Answer on Question 59286, Physics, Mechanics | Relativity

Question:

A rock is tossed upward with an initial velocity of 8 feet per second from the top of a one hundred and twenty foot cliff that overlooks the ocean. After how many seconds does the rock hit the water?

Solution:

We can find after how many seconds does the rock hit the water from the kinematic equation (also, we take the upwards as the positive direction):

$$y(t) = y_0 + v_0 t + \frac{1}{2}at^2,$$

here, $y(t)$ is the height of the rock when it hits the water, $y_0 = 120\ ft$ is the point of release, $v_0 = 8\ ft/s$ is the initial velocity, t is the time we searching for, $a = g = -32\ ft/s^2$ is the acceleration due to gravity in the British system of units.

Because we want to know what the value of t will be when $y(t) = 0$ (when rock hits the water), we must substitute 0 for $y(t)$ and solve the quadratic equation for t:

$$120 + 8t - \frac{1}{2} \cdot 32t^2 = 0,$$

$$2t^2 - t - 15 = 0.$$

This quadratic equation has two roots:

$$t_1 = \frac{-b - \sqrt{b^2 - 4ac}}{2a} = \frac{1 - \sqrt{1 - 4 \cdot 2 \cdot (-15)}}{2 \cdot 2} = \frac{1 - \sqrt{121}}{4} = -2.5,$$

$$t_2 = \frac{-b + \sqrt{b^2 - 4ac}}{2a} = \frac{1 + \sqrt{1 - 4 \cdot 2 \cdot (-15)}}{2 \cdot 2} = \frac{1 + \sqrt{121}}{4} = 3.$$

Because the time can't be negative the correct answer is $t = 3\ s$.

Answer:

$t = 3\ s.$