

Reflection, refraction and images from mirrors and lenses

AP Physics 2 (algebra-based) · Lab answers

The sample readings give $1/d_o + 1/d_i$ nearly constant at about 6.66 m^{-1} , which means f is close to 15.0 cm. The answers below show the calculation and discuss the main sources of error.

Level: AP Physics 2 (algebra-based) · **Curriculum:** AP P2 Unit 13

Question 1 One value of f

$1/f = 1/d_o + 1/d_i = 4.00 + 2.67 = 6.67 \text{ m}^{-1}$, so $f = 1 / 6.67 = \mathbf{15.0 \text{ cm}}$.

Question 2 Mean focal length

The five sums are 6.67, 6.64, 6.70, 6.65 and 6.65 m^{-1} (values are constant within the reading error). Their mean is 6.66 m^{-1} , so $f = 1 / 6.66 = \mathbf{15.0 \text{ cm}}$.

Question 3 Graph

From $1/d_i = -1/d_o + 1/f$, the graph is a **straight line with gradient -1** . The y-intercept equals $1/f$, about 6.7 m^{-1} .

Question 4 Magnification

$m = -d_i/d_o = -37.4 / 25.0 = \mathbf{-1.50}$: the image is real, inverted and 1.5 times larger.

Question 5 Uncertainty

$1.0 / 37.4 = \mathbf{2.7 \%}$. The uncertainty arises because the image stays acceptably sharp over a small range of screen positions (depth of focus).

Question 6 Minimum object distance

If $d_o < f$, then $1/d_i = 1/f - 1/d_o$ is negative, so d_i is negative. The rays diverge and the image is **virtual**, so it cannot appear on a screen.

Question 7 Improvements

Find the sharpest image by moving the screen from both sides and take the mean position.

Use a more distant object and repeat for more pairs of distances. A bigger set of data lowers the random error in **f**.