

Answer on Question #58686, Physics / Mechanics | Relativity

Question: A kangaroo can jump over an object 2.50 m high. (a) Calculate its vertical speed when it leaves the ground. (b) How long is it in the air?

Answer: a) Vertical coordinate Y depends on time:

$$y(t) = v_0 t - \frac{g}{2} t^2$$

$$v(t) = \dot{y}(t) = v_0 - gt$$

When kangaroo achieves the highest point,

$$v(t_0) = 0 \Rightarrow t_0 = \frac{v_0}{g}$$

Substitute to first equation, we obtain:

$$h = y(t_0) = v_0 t_0 - \frac{g}{2} t_0^2 = \frac{v_0^2}{2g}$$

$$v_0 = \sqrt{2gh} = 7 \text{ ms}^{-1}$$

b) Kangaroo fall down to the ground at the time τ :

$$0 = y(\tau) = v_0 \tau - \frac{g}{2} \tau^2 =$$

$$\tau = \frac{2v_0}{g} = 2 \frac{\sqrt{2gh}}{g} = 2 \sqrt{\frac{2h}{g}} = 1.43 \text{ s}$$

Answer: a) $v_0 = 7 \text{ ms}^{-1}$; b) $\tau = 1.43 \text{ s}$