Answer on Question #51348, Physics, Mechanics | Kinematics | Dynamics

A startled armadillo leaps upward, rising 0.525 m in the first 0.215 s. (a) What is its initial speed as it leaves the ground? (b) What is its speed at the height of 0.525 m? (c) How much higher does it go?

Solution.

V_i – initial speed; V_t – speed in moment "t"; H_{max} – maximum height.

$$V_t = V_0 - g * t; \qquad a = \frac{V_t - V_i}{t} = \frac{V_i}{t} - g - \frac{V_i}{t} = -g; \qquad h = V_i * t + \frac{a * t^2}{2} = V_i * t - \frac{g * t^2}{2};$$

Initial speed will be:

$$V_i = \frac{2 * h + g * t^2}{2 * t} = \frac{1.05 + 0.453}{0.43} = 3.4953 \; m/s;$$

Speed at the height of 0.525 m (in time = 0.215 s):

$$V_t = V_0 - g * t = 3.4953 - 9.8 * 0.215 = 1.3883 \; m/s;$$

How much higher does it go:

We have maximum height in moment of time, when speed of armadillo equals to 0;

Then : $V_t = V_i - g * t = 0; \qquad t = \frac{V_i}{g} = \frac{3.4953}{9.8} = 0.35666;$

$$H_{max} = V_i * t - \frac{g * t^2}{2} = 3.4953 * 0.35666 - \frac{9.8 * 0.35666^2}{2} = 0.6233 \; m;$$

How much higher : $H_{max} - h = 0.6233 - 0.525 = 0.0983 \; m;$

Answer.

$V_i = 3.4953 \; m/s; \quad V_t = 1.3883 \; m/s; \; : \quad H_{max} - h = 0.0983 \; m.$