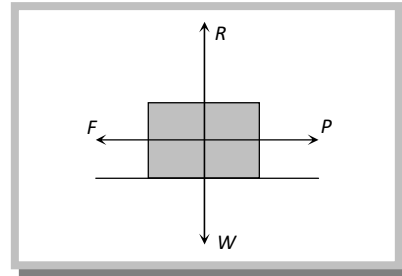


Friction.

Friction is a retarding force which prevent one body from sliding on another. It is, therefore a reaction.

When two bodies are in contact with each other, then the property of roughness of the bodies by virtue of which a force is exerted between them to resist the motion of one body upon the other is called friction and the force exerted is called force of friction.



(1) **Friction is a self-adjusting force:** Let a horizontal force P pull a heavy body of weight W resting on a smooth horizontal table. It will be noticed that up to a certain value of P , the body does not move. The reaction R of the table and the weight W of the body do not have any effect on the horizontal pull as they are vertical. It is the force of friction F , acting in the horizontal direction, which balances P and prevents the body from moving.

As P is increased, F also increases so as to balance P . Thus F increases with P . A stage comes when P just begins to move the body. At this stage F reaches its maximum value and is equal to the value of P at that instant. After that, if P is increased further, F does not increase anymore and body begins to move.

This shows that friction is self-adjusting, i.e. amount of friction exerted is not constant, but increases gradually from zero to a certain maximum limit.

(2) **Static friction:** When one body tends to slide over the surface of another body and is not on the verge of motion then the friction called into play is called statical friction.

(3) **Limiting friction :** When one body is on the verge of sliding over the surface of another body then the friction called into play is called limiting friction.

(4) **Dynamical friction :** When one body is actually sliding over the surface of another body the friction called into play is called dynamical friction.

(5) **Laws of limiting friction/statical friction/Dynamical friction:**

- (i) Limiting friction acts in the direction opposite to that in which the body is about to move.
- (ii) The magnitude of the limiting friction between two bodies bears a constant ratio depends only on the nature of the materials of which these bodies are made.

(iii) Limiting friction is independent of the shape and the area of the surfaces in contact, so long as the normal reaction between them is same, if the normal reaction is constant.

(iv) Limiting friction f_s is directly proportional to the normal reaction R , i.e. $f_s \propto R$

$f_s = \mu_s \cdot R$; $\mu_s = f_s / R$, where μ_s is a constant which is called coefficient of statical friction.

In case of dynamic friction, $\mu_k = f_k / R$, where μ_k is the coefficient of dynamic friction.

(6) **Angle of friction:** The angle which the resultant force makes with the direction of the normal reaction is called the angle of friction and it is generally denoted by λ .

Thus λ is the limiting value of α , when the force of friction F attains its maximum value.

$$\therefore \tan \lambda = \frac{\text{Maximum force of friction}}{\text{Normal reaction}}$$

Since R and μR are the components of S , we have, $S \cos \lambda = R$, $S \sin \lambda = \mu R$.

Hence by squaring and adding, we get $S = R\sqrt{1 + \mu^2}$ and on dividing them,

we get $\tan \lambda = \mu$. Hence we see that the coefficient of friction is equal to the tangent of the angle of friction.

