

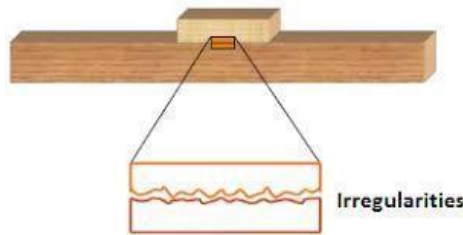
Chapter – 9: Friction

Friction

- Take a ball – role it on floor – stops after some time
- Stop peddling – cycle stops
- Force – stop moving objects
- Some force – acts on objects – change state of motion – moving to rest
- This force – **frictional force** or **friction**
- Contact force
- Ball moves on floor – both surfaces in contact – rub against each other – friction generated
- Friction – opposite direction of motion
- Friction opposes motion
- Objects – overcome friction – keep moving
- Friction – also exists – only contact – no motion
- Brick on floor – make it move – apply force (Muscular) – overcome friction between brick and floor
- More bricks – more friction – more pressure on surfaces

What causes friction?

- Irregularities of 2 surfaces in contact – lock into each other – create friction



- Characteristics –
 - Acts only when contact is there
 - Always opposes the motion
 - Increases when surfaces are pressed harder
 - Causes wear and tear (damage) of surfaces in contact

Types of friction

- Static friction
 - Between 2 surfaces in contact – no relative movement
 - Static friction – force applied at instant (exact time) – object starts to move
 - Heavy box on floor – push it – force applied by you to make it move – static friction
- Sliding friction
 - Between 2 surfaces in contact – in motion
 - Sliding friction – force required to keep the object moving
 - Already moving box – apply force to keep it moving – sliding friction
 - Always less than – static friction – easier to keep it moving than moving a stationary object
- Rolling friction
 - Between 2 surfaces in contact – 1 of them rolling over other
 - Lesser magnitude than sliding friction

- Wheels in suitcase – offer less friction – make it easy to carry luggage
- Type of friction – can be changed
- Ball bearings – convert sliding friction to rolling friction – ensure smooth motion and prevent wear and tear
- Fluid friction
 - Opposes movement within fluids (liquids and gases)
 - Also known as drag
 - Air exerts force on moving objects
 - Cycle stops moving – not only by rolling friction – but also by fluid friction by air
 - Experienced by aeroplane
 - Boat stops when boatmen stops rowing – fluid friction by water
 - Depends on nature of fluid
 - Easier to stir water – harder to stir honey
 - Honey – more thicker or viscous – more friction
 - Depends on speed with respect to fluid
 - Higher speed – higher friction
 - Depends on shape of object
 - Objects shaped – streamlined – require less force to overcome friction

Factors affecting friction

- Magnitude of friction depends on –
 - Nature of surfaces in contact
 - Weight of body
 - Pushing a box on cemented floor – easy – it is smoother – pushing a box on grass – difficult – it is rough
 - Pushing a lighter box – easy – less weight – pushing a heavier box – harder – more weight
 - Force – body presses down the other
 - Take a brick – tie some weight on one end – hang the weight – with a pulley over the edge of table – leave it gently – brick moves some distance
 - Now add some more weight to the hanging weight – bricks move greater distance

Methods of reducing friction

- Friction – opposes motion
- Sometimes – cause wear and tear (damage)
- Methods to reduce friction –
 - Oiling –
 - Make the surfaces smoother – done by oiling (applying oil to surface) – **lubrication**
 - Movement improved – less friction
 - Polishing –
 - Make the surfaces smoother – done by polishing surfaces in contact
 - Streamlining –
 - Object – flowing in water – receive friction from water
 - Object – floating in air – receive friction from air

- Reduce by **streamlining** – narrow in front and back, broad in centre – ships and aeroplane
- All birds – streamline by nature
- All fish – streamline by nature
- Using anti-friction alloys –
 - Steel slides on steel – more friction – steel slides on bronze – less friction
 - Reduce friction by using alloys
- Using air cushions –
 - Reduce friction by – thin cushion of compressed air – between solid surfaces in motion
 - Hovercraft – work on this concept



- Using ball bearings –
 - Try to walk over marbles – you will slip
 - Circular marbles – reduce friction
 - Same concept – used in machines
 - Ball bearings – reduce friction – between moving surfaces
 - Made of ceramic or hard steel
 - Reduce friction by converting sliding friction to rolling friction

Methods of increasing friction

- Sometimes – necessary to oppose motion
- Methods to increase friction –
 - Treading of tyres –
 - Tyres – grooves (design) on the surface – increase friction
 - Tyres do not skid
 - Synthetic rubber – offer lots of friction



- Sanding –
 - Sand – thrown on tracks with snow – increases friction – vehicles do not skid
- Athletes and players – **spikes** on boots – run very fast – do not slip

- Cleaning floors – **hard brushes** – increase efficiency
- Sides of matchboxes – made **rough** – match rubbed – enough friction to light matchstick

Advantages and disadvantages of friction

- Advantages –
 - Helps in walking – friction between foot (sole) and ground – wet floor – you may slip
 - Helps in writing – friction between pen and paper – oily surface of paper – pen may slip
 - Friction produces heat – friction between matchstick and matchbox – matchstick catches fire
 - Wood – friction between wood and axe – wood cut easily
 - Helps in all the daily jobs – opening lid (cap)
- Disadvantages –
 - Parts of machine – wear and tear – continuous friction
 - Sole of shoes after some time – wear off – regular use
 - Friction produce heat – car parts, engines – heat up
 - Moving objects – overcome friction – waste energy