Friction

FRICTION

FRICTION FORCE

The force acting along the two surfaces in contact which opposes the motion or the tendency of motion of one body over the other is known as the force of friction or frictional force. It acts on both the surfaces in contact.

Reason behind friction

Force of friction arises due to the force of adhesion at the point of contact. Adhesion is the force of attraction between molecules (material) of different kind.

When two rough surfaces come in contact, many contact points are formed. The atoms or molecules present at such points of contact attracts due to adhesive forces which opposes motion of one body over other.

There are two areas of contact- apparent area of contact & actual area of contact.

Factors Affecting Friction

Friction depends on the following:

1. Nature of surfaces.
2. Normal forces (friction forces is directly proportional to normal force between the contact surfaces).
3. Actual area of contact and the apparent (increases with increase in actual area of contact).

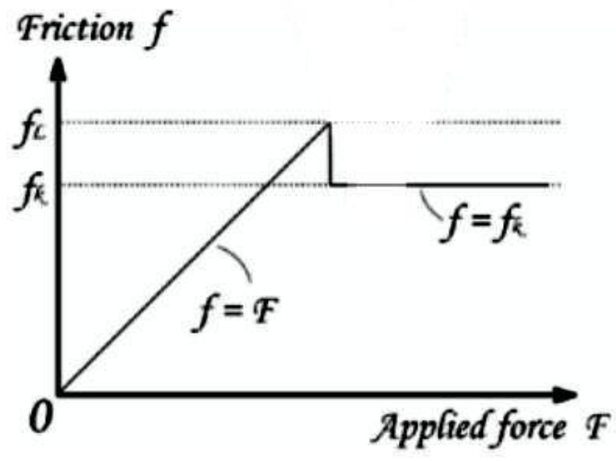
Types of friction

Friction is of three types:

1. Static friction
2. Sliding friction
3. Rolling friction

Static friction is the friction acting when one body is not moving over other body but there is a tendency to move.

Sliding friction is the friction acting when one body is moving over other body. Sliding friction is also known as kinetic friction



Rolling friction acts when body rolls over another rough body.

Friction due to liquid and gases

When a solid moves in a liquid or gas its surface experiences a frictional force. This frictional force exerted by fluids is also known as drag.

It is established that $f_{solid} > f_{liquid} > f_{gas}$

The shape of the body around which fluid (liquid or gas) can easily flow, offering minimum friction is called as streamlined flow.

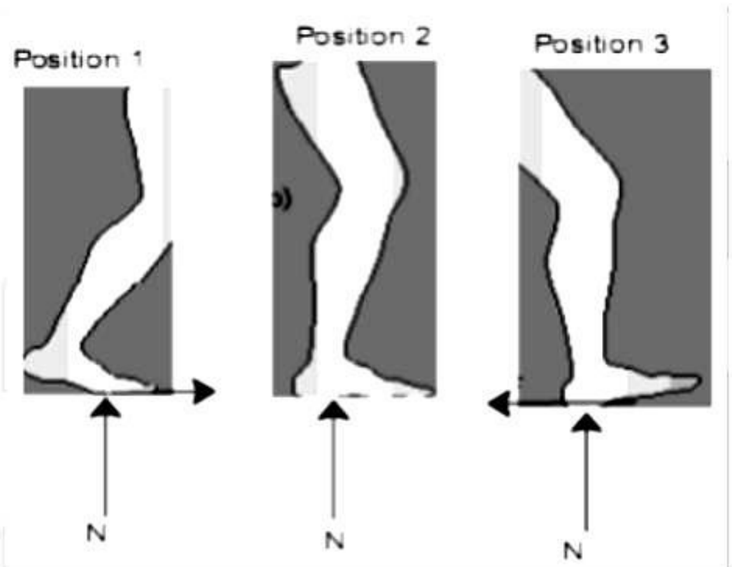
Effects of Friction

i) Friction opposes motion of body over other body,

ii) Friction produces Heat (rubbing of surfaces leads to evolution of heat)

iii) Friction causes wear & Tear.

Friction enables us to walk



In position 1, friction acts on the leg in the forward direction which is the driving force for walking.

In position 2, no friction force acts on the leg.

In position 3, friction acts on the leg in the backward direction which is the decelerating force for stop.

IRUST AND PRESSURE

Thrust

The total force acting normal (perpendicular) to any given area is called as Thrust

Pressure:

When a force acts perpendicularly on a surface and is uniformly distributed over an area A of the surface, then the pressure on the points over the area is defined as pressure.

Hence, pressure is the force acting perpendicularly on a unit area of the object.

Unit of Pressure:

SI unit of pressure is Newton/metre^2 (N/m^2)

Newton/metre^2 is also called Pascal (Pa)

$$1N/m^2 = 1Pa$$

Atmospheric Pressure:

The pressure at any place due to atmosphere is called atmospheric pressure. Its value varies from place to place. The value of atmospheric pressure at the earth's surface near the sea level is approximately 1.01×10^5 Pa, which is also known as 1 atmospheric pressure (atm). Thus atm is the unit of pressure.

1 atm is similar to the pressure that 10^4kgs of mass(mass of atmosphere above us) will exert on 1 m^2 of land. Also, 1 atm = pressure exerted by a mercury column of length 760 mm = 760 mm of Hg

Effects of Force

1) Sets into motion a body at rest
2) Stops a moving body
3) Changes Speed
4) Changes Direction
5) Changes Shape & Size

Classification of Forces

Non Contact	Contact
Magnetic	Muscular
Gravitation	Normal
Electrostatic	Elastic Spring
	FRICTION

PRESSURE

Force per unit area

$$P = \frac{F}{A}$$

Pressure in a liquid

1) Same at same horizontal depth
2) Increases with depth
3) depends on density of liquid
4) Lateral Pressure on wall
5) Measured by MANOMETER

PASCAL'S LAW

Pressure inside a fluid is transmitted equally in an enclosed liquid

Applications of Pascal's law

1) Hydraulic Brakes
2) Press
3) Jacks
4) Lift etc.

Atmospheric Pressure

Pressure due to the weight of atmosphere above us

FORCE

FRICTION

force opposing relative motion between two surfaces

Reasons for friction

Adhesion
Cohesion

limiting friction(maximum value, f_{limit})

$F(external) > f_{limit}$ (motion)
$F(external) \leq f_{limit}$ (no motion & f=F)

Factors Affecting

i) Nature of Surface
ii) Normal forces on the contact surface
iii) Actual area of contact

Types of friction

Static friction(f_s)
Kinetic friction(f_k)
Rolling friction(f_r)

$f_s > f_k > f_r$

Ways to reduce friction

1) Streamlined body
2) Polishing
3) Wheels
4) Lubricating
5) Ball bearing
6) Air Cushion

BUOYANT FORCE

Buoyant Force depends on

i) Volume of Solid Immersed
ii) Density of fluid

Archimedes principle

The apparent loss in weight of a body immersed in a fluid is equal to the weight of the fluid displaced

Buoyant Force(B)= Weight of fluid displaced

W(body)>B
(Sinking)
W(body)<B
(Floatation)
W(body)=B
(Equillibrium)

Apparent Weight= Weight in liquid

$$\text{Relative Density} = \frac{\text{Mass of Substance}}{\text{Mass of equal volume of water}}$$