To find how high the cup rises, we need to know its acceleration:

\[ \vec{F}_{\text{net}} = m \vec{a} \] from Newton's 2nd law, so we need to find \( \vec{F}_{\text{net}} \).

\[ \vec{F}_{\text{net}} = \sum \vec{F}_i = \vec{F}_N + \vec{F}_g + \vec{F}_{\text{KF}}. \]

Let's analyze the \( x \) and \( y \) components (see diagram above for the way the \( x \) and \( y \) axes are drawn) separately:

\[
\begin{align*}
F_{\text{net},x} &= -mg \sin \theta - F_{\text{KF}} \\
F_{\text{net},y} &= F_N - mg \cos \theta = 0 \quad \text{no motion in this direction}
\end{align*}
\]

\[ \rightarrow F_N = mg \cos \theta. \]

Plug this into \( F_{\text{KF}} = \mu_k F_N = \mu_k mg \cos \theta \) in the other equation (for \( F_{\text{net},x} \))

\[ F_{\text{net},x} = -mg \sin \theta - \mu_k mg \cos \theta = ma_x \]

\[ \text{solve for } a_x = -g (\sin \theta + \mu_k \cos \theta) \]

\[ \uparrow \text{This is our (constant) acceleration in the } x \text{-direction.} \]

Now, plug this into the \textit{Kinematics} eqns. for motion w/constant acceleration:
\[ X = X_0 + V_0 x t + \frac{1}{2} a_x t^2 = V_0 t + \frac{1}{2} a_x t^2 \]
\[ V = V_0 + a_x t \quad \Rightarrow \quad t = \frac{(V-V_0)}{a_x} \]

- At the highest point the cup reaches before stopping or turning around, \( V=0 \), so \( t_{\text{top}} = \frac{-V_0}{a_x} \) (which is the correct sign because \( a_x < 0 \)). Plug this into eqn. for \( x \):

\[ x_{\text{top}} = V_0 t_{\text{top}} + \frac{1}{2} a_x t_{\text{top}}^2 = V_0 \left( \frac{-V_0}{a_x} \right) + \frac{1}{2} a_x \left( \frac{-V_0}{a_x} \right)^2 = -\frac{V_0^2}{a_x} + \frac{1}{2} \frac{V_0^2}{a_x} = -\frac{V_0^2}{2a_x} \]

- So we have

\[ x_{\text{top}} = \frac{V_0^2}{2g(sin\theta + \mu_k cos\theta)} = \frac{(3.5 \text{ m/s}^2)^2}{2 \left( 9.80 \text{ m/s}^2 \right) \left[ \sin(16^\circ) + (0.2) \cos(16^\circ) \right]} \approx 1.34 \text{ m}. \]

This means that the height \( h_{\text{max}} \) to which the cup rises is

\[ 0.5 \text{ m} \]  
\[ \downarrow \]  
\[ 1.34 \text{ m} \]  
\[ \leftarrow \]  
\[ h_{\text{max}} \]  
\[ 16^\circ \]  
\[ \Rightarrow \quad h = (1.34 \text{ m}) \sin(16^\circ) \approx 0.368 \text{ m} \]

b) To determine whether the cup starts moving again, we need to know whether the applied force on the block overcomes static friction:

\[ F_{\text{app,x}} = |F_{g,x}| = mg \sin \theta \quad \text{(because gravity is supplying this force)} \]

- The cup gets stuck when \( F_{\text{app,x}} \leq \mu_s F_N = \mu_s mg \cos \theta \)

at the threshold

\[ F_{\text{app,x}} = mg \sin \theta = (mg \cos \theta) \mu_s \quad \Rightarrow \quad \mu_s = \frac{\sin \theta_{\text{max}}}{\cos \theta_{\text{max}}} = \tan \theta_{\text{max}} \]

so \( \theta_{\text{max}} = \arctan(\mu_s) = \arctan(0.4) \approx 21.8^\circ \)

- Since \( \theta = 16^\circ < \theta_{\text{max}} \), the cup won't slip when static friction kicks in, so it just "sticks" at \( h_{\text{max}} \) and doesn't slide down.