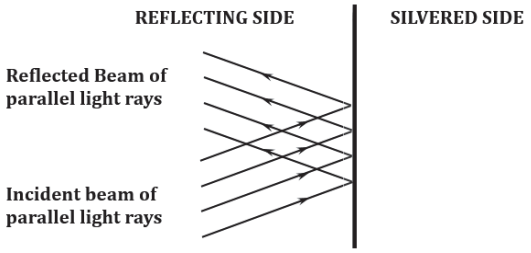
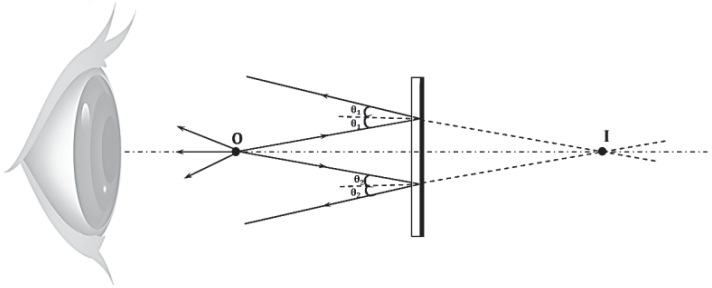
FIELD OF VIEW

Reflection In Plane Mirror

Silvering of thin glass plate on one side.

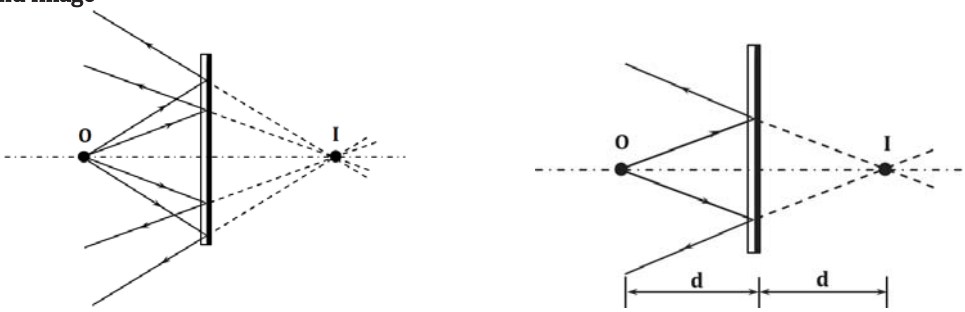


Formation of Image on the Eye



- All rays emanating from the object seem to converge at point (O').
- The image is formed at O'
- For a plane mirror
- Distance of object from mirror = Distance of image from mirror

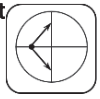
Object and Image



Image

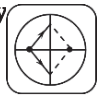
The image is formed at the point where the reflected rays intersect.

Object



The object is located at the point where the incident rays intersect.

Normality



The plane mirror serves as the perpendicular bisector of the line connecting the object point and the image point.

The image is created by an infinite number of incident rays.
The perpendicular distance of an object from the mirror is equal to the perpendicular distance of the image from the mirror.

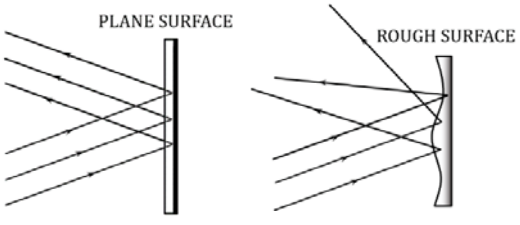
Types of Reflection

Regular Reflection

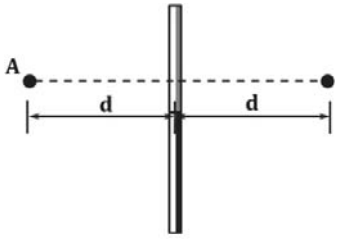
1. Reflected light rays travel in the same direction.
2. In regular reflection, a clear image is produced.

Diffused Reflection

1. Reflected light rays diverge in various directions.
2. Diffused reflection does not result in the formation of a clear image.

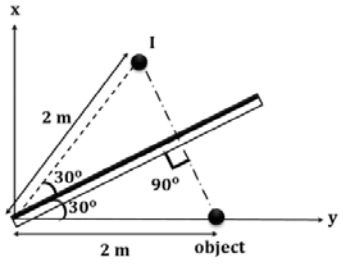


How To Locate Image In Plane Mirror



- The image that is formed does not depend on the length of mirror.
- When we don't find a mirror during a perpendicular drop, we extend this.
- Image show or not depends on the length of the mirror.
- Draw a perpendicular line to the mirror.
- Extend it behind the mirror.
- To precisely locate the image, employ the following concept.
- The perpendicular distance of the object from the mirror equals the perpendicular distance of the image from the mirror.

Ex. A plain mirror is inclined at 30° from the horizontal as shown, an object is placed on x – axis at a distance of 2, from the origin. Find the coordinates of the image formed.

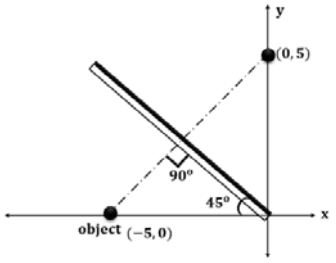


Sol. At first, drop a perpendicular on the mirror from the object and then extend it in such a way that the mirror becomes the perpendicular bisector of the line joining the image (I) and object (O), as shown in the figure.

Since △ ABO and △ ABI are congruent, and AO = 2m therefore, AI = 2 m

$$(x, y) = (1, \sqrt{3})$$

Ex. A plane mirror is inclined at 45o from the horizontal as shown, and an object is placed at (−5, 0). Find the coordinates of the image formed.

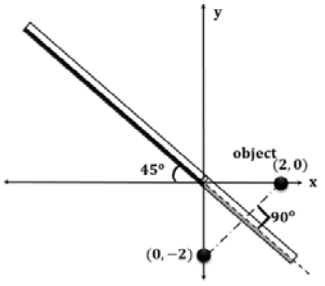


Sol. When the object is placed at one of the axes and the mirror is at an angle 45∘ then the image is formed on the other axis.

Therefore, coordinate of the image is given by,

$$(x, y) = (0,5)$$

Ex. A plain mirror is inclined at 45° from the horizontal as shown, and an object is placed at (2, 0). Find the coordinates of the image formed.



Sol. When the object is placed at one of the axes and the mirror is at an angle 45° then the image is formed on the other axis.

Extend the mirror, as shown.

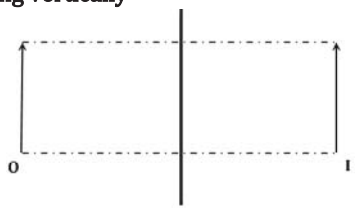
Drop a perpendicular to the extended mirror and extend the perpendicular up to −ve y-axis.

Therefore, the coordinate of the image is given by,

$$(x, y) = (0, -2)$$

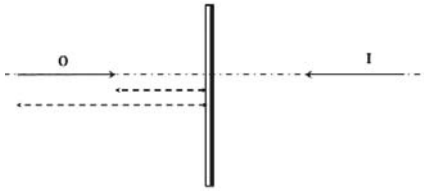
Extended Object

Lying vertically



The image of an elongated object can be illustrated by depicting the images of its outermost points and then connecting them.

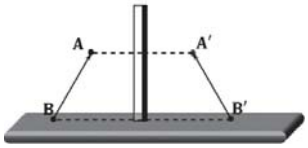
Lying horizontally



As the plane mirror acts as a perpendicular bisector of the line connecting the object and its image, the point (B) of the object, which is near the mirror, will create its image (B') in close proximity to the mirror.

Ex. Draw the image of a line object *AB* when kept in front of a plane mirror as shown.

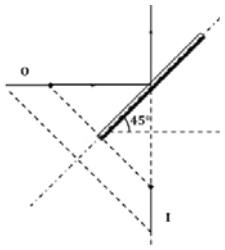
Sol. To locate the image exactly, use the following concept: Perpendicular distance of the object from the mirror is equal to the perpendicular distance of the image from the mirror



Inclined Mirror

Horizontal object

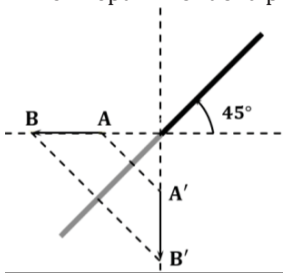
Steps to draw image:
Extend the mirror.
Draw perpendiculars from point A to B.
Since the mirror is positioned at a 45-degree angle, the perpendicular lines will intersect at the vertical axis, representing the images of the corresponding points A and B.
Join A'B' and this is the image.



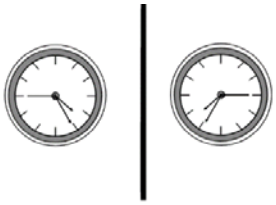
Note: When the mirror is tilted at a 45° angle, a horizontal object appears vertical, and conversely, a vertical object appears horizontal.

Ex. Draw the image of a line object *AB* when kept in front of a plane mirror inclined at 45° as shown.

Sol.



Ex. What time will the mirror image of a clock show when the actual time in the clock is 4:25:45?



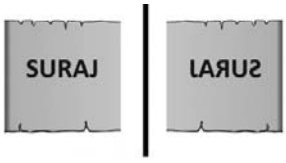
Sol. For solving this type of problem:
We have to subtract the actual time from 12 : 00 : 00.
The time on the mirror image will be,

$$\begin{array}{r} 12:00:00 \\ \underline{-04:25:45} \\ 07:34:15 \end{array}$$

$$T = 7:34:15$$

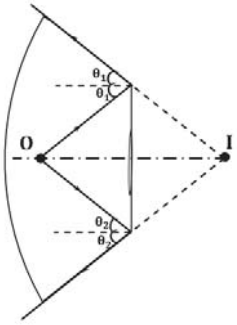
Ex. How will the mirror image of word "SURAJ" look?

Sol. Draw the figure (Or write the name) given on blank transparent paper and see the drawn picture from opposite side of the paper. That will be the mirror image.



Field Of View In Plane Mirror.

The field of view of a plane mirror refers to the area within which the observer can see the image formed on the mirror's surface.
The shaded region in the figure is the field of view



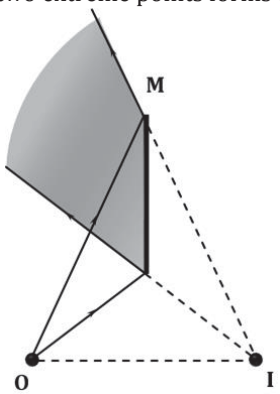
Ex. What will be the field of view for the point object *O* shown in the following diagram?

Sol. Steps to find field of view:

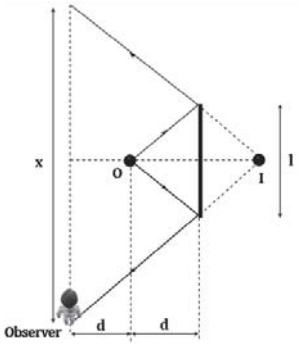
Locate the image.

Draw rays passing from the extreme points A to B.

The reflected ray from those two extreme points forms the field of view.



Ex. Find the length of the path for which the observer moving as shown could view the image formed by object O.



Sol. Draw the ray diagram to find the image

$\triangle$ ACE and $\triangle$ BCD are similar triangle.

In $\triangle$ ACE and $\triangle$ BCD,

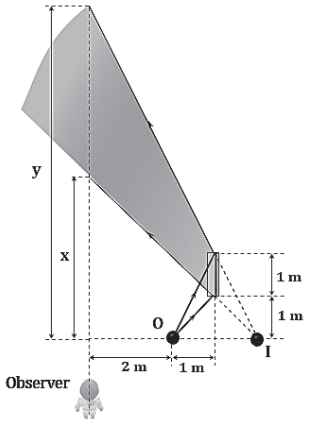
$$\frac{l/2}{d} = \frac{x}{3d}$$

$$x = \frac{3l}{2}$$

$$2x = 3l$$

Length of the path is 3l.

Ex. Consider the following arrangement and find out the length of the path for which the observer will be able to see the image of the point object placed 1 m away from the mirror.



Sol. $\triangle$ AFI and $\triangle$ BIC are similar triangle.

In $\triangle$ AFI and $\triangle$ BIC,

$$\frac{1}{1} = \frac{x}{4} \Rightarrow x = 4m$$

Now, $\triangle$ AIE and $\triangle$ BID are also similar triangle.

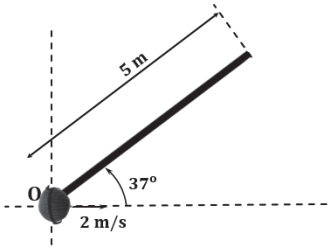
In $\triangle$ AIE and $\triangle$ BID,

$$\frac{2}{1} = \frac{y}{4} \Rightarrow y = 8m$$

Length of the path for which the observer will be able to see the image of the point object is given by,

$$y - x = 4m$$

Ex. An Observer O is moving with the velocity of 2 m/s in the direction as shown. Find the time after which he will not be able to see his image in the mirror placed at an angle of 37° with the horizontal.



Sol. The observer can see the image only when he is between the perpendiculars drawn at the extreme of the mirror as shown in the figure.

From the right angled triangle ΔOAB,

$$OB = AO\sec 37° \Rightarrow OB = 5 \times \frac{5}{4} = \frac{25}{4} \text{ m}$$

Time taken to travel distance OB.

$$t = \frac{\text{Distance}}{\text{Velocity}} = \frac{25/4}{2} = \frac{25}{8}\text{sec}$$