

## 8<sup>th</sup> - Friction



As you already know a rolling ball slows down and stops after sometime. Similarly, if you stop pedalling a bicycle, it slows down and ultimately stops. There is some kind of force that acts on the ball or the bicycle and makes them stop. This force is known as frictional force, or simply friction. The force of friction acts between the ball and the floor (or lawn) and between the cycle and the road. It always tries to prevent movement; because of this the ball and bicycle slows down and then stops. If a body exerts a force on another body, placed in its contact, in a direction parallel to the contact surface, the force is called force of friction. It is always in the direction site to the direction of motion.

**Causes of Friction:** If the two surfaces in contact are smooth, friction is very small. If the surfaces are rough, friction is large. So, we observe that nature of surface (whether smooth or rough) plays a very important role in the origin of friction. It cannot be reduced to zero, how so ever smooth the surfaces may be. This is because a surface that appears to be very smooth to naked eyes may not really be so when examined under a powerful microscope. Under a powerful microscope, you will observe a number of peaks and valleys, called irregularities. When a book is kept on a table, the peaks and valleys of both surfaces interlock. When the book is made to slide on the table, these interlocked points try to hold the book and hence oppose the motion. That is why, sufficient force has to be applied, before one body starts rolling upon the other. More irregularities on the two surfaces, the more rough the surfaces in contact and more is the force of friction.

**Properties of friction:**

1. Friction is produced only when one body is made to move upon another body.)
2. It always tries to prevent movement and tries to stop the body.
3. It wears off the surface of contact of two bodies.
4. It is always in the direction opposite to the direction of motion.

**Types of Friction:** Static Friction      Sliding Friction      Rolling Friction

**Static friction:** when we apply a force on a body to make it move and it does not move, the force applied is balanced by the force of friction. Thus, "the force of friction in static (stationary) situation is self adjusting. Such force of is called static friction"

**Sliding Friction:** the force of friction acting between the two surfaces, when one of them just slides over the other surface with a uniform speed is called sliding friction. Sliding friction is less than the static friction'

**Rolling Friction:** When a body is placed over the other bodies like roller or a wheel and is allowed to move this is called rolling friction. It is same as the sliding friction. So, whenever possible sliding friction can easily be replaced by rolling friction. This can be done by using wheels, roller bearings, ball bearings, etc.

Examples of Rolling Friction:

1. The suitcases and travelling bags are provided with small wheels. These wheels have very small amount of rolling friction which help easy movement of suitcase and travelling bags.
2. Roller skates are having small wheels which offer very small rolling friction and help skater to move fast.

**Friction due to liquids and gases:** liquids and gases also exert friction on the bodies moving through them. However, they offer much less friction as compared to solid surfaces.



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**Friction due to water:** when an object moves through water, it experiences the force of friction. Friction due to water is more than the friction due to air.

Examples:

1. Streamlined Shape: It is a special shape i.e. narrow in front and broader in the middle of a body around which air or water can flow fast easily, offering minimum amount of frictions. The streamlined shape of bodies of fishes and all other marine animals helps them in reducing the force of friction between their body and water through which they move. The friction due to water is important for the movement of boats and ships. This is done so to offer a minimum amount of friction while moving through water.

2. While swimming, a swimmer tries to streamline his body so that he experiences least friction due to water.

3. Since the friction in water is much less than that between solid surfaces, it becomes difficult to apply brakes in ships or boats. To stop a moving boat, the boatman moves his oars in the reverse direction, Similarly, to stop or slow down big ships, their engines are fire opposite direction.

**Friction due to air:** Friction arises even when an object is made to move through air. Examples:

1. The bodies of aeroplanes are made streamlined in order to ensure the minimum friction as they move through air.

2. In nature the bodies of all birds are shaped in a manner that they experience a minimum friction while flying in air and can fly with a lot of speed.

3. All automobiles (motorcycle, car, buses, etc.) and space launch vehicles are specially designed to minimize the effect of friction of air.

4. The most spectacular example of friction of air, is a shooting star or a meteor. Shooting stars are actually stone like objects that enter earth's atmosphere from space. Since they have a very high velocity (speed), so the friction due to air is extremely high. Due to this high friction the temperature of meteors rises to such a high degree that they catch fire and begin to glow. Thus, the heat generated due to the friction of air is so large that they usually get evaporated before reaching the surface of the Earth. Only very large meteors can reach earth's surface; they are meteorites.

**Advantages of Friction:**

1. It helps us in walking and running. When we walk, there is friction between our foot (or of our shoe) and the ground. This prevents you from slipping. If you try to walk on wet floor, you tend to slip because the water reduces the friction between your foot and the floor.

2. It helps us in writing and making drawings. If there were no friction, we would not be able to hold a pen vertically. It is friction that opposes slipping and helps us to hold the pen. Also there is friction between our pen and the paper which prevents the pen from slipping on the paper.

3. Tyres of vehicles are made with special kinds of grooves so that they can move properly on the road. These grooves help to have considerable friction and good grip between the tyres and the road. When a tyre gets old, its surface becomes smooth. Vehicles with worn-out tyres stop after covering a longer distance (when brakes are applied) and hence, there is a greater risk of accident.

4. The force of friction helps to hold the nails and screws on the walls and in the wood.



5. Friction produces heat. A matchstick lights up due to the friction against the side of matchbox when we strike it.
6. Wood can be cut because there is friction between the axe and the wood.
7. Friction helps us to do small jobs like opening the lid of a bottle or the top of a pen. If your hands are oily or if you apply powder to your hands you will not be able to open it. Your hands will slip.
8. The shoes of athletes are provided with spikes so to increase friction and prevent slipping.

### Disadvantages of Friction:

1. When you wear the same pair of shoes for a few months their soles wear out. This happens because of continuous friction.
2. Due to the friction of pencil and chalk while writing they get smaller and smaller. Similarly, continuous use of eraser while making drawings, etc., makes it smaller. While white washing the houses, etc., a painter uses sand paper. This sand paper is worn out and becomes smooth due to its repeated use on walls.
3. Tyres of vehicles wear out due to constant use. Because of continuous friction between tyres and roads the grooves of tyres disappear and tyres become smooth. This can cause serious accidents.
4. In factories where machinery is in use all the time, friction can be a nuisance. Parts of machines which rub against each other become hot and wear out quickly.
5. Since friction also produces heat, the engines of cars and other machinery, therefore, become very hot after running for some time.
6. Energy is wasted in overcoming the force of friction.
7. It is due to the friction between branches of trees which rub against each other, forest fires occur.
8. Friction reduces the speed of moving vehicles to a great extent.

**Friction is a necessary evil:** A matchstick lights up due to friction against the side of matchbox when we strike it. This can destroy houses when catches fire. A tyre of wheel has rough surface to have more of a friction. If there is no friction the vehicle will skid. Friction is necessary for carrying out day to day activities because without this force we cannot set the bodies in motion or stop the moving bodies. On the other hand, friction wastes energy, brings about wear and tear and slows down motion. Thus, we can say that friction is a necessary evil as without it, we cannot do our day -to-day activities and with it we lose energy, speed.

### Methods of reducing Friction:

1. Making surfaces smooth by using lubricant: Moving parts of machines are therefore, made very smooth. For this, the moving parts are covered with oil or grease. By the use of a suitable lubricant, like oil (for light machinery) or grease (for heavy machinery) friction can be reduced. Lubricants may be in solid, liquid or gaseous forms. When a lubricant is used between two moving surfaces its particles get into the uneven parts of the surfaces and make a thin layer of their own between them. As a result, the motion actually occurs between the layers of lubricating material which are relatively smoother. This is helpful because fluid friction is less than solid friction.
2. If you leave your bicycle unused for a month and then ride it, it needs great effort from you. When you put some machine oil on the chain and sprocket-wheel, the bicycle runs with much less effort. This is because, the friction opposes motion





and hence you have to put more effort to move it. The machine oil reduces friction and the bicycle runs more easily.

3. By polishing: The surfaces are highly polished, to eliminate the irregularities. This makes the surfaces smooth and reduces friction to a great extent.

4. By using fine powders: Talcum powder is used as a lubricant. When we sprinkle powder on a carrom board, the depressions on the surface of the board and the coins of carrom get filled with the powder. This makes the surface smoother and reduces friction between the board, the striker and the coins of the carrom.

5. Graphite being very soft solid which can be ground to a very fine state. It is then used as a lubricant in those parts of machines, where it is difficult to apply oil. It reduces friction by filling up unevenness between the surfaces.

6. By streamlining: Friction due to air (air resistance) or water is reduced by using streamlined shapes in aeroplanes or ships. A streamlined shape is narrow in front and broader at the back. All birds have streamlined bodies to ensure minimum friction as they fly through the air. In the same way, ships, boats and fish have streamlined bodies, so that they can move easily in water.

7. By using soap solutions: Soap solutions are used in cutting and grinding machines to reduce friction.

8. Using ball bearings: Ball bearings are used in machines to reduce friction. These are tiny steel balls often placed between moving parts of machines. You might have seen them fitted in the wheels of a bicycle. They reduce friction and save a lot of energy.

9. Using wheels or by converting sliding friction into rolling friction: Use of wheels between surfaces moving over each other reduces friction. We know that rolling friction is very less than the sliding friction between the two surfaces. Due to this reason, many heavy objects, such as suitcases, travelling bags are provided with small wheels, called as rollers. The rollers reduce friction and help in moving heavy objects easily from one place to another.

### Methods of increasing friction

1. By making the moving surfaces rough: Tyres of vehicles have designed with grooves on the surface to increase friction. A large friction provides a better grip to vehicles on the road and prevents them from skidding.

2. By increasing roughness of surfaces: The surface of a matchbox and the head of the matchstick are deliberately made rough to increase friction.

3. During rains the ground become slippery. So, sand and gravels are spread on grounds to increase friction.

4. You must have seen the spikes in the soles of shoes used by players and athletes. This is done only to increase friction.