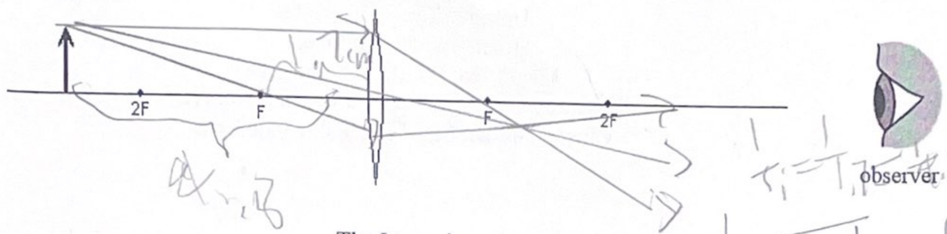
Ray Optics

Ray Tracing Worksheet - Lenses

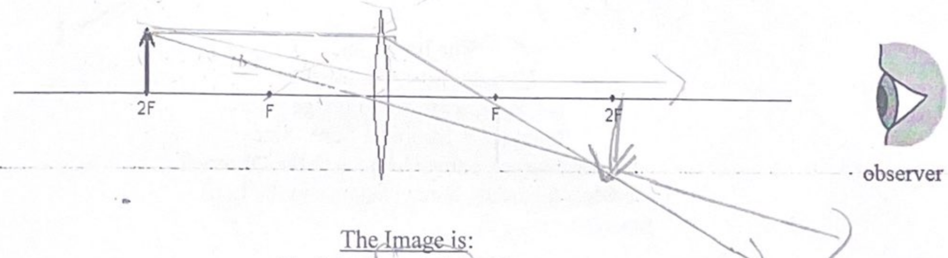
Name: Junyuxu

Date: 03/08/2023 Period: 2

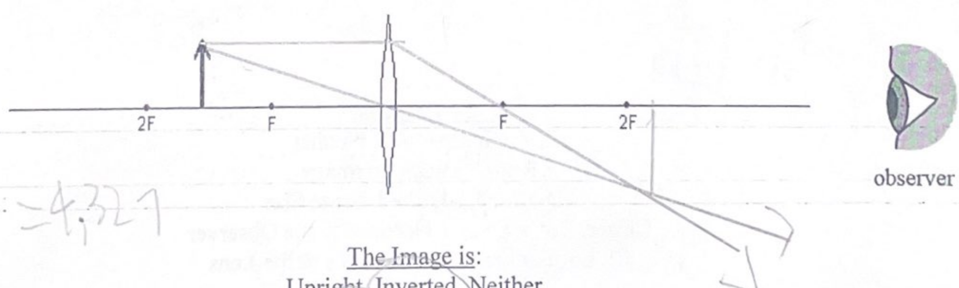
Convex Lenses



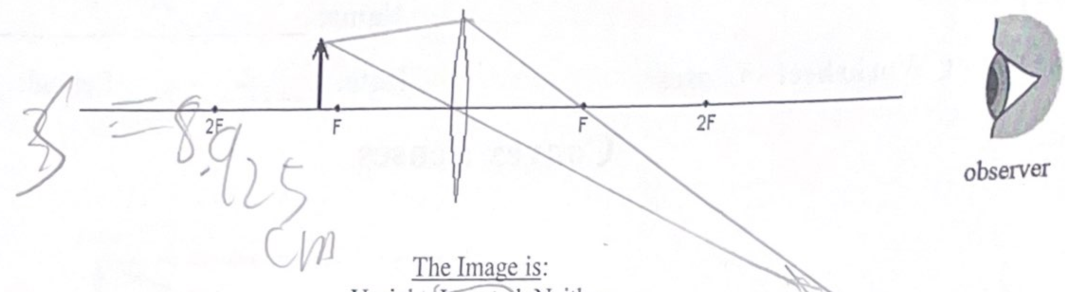
The Image is:
Upright, Inverted, Neither
Real, Virtual, No Image
Magnified, Minified, Same Size
Closer, Farther, Same Distance to the Observer
Closer, Farther, Same Distance to the Lens



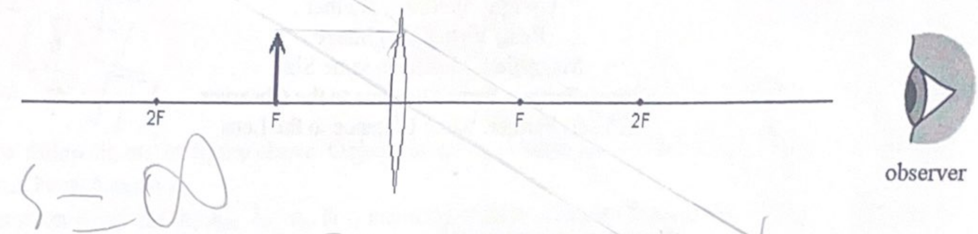
The Image is:
Upright, Inverted, Neither
Real, Virtual, No Image
Magnified, Minified, Same Size
Closer, Farther, Same Distance to the Observer
Closer, Farther, Same Distance to the Lens



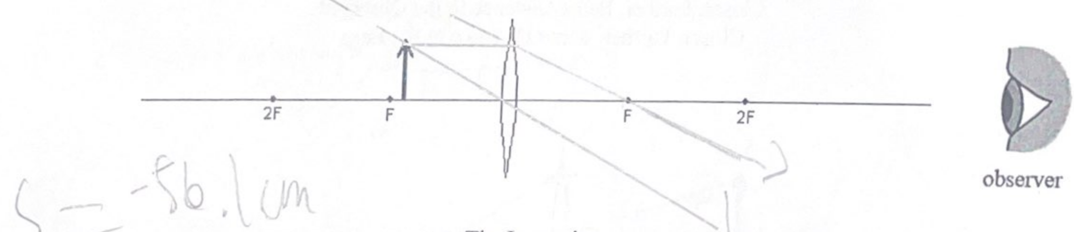
The Image is:
Upright, Inverted, Neither
Real, Virtual, No Image
Magnified, Minified, Same Size
Closer, Farther, Same Distance to the Observer
Closer, Farther, Same Distance to the Lens



The Image is:
Upright, Inverted, Neither
Real, Virtual, No Image
Magnified, Minified, Same Size
Closer, Farther, Same Distance to the Observer
Closer, Farther, Same Distance to the Lens

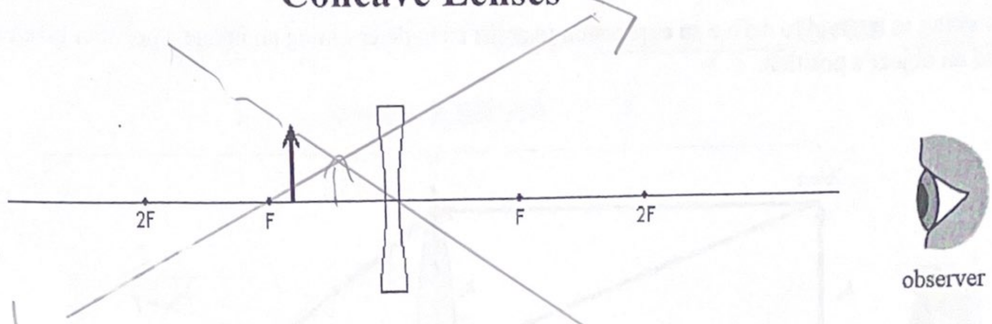


The Image is:
Upright, Inverted, Neither
Real, Virtual, No Image
Magnified, Minified, Same Size
Closer, Farther, Same Distance to the Observer
Closer, Farther, Same Distance to the Lens



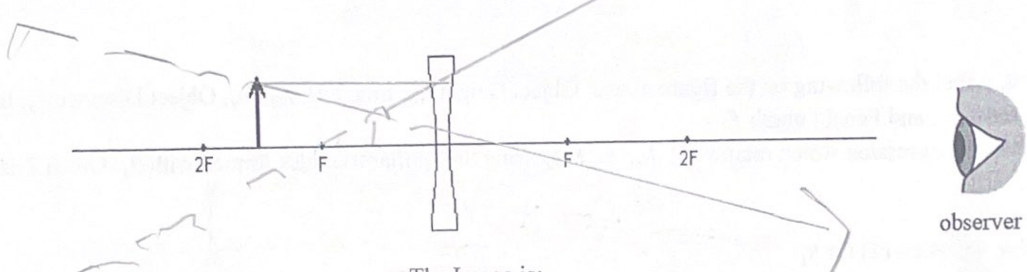
The Image is:
Upright, Inverted, Neither
Real, Virtual, No Image
Magnified, Minified, Same Size
Closer, Farther, Same Distance to the Observer
Closer, Farther, Same Distance to the Lens

Concave Lenses

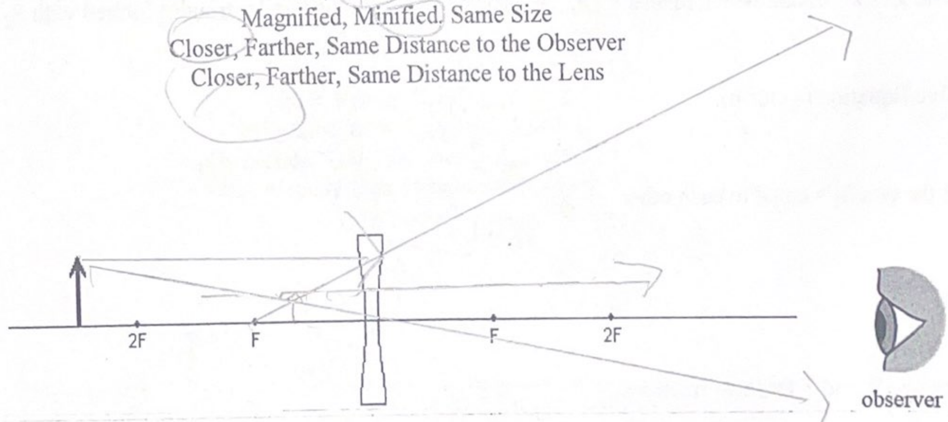


S=-12.75

The Image is:
Upright, Inverted, Neither
Real, Virtual, No Image
Magnified, Minified, Same Size
Closer, Farther, Same Distance to the Observer
Closer, Farther, Same Distance to the Lens



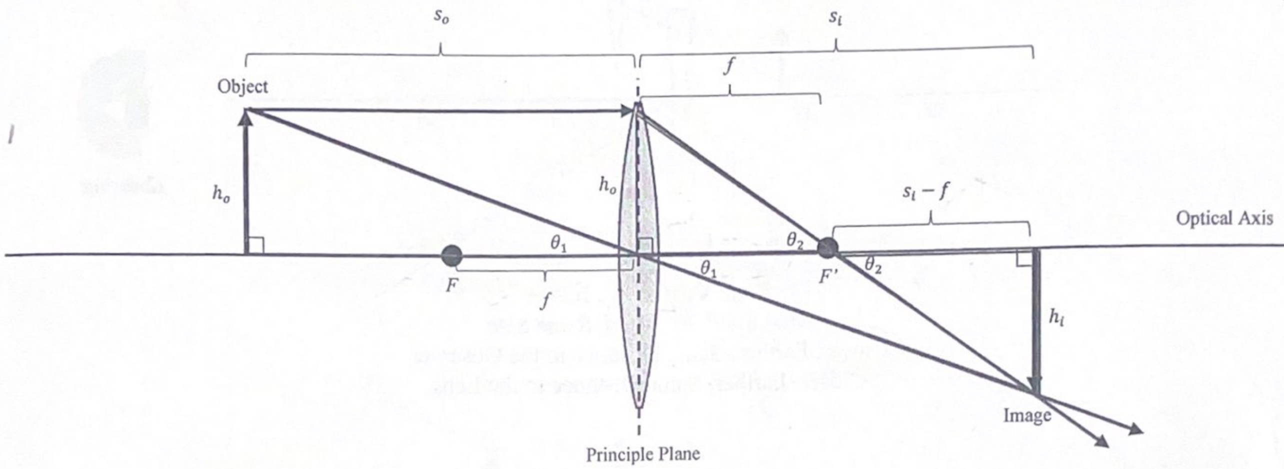
The Image is:
Upright, Inverted, Neither
Real, Virtual, No Image
Magnified, Minified, Same Size
Closer, Farther, Same Distance to the Observer
Closer, Farther, Same Distance to the Lens



The Image is:
Upright, Inverted, Neither
Real, Virtual, No Image
Magnified, Minified, Same Size
Closer, Farther, Same Distance to the Observer
Closer, Farther, Same Distance to the Lens

The Thin Lens Equation

We are going to attempt to derive an expression to assist us in determining an image's position given the focal length of a lens and an object's position.



1. First, Label the following on the figure above: Object Height h_o, Image Height h_i, Object Distance s_o, Image Distance s_i, and Focal Length f.
2. Write an Expression which relates h_o, h_i, s_o, & s_i using the similar triangles formed with θ_1. Green Triangles

   $\frac{h_o}{s_o} = \frac{h_i}{s_i}$ $\quad s_i h_o = s_o h_i$

3. Solve Equation (2) for h_i.

   $h_i = \frac{s_i h_o}{s_o}$

4. Write an Expression which relates f, h_o, h_i, & $(s_i - f)$ using the similar triagles formed with θ_2. Blue Triangles
5. Solve Equation (4) for h_i.

   $\frac{h_o}{f} = \frac{h_i}{(s_i - f)}$

   $h_i = \frac{h_o(s_i - f)}{f}$

6. Set the two h_i's equal to each other

   $\frac{s_i h_o}{s_o} = \frac{h_o(s_i - f)}{f}$

7. Cancel h_o

   $\frac{s_i}{s_o} = \frac{s_i - f}{f}$

8. Separate s_i and f into two fractions.

   $\frac{s_i}{s_o} = \frac{s_i}{f} - \frac{f}{f}$ $\quad \frac{s_i}{h_o} = \frac{s_i}{f} - 1$

9. Divide both sides by s_i

   $\frac{s_i}{s_o s_i} = \frac{s_i}{f s_i} - \frac{1}{s_i}$

10. Isolate $\frac{1}{f}$

   $\frac{1}{f} = \frac{1}{s_o} + \frac{1}{s_i}$ $\quad \frac{1}{s_o} = \frac{1}{f} - \frac{1}{s_i}$