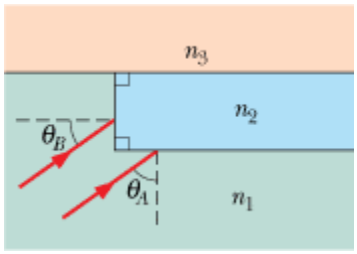
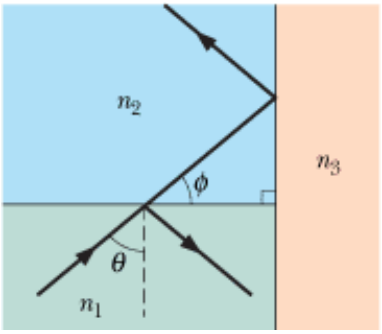
Homework: Ch. 25

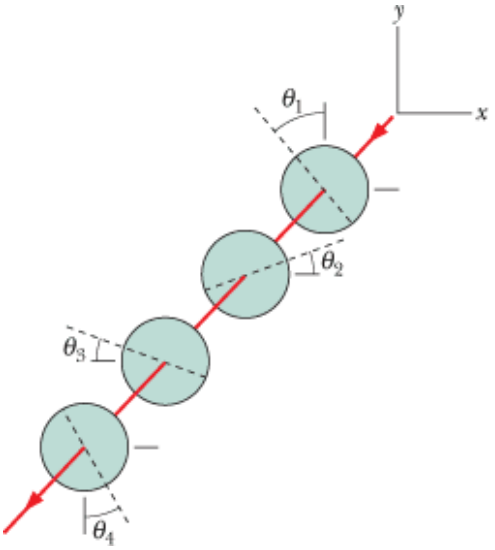
1. In the figure, light from ray *A* refracts from material 1 (n_1 = 1.60) into a thin layer of material 2 (n_2 = 1.30), crosses that layer, and is then incident at the critical angle on the interface between materials 2 and 3 (n_3 = 1.80). What is the value of incident angle θ_A?



2. In the ray diagram to the right, where the angles are not drawn to scale, the ray is incident at the critical angle on the interface between materials 2 and 3. Angle ϕ = 60.0°, and two of the indexes of refraction are n_1 = 1.70 and n_2 = 1.60. Find index of refraction n_3 and angle θ.



3. In the figure below, unpolarized light with an intensity of 25 W/m^2 is sent into a system of four polarizing sheets with polarizing directions at angles θ_1 = 40.0°, θ_2 = 20.0°, θ_3 = 20.0°, and θ_4 = 30.0°. What is the intensity of the light that emerges from the system?



4. During a test, a NATO surveillance radar system, operating at 12 GHz at 180 kW of power, attempts to detect an incoming stealth aircraft at 90 km. Assume that the radar beam is emitted uniformly over a hemisphere.
    a. What is the intensity of the beam when the beam reaches the aircraft's location?
    b. The aircraft reflects radar waves as though it has a cross-sectional area of only 0.22 m^2. What is the power of the aircraft's reflection? Assume that the beam is reflected uniformly over a hemisphere.
    c. Back at the radar site, what are the intensity, the maximum value of the electric field vector, and the rms value of the magnetic field of the reflected radar beam?

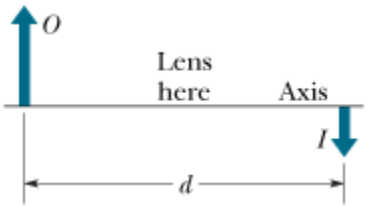
5. An object is at distance p = 3.00 m from a plane (flat) mirror. What are the image distance i and lateral magnification m? Is the image real or virtual, inverted or noninverted, on the same side of the mirror as the object or on the opposite side?

6. An object is on the central axis through a converging lens of focal distance f = 2.00 m. What are the image distance i and lateral magnification m if p = 6.00 m?

7. An object is at distance p = 6.00 m on the central axis through a spherical convex mirror of radius of curvature r = - 1.00 m. (Any convex mirror is given a negative radius of curvature so that the other parameters have the appropriate signs.) What are the image distance I and lateral magnification m?

8. A concave shaving mirror has a radius of curvature of 35.0 cm. It is positioned so that the (upright) image of a man's face is 2.50 times the size of the face. How far is the mirror from the face?

9. In the figure to the right, a real inverted image I of an object O is formed by a certain lens (not shown); the object-image separation is d = 40.0 cm, measured along the central axis of the lens. The image is just half the size of the object.



    a. What kind of lens must be used to produce this image?
    b. How far from the object must the lens be placed?
    c. What is the focal length of the lens?

10. Object O stands on the central axis of a thin symmetric lens. For this situation, each row in the table below refers to (a) the lens type, converging (C) or diverging (D), (b) the focal distance f, (c) the object distance p, (d) the image distance i, and (e) the lateral magnification m. (All distances are in centimeters.) It also refers to whether (f) the image is real (R) or virtual (V), (g) inverted (I) or noninverted (NI) from O, and (h) on the *same* side

of the lens as *O* or on the *opposite* side. Fill in the missing information, including the value of *m* when only an inequality is given. Where only a sign is missing, answer with the sign.

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Type	***f***	***p***	***i***	***m***	**R/V**	**I/NI**	**Side**
	+10	+5.0					
	20	+8.0		<1.0		NI	
		+16		+0.25			
		+16		-0.25			
		+10		-0.50			
C	10	+20					
	10	+5.0		<1.0			Same
	10	+5.0		>1.0			
		+16		+1.25			
		+10		0.50		NI	
	20	+8.0		>1.0			

11. Object *O* stands on the central axis of a spherical or plane mirror. For this situation, each row in the table below refers to (a) the type of mirror, (b) the focal distance *f*, (c) the radius of curvature *r*, (d) the object distance *p*, (e) the image distance *i*, and (f) the lateral magnification *m*. (All distances are in centimeters.) It also refers to whether (g) the image is real (R) or virtual (V), (h) inverted (I) or noninverted (NI) from *O*, and (i) on the *same* side of the mirror as object *O* or on the *opposite* side. Fill in the missing information. Where only a sign is missing, answer with the sign.

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
Type	***f***	***r***	***p***	***i***	***m***	**R/V**	**I/NI**	**Side**
Concave	20		+10					
			+24		0.50		I	
		-40		-10				
			+40		-0.70			
	+20		+30					
	20				+0.10			
	30				+0.20			
			+60		-0.50			
			+30		0.40		I	
	20		+60					Same
	-30			-15				
			+10		+1.0			
Convex		40		4.0				