Swinging Pendulum

\[ a(\theta) = l \cos \theta \]
\[ y = l - a(\theta) = l - l \cos \theta = l(1 - \cos \theta) \]
\[ \rightarrow \quad y_o = l(1 - \cos \theta_o) \]
\[ y = l(1 - \cos \theta) \]

\[ \begin{align*}
(\theta = 0) & \quad (v_i = 0) \\
y_o & \quad (U = 0)
\end{align*} \]

a) What is the tangential speed of mass \( m \) as a function of \( y \)?

\[ E_i = E_f \]
\[ \frac{1}{2} m v_i^2 + m g y_o = \frac{1}{2} m v^2 + m g y \]
\[ 0 + m g y_o = \frac{1}{2} m v^2 + m g y \]
\[ v = \sqrt{2 g (y_o - y)} \]

b) What is the tangential speed of mass \( m \) as a function of \( \theta \)?

\[ v = \sqrt{2 g ([l(1 - \cos \theta_o)] - [l(1 - \cos \theta)])} \]
\[ v = \sqrt{2 g l (1 - \cos \theta_o - 1 + \cos \theta)} \]
\[ v = \sqrt{2 g l (\cos \theta - \cos \theta_o)} \]

c) What is the tangential speed of mass \( m \) at \( \theta = 0 \)?

\[ v = \sqrt{2 g l (1 - \cos \theta_o)} \]