Question.

A student drops a water balloon out of a dorm window onto a passing professor 23 m below. What is the speed of the balloon as hits the professor?

Given:

$h = 23\, m$

Find:

$v = ?$

Solution.

As we know from the basic of kinematics:

$$h = \frac{gt^2}{2}, where$$

$g = 9.8\, \frac{m}{s^2}$ is the gravitational acceleration;

t is the time of falling.

From other side, by definition the acceleration is:

$$g = \frac{v - v_0}{t}$$

In our case, $v_0 = 0$. Therefore,

$$g = \frac{v}{t} \rightarrow v = gt$$

So, to find the terminal speed we must find the time of falling.

$$t = \sqrt{\frac{2h}{g}}$$

Finally,

$$v = gt = g\sqrt{\frac{2h}{g}} = \sqrt{2gh}$$

Calculate:

$$v = \sqrt{2 \cdot 9.8 \cdot 23} = \sqrt{450.8} = 21.23\, \frac{m}{s}$$

Answer.

$$v = \sqrt{2gh} = 21.23 \ \frac{m}{s}$$

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