

Answer on Question #55252, Physics Quantum Mechanics

David hits a volleyball at $v_i=9.0$ meters per second it starts at 1.8 meters. How long will it take to hit the floor?

Solution

The condition of the problem is ambiguous because it does not indicate the direction of the velocity. For simplicity, assume that the velocity vector is directed vertically downward.

According to the law of energy conservation

$$\frac{mv_1^2}{2} + mgh = \frac{mv_2^2}{2} \quad (1)$$

where m is the mass volleyball; $g = 10\text{m/s}^2$ is the acceleration of gravity; $v_1 = 9\text{m/s}$ is the initial speed; v_2 is the final speed; $h = 1.8\text{m}$

Then

$$v_2 = \sqrt{v_1^2 + 2gh} \quad (2)$$

The time is given by Eq.(3)

$$t = \frac{v_2 - v_1}{g} = \frac{\sqrt{v_1^2 + 2gh} - v_1}{g} = \frac{\sqrt{9^2 + 2 \cdot 10 \cdot 1.8} - 9}{10} = 0.18\text{s} \quad (3)$$

Answer: $t = \frac{\sqrt{v_1^2 + 2gh} - v_1}{g} = 0.18\text{s}.$