Coulomb's laws of dry friction

(i) Laws of static friction

1. The frictional force always acts in the opposite direction to that the body tends to move.
2. The frictional force does not depend on the shape and area of contact of the bodies.
3. The frictional force depends on the degree of roughness of the contact area between the bodies.
4. The frictional force is equal to the force applied to the body, so long as the body is at rest.
5. The limiting frictional force (F_m) bears a constant ratio to the normal reaction N_R between the surfaces of contact.

   i.e $F_m \propto N_R$

   (or) $F_m = \mu_s N_R$

(ii) Laws of dynamic friction

1. The frictional force always acts in the opposite direction to that the body moves.
2. The magnitude of dynamic friction bears a constant ratio to the normal reaction between the two surfaces.
3. Co-efficient of kinetic friction is less than the co-efficient of static friction

Impending motion

The state of motion of a body which is just to move or slide is called impending motion.

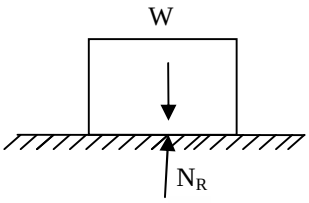
When the maximum frictional force is attained and if the applied force exceeds the limiting friction, the body starts sliding or rolling this state is called impending motion.

Basic concepts

(i) F=0

$\sum V = 0$

$W = N_R$



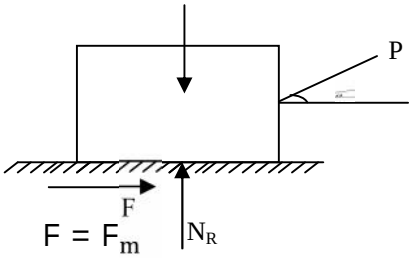
(ii) $F < F_m$

$\sum H = 0$

$\sum V = 0$

$F = P\cos\theta$

$N_R = W + P\sin\theta$



(iii) $F = F_m$

The block is in impending motion, i.e the block just start to move towards left.

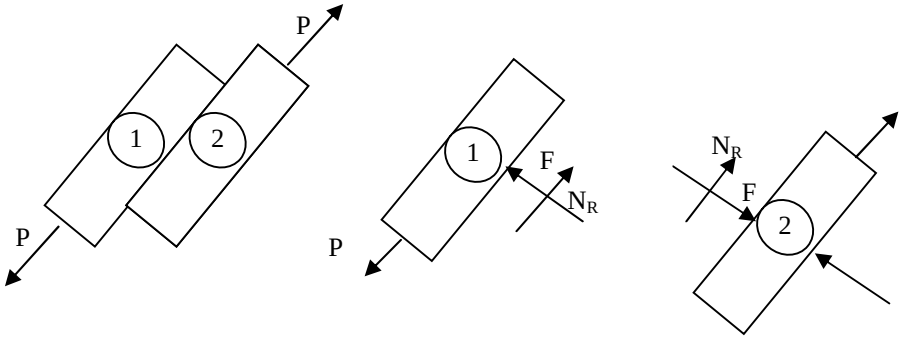
$$\sum H = 0 \qquad F = P\cos\theta$$

$$\sum V = 0 \qquad N_R = W + P\sin\theta$$

(iv) $F > F_m$

The body is in motion; the body is not in equilibrium condition. Hence both equations of equilibrium cannot be used and $F_m = \mu_N$ cannot be applied.

Important points


P
1
2
P
1
F
N_R
P
N_R
F
2