A rubber ball is dropped from a height of 5 m on a plane where the acceleration due to gravity is
not known. On bouncing it rises to a height of 1.8 metre. The ball loses its velocity on bouncing by a factor of :

Solution:

If we drop the ball on a flat surface, and it bounces back up but not as high because energy was lost due to the sound, heat, and the energy absorbed by the surface. Also we can measure how much energy the surface absorbed.

$$h_1 = 5m - \text{initial height}, h_2 = 1.8m - \text{final height.}$$

$E_{1P} = mgh_1$ – initial mechanical energy (potential energy at a height h_1);

$E_{1K} = \frac{mV_1^2}{2}$ – kinetic energy of the ball before hitting the plane

$E_{2P} = mgh_2$ – final mechanical energy at a height h_2 ($h_2 < h_1$);

$E_{2K} = \frac{mV_2^2}{2}$ – kinetic energy of the ball after hitting the plane

The conservation of the total mechanical energy:

$E_{1P} = E_{1K}; E_{2P} = E_{2K}$

$$\frac{mV_1^2}{2} = mgh_1 \Rightarrow V_1 = \sqrt{2gh_1} \qquad (1)$$

$$\frac{mV_2^2}{2} = mgh_2 \Rightarrow V_2 = \sqrt{2gh_2} \qquad (2)$$

$(1) \div (2)$:

$$\frac{V_1}{V_2} = \frac{\sqrt{2gh_1}}{\sqrt{2gh_2}} = \sqrt{\frac{h_1}{h_2}} = \sqrt{\frac{5m}{1.8m}} = 1.67$$

Answer: The ball loses its velocity on bouncing by a factor of : 1.67.