PROBLEM: 13-56

Given:
A girl of mass 15 kg sits on plate (circular) motionless at dist 5 m from center.
Static friction between girl and plate, \( \mu = 0.2 \). Girls tangential speed is increased at \( \text{a}_t = 0.5 \text{ m/s}^2 \).

Required: Maximum speed at which the girl will start to slip.

Solution:

\[ W = m \cdot g = 15 \text{ kg} \cdot (9.81 \text{ m/s}^2) = 147.15 \text{ N} \]

Under impending motion condition (Just about to slip)
\[ F_s = \mu \cdot N = 0.2 \cdot N \]

\[ \uparrow \Sigma F_x = \text{ma}_z \Rightarrow N - 147.15 = 0 \Rightarrow N = 147.15 \text{ N} \]

\[ \Rightarrow F_s = 0.2 \cdot 147.15 = 29.43 \text{ N} \]

\[ \uparrow \Sigma F_n = \text{ma}_n \Rightarrow F_s \cdot \cos \theta = 15 \cdot a_n \Rightarrow 29.43 \cdot \cos \theta = 15 \cdot a_n \]

\[ \Rightarrow \sin \theta = \frac{0.255}{0.967} \Rightarrow \theta = 14.8^\circ \]

From eq (1) \[ a_n = \frac{29.43 \cdot 0.967}{15} = 1.897 \text{ m/s}^2 \]

But \( \frac{V^2}{r} = a_n \) and r = 5 m.

\[ V = \sqrt{5 \cdot (1.897 \text{ m/s}^2)} = 3.08 \text{ m/s} \]

Ans:
Maximum Speed the girl can have \( V = 3.08 \text{ m/s} \)