

A wedge of mass $M = 4m$ lies on a frictionless plane. A particle of mass m approaches the wedge with speed v . There is no friction between the particle and the plane or between the particle and the wedge. The maximum height climbed by the particle on the wedge is given by **(2019 Main, 9 April II)**

(a) $\frac{2v^2}{7g}$

(b) $\frac{v^2}{g}$

(c) $\frac{2v^2}{5g}$

(d) $\frac{v^2}{2g}$

Solution

Note Since ground is frictionless, so when the particle will collide and climb, then the wedge will also move.

- Momentum conservation can be applied only along x-axis. Because along y-axis will act.
- When ball reaches max height its y component of velocity must be zero.

$$mv + 0 = (m + 4m) V'$$

$V' \rightarrow$ is final velocity along ~~y~~ x-axis

$$V = 5V'$$

- Applying energy conservation,

$$\frac{1}{2} m v^2 + 0 = \frac{1}{2} m v'^2 + mgh + \frac{1}{2} (4m) V^2$$

$$m v^2 = (m + 4m) (v')^2 + 2mgh$$

$$v^2 = 5(v')^2 + 2gh$$

$$\frac{4v^2}{5} = 2gh$$

$$h = \frac{2v^2}{5g}$$