Question

A point-like object is placed at a distance of $1m$ in front of a convex lens of focal length $0.5m$. A plane mirror is placed at a distance of $2m$ behind the lens. The position and nature of the final image formed by the system is

A 2.6m from the mirror, real

B 1m from the mirror, real

C 2.6m from the mirror, virtual

D 1m from the mirror, virtual

Solution

Correct option is A)

For first reflection at convex lens

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\Rightarrow \frac{1}{+0.5} = \frac{1}{v} - \frac{1}{-1}$

$\Rightarrow \frac{1}{v} = 2 - 1$

$\Rightarrow c = -1m.$

Real image is formed at $1m$ from the lens.
This image acts as an object for the plane mirror after reflection, it's image is formed at $1m$ behind the plane mirror at I'
The image at I' is the virtual object for the convex lens.
So, $\mu = -3m$ for I'
$f = +0.5m$ for I'
For second refraction at convex lens.

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\Rightarrow \frac{1}{0.5} = \frac{1}{v} - \frac{1}{-3}$

$\Rightarrow 2 - \frac{1}{3} = \frac{1}{v}$

$\Rightarrow \frac{5}{3} = \frac{1}{v}$

$\Rightarrow v = +\frac{3}{5}$

For $v = \frac{3}{5} = 0.6$ (towards left of lens).

So distance from mirror $\Rightarrow 2 + 0.6 = 2.6m$ (real image)