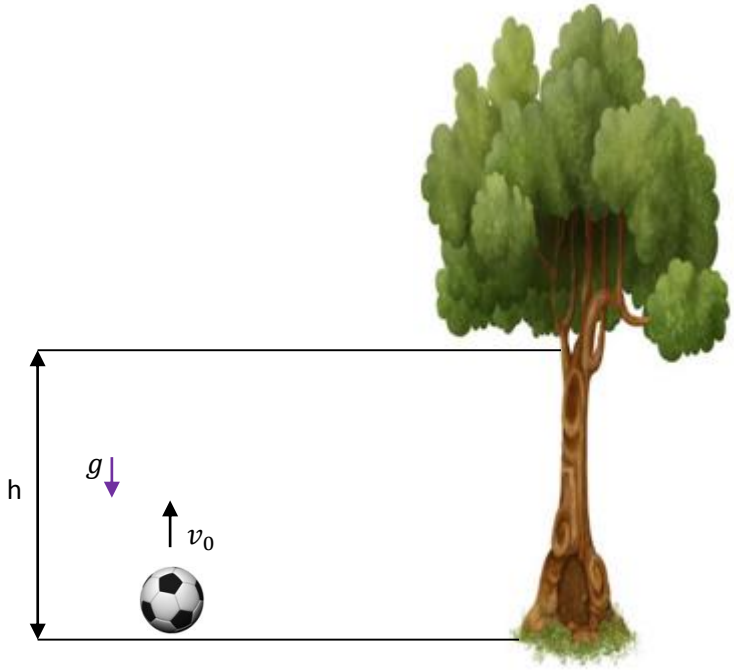
Answer on Question#60306 –Physics– Mechanics –Relativity

You throw a ball straight up with an initial velocity of 14.3 m/s. On the way up it passes a tree branch at a height of 7.8 m. How much additional time will pass before the ball passes the tree branch on the way back down? Numeric: A numeric value is expected and not an expression.
t = _____

Solution.

$v_0 = 14.3$ m/s
$g = 9.8$ m/s^2
$h = 7.8$ m

$\Delta t - ?$



The movement of the ball consists of two parts. First, the ball moves upward until its speed reaches zero then moves down. The ball moves with an initial velocity $v_0 = 14.3$ m/s and constant acceleration $g = 9.8$ m/s^2 downwards. Hence the height of the ball is described by the equation

$$h = v_0 t - \frac{gt^2}{2} \to 7.8 = 14.3t - 4.9t^2$$
$$4.9t^2 - 14.3t + 7.8 = 0$$

Solve this quadratic equation

$$D = 14.3^2 - 4 \cdot 4.9 \cdot 7.8 = 51.61$$

$t_1 = \frac{14.3 - \sqrt{51.61}}{2 \cdot 4.9} \approx 0.7$ s and $t_2 = \frac{14.3 + \sqrt{51.61}}{2 \cdot 4.9} \approx 2.2$ s

t_1 corresponds to the time during ascent to a height of h after the start of movement; the time t_2 corresponds to the time of descent to a height of h after the start of movement. Therefore

$\Delta t = t_2 - t_1 = 2.2 - 0.7 = 1.5$ s

Answer: $\Delta t = 1.5$ s