

Extra Problems

①

Remember: $c = \text{speed of light} = 3 \times 10^8 \text{ m/s}$

$$c = \lambda f$$

Energy of a photon = $E = hf$ where $h = 6.63 \times 10^{-34} \text{ J}\cdot\text{s}$

$n = \text{index of refraction}$ $n_1 \sin \theta_1 = n_2 \sin \theta_2$

$$\frac{1}{f} = \frac{1}{o} + \frac{1}{i} \quad \text{magnification } M = \frac{-i}{o}$$

① Calculate the energy of the following 3 photons.

a) Red $\lambda = 600 \text{ nm} = 6 \times 10^{-7} \text{ m}$

b) Green $\lambda = 514 \text{ nm}$

c) Purple $\lambda = 450 \text{ nm}$

② If the energy of a photon is $9.95 \times 10^{-16} \text{ J}$,

a) what is its frequency?

b) what is its wavelength?

c) what part of the spectrum does it come from?

Extra Problems

2

- 3 9. Suppose you want to use a converging lens to project the image of two trees onto a screen. One tree is a distance x from the lens, the other is at $2x$, as in Figure Q23.9. You adjust the screen, so that the near tree is in focus. If you now want to move the screen so that the far tree is in focus, do you move the screen toward, or away from, the lens?

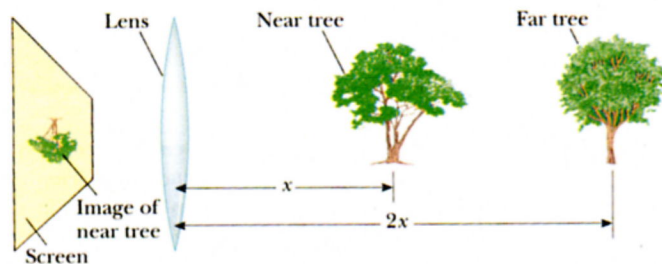
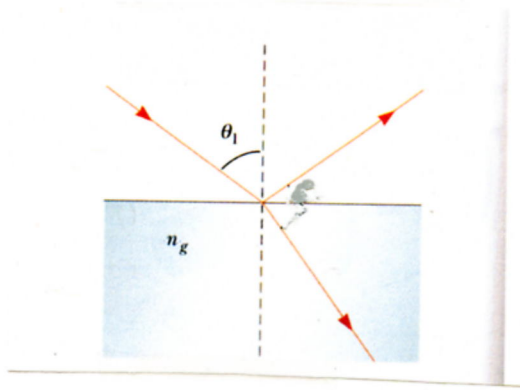


Figure Q23.9

- 4 30. A converging lens has a focal length of 20.0 cm. Locate the images for object distances of (a) 40.0 cm, (b) 20.0 cm, and (c) 10.0 cm. For each case, state whether the image is real or virtual and upright or inverted, and find the magnification.
- 5 32. A diverging lens has a focal length of 20.0 cm. Locate the images for object distances of (a) 40.0 cm, (b) 20.0 cm, and (c) 10.0 cm. For each case, state whether the image is real or virtual and upright or inverted, and find the magnification.
- 6 33. Where must an object be placed to have no magnification ($|M| = 1.00$) (a) for a converging lens of focal length 12.0 cm? (b) for a diverging lens of focal length 12.0 cm?
- 7 36. A slide projector is made by placing an illuminated slide slightly more than one focal length in front of a converging lens. If the lens has a 10.0-cm focal length and the object distance can be adjusted to any value between 10.2 cm and 11.0 cm, for what range of distances between projector and screen can a sharp image be obtained?

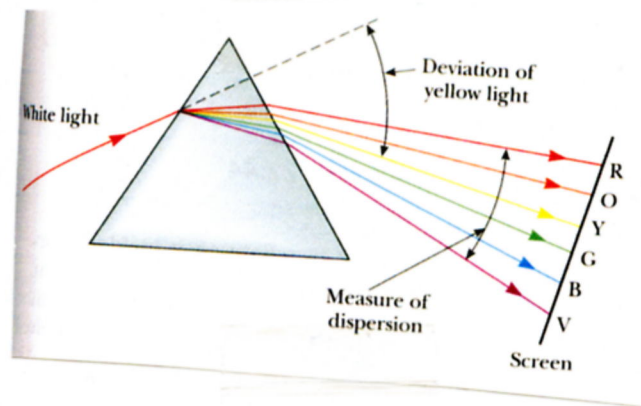
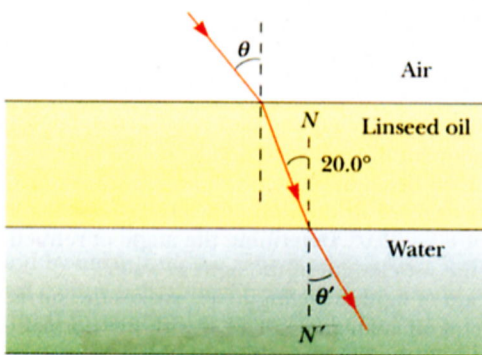
Extra Problems

(3)



8. In the picture above, a light ray strikes the blue surface at an angle of 27° . What is the reflected angle & what is the refracted angle if the blue substance is a) carbon disulfide ($n = 1.628$) or b) zircon ($n = 1.923$)

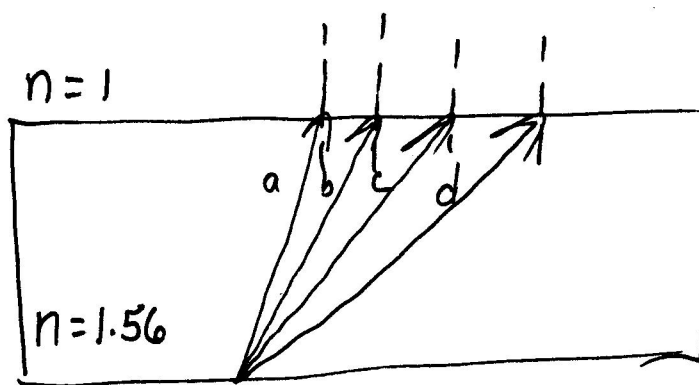
9. The light beam shown in Figure P22.18 makes an angle of 20.0° with the normal line NN' in the linseed oil. Determine the angles θ and θ' . (The refractive index for linseed oil is 1.48.)



10. Looking at the picture of the prism, what does it tell you about the index of refraction of glass for different wavelengths (colors) of light?

Extra Problems

4



11. For the 4 rays above, draw the exiting beam.

12. a) If ray a has an angle of 15 degrees, what is its exit angle?

b) Ray b has an angle of 30 degrees in the glass, what is the exit angle?

c) Ray c has an angle of 39.87° , what is its exit angle?

d) If Ray d has an angle of 45° , what will happen to it?