Answer on Question #69398 - Physics / Mechanics | Relativity

Condition.

A Ferris wheel with a radius of 8.0 m makes 1 revolution every 10 seconds. When a passenger is at the top, essentially a diameter above the ground, he releases a ball. How far from the point of on the ground directly under the relesase point does the ball land?

Solution.

The beginning O of plane coordinate system Oxy is located on the ground under the point of release. Oy axis is directed upward, Ox axis has horizontal direction in the plane of the Ferris wheel. In such coordinate system ball has coordinates:

$$(1)\ x(t) = \omega R\, t,$$

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

where $\omega = 2\frac{\pi}{T} = (T = 10\,\text{s.}) \approx 0{,}63\ \text{rad/sec}$ - a circular frequency of wheel's rotation, R – the radius of the Ferris wheel, g = 9,81 m/s^2 – the gravitational acceleration, t – time after release. If the ball fallen, then y = 0. According to (2), it is possible to find a time of flight of the ball:

$$(3)\ t = 2\sqrt{\frac{R}{g}},$$

and, according to (1) and (3) it is easy to define required distance:

$$(4)\ x = 2\omega R\sqrt{\frac{R}{g}} \approx 2 \cdot 0{,}63 \cdot 8 \cdot \sqrt{\frac{8}{9{,}81}} \approx 9{,}1\,\text{meters.}$$

Answer.

Requred distanse is $x = 2\omega R\sqrt{\frac{R}{g}} \approx 9{,}1\,\text{meters.}$