Home Work 14

14-1 *More mirrors*. Object *O* stands on the central axis of a spherical or plane mirror. For this situation, each problem in the Tablerefers 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
17	Concave	20		+10					
18				+24		0.50		I	
22		20				+0.10			
23		30				+0.20			
29	Convex		40		4.0				

14-2 *Spherical refracting surfaces*. An object *O* stands on the central axis of a spherical refracting surface. For this situation, each problem in the Table refers to the index of refraction n_1 where the object is located, (a) the index of refraction n_2 on the other side of the refracting surface, (b) the object distance *p*, (c) the radius of curvature *r* of the surface, and (d) the image distance *i*. (All distances are in centimeters.) Fill in the missing information, including whether the image is (e) real (R) or virtual (V) and (f) on the *same* side of the surface as object *O* or on the *opposite* side.

		(a)	(b)	(c)	(d)	(e)	(f)
	n_1	n_2	*p*	*r*	*i*	R/V	Side
33	1.0	1.5	+10		-13		
34	1.5		+ 100	-30	+600		
35	1.5	1.0	+70	+30			
36	1.5	1.0		-30	-7.5		
37	1.5	1.0	+10		-6.0		

14-3 *Thin lenses*. Object *O* stands on the central axis of a thin symmetric lens. For this situation, each problem in the Table gives object distance p (centimeters), the type of lens (C stands for converging and D for diverging), and then the distance (centimeters, without proper sign) between a focal point and the lens. Find (a) the image distance i and (b) the lateral magnification m of the object, including signs. Also, determine whether the image is (c) real (R) or virtual (V), (d) inverted (I) from object *O* or noninverted (NI), and (e) on the *same* side of the lens as object *O* or on the *opposite* side.

			(a)	(b)	(c)	(d)	(e)
	p	Lens	i	m	R/V	I/NI	Side
53	+8.0	D, 12					
54	+10	D, 6.0					
55	+22	D, 14					
56	+12	D, 31					
57	+45	C, 20					

14-4 (a) A luminous point is moving at speed v_O toward a spherical mirror with radius of curvature r, along the central axis of the mirror. Show that the image of this point is moving at speed

$$v_1 = -\left(\frac{r}{2p - r}\right)^2 v_0,$$

where p is the distance of the luminous point from the mirror at any given time. Now assume the mirror is concave, with r = 15 cm, and let v_O = 5.0 cm/s. Find v_I when (b) p = 30 cm (far outside the focal point), (c) p = 8.0 cm (just outside the focal point), and (d) p = 10 mm (very near the mirror).

14-5 The formula $1/p + 1/i = 1/f$ is called the *Gaussian* form of the thin-lens formula. Another form of this formula, the *Newtonian* form, is obtained by considering the distance x from the object to the first focal point and the distance x' from the second focal point to the image. Show that $xx' = f^2$ is the Newtonian form of the thin-lens formula.