Answer on Question 49445, Physics, Mechanics | Kinematics | Dynamics

Question:

A stunt cyclist attempts to jump over 18 buses, each 3m wide. The approach ramp is inclined at 30 degrees to the horizontal. What is the minimum velocity with which he must leave the approach ramp in order to reach the landing ramp?

Solution:

Let's write the horizontal and vertical displacement of the stunt cyclist along x and y axis respectively:

$$x = v_0 t \cos\theta,$$

$$y = v_0 t \sin\theta - \frac{1}{2} g t^2,$$

where v_0 is the initial velocity of the stunt cyclist, t is the time of the stunt cyclist in air, θ is the angle between approach ramp and the horizontal, g is the acceleration of gravity. Assuming that $x = 18 \cdot 3m = 54m, y = 0$ and solving the first equation for time in air and substituting t into the second equation we have:

$$v_0 \sin 30^\circ \frac{x}{v_0 \cos 30^\circ} - \frac{1}{2} g \left(\frac{x}{v_0 \cos 30^\circ} \right)^2 = 0.$$

From this equation we can obtain v_0:

$$v_0 = \sqrt{\frac{4.9 \frac{m}{s^2} \cdot x}{\sin 30^\circ \cdot \cos 30^\circ}} = \sqrt{\frac{4.9 \frac{m}{s^2} \cdot 54m}{0.5 \cdot 0.866}} = 24.72 \frac{m}{s}.$$

Answer:

The minimum velocity is $v_0 = 24.72 \frac{m}{s}$.