Friction

Improve your learning

Q. 1. Do you agree with the statement, "Friction is both good and an evil"? Explain with examples.

Answer : Yes, friction is both good and bad.

Friction is advantageous:

1. While walking as without friction it would be difficult for us to step on the ground

2. In the movement of vehicles on road.

3. In holding a pencil while writing.

Friction is disadvantageous:

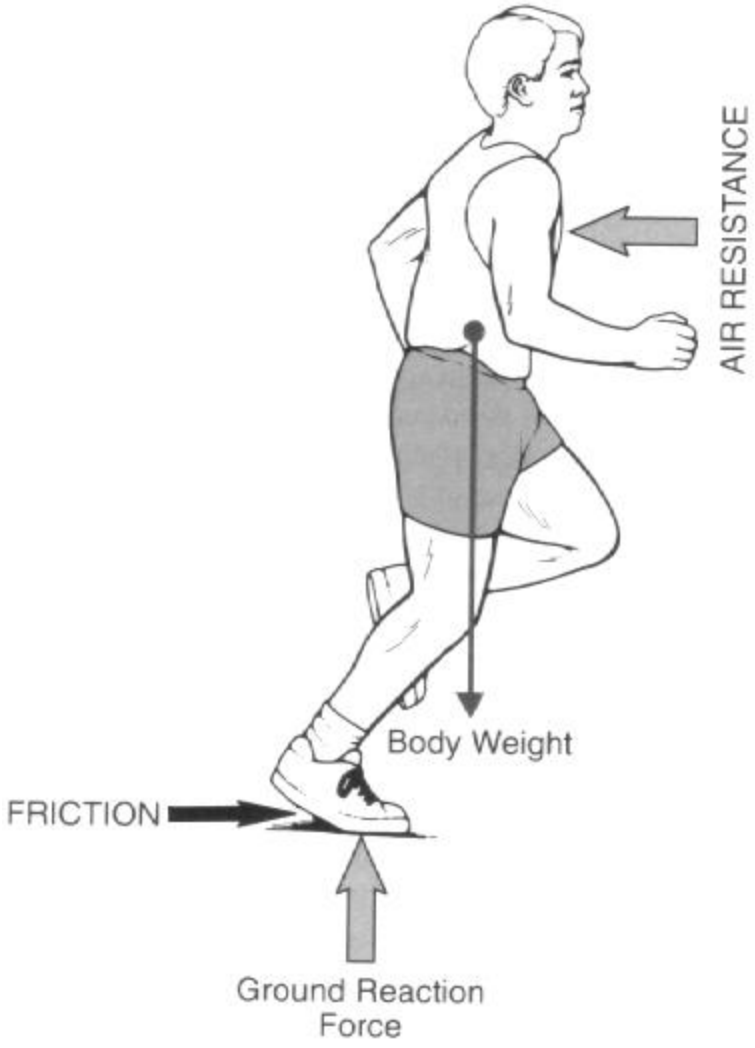
1. As more work is to be done while movement of an object.

2. Due to friction, there will be wear in machines. As a result, their life and efficiency get reduced.

Q. 2. Explain why sportsmen use shoes with spikes?

Answer : The spikes in shoes increase the interlocking between the shoes and rough surface of the ground increasing the friction between the two surfaces. This decreases the chances of slipping at the surface to a great extent and increases the grip between the shoes and the ground. Fast movement becomes easier as the grip increases. Therefore sportsmen use shoes with spikes.

Below is a diagram of a sportsperson along with the forces acting on him:



Q. 3. Would it be easier or more difficult for you to walk on soapy water on the marble floor? Why?

Answer : When we walk on the floor, the friction acts opposite to the motion as shown in the figure below.

On a marble force, the surface is rough. And, we know rough surface offers more friction. But, on a soapy floor, the soap acts as a lubricant and the lubricant decreases the friction between the shoe & the floor.

So, people tend to slip on a marble floor covered with soapy water.

Q. 4. What ways do you suggest to reduce friction?

Answer : Friction can be reduced by:

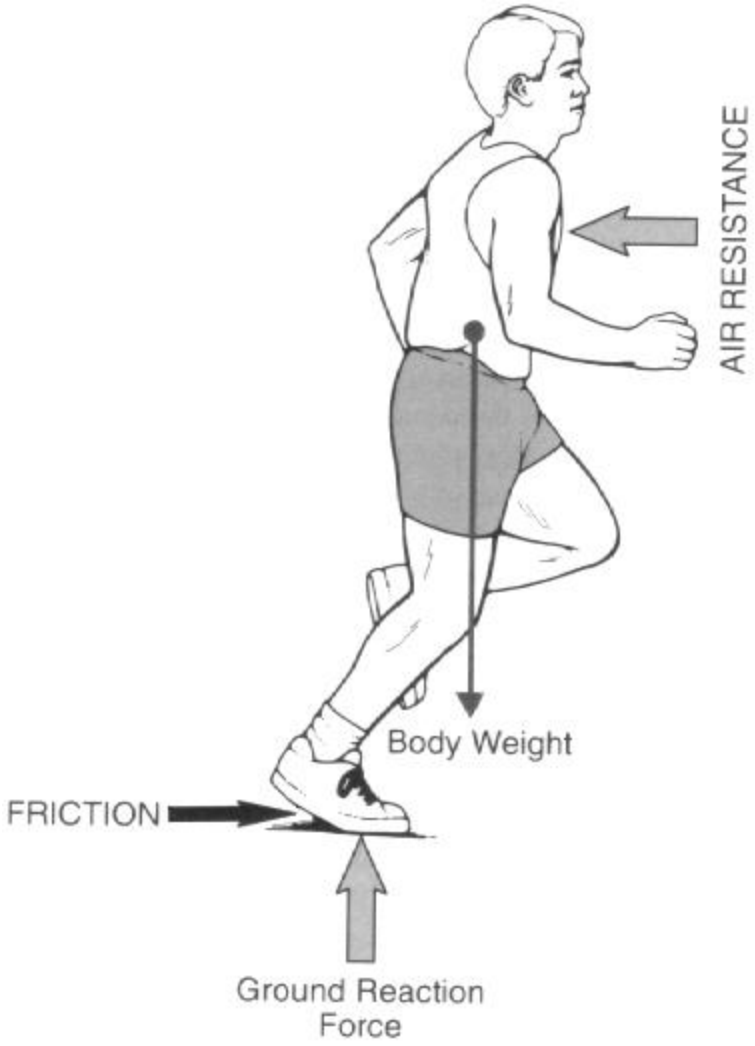
1. Making the rough surfaces smooth – When the interacting surfaces are rough, the interlocking between these surfaces is more and as a result there is an opposition to advancement of the object (i.e. friction). If the surface is made smooth, the interlocking between the surfaces decreases and as a result opposition to the movement of the body decreases. This reduces friction.

2. Adding lubricant to a rough surface – Lubricant serves as a medium that prevents interlocking between the surfaces by filling up the gaps, thereby reducing friction.

3. Making the objects more streamlined- When objects move, the air around them drags them. To prevent this we make the surfaces curved so that they cut through the air this, reducing the drag(i.e. friction).

4. Reducing forces acting on the surface- Friction is directly proportional to the normal force acting on the object. So by reducing the forces acting on the object, normal force can be reduced and as a result, friction also reduces.

Example, the forces acting on a sportsperson:



5. <u>Reducing contact area between the surfaces</u>- If the contact area between the surfaces is reduced, the interlocking between surfaces is reduced. As a result, the opposition to movement is reduced and friction reduces.

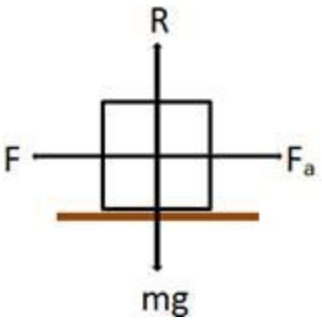
Q. 5. What conditions are needed for static friction to come into play?

Answer : Conditions required for static friction to come into play are:

1. A force needs to be applied to the object being considered.

2. The applied force should not be able to move the object. It should be less than maximum static friction.

Consider an object M of mass m kg. Consider a force F acting on the object.



In the above figure, F_a is the frictional force on the object.

For static friction to exist, $F_a > F$.

Q. 6. Give examples of practical application of static friction.

Answer : Static friction comes into play when

1. Tyres gain grip which is also known as the attraction between the drive wheel and the road surface.

2. Consider a person climbing a 'chimney', which is a gap between two stone walls, with no hand holds or grips, but plenty of friction as shown in the figure below.

Here the friction is increased by increasing the normal force between the person and the walls. As the normal force increases friction also increases as

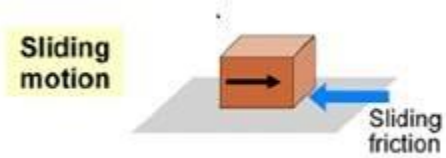
Frictional force = friction coefficient × normal force

Q. 7. Give examples showing the existence of sliding friction.

Answer : Sliding Friction: Sliding friction is also known as kinetic friction, or moving friction, and is defined as the force that is required to keep a surface sliding along another surface.

Examples of sliding friction are:

1. A block being slid across the floor or an inclined surface.



2. Heat produced while rubbing hands is due to sliding friction.

Rubbing your hands together is an example of friction. The friction causes the hands to slow down as they are rubbed and this generates heat.

Heat is created whenever there is friction.

Q. 8. Explain how can you measure frictional force?

Answer : Frictional force can be measured by spring balance method.

SPRING BALANCE METHOD:

1. Place a wooden block on a table and connect it to a spring balance. Ensure that the spring is parallel to the table.

2. Pull the spring balance slowly until the block begins to slide.

3. The load on the spring balance when the block begins to slide is a measure of the static friction.

4. The reading on the spring balance when the block continues to slide is a measure of the sliding friction.

5. We can also measure the coefficient of friction ;

μ = spring force/normal force.

(OR)

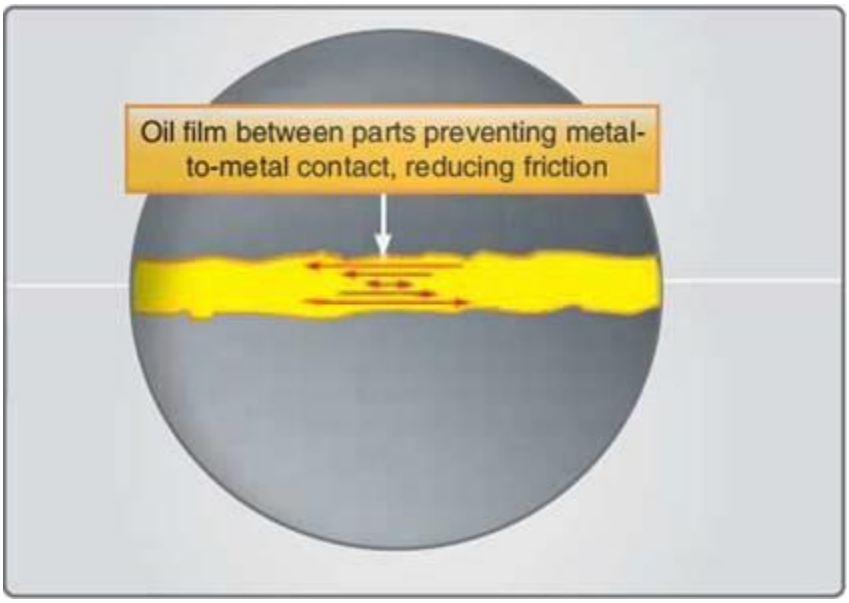
Frictional force can be measured if we know he friction coefficient of a surface. Consider a surface having a coefficient of friction as μ.

Frictional force = μ × Normal force acting on the surface (load)

Q. 9. Explain how does lubrication reduce friction?

Answer : Friction comes into play when two bodies in relative motion come in contact with each other.

Friction restricts the relative motion between two bodies in contact. This is due to uneven surfaces which discourage smooth motion. But when a lubricant is added it fills in the uneven surface making it smooth. So frictional force between two surfaces gets reduced.

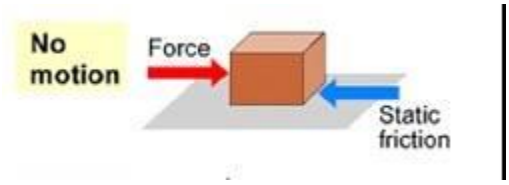


In the above figure, the lubricating oil fills the rough gaps between the two surfaces making them smooth.

Q. 10. What kinds of friction do you know?

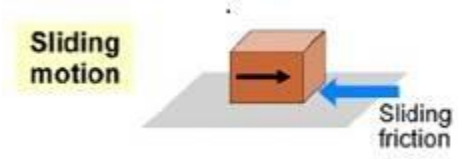
Answer : There are three kinds of friction:

1. <u>Static friction:</u> It is a force acting on the surface which keeps the object at rest when acted upon by an external force which tends to move the object across the floor.



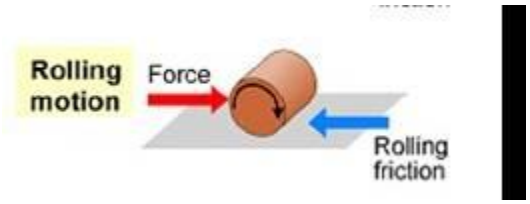
Example: Holding a wooden block against a wall by applying force perpendicular to the wall. Here the block stays at rest until a perpendicular force acts on the block and is set into motion once the force is removed. While the block is at rest, the friction acting is known as static friction.

2. <u>Sliding friction:</u> Once the object is set in motion, it experiences sliding friction.



Example: A block being slid across a slant surface experiences sliding friction.

3. <u>Rolling friction:</u> It is a type of frictional force resisting the motion when a body rolls on a surface.



Example: The friction between car wheel and the road is called rolling friction and it is responsible for halt of the car when the tyres of the car are not driven by the engine.

Q. 11. Explain why sliding friction is less than static friction?

Answer : Static friction is less than sliding friction as in sliding friction, the object does not move. So the interlocking between the two rough surfaces is more. When a body starts moving the time for interlocking gets reduced. As a result sliding friction is less than static friction.

Q. 12. Give examples of how is friction responsible for energy wastages? Give suggestions to reduce energy wastages by friction.

Answer : Friction resists the relative motion between two bodies. So greater the resistive force, lesser is the amount of work done. This leads to wastage of applied with the intent of having some work done b the object.

Examples:

1. Overheating of the engine of vehicles. The friction in the engine is responsible for producing heat (Total energy remains constant according to Law of Conservation of Energy. So the amount of energy which is not being used to do work is getting converted into heat energy.)

2. Friction also causes wear and tear of moving parts of a device. Materials get torn away at the surfaces because of the movement between rough and uneven surfaces.

Suggestions to reduce energy wastages:

1. Friction can be reduced by using lubricating oil between two rough surfaces to make them smooth.

2. We know that rolling friction is lesser than kinetic friction. So wheels can be attached to a moving object to convert the kinetic friction into rolling friction.

Q. 13. Seetha is observing a moving bus with the luggage on its top. As the bus is moving slowly there is a change in the state of luggage on its top. But when the bus speeds up and starts moving fast, she noticed that the luggage on the top of the bus fell to the back of the bus. This raised many doubts in her mind regarding the effect of a frictional force acting on the luggage as well as on the tyres of the bus. Can you guess the questions raised in her mind? Write them.

Answer : The questions raised in her mind might be:

1. How does friction affect the luggage on the bus?

2. What is the kind of friction when the bus is moving slowly?

3. What is the kind of friction when the bus is moving rapidly?

4. What effect does friction have on tyres of the bus?

Q. 14. Collect information either from the internet or from books in the library, about various new techniques being adopted by human beings to reduce energy losses due to friction. Prepare a note on that.

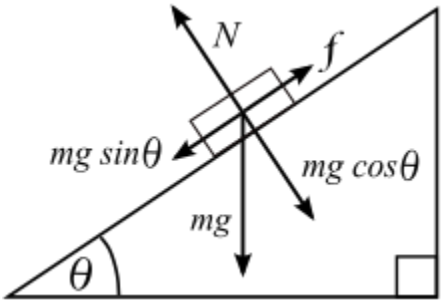
Answer : 1. Lubrication of surfaces by filling the rough uneven surfaces by a suitable lubricant reduces friction. Common lubricants are oils, powders etcetera.

2. Smoothening of the surface also helps in reducing the energy losses due to friction. This is because the interlocking between the surfaces reduce when they are smoothened. As a result of the force required to overcome friction reduces.

3. By using bearings and wheels, sliding friction can be converted to rolling friction which is much lesser than the latter.

Q. 15. Draw a free body diagram (FBD) to show various forces acting on a body which is sliding on an inclined plane.

Answer :



In the above figure

Mg = weight of the object.

N= Normal force due to a component of weight of the object

F = frictional force

Q. 16. "Reducing friction to the lowest possible level in machine tools solves the problem of the energy crisis and conserve biodiversity". How do you support the statement? Explain?

Answer : We know that friction increases the wastage of energy in devices. More is the friction, more energy is used to make the device overcome friction to do some work. If a device is run by fuel then in case of excess friction, it requires huge amounts of fuel to provide more energy. By lessening the frictional force, it is possible to reduce energy consumption thus paving way for conservation of biodiversity. (As fuel is obtained from trees and fossils.)