A ball kept on a wall is pushed horizontally with certain velocity and allowed to move under gravity. Such a motion is two-dimensional motion with ball covering displacements in both x and y-directions. But both the x & y direction motions are independent of each other. Hence, motion in x-direction can be considered as similar to straight line motion with no acceleration. Motion in y-direction can be considered as free fall under gravity. In the figure shown, ball is pushed horizontally from a height of 19 m.If there is no energy loss when particle collides at point B on ground, find the maximum height attained by the particle after it rebounds.

Solution

When a ball is pushed horizontally with certain velocity v_x from height $h = 19\,m$ its energy consist of kinetic energy and potential energy:

$$E = \frac{mv_x^2}{2} + mgh.$$

If there is no energy loss when particle collides at point B on ground energy conserves, so

$$E = \frac{mv^2}{2} + mgh_{max}\,,$$

when a ball at its maximum height.

But at maximum height ball have vertical component of velocity $v_y = 0$ and its horizontal component of velocity v_x doesn't change. That's why $v = v_x$. So

$$\frac{mv_x^2}{2} + mgh = \frac{mv^2}{2} + mgh_{max}\,, v = v_x.$$

$$mgh = mgh_{max} \rightarrow h_{max} = h = 19\,m.$$

Answer: 19 $\boldsymbol{m}$.