

Answer on Question #61720-Physics-Mechanics | Relativity

A ball is kicked with an initial velocity of 14 m/s in the horizontal direction and 21 m/s in the vertical direction. (Assume the ball is kicked from the ground.)

(a) At what speed (in m/s) does the ball hit the ground?

(b) For how long (in s) does the ball remain in the air?

(c) What maximum height (in m) is attained by the ball?

Solution

(a) The energy of the ball conserves. So, kinetic energy has the same value at the same height. Thus, the velocity of the ball has the same value at the same height.

$$v_{ground} = v_0 = \sqrt{14^2 + 21^2} = 7\sqrt{13} \frac{m}{s} \approx 25.2 \frac{m}{s}.$$

(b) Assume no air friction. So, the motion of the ball is the projectile motion. The time of flight of projectile is

$$T = \frac{2v_0 \sin \theta}{g} = \frac{2v_{0y}}{g} = \frac{2(21)}{9.81} = 4.3 \text{ s}.$$

(c) Maximum height of projectile is

$$H = \frac{(v_0 \sin \theta)^2}{2g} = \frac{v_{0y}^2}{2g} = \frac{21^2}{2(9.81)} = 22.5 \text{ m}.$$