PHYSICS 242 BLOCK 12 DRILL SET, SPRING '17 SIDE 1 NAME ________________________

DO NOT HAND THIS DRILL SET IN.

For best results, work it out like an ordinary drill set. *After* you've done your best, turn it over to check it.

1.The radius of curvature of a convex spherical mirror has an absolute value of 10.2 cm. Find its focal length.

ONE EQUATION USED	SOLUTION	ANSWER

2. The focal length of a diverging thin lens has an absolute value of 25.4 cm. A virtual object is 76.2 cm from the lens. Find the image distance. From your answer, determine whether the image is real or virtual.

ONE EQUATION USED	SOLUTION	ANSWER
		Circle one below: Real Virtual

3. A real object placed 14.0 cm from a mirror produces a virtual image 35.7 cm from the mirror. Find the lateral magnification. Then use your answer to determine whether the image is erect or inverted and also whether it is reduced, enlarged, or the same size. (By the way, the answers are the same for a thin lens.)

EQUATION USED (*ONE* EQUAL SIGN)	SOLUTION	ANSWER
=		Circle two below: erect inverted reduced enlarged same size as object

4. A thin lens is in air. Its index of refraction is 1.54. The absolute value of radius of curvature of its concave left side is 27 cm. Its right side is flat. Use our sign conventions to find its focal length.

ONE EQUATION USED	SOLUTION	ANSWER

5. Use principal rays from a real object to locate and sketch the image arrow for a spherical mirror or a thin lens. Use solid lines for real rays and real image arrows. Use dashed lines for virtual rays and virtual image arrows.

1.The radius of curvature of a convex spherical mirror has an absolute value of 10.2 cm. Find its focal length.

ONE EQUATION USED	SOLUTION	ANSWER
$f = \frac{R}{2}$	Given: Convex spherical mirror, $\lvert R \rvert = 10.2$ cm Wanted: f Solution: Both R and f are negative for a *convex* spherical mirror, so $R = -10.2$ cm, giving $f = \frac{R}{2} = \frac{-10.2\text{ cm}}{2} = -5.1$ cm	$f = -5.1$ cm

2. The focal length of a diverging thin lens has an absolute value of 25.4 cm. A virtual object is 76.2 cm from the lens. Find the image distance. From your answer, determine whether the image is real or virtual.

ONE EQUATION USED	SOLUTION	ANSWER
$\frac{1}{s} + \frac{1}{s'} = \frac{1}{f}$	Given: Diverging thin lens, $\lvert f \rvert = 25.4$ cm, virtual object with $\lvert s \rvert = 76.2$ cm. Wanted: s', real or virtual image? Solution: *Diverging* lens, so f is negative, $f = -25.4$ cm. *Virtual* object, so s is negative, $s = -76.2$ cm. $\frac{1}{s'} = \frac{1}{f} - \frac{1}{s} = \frac{1}{-25.4\text{ cm}} - \frac{1}{-76.2\text{ cm}}$, giving $s' = -38.1$ cm Since s' is negative, the image is virtual.	$s' = -38.1$ cm Circle one below: Real CIRCLE Virtual

3. A real object placed 14.0 cm from a mirror produces a virtual image 35.7 cm from the mirror. Find the lateral magnification. Then use your answer to determine whether the image is erect or inverted and also whether it is reduced, enlarged, or the same size. (By the way, the answers are the same for a thin lens.)

EQUATION USED (*ONE* EQUAL SIGN)	SOLUTION	ANSWER
$m = -\frac{s'}{s}$	Given: A *real object*, so $s = +14.0$ cm, but a *virtual image*, so $s' = -35.7$ cm Wanted: m, character of image Solution: $m = -\frac{-35.7\text{ cm}}{+14.0\text{ cm}} = +2.55$ Since m is plus, the image is *erect*. CIRCLE erect. Since the absolute value of m (i.e., 2.55) is greater than one, the image is *enlarged*. CIRCLE enlarged.	$m = = +2.55$ Circle two below: erect inverted reduced enlarged same size as object

4. A thin lens is in air. Its index of refraction is 1.54. The absolute value of radius of curvature of its concave left side is 27 cm. Its right side is flat. Use our sign conventions to find its focal length.

ONE EQUATION USED	SOLUTION	ANSWER
$\frac{1}{f} = (n-1)(\frac{1}{R_1} - \frac{1}{R_2})$	Given: Thin lens in air, $n = 1.54$, $R_1 = -27$ cm, $R_2 = \infty$. [R_1 is negative because the center of curvature of the left side (the first side the light hits) is *not* where the light really goes after refracting through the lens and $R_2 = \infty$ because the right side (the second side the light hits) is flat.] Wanted: f Solution: $\frac{1}{f} = (1.54 - 1)(\frac{1}{-27\text{ cm}} - \frac{1}{\infty}) =$ $(0.54)(\frac{1}{-27\text{ cm}} - 0)$, so $f = \frac{-27\text{ cm}}{0.54} = -50$ cm.	$f = -50$ cm Check: You *should* draw a sketch of this lens. You'll then see it is thinnest at its center and is therefore a *diverging* lens and thus has a negative f.

5. Use principal rays from a real object to locate and sketch the image arrow for a spherical mirror or a thin lens. Use solid lines for real rays and real image arrows. Use dashed lines for virtual rays and virtual image arrows.

You should be able to reproduce textbook Figures 34.19b, 34.19a (along with different $s > f$ object positions such as in 34.20a and 34.20b), and 34.20d for spherical mirrors; as well as Figures 34.36b, 34.36a (along with different $s > f$ object positions such as in 34.37a, 34.37b, and 34.37c), and 34.37e.

Don't worry about Figure 34.37f, as it is for a *virtual* object, not a *real* object. Also, don't worry about Figures 34.20c and 34.37d for which $s = f$, thus $s' = \infty$. That is, you cannot draw their image arrows because they are at an infinite distance away (and have infinite $\lvert$height$\rvert$).