Answer of question #77153-Physics-Mechanics- Relativity

A uniform sphere of radius= R/16 starts rolling down without slipping from the top of another sphere of radius R=1m.Find the angular velocity of the sphere on rad^-1,after it leaves the surface of larger sphere

Input Data:

Radius: $R = 1$ m

Acceleration of gravity: $g = 9.81\ {}^{m}/_{s^2}$

Solution:

Suppose that the loss of height is H, then rolling speed of a small sphere:

$$v = \sqrt{2 * g * H};$$

The ball will detach from the sphere at the moment when the force of pressing is equal to the centrifugal force.

Centrifugal force: $F_c = \frac{mV^2}{R} = \frac{2*g*H*m}{R};$

Force of pressing: $F_{pressing} = m * g * \cos(\varphi);$

$$\cos(\varphi) = \frac{R - H}{R};$$

The condition for the separation of the ball:

$$F_c = F_{pressing};$$

Simplifying the equation, we get:

$$2H = R - H;$$

$$H = \frac{R}{3};$$

Hence, we get the speed: $v = \sqrt{2 * g * R/3};$

Angular velocity: $\Omega = \frac{V}{R} = \sqrt{\frac{2g}{3R}};$

Answer:

Angular velocity is 2.56 rad/s