Friction in Solids

Types of Friction

Static Friction: Friction acting on an object so as to keep it static.

Kinetic Friction: Friction acting on a moving object so as to reduce its velocity. The direction of Kinetic Frictional Force is in opposite direction to its motion.

Rolling Friction: Friction acting on Rolling objects.

Law of Static Friction

$F_s \leq \mu_s N$

Law of kinetic Friction

$F_k \leq \mu_k N$

Law of Rolling Friction

$F_R \leq \mu_R N$

Angle of Friction:-

The angle made by the resultant reaction force with the vertical (normal reaction) is known as the angle of the friction.

Now, in the triangle OAB

$AB/OB = \cot\theta$

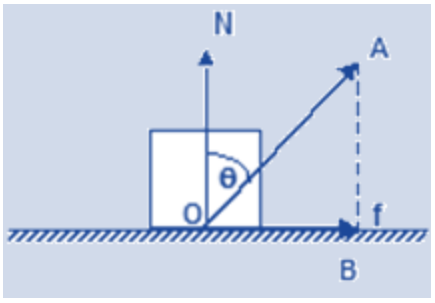
So, $OB = AB/\cot\vartheta$

$= AB \tan\vartheta$

Or, $\tan\vartheta = OB/AB$

$= f / N$

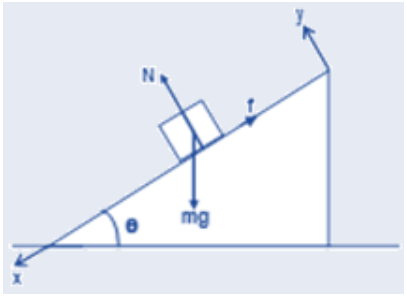
So, $\tan\vartheta = f / N = \mu_s$



Angle of Repose:

It is the angle which an inclined plane makes with the horizontal so that a body placed over it just begins to slide of its own accord.

Consider a body of mass *m* resting on an inclined plane of inclination*q*. The forces acting on the body are shown – F_f being the force of friction. If friction is large enough, the body will not slide down.



along x: *mg* sin θ – *f* = 0 …(1)

Along y: *N* –*mg* cosθ = 0 …(2)

i.e. *N* = *mg* cos θ and *f* = *mg* sin θ

Thus, $f \leqslant \mu_S N$ gives,

mg sin θ ≤ μ_S *mg* cos θ

So, tanθ ≤ μ_S. This signifies, the coefficient of static friction between the two surfaces, in order that the body doesn't slide down.

When *q* is increased, then tan θ > μ. Thus sliding begins, and the angle $\theta_r = \tan^{-1}\mu$. This angle is known as the angle of repose.