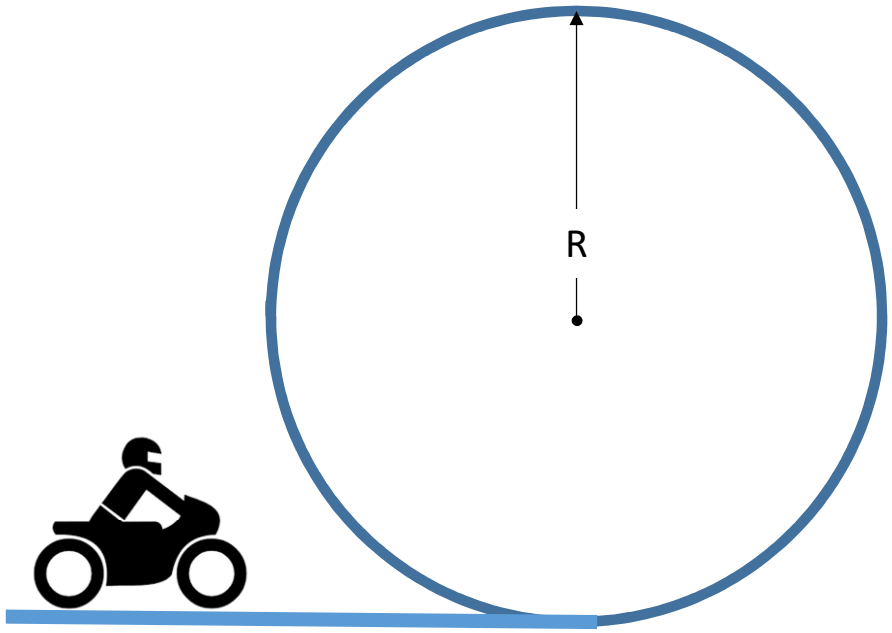
A biker enter a loop track at high speed, v_0, by speeding up along the horizontal part of the track.

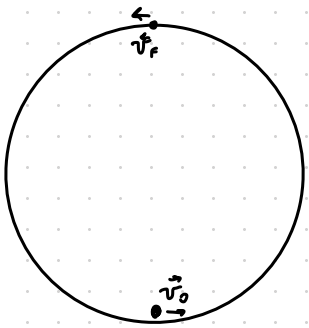
The loop has a radius r = 10 m.

What is the minimum value of v_0 for which he/she will be able to drive the whole loop without falling down when passing through the vertical?



$r = 10\,m$

$v_{0MIN} = ?$



$y_0 = 0\,m$

$y_f = 2r = 20\,m$

CONSERVATION OF ENERGY

SUPPOSE THERE IS NO FRICTION
THE ENERGY IS PRESERVED

$\Delta E_0 = 0J$

$E_f - E_i = 0J$

$K_f + U_f = K_i + U_i$

$\frac{1}{2} m v_f^2 + mgh_f = \frac{1}{2} m v_0^2 + mgh_0$

THE PROBLEM IS NOT RELATED TO THE MASS OF THE MOTO

$h_f = y_f = 20\,m$

$h_0 = y_0 = 0\,m$

$\frac{1}{2} v_f^2 + gh_f = \frac{1}{2} v_0^2$

$v_f = \sqrt{v_0^2 - 2gh_f} = \sqrt{v_0^2 - 4gr} = \sqrt{v_0^2 - 4gr}$

CHECK IF v_f IS ENOUGH TO NOT FALL FROM THE HIGHEST POINT.

$a_c = \frac{v_f^2}{r} \qquad a_c = g$

$a_c = \frac{v_0^2 - 4gr}{r} = g$

$v_0 = \sqrt{rg + 4gr} = \sqrt{(10\,m)\left(9.81\,\frac{m}{s^2}\right) + 4\cdot\left(9.81\,\frac{m}{s^2}\right)\cdot(10\,m)} = 22.15\,\frac{m}{s}$