Q- A box sits on a horizontal wooden ramp. The coefficient of static friction between the box and the ramp is 0.43. You grab one end of the ramp and lift it up, keeping the other end of the ramp on the ground. What is the angle between the ramp and the horizontal direction when the box begins to slide down the ramp?

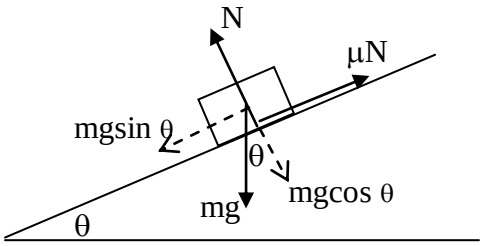
Let the box of mass m is just at the verge of sliding (limiting equilibrium) when the ramp makes an angle θ with the horizontal. The forces acting on the block are

The weight of the block	mg
The normal force of the ramp	N
And the limiting friction	μN

Resolving (breaking up) the weight along the ramp and perpendicular to the ramp the components are

Along the ramp	mg*sin θ
Normal to the ramp	mg*cos θ

The normal force balances the component of the weight in the normal direction and the component of the weight along the ramp is balanced by the limiting friction. Hence writing the equation we have



μ N - mg sin θ = 0 ---------- (1)

And N - mg cos θ = 0 ---------- (2)

Substituting the value of N from equation 2 in equation 1 and re arranging we get

μ*mg cos θ - mg sin θ = 0

Or $\tan \theta = \mu$

Gives $\theta = \tan^{-1}(\mu) = \tan^{-1}(0.43) = 23.27$ deg.

Hence if the angle is slightly greater than 23.27 degrees, the box will start sliding on the ramp. [This angle is called angle of repose]