Q- A ball is launched vertically upwards with an initial velocity of 4 m/s from a height of 8 meters above the ground. the ball rises and then falls to the ground. After hitting the ground once, the ball rises back up to a maximum height of 3 meters. Determine the coefficient of restitution between the ball and the ground.

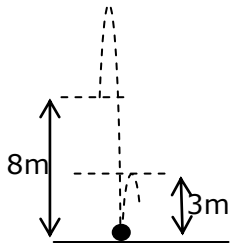
The velocity of the ball just before collision with ground can be determined directly by law of conservation of energy at point of projection and the ground.

Gain in kinetic energy = loss of potential energy

Final kinetic energy – initial kinetic energy = loss in gravitational potential energy

Or ½ mv^2 – ½ mu^2 = mg h
Or $v^2 = 4^2 + 2gh = 16 + 2*9.8*8 = 172.8$

Or v = 13.15 m/s



Now the velocity of the ball just after collision v′ is such that it rises to a height of 3 m hence it is given by

Loss in kinetic energy = Gain in potential energy

Or $\frac{1}{2}\, mv'^2 - 0 = mgh'$

Gives $v' = \sqrt{2gh'} = \sqrt{2*9.8*3} = 7.67$ m/s

Now as the ground is not moving at all v is the velocity of approach and v′ is the velocity of separation and hence coefficient of restitution is given by

$$e = \frac{v'}{v} = \frac{7.67}{13.15} = 0.58$$