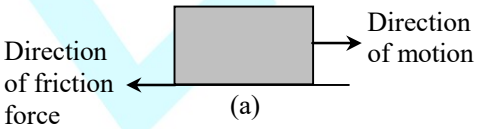
FRICTION

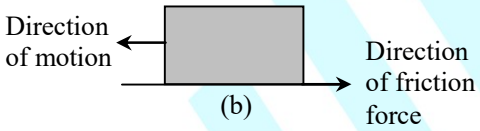
CONTENTS

FRICTION

If the switch off the engine of car it will stop after moving a certain distance. It means that some retarding force is acting on the car which stops it. *The force opposing the motion of the car (body) is called "force of friction".*

- The frictional force is tangential to the surface in contact and always in a direction opposite to the direction of motion of the object.





- Frictional force is a force opposing the relative motion between two surfaces which are in contact with each other.
- The force of friction arises due to the interlocking of irregular projections on the two surfaces and is called as "force of contact".

TYPES OF FRICTION

(A) Static friction (Upto limiting friction) :

The frictional force that exists between the body and the surface so long as they are relatively at rest even when the external force acts, is called the static friction.

- When there is no external force acting on the body, the frictional force is zero.
- If we increase the magnitude of the external force, the static friction also increases.
- At one point, when there is a slight increase in the magnitude of the external force, the body just starts sliding over the surface.
- The force of friction at the limiting stage is called the **'limiting friction.'**
- The limiting friction depends upon the nature of the two surfaces in contact.

(B) Kinetic or Sliding friction :

- When the external force exceeds the limiting friction, the body just starts sliding.

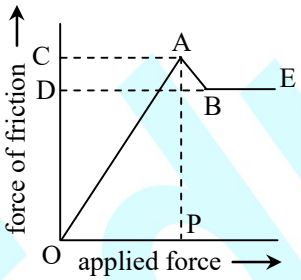
- The minimum force required to maintain the motion of the body over the other surface is called the "kinetic friction".
- The frictional force that exists between the two surfaces when there is a uniform relative motion between them is called the "dynamic friction" or "sliding friction".
- Kinetic friction is smaller than the limiting friction.

(C) Rolling friction :

- The frictional force that exists between the two surfaces when a body rolls over the other is called the "rolling friction".
- It deforms the surface over which it rolls.
- Rolling body it-self gets deformed at the point of contact over the surface.

VARIATION OF FRICTIONAL FORCE WITH APPLIED FORCE

- The part OA of the graph shows that the static friction increases with the increase in applied force.



- The force of friction is maximum at a point A which is equal to AP.
- If the applied force is increased further, the body will continue to be in motion but the force of friction is slightly lesser.
- After this the force of friction remains constant.

  Note : Rolling friction is smaller than sliding friction which in turn is smaller than the limiting friction.

FACTORS AFFECTING FRICTION

The force of friction depends upon the following factors :

- Materials of the bodies in contact.
- Roughness of the surfaces in contact
- Force of friction is independent of the area of the two surfaces in contact.
- The limiting frictional force is directly proportional to the normal reaction.

REDUCING FRICTION

Frictional force can be reduced in the following ways:

- **Use of lubricants :** In machines, friction can be reduced by applying lubricants between the contact surfaces to fill the fine pores or depressions in the surfaces and make them smooth thereby reducing friction.
- **Polishing :** unevenness of the surfaces can be reduced by polishing, thereby reducing the friction.
- **Use of ball bearings :** In rotating machines, shafts are mounted on ball bearings. By doing so, rolling friction occurs lesser than sliding friction, thereby reducing the friction.
- **By streamlining :** Air friction is reduced by designing streamlined bodies of cars or aeroplanes. Similarly, if the bodies of boats and ships are streamlined, friction of water can be reduced.

DISADVANTAGES OF FRICTION

- Wear and Tear : In machine parts like gears, brakes when they come in contact with each other continuously, they wear out gradually, which should be replaced time to time.
- Friction reduces efficiency of the machine.
- Friction in machine produces heat and undesirable noise which damages the machine. To avoid excessive heating, water is circulated in machines generally.

APPLICATIONS OF FRICTIONAL FORCES

- We would not be able to walk if there had been no friction b/w the soles of our shoes and the ground.
- If there had been no friction, the wheels of a car will slip instead of rotating and stop moving. For that we have to increase the friction by making the tyres corrugated to get better grip of tyres on the road. Also, the friction is increased.
- When brakes are applied, the vehicle stops due to the force of friction b/w the brakelining and the drum.
- In the absence of friction, we cannot write on a blackboard with a chalk stick because the chalk stick will slide off the board without leaving any mark on the board.