Examples

converging

A convex lens has a focal length of 12 cm. How far from the lens should an object be to produce a real image 4 times larger than the object?

$d_o = ?$

$M = -4$

real image

$f = 12\text{cm}$

$12 < d_o < 24$ *

$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$

$M = \frac{-d_i}{d_o}$

$-4 = \frac{-d_i}{d_o}$ * solve for d_i

$-4d_o = -d_i$

$4d_o = d_i$ * Sub into lens eq.

$\frac{1}{d_o} + \frac{1}{4d_o} = \frac{1}{12}$ $\quad \times 4$

$\frac{4}{4d_o} + \frac{1}{4d_o} = \frac{1}{12}$

$\frac{5}{4d_o} = \frac{1}{12}$

$(5)(12) = 4d_o$

$60 = 4d_o$

$15\text{cm} = d_o$

A convex lens has a focal length of 8.0 cm and is used as a magnifying glass. How far from the lens should an object be to produce a virtual image 3 times larger than the object?

$d_o = ?$

$0 < d_o < 8$

$f = 8\text{cm}$

$M = +3$

virtual

$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{8}$

$M = \frac{-d_i}{d_o}$

$+3 = \frac{-d_i}{d_o}$

$3d_o = -d_i$

$-3d_o = d_i$

$\frac{1}{d_o} + \left(\frac{1}{-3d_o}\right) = \frac{1}{8}$

$\frac{1}{d_o} \times 3 - \frac{1}{3d_o} = \frac{1}{8}$

$\frac{3}{3d_o} - \frac{1}{3d_o} = \frac{1}{8}$

$\frac{2}{3d_o} = \frac{1}{8} \rightarrow 16 = 3d_o$

$5.3\text{cm} = d_o$