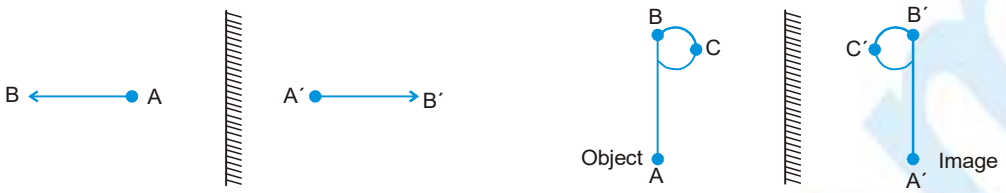
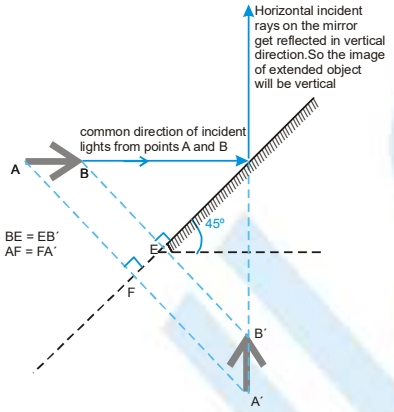
(3) The image is inverted if the extended object lies perpendicular to the plane mirror.

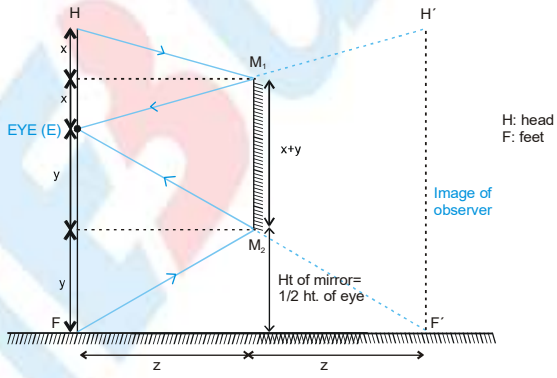


(4) If an extended horizontal object is placed infront of a mirror inclined 45° with the horizontal, the image formed will be vertical. See figure.



Ex. Show that the minimum size of a plane mirror, required to see the full image of an observer is half the size of that observer.

Sol. See the following figure. It is self explanatory if you consider lengths 'x' and 'y' as shown in figure.



Alter :

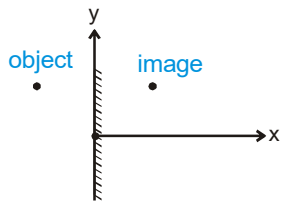
ΔEM_1M_2 and $\Delta E\,H'F'$ are similar

$$\therefore \quad \frac{M_1M_2}{H'F'} = \frac{z}{2z} \quad \text{or} \quad M_1M_2 = H'F'/2 = HF/2$$

Relation between velocity of object and image :

From mirror property : $x_{im} = - x_{om}$, $y_{im} = y_{om}$ and $z_{im} = z_{om}$

Here x_{im} means 'x' coordinate of image with respect to mirror. Similarly others have corresponding meaning.



Differentiating w.r.t time , we get

$v_{(im)x} = -v_{(om)x}$; $v_{(im)y} = v_{(om)y}$; $v_{(im)z} = v_{(om)z}$,

$\Rightarrow$ For x axis $v_{iG} - v_{mG} = -(v_{oG} - v_{mG})$

but For y axis and z axis $v_{iG} - v_{mG} = (v_{oG} - v_{mG})$ or $v_{iG} = v_{oG}$.

here: v_{iG} = velocity of image with respect to ground.

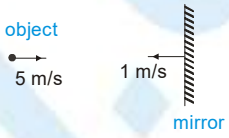
Ex. An object moves with 5 m/s towards right while the mirror moves with 1m/s towards the left as shown. Find the velocity of image.

Sol. Take $\rightarrow$ as + direction. $v_i - v_m = v_m - v_0$

$v_i - (-1) = (-1) - 5$

$\therefore$ $v_i = - 7$m/s.

$\Rightarrow$ 7 m/s and direction towards left.



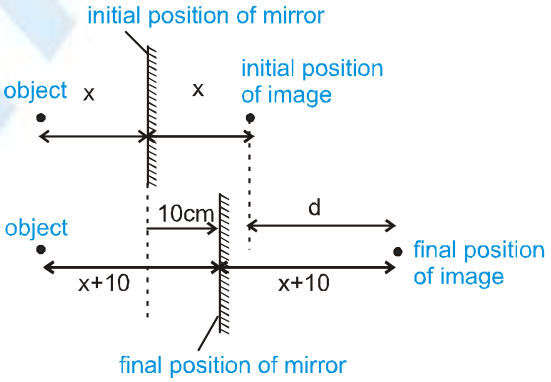
Ex. There is a point object and a plane mirror. If the mirror is moved by 10 cm away from the object find the distance which the image will move.

Sol. We know that $x_{im} = - x_{om}$ or $x_i - x_m = x_m - x_o$

or $\Delta x_i - \Delta x_m = \Delta x_m - \Delta x_o$.

In this question $\Delta x_o = 0$; $\Delta x_m = 10$ cm.

Therefore $\Delta x_i = 2\Delta x_m - \Delta x_o = 20$ cm.

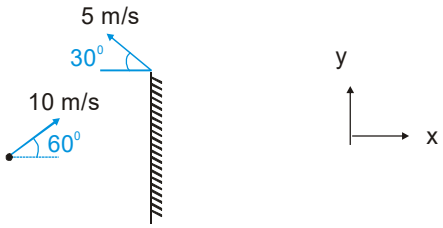


Alter : -

$2(x + 10) = 2x + d$

$\therefore$ $d = 20$ cm

Ex. In the situation shown in figure ,find the velocity of image.



Sol. Along x direction, applying $v_i - v_m = -(v_0 - v_m)$

$v_i - (-5\cos 30°) = -(10 \cos 60° - (-5 \cos 30°))$

$\therefore$ $v_i = - 5 (1+\sqrt{3})$ m/s

Along y direction $v_0 = v_i$

$\therefore$ $v_i = 10 \sin 60° = 5\sqrt{3}$ m/s

$\therefore$ Velocity of the image $= - 5 (1+\sqrt{3}) \hat{i} + 5\sqrt{3} \hat{j}$ m/s.