1. (b).
2. (d).
3. (a). The object distance is greater than twice the focal length ($d_o > 2f$), so the image is real, inverted, and reduced.
4. (a). The eye focuses by changing the shape of its lens to change the focal length according to the lens-maker's equation. The focal length is adjusted to form a sharp image. The image distance is fairly constant and so is the distance from the lens to the retina. From the thin lens equation, the eye must have long focal length for looking at distant objects and so the radius is large; the eye must have short focal length for looking at close objects and so the radius is small.

5. The pre-flash occurs before the aperture is open and the film exposed. The bright light causes the iris to reduce down (giving a small pupil) so that when the second flash comes momentarily, you don't have a wide opening through which you get the red-eye reflection from the retina.

6. Iris, crystalline lens, and retina correspond to the aperture, lens, and film, respectively, of the camera.

12. (a) She has (1) nearsightedness, because she cannot clearly see distant objects.

(b) The diverging lens is to form an image of an object at infinity at the far point (12.5 m).

$d_o = \infty$, $d_i = -12.5$ m (virtual image on object side). $P = \frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{\infty} + \frac{1}{-12.5\text{ m}} =$ −0.0800 D.

26. (d).
27. (d).
28. A short focal length lens has a very small radius according to the lens-maker's equation in Chapter 24. The aberration (geometrical optics or small angle approximation is no longer valid if the object is large compared with the size of the lens) will be bigger and bigger as the focal length gets smaller and smaller. This limits the magnification to about 3× to 4×.

32. $m = 1 + \frac{25\text{ cm}}{f} = 1 + \frac{25\text{ cm}}{12\text{ cm}} =$ 3.1×.

46. (c).
47. (b).
48. (d).

49. No, the whole star can still be seen. The obstruction will reduce the intensity or brightness of the image.

50. This is because reflection is frequency independent. All frequency reflects with the same angle of reflection. In refraction, however, the angle of refraction depends on the frequency due to dispersion.

51. The one with the shorter focal length should be used as the eyepiece for a telescope. The magnification of the telescope is inversely proportional to the focal length of the eyepiece ($m = -f_o/f_e$).

53. (a) $m = -\frac{f_o}{f_e} = -\frac{60\text{ cm}}{15\text{ cm}} =$ −4.0×.

(b) $L = f_o + f_e = 60\text{ cm} + 15\text{ cm} =$ 75 cm.

78. (d).
79. (d).
80. (d).
81. With red light, red and white appear red; blue appears black.
With green light, only white appears green; both red and blue appear black.
With blue light, red appears black; white and blue appear blue.
82. Since white is obtained by adding colors, it cannot be obtained by the subtractive method. That method subtracts colors, and the one we see is the one that is not absorbed.
Black objects do not absorb all wavelengths of light. We see the objects because we perceive the extremely faint light as black (Think of twilight vision).