Answer on Question #45187, Physics, Mechanics | Kinematics | Dynamics

A ball is dropped from bridge of 122.5 m above river. After the ball has been falling for 2 seconds ,a second ball is thrown straight down after it. Initial velocity of second ball ao that both hit the water at same time.

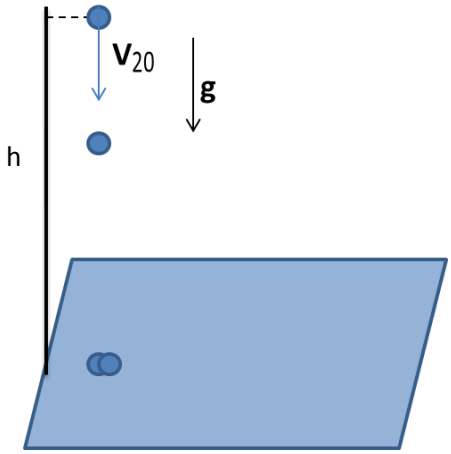
(1) 49m/sec

(2) 55.5m/sec

(3) 26.1m/sec

(4)9.8m/sec

Solution



Let t_1 be the time of flight of the first ball and t_2 for the second one.

Then

$$t_1 = t_2 + \Delta t \rightarrow t_2 = t_1 - \Delta t$$

Where Δt = 2s. Equations of motion for the both balls:

$$h = \frac{gt_1^2}{2} \rightarrow t_1 = \sqrt{\frac{2h}{g}}$$

$$h = V_{02}t_2 + \frac{gt_2^2}{2} = V_{02}t_2 + \frac{gt_2^2}{2} = V_{02}(t_1 - \Delta t) + \frac{g(t_1 - \Delta t)^2}{2}$$

$$= V_{02}\left(\sqrt{\frac{2h}{g}} - \Delta t\right) + \frac{g\left(\sqrt{\frac{2h}{g}} - \Delta t\right)^2}{2}$$

So:

$$V_{02} = \frac{h - \frac{g\left(\sqrt{\frac{2h}{g}} - \Delta t\right)^2}{2}}{\sqrt{\frac{2h}{g}} - \Delta t} = \frac{h}{\sqrt{\frac{2h}{g}} - \Delta t} - - \frac{g\left(\sqrt{\frac{2h}{g}} - \Delta t\right)}{2}$$

Numerically:

$$V_{02} = \frac{122.5m}{\sqrt{\frac{2 \cdot 122.5m}{9.8\frac{m}{s^2}}} - 2\text{s}} - \frac{9.8\frac{m}{s^2} \cdot \left(\sqrt{\frac{2 \cdot 122.5m}{9.8\frac{m}{s^2}}} - 2\text{s}\right)}{2} \approx 26.1\frac{m}{s}$$

Answer: (3) 26.1m/sec