

Name: _____

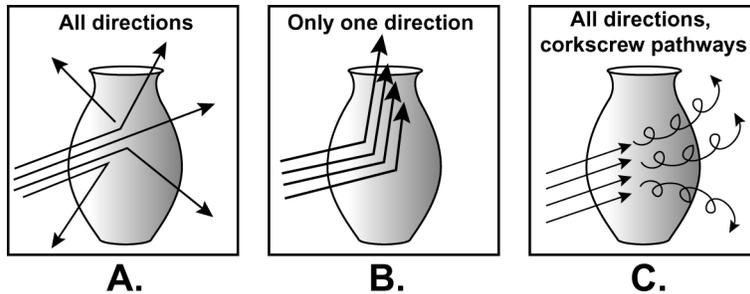
Skill Sheet 17.2

Ray Diagrams

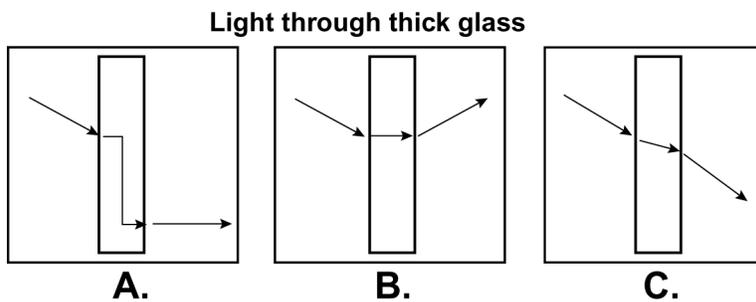
Here you will get practice in making ray diagrams. A ray diagram helps you determine where an image produced by a lens will form and whether the image will be upside down or right side up. For each question on this skill sheet, read the directions carefully and plot your ray diagram in the space provided.

1. Getting started

1. Of the diagrams below, which one correctly illustrates how light rays come off an object? Explain your answer.

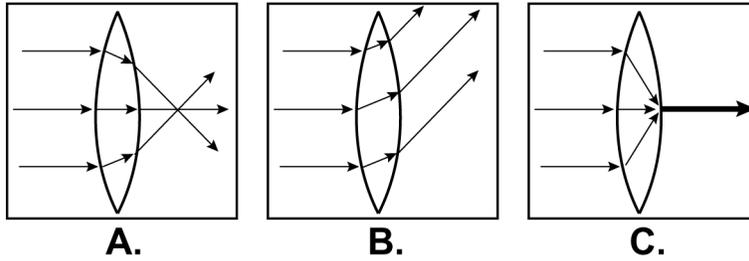


2. Of the diagrams below, which one correctly illustrates how a light ray enters and exits a piece of thick glass? Explain your answer.



3. In your own words, explain what happens to light as it enters glass from the air. Why does this happen? Use the terms *refraction* and *index of refraction* in your answer.

4. Of the diagrams below, which one correctly illustrates how parallel light rays enter and exit a converging lens? Explain your answer.



5. Draw a diagram of a converging lens that has a focal point of 10 centimeters. In your diagram, show three parallel lines entering the lens and exiting the lens. Show the light rays passing through the focal point of the lens. Be detailed in your diagram and provide labels.

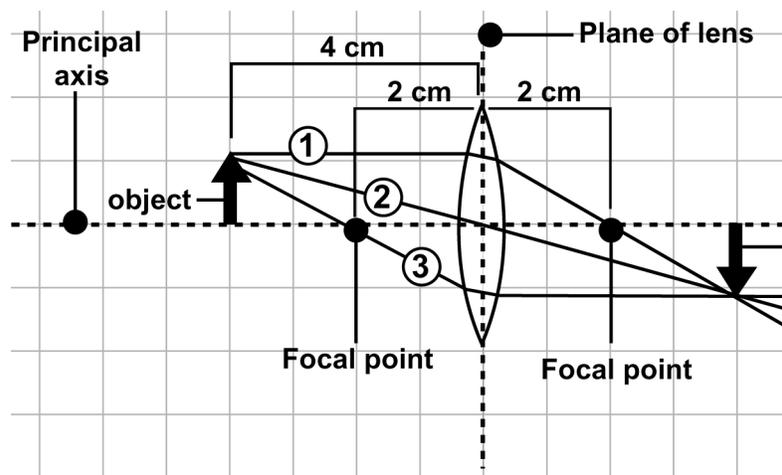
2. How to draw ray diagrams

A ray diagram helps you see where the image produced by a lens appears. The components of the diagram include the lens, the principal axis, the focal point, the object, and three lines drawn from the tip of the object and through the lens. These light rays meet at a point and intersect on the other side of the lens. Where the light rays meet indicates where the image of the object appears.

Example: A lens has a focal length of 2 centimeters. An object is placed 4 centimeters to the left of the lens. Follow the steps to make a ray diagram using this information. Trace the rays and predict where the image will form.

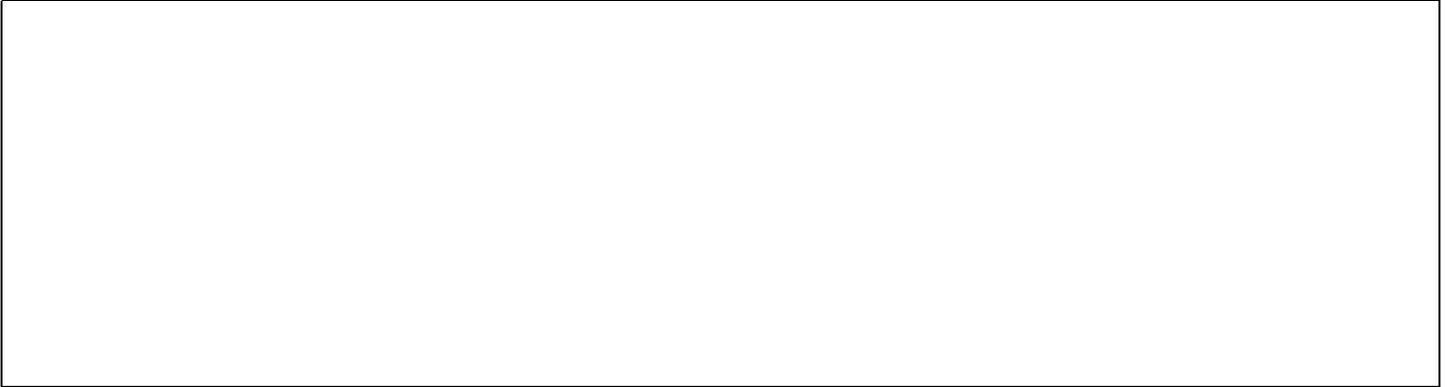
Steps:

- Draw a lens and show the principal axis.
- Draw a line that shows the plane of the lens.
- Make a dot at the focal point of the lens on the right and left sides of the lens.
- Place an arrow (pointing upward and perpendicular to the principle axis) at 4 centimeters on the left side of the lens.
- **Line 1:** Draw a line from the tip of the arrow that is parallel to the principal axis on the left, and that goes through the focal point on the right of the lens.
- **Line 2:** Draw a line from the tip of the arrow that goes through the center of the lens (where the plane and the principal axis cross).
- **Line 3:** Draw a line from the tip of the arrow that goes through the focal point on the left side of the lens, through the lens, and parallel to the principal axis on the right side of the lens.
- Lines 1, 2, and 3 converge on the right side of the lens where the tip of the image of the arrow appears.
- The image is upside down compared with the object.

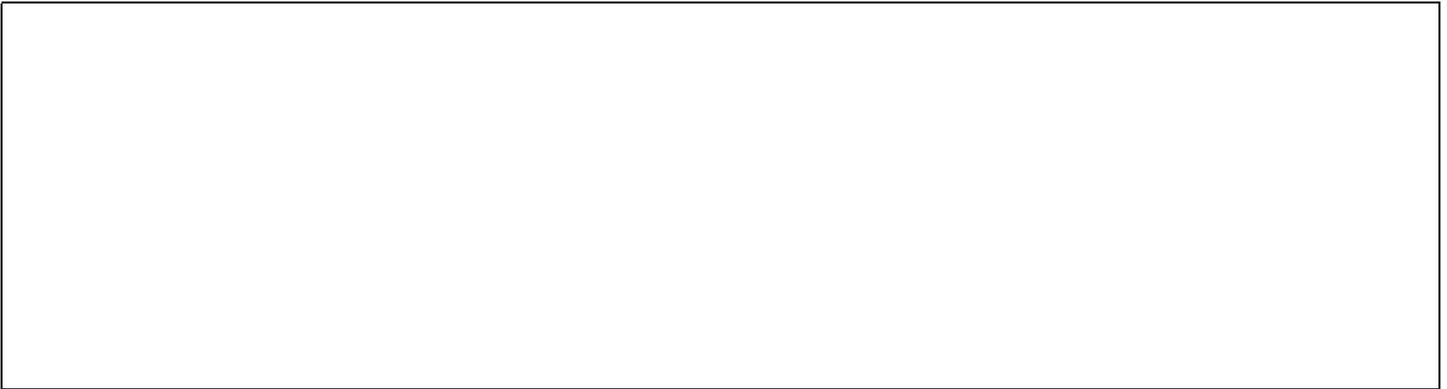


3. Drawing ray diagrams

1. A lens has a focal length of 4 centimeters. An object is placed 8 centimeters to the left of the lens. Trace the rays and predict where the image will form. Is the image bigger, smaller, or inverted as compared with the object?



2. **Challenge question:** An arrow is placed at 3 centimeters to the left of a converging lens. The image appears at 3 centimeters to the right of the lens. What is the focal length of this lens? (HINT: Place a dot to the right of the lens where the image of the tip of the arrow will appear. You will only be able to draw lines 1 and 2. Where does line 1 cross the principal axis if the image appears at 3 centimeters?)



3. What happens when an object is placed at a distance from the lens that is less than the focal length? Use the term *virtual image* in your answer.
