

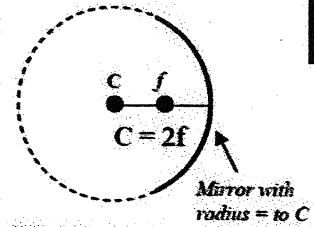
Name: _____
 Period: _____

Ray Diagrams

Ray diagrams are a way to visualize how mirrors and lenses work. If drawn precisely and to scale (with a ruler), a ray diagram can tell you exactly where the image is, whether it is real or virtual, and its size.

Radius of Curvature

A spherical mirror or lens is a portion of large sphere that has a radius of C . C is always equal to $2f$.



Ray 1

Ray 1 is horizontal and goes from the top of the object to the device. From the device it is drawn to the real focal point if convergent or from the virtual focal point if divergent.

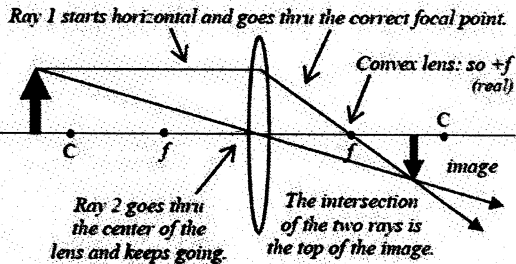
Ray 2

Ray 2 starts at the top of the object and goes to the center of the device. Ray 2 continues thru a lens or reflects back from a mirror.

The Image

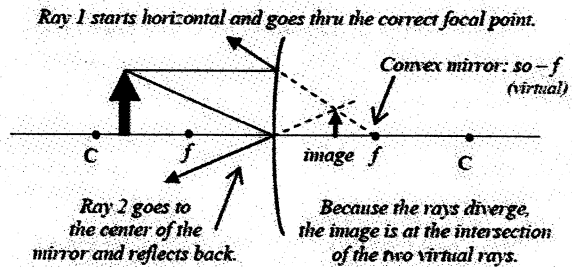
If the rays converge, the top of the image is where rays 1 and 2 cross. If the rays diverge, draw them backwards (virtually). The virtual intersection is where the top of the image SEEMS to be.

Convex Lens (convergent)



If the object is outside C ($2f$) in front of a convex lens, then the image is real, reduced, and located between f and C .

Convex Mirror (divergent)



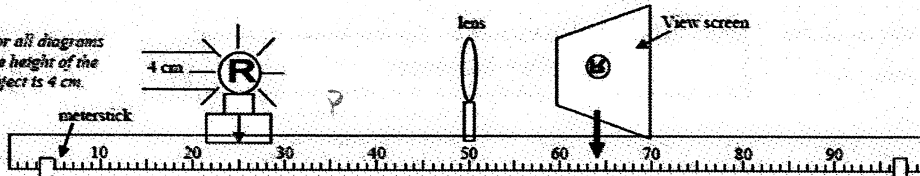
If the object is between f and C in front of a convex mirror, then the image is virtual, reduced, and located inside f .

For all of the following diagrams: 1) label f and C on both sides of the device; 2) circle the correct focal point; 3) draw the ray diagram using the above rules.

Hand-drawn ray diagrams for various optical devices:

- Convex Lens:** Two diagrams showing object placement at different distances relative to focal points (F) and center of curvature (C). The first shows a real, inverted image. The second shows a virtual, upright image.
- Convex Mirror:** One diagram showing a virtual, upright, and reduced image behind the mirror.
- Concave Lens:** One diagram showing a virtual, upright, and reduced image on the same side as the object.
- Concave Mirror:** One diagram showing a real, inverted image in front of the mirror.

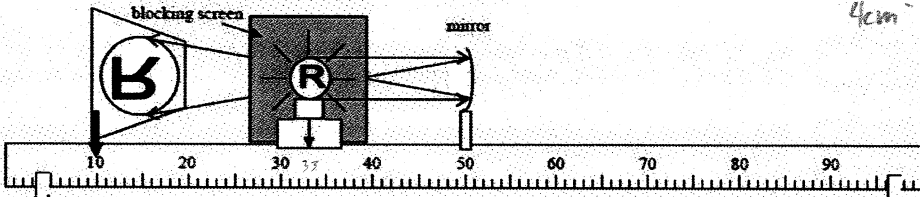
For all diagrams the height of the object is 4 cm.



1. A. Convex or concave? B. Real or virtual image? C. $p = 25\text{cm}$ D. $q = 50\text{cm}$ E. $h' =$

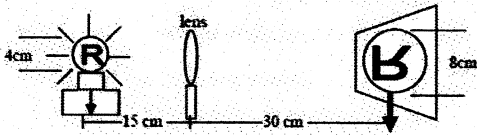
$$\frac{h'}{4\text{cm}} = \frac{25\text{cm}}{25\text{cm}} = 1$$

$$h' = -2.24\text{cm}$$



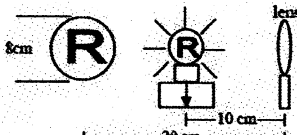
2. A. Concave or convex? B. Real or virtual? C. $p = 17\text{cm}$ D. $q = 40\text{cm}$ E. $h' =$

$$\frac{h'}{4\text{cm}} = \frac{17\text{cm}}{40\text{cm}} = -9.4\text{cm}$$



3. A. What kind of device? Convex
 B. Convergent or divergent?
 C. Which side is real? R
 D. $p = 15\text{cm}$
 E. $q = 30\text{cm}$
 F. $h = 8\text{cm}$
 G. $h' = 4\text{cm}$
 H. real or virtual image?

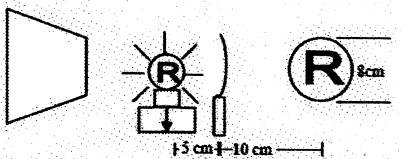
$$I.M = \frac{h'}{h} = \frac{8\text{cm}}{4\text{cm}} = 2$$



4. A. What kind of device? Convex
 B. Convergent or divergent?
 C. Which side is real? R
 D. $p = 10\text{cm}$
 E. $q = 20\text{cm}$
 F. $h = 8\text{cm}$
 G. $h' = 4\text{cm}$
 H. real or virtual image?

$$M = \frac{h'}{h} = \frac{4\text{cm}}{8\text{cm}} = 0.5$$

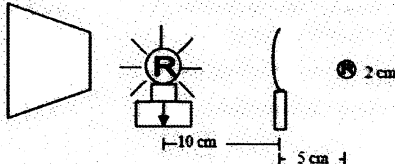
$$I.M = \frac{p}{q} = \frac{10\text{cm}}{20\text{cm}} = 0.5$$



5. A. What kind of device? Convex
 B. Convergent or divergent?
 C. Which side is real? L
 D. $p = 15\text{cm}$
 E. $q = 10\text{cm}$
 F. $h = 8\text{cm}$
 G. $h' = 4\text{cm}$
 H. real or virtual image?

$$I.M = \frac{p}{q} = \frac{15\text{cm}}{10\text{cm}} = 1.5$$

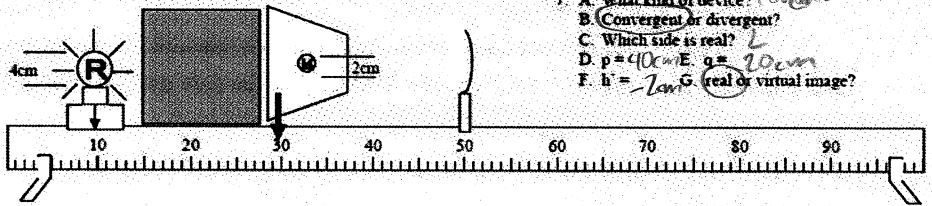
$$h' = \frac{h}{M} = \frac{8\text{cm}}{2} = 4\text{cm}$$



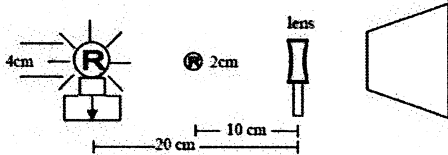
6. A. What kind of device? Convex
 B. Convergent or divergent?
 C. Which side is real? L
 D. $p = 10\text{cm}$
 E. $q = 5\text{cm}$
 F. $h = 4\text{cm}$
 G. $h' = 2\text{cm}$
 H. real or virtual image?

$$I.M = \frac{h'}{h} = \frac{2\text{cm}}{4\text{cm}} = 0.5$$

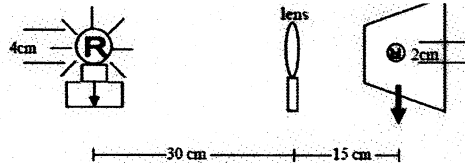
$$h' = \frac{h}{M} = \frac{4\text{cm}}{1} = 4\text{cm}$$



7. A. What kind of device? Convex
 B. Convergent or divergent?
 C. Which side is real? R
 D. $p = 10\text{cm}$ E. $q = 30\text{cm}$
 F. $h = 4\text{cm}$ G. $h' = 2\text{cm}$
 H. real or virtual image?



8. A. What kind of device? Convex
 B. Convergent or divergent?
 C. Which side is real? R
 D. $p = 10\text{cm}$
 E. $q = 20\text{cm}$
 F. $h = 4\text{cm}$
 G. $h' = 2\text{cm}$
 H. real or virtual image?



9. A. What kind of device? Convex
 B. Convergent or divergent?
 C. Which side is real? R
 D. $p = 30\text{cm}$
 E. $q = 15\text{cm}$
 F. $h = 4\text{cm}$
 G. $h' = 2\text{cm}$
 H. real or virtual image?

Use what you learned from the diagrams above to answer the following:

10. + or -?

- A. - h' for a real image.
 B. - q for a virtual image.
 C. + p for a real image.
 D. + q if on the left side of a mirror.
 E. + h if on the left side of a lens.
 F. + h' if on the right side of a mirror.
 G. + q for a real image.
 H. + h' for a virtual image.
 I. - q if on the right side of a mirror.
 J. - q if on the left side of a lens.
 K. - M if a real image.
 L. + M if a virtual image.

11. A mirror produces a real image.

- A. Which side is the image on? L
 B. Is q + or -?
 C. Is it upright or inverted?
 D. Is h' + or -?

12. A lens produces a real image.

- A. Which side is the image on? R
 B. Is q + or -?
 C. Is it upright or inverted?
 D. Is h' + or -?