CHAPTER 11 PRACTICE PASSAGE

Optical instruments, such as mirrors and lenses, are often used to converge or diverge light. When more than one optical instrument bends light in succession, it is sometimes useful to consider the image produced by the first mirror or lens to be the object from which the light comes to the second mirror or lens. In such cases, the virtual object for the second instrument is sometimes on the opposite side of the instrument as the incoming light. The convention for these objects is that their distances are negative in optics equations.

One example of the use of multiple optical instruments together can be found in vision correction. For an object to appear in focus, light from that object must converge on the retina at the back of the eye, roughly 2 cm away from the front in most humans. Normally, the cornea and crystalline lens (together effectively constituting one converging lens, with an index of refraction of about 1.4) at the front of the eyeball do this. When this does not occur, eyeglasses can often be used to fix the problem. Eyeglasses are made of converging or diverging lenses in frames, and they change the angle of the incoming light that reaches the lens at the front of the eye, which then is able to focus the differently angled light at the retina.

A lens bends light by refraction, so the refractive index of the lens material is one of the determinants of the focal length of the lens. For a lens with circular curvatures on either side, the radius of curvature of each side is another determinant. In a vacuum or air, the thin lens equation gives the focal length of a lens of minimal thickness, index of refraction n, radius of curvature of the side nearest the source of light R_1, and radius of curvature of the side opposite the source of light R_2.

$$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

Equation 1

1. If a certain eye can only focus on objects at least 50 cm away, which of the following lenses, if placed in front of the eye, would allow it to focus on an object 25 cm away?

A) A converging lens with focal length 17 cm
B) A diverging lens with focal length 17 cm
C) A diverging lens with focal length 50 cm
D) A converging lens with focal length 50 cm

2. Which of the following is true of a nearsighted eye's native lens?

A) Its lens power is too small, causing the light rays to converge before they reach the retina.
B) Its lens power is too small, causing the light rays not to have converged even when they reach the retina.
C) Its lens power is too great, causing the light rays to converge before they reach the retina.
D) Its lens power is too great, causing the light rays not to have converged even when they reach the retina.

3. Which of the following describes the image formed in a typical human eye from light rays from an object 10 cm away?

A) The image is virtual and 0.4 cm away from the lens.
B) The image is real and 2 cm away from the lens.
C) The image is real and 2.5 cm away from the lens.
D) The image is virtual and 2.5 cm away from the lens.

4. Which of the following is true of images created with optical instruments by virtual objects with negative object distances?

A) Real images are always upright, and virtual images are always inverted.
B) Real images are always inverted, and virtual images are always upright.
C) Both real and virtual images are always upright.
D) Both real and virtual images are always inverted.

5. What is the speed of light in the lens of the eye?

A) 1.50×10^8 m/s
B) 2.14×10^8 m/s
C) 3.00×10^8 m/s
D) 4.20×10^8 m/s

6. A person notices that an object at a given distance is clearly in focus when viewed in air, but when the same object at the same distance is viewed in clear water, it appears blurry. Which of the following best explains this phenomenon?

A) The water absorbs much of the light energy coming from the object.
B) The index of refraction of water is different from that of air.
C) Dispersion in the water causes only a few of the light rays from the object to reach the eyes.
D) The water acts as a polarizing filter.

7. How will the lens power of a thin lens with a greater index of refraction compare to that of a thin lens with a smaller index of refraction, if the two lenses have all the same radii of curvatures?

A) It will be greater.
B) It will be equal.
C) It will be less.
D) It cannot be determined.