

Textbook problems Ch. 14-15 Light and Electromagnetic waves

10. The compound eyes of bees and other insects are highly sensitive to light in the ultraviolet portion of the spectrum, particularly light with frequencies between 7.5×10^{14} Hz and 1.0×10^{15} Hz. To what wavelengths do these frequencies correspond?
(See Sample Problem 14A.)

12. What is the wavelength for an FM radio signal if the number on the dial reads 99.5 MHz?
(See Sample Problem 14A.)

20. Two flat mirrors make an angle of 90.0° with each other, as diagrammed in **Figure 14-29**. An incoming ray makes an angle of 35° with the normal of mirror A. Use the law of reflection to determine the angle of reflection from mirror B. What is unusual about the incoming and reflected rays of light for this arrangement of mirrors?

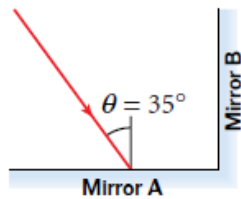


Figure 14-29

34. A concave shaving mirror has a radius of curvature of 25.0 cm. For each of the following cases, find the magnification and determine whether the image formed is real or virtual and upright or inverted.
- an upright pencil placed 45.0 cm from the mirror
 - an upright pencil placed 25.0 cm from the mirror
 - an upright pencil placed 5.00 cm from the mirror

(See Sample Problem 14B.)

35. A concave spherical mirror can be used to project an image onto a sheet of paper, allowing the magnified image of an illuminated real object to be accurately traced. If you have a concave mirror with a focal length of 8.5 cm, where would you place a sheet of paper so that the image projected onto it is twice as far from the mirror as the object is? Is the image upright or inverted, real or virtual? What would the magnification of the image be?

(See Sample Problem 14B.)

36. A convex mirror with a radius of curvature of 45.0 cm forms a 1.70 cm tall image of a pencil at a distance of 15.8 cm behind the mirror. Calculate the object distance for the pencil and its height. Is the image real or virtual? What is the magnification? Is the image inverted or upright? (See Sample Problem 14C.)
37. What are the three primary additive colors? What happens when you mix them?
38. What are the three primary subtractive colors (or primary pigments)? What happens when you mix them?
42. A substance is known to reflect green and blue light. What color would it appear to be when it is illuminated by white light? by blue light?
44. Why would sunglasses with polarizing lenses remove the glare from your view of the hood of your car or a distant body of water but not from a tall metal tank used for storing liquids?
46. The real image of a tree is magnified -0.085 times by a telescope's primary mirror. If the tree's image forms 35 cm in front of the mirror, what is the distance between the mirror and the tree? What is the focal length of the mirror? What is the value for the mirror's radius of curvature? Is the image virtual or real? Is the image inverted or upright?
47. A candlestick holder has a concave reflector behind the candle, as shown in **Figure 14-30**. The reflector magnifies a candle -0.75 times and forms an image 4.6 cm away from the reflector's surface. Is the image inverted or upright? What are the object distance and the reflector's focal length? Is the image virtual or real?



Figure 14-30

10. Light passes from air into water at an angle of incidence of 42.3° . Determine the angle of refraction in the water.

(See Sample Problem 15A.)

12. A narrow ray of yellow light from glowing sodium ($\lambda_0 = 589 \text{ nm}$) traveling in air strikes a smooth surface of water at an angle of $\theta_i = 35.0^\circ$. Determine the angle of refraction, θ_r .

(See Sample Problem 15A.)

14. The light ray shown in **Figure 15-18** makes an angle of 20.0° with the normal line at the boundary of linseed oil and water. Determine the angles θ_1 and θ_2 . Note that $n = 1.48$ for linseed oil.

(See Sample Problem 15A.)

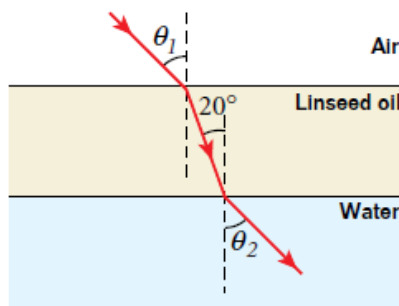


Figure 15-18

24. An object is placed in front of a diverging lens with a focal length of 20.0 cm . For each object distance, find the image distance and the magnification. Describe each image.

- 40.0 cm
- 20.0 cm
- 10.0 cm

(See Sample Problem 15B.)

25. A person looks at a gem using a converging lens with a focal length of 12.5 cm . The lens forms a virtual image 30.0 cm from the lens. Determine the magnification. Is the image upright or inverted?

(See Sample Problem 15B.)

26. An object is placed in front of a converging lens with a focal length of 20.0 cm . For each object distance, find the image distance and the magnification. Describe each image.

- 40.0 cm
- 10.0 cm

(See Sample Problem 15B.)

38. Light traveling in air enters the flat side of a prism made of crown glass ($n = 1.52$), as shown in **Figure 15-19**. Will the light pass through the other side of the prism or will it be totally internally reflected? Show your work.

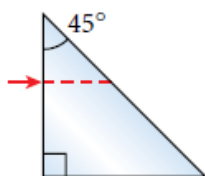


Figure 15-19

(See Sample Problem 15C.)



Figure 15-20

44. The image of the United States postage stamps in **Figure 15-20** is 1.50 times the size of the actual stamps in front of the lens. Determine the focal length of the lens if the distance from the lens to the stamps is 2.84 cm.
56. A fiber-optic cable used for telecommunications has an index of refraction of 1.53. For total internal reflection of light inside the cable, what is the minimum angle of incidence to the inside wall of the cable if the cable is in the following:
- air
 - water

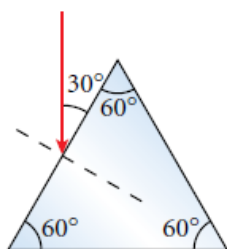


Figure 15-22

57. A ray of light traveling in air strikes the midpoint of one face of an equiangular glass prism ($n = 1.50$) at an angle of exactly 30° , as shown in **Figure 15-22**.
- Trace the path of the light ray through the glass and find the angle of incidence of the ray at the bottom of the prism.
 - Will the ray pass through the bottom surface of the prism or will it be totally internally reflected?