Question #69595

Condition.

You throw a small rock straight up from the edge of a highway bridge that crosses a river. The rock passes you on its way down, 7.00 s after it was thrown. What is the speed of the rock just before it reaches the water 29.0 m below the point where the rock left your hand? Ignore air resistance.

Solution.

The rock moves in the gravitation field, thus, it has the gravitation acceleration g = 9,81 m/s^2. According to the law of conservation of mechanical energy, the rock has speed equal to the original speed when it falls by you. So, all it's way from you to you takes doubled time of free falling. Therefore, if t = 7 seconds, then:

$$(1)\ t = 2 \cdot \sqrt{\frac{2h}{g}},$$ where h is a lifting height above the bridge.

According to (1) it is easy to define h: $(2)\ h = \frac{g t^2}{8}$. If result lifting height H = h + h_1, where h_1 = 29 meters, above the river is defined, then, according to the law of conservation of mechanical energy, required speed is $\upsilon = \sqrt{2gH} = \sqrt{2g\left(h_1 + \frac{g t^2}{8}\right)} \approx 41{,}81\ \frac{m}{s}$.

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