Task. A ball of mass $m = 0.192$ kg is dropped from a height $h_0 = 2.764$ m above the ground. The acceleration of gravity is $g = 9.8\, m/s^2$.

Neglecting air resistance, determine the speed of the ball when it is at a height $h_1 = 0.699$ m above the ground. Answer in units of m/s.

Solution. There is a gravitation force acting on a ball, and so it moves down with constant acceleration $g = 9.8\, m/s^2$. Since the ball is dropped, its initial velocity is zero, and so the velocity $v(t)$ and the height $h(t)$ of the ball at time t are given by the following formulas:

$$v(t) = gt,$$

$$h(t) = h_0 - \frac{gt^2}{2}.$$

Let us find the time when the ball reach the height $h_1 = 0.699$ m. So we should solve the following equation:

$$h_1 = h_0 - \frac{gt^2}{2},$$

$$\frac{gt^2}{2} = h_0 - h_1$$

$$t = \sqrt{2(h_0 - h_1)/g}.$$

Then the velocity of the ball at that time will be

$$v = gt = g\sqrt{2(h_0 - h_1)/g} = \sqrt{2g(h_0 - h_1)}.$$

Substituting values we get

$$v = \sqrt{2g(h_0 - h_1)} = \sqrt{2 * 9.8 * (2.764 - 0.699)} = \sqrt{40.474} \approx 6.36\, m/s.$$

Answer. $v = 6.36$ m/s.