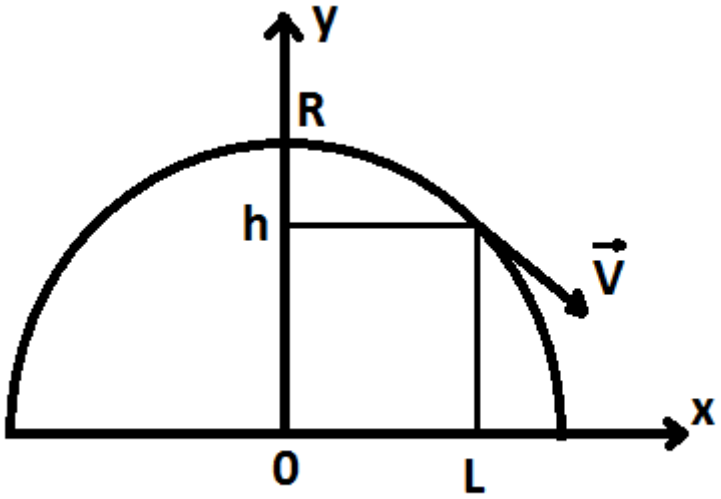
Answer on Question#49489 – Physics – Mechanics | Kinematics | Dynamics

$$h = \frac{2R}{3}$$

Solution



Due to the conservation law:

$$mgh + \frac{mV^2}{2} = const$$

At the begin point $V = 0$, hence $const = mgR$

At the end point: $mgh_1 + \frac{mV_1^2}{2} = mgR;\ V_1 = \sqrt{2g(R - h_1)}$

Formula of centripetal acceleration: $a = \frac{V^2}{R}$

Projections of the force acting on a boy:

Normal (to surface): $F_n = mgsin(\phi)$

Tangential (to surface): $F_t = mgcos(\phi)$

We count angle from $x - axis$.

Newton's law: $ma = F$.

Boy will lose contact with surface when next condition become true:

$$(ma = F_n) < m\frac{V^2}{R}$$

So we solve equation $mgsin(\phi) = m\frac{V^2}{R}$ for $\sin(\phi)$.

$$mgsin(\phi) = m\frac{V^2}{R}$$

$$gsin(\phi) = \frac{2g(R-h)}{R}$$

$$gsin(\phi) = 2g - \frac{2gh}{R}$$

$$h = Rsin(\phi)$$

$$gsin(\phi) = 2g - \frac{2gRsin(\phi)}{R}$$

$$gsin(\phi) = 2g - 2gsin(\phi)$$

$$3gsin(\phi) = 2g$$

$$\sin(\phi_1) = \frac{2}{3}$$

Thus, boy will last contact with the surface at height $h = Rsin(\phi_1)$:

$$h = \frac{2R}{3}$$