

Question #54122, Physics / Mechanics | Kinematics | Dynamics |

A ball rolls off a cliff 21.0 m above the ground with an initial horizontal speed of 5.0 m/s. Acceleration due to gravity is 9.8 m/s².

- a) How long after leaving the top of the cliff does the ball hit the ground?
- b) How far from the base of the cliff does the ball land?

Solution:

- a) The vertical motion of the object is described by the equation:

$h = v_0 t + \frac{1}{2} g t^2$, v_0 – the initial vertical speed, which equals zero, h – the height of the cliff.

Therefore,

$$h = \frac{1}{2} g t^2,$$

$$t = (2h/g)^{1/2} = (42 \text{ m}/9.8 \text{ m s}^{-2})^{1/2} = 2.07 \text{ s}$$

Answer (a): The object hits the ground in 2.07 s.

- b) The horizontal motion with the constant speed is defined by the equation:

$d = v_x t$, where d – the distance between the base of the cliff and a landing place, t – the time of the object flight.

$$d = 5.0 \text{ m/s} \times 2.07 \text{ s} = 10.35 \text{ m}$$

Answer (b): The ball moves 10.35 m horizontally.