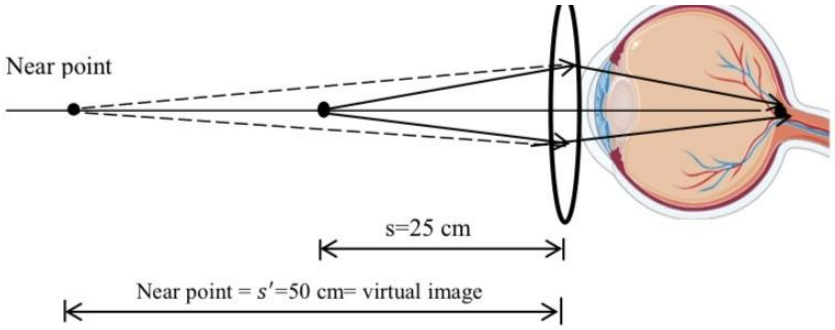


Figure 4: Corrective presbyopia by using a bifocal lens.

Example-1- The near point of a hypermetropic eye is 50 cm. What is the power of the lens required to correct this defect?



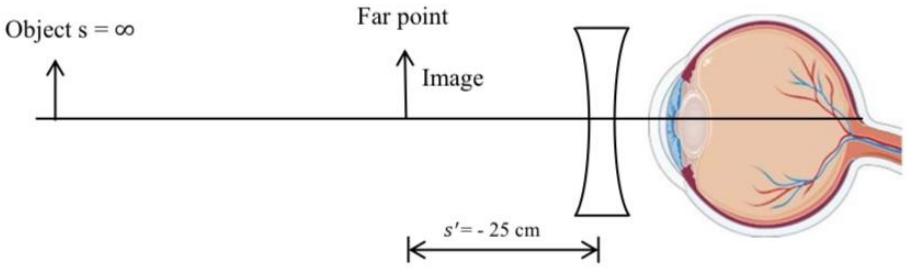
$$\frac{1}{f} = \frac{1}{s} + \frac{1}{s'}$$

$$\frac{1}{f} = \frac{1}{25} + \frac{1}{-50} \longrightarrow \frac{1}{f} = \frac{1}{50}$$

f = 50 cm

$$p = \frac{1}{f} = \frac{1}{0.5\ m} = +2\ D$$

Example-2- A man has a myopia eye what is the power of the lens required to correct this defect for an object at infinity.



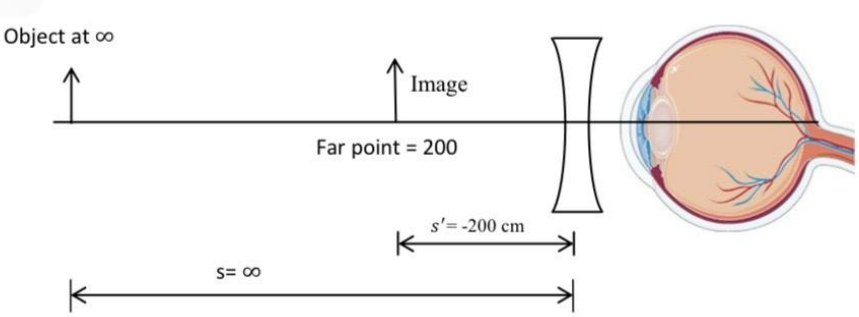
$$\frac{1}{f} = \frac{1}{s} + \frac{1}{s'}$$

$$\frac{1}{f} = \frac{1}{\infty} + \frac{1}{-25}$$

f = -25 cm

$$p = \frac{1}{f} = \frac{1}{-0.25\ m} = -4\ D$$

Example-3 - Someone cannot see things clearly which are farther than 200 cm . What is the defect in this eye, prescribe a lens with suitable power?



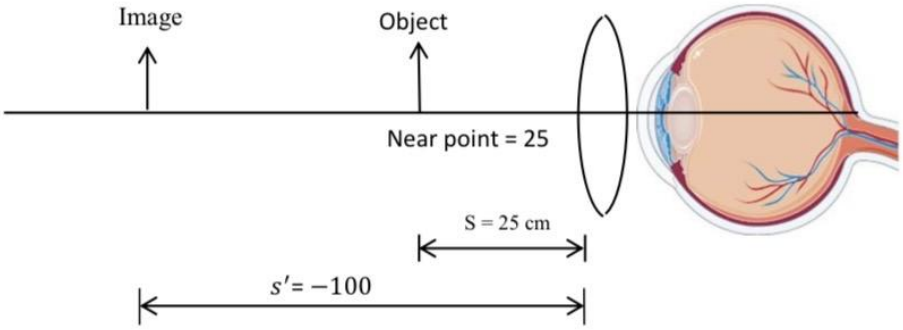
$$\frac{1}{f} = \frac{1}{s} + \frac{1}{s'}$$

$$\frac{1}{f} = \frac{1}{\infty} + \frac{1}{-200}$$

f = -200 cm

$$p = \frac{1}{f} = \frac{1}{-2\ m} = -0.5\ D$$

Example -4- Someone cannot read a book held closer than 100 cm . Name the eye defect and prescribe a corrective lens of suitable power .(near point for normal eye =25 cm)?



$$\frac{1}{f} = \frac{1}{s} + \frac{1}{s'}$$

$$\frac{1}{f} = \frac{1}{25} + \frac{1}{-100}$$

$$f = \frac{100}{3}\ cm = \frac{1}{3}\ m$$

$$p = \frac{1}{f} = +3\ D$$