Answer on Question #48876 – Physics – Other

1. A bowling ball that weighs 13 pounds is rolled down a ramp. The ball rolls without slipping for 5m and the angle of the ramp is 35 degrees. If the bowling ball started at rest, determine its angular speed and translational speed at the bottom of the ramp.

$m = 13\ pounds = 5.90\ kg$
$l = 5\ m$
$\varphi = 35^0$
$\omega, v - ?$

Solution.

We should use the conservation law. The kinetic energy of the ball equals to the change of its potential energy: $\frac{I\omega^2}{2} = mgh$,

where $I = \frac{2}{5}mr^2 + mr^2 = \frac{7}{5}mr^2$ is the moment of inertia of a uniform ball during its rolling, the height is $h = \frac{l}{\sin\varphi}$.

The angular speed is connected with the translational speed as $\boxed{\omega = \frac{v}{r}}$. So,

$\frac{7}{5}mr^2 \cdot \frac{(v/r)^2}{2} = mg \cdot \frac{l}{\sin\varphi}$, $\boxed{v = \sqrt{\frac{10gl}{7\sin\varphi}}}$.

Let check the dimensions: $[v] = \sqrt{\frac{m}{s^2} \cdot m} = \frac{m}{s}$, $[\omega] = \frac{m}{s} : m = \frac{rad}{s}$.

Let evaluate the quantities: $v = \sqrt{\frac{10 \cdot 9.8 \cdot 5}{7 \cdot \sin 35^0}} = 11.1\left(\frac{m}{s}\right)$.

Answer: the translational speed is $11.1\frac{m}{s}$. For calculating the angular speed of the ball, we must know the ball radius.