

What is Frictional Force?

Friction is the force that resists motion when the surface of one object comes in contact with the surface of another. The mechanical advantage of a machine is reduced by friction, or in other words, the ratio of output to input is reduced because of friction. An automobile uses one-quarter of its energy on limiting friction. Yet, it is also friction in the tires that allows the car to stay on the road and friction in the clutch that makes it possible to drive. From matches to machines to molecular structures, friction is one of the most significant phenomena in the physical world. In this article, let us discuss frictional force and its different types.

What Is Frictional Force?

Frictional force is the force generated by two surfaces that contact and slide against each other.

A few factors affecting the frictional force:

- These forces are mainly affected by the surface texture and the amount of force impelling them together.
- The angle and position of the object affect the amount of frictional force.
- If an object is placed flat against an object, then the frictional force will be equal to the object's weight.
- If an object is pushed against the surface, then the frictional force will be increased and becomes more than the weight of the object.

Calculating the Force of Friction

The maximum amount of friction force that a surface can apply upon an object can be easily calculated with the use of the given formula:

$$F_{\text{frict}} = \mu \cdot F_{\text{norm}}$$

To help you calculate the frictional force, here we have provided methodical steps to follow while calculating the force of friction.

- **Find the Normal Force**

The normal force is the support force exerted upon an object that is in contact with another stable object. The normal force can be simply described in most cases by the following formula:

$$N = mg$$

In this formula, m describes the object's mass, and g stands for the acceleration due to gravity. In the case of an inclined surface, the strength of the normal surface is reduced the more the surface is inclined, hence the formula becomes:

$$N = mg \cos(\theta)$$

θ represents the angle to the surface is inclined to. In a simple calculation, you would calculate the normal force of a 2-kg block of wood sitting on a surface as $N = 2 \text{ kg} \times 9.8 \text{ N/kg} = 19.6 \text{ N}$

- **Finding the Right Co-efficient**

The co-efficient you choose depends on the object and the specific situation. If the object isn't moving across the surface, you use the coefficient of static friction

but if the object under consideration is moving, you use the coefficient of sliding friction

The type of materials used also affects the co-efficient. For example, if a block was on a brick surface, the coefficient would be 0.6, but if it were on a block of clean wood, it would range from 0.25 to 0.5.

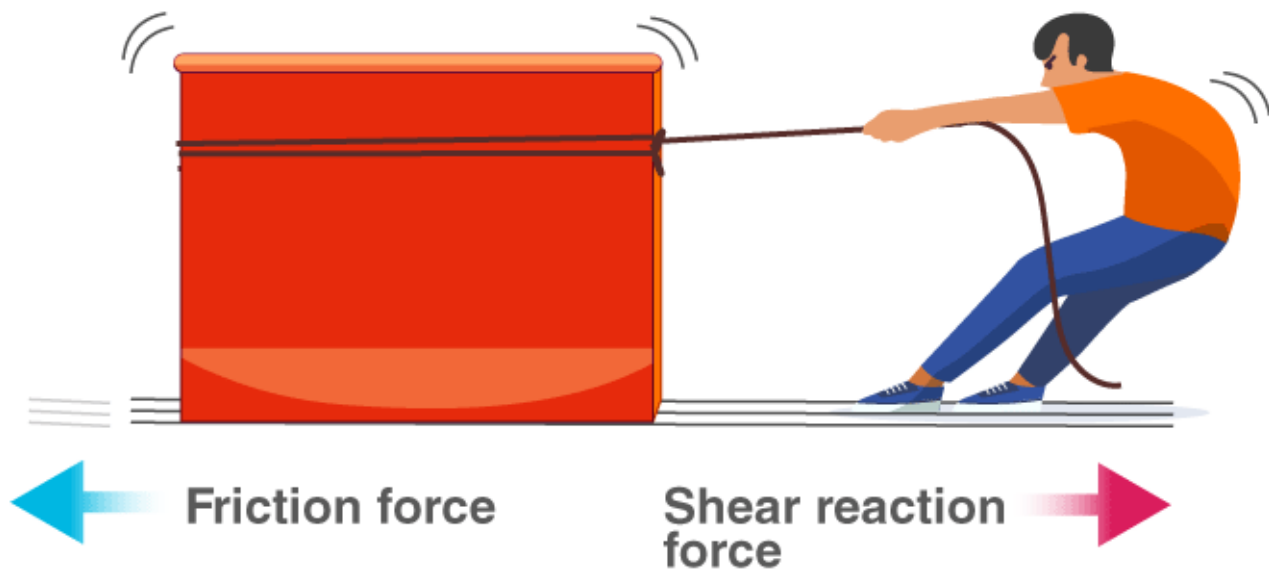
- **Calculating Frictional Force**

As discussed, the formula for frictional force is given by $F = \mu N$.

As an example, let us consider the block of wood that weighs 2-kg resting on a table to be pushed from rest. In this case, we consider the static friction coefficient. 0.5 is the static coefficient of wood.

With the given details, we can calculate the normal force as $N = 2 \text{ kg} \times 9.8 \text{ N/kg} = 19.6 \text{ N}$ Now that we have the values of normal force and static friction co-efficient, we can calculate the frictional force as follows:

$$F = 0.5 \times 19.6 \text{ N} = 9.8 \text{ N}$$



Are there Different Types of Frictional Force?

Yes, there are different types of frictional forces. The friction that takes place between solid surfaces is classified as **Static**, **Kinetic**, **Rolling**, and **Sliding Friction**. The friction that takes place between fluids and gases is termed as fluid Friction. Hence, friction is broadly classified as:

- Dry Friction
 - Static Friction
 - Kinetic Friction
 - Rolling Friction
 - Sliding Friction
- Fluid Friction

Dry Friction

Dry friction describes the reaction between two solid bodies in contact when they are in motion (kinetic friction) and when they are not (static friction). Both static and kinetic friction is proportional to the normal force exerted between the solid bodies. The interaction of different substances is modelled with different coefficients of friction. By this, we mean that certain substances have a higher resistance to movement than others for the same normal force between them. Each of these values are experimentally determined.

Fluid Friction

Fluid Friction is the force that obstructs the flow of fluid. It is a situation where the fluid provides resistance between the two surfaces. If both surfaces offer high resistance, then it is known as high viscous and, generally, we call them greasy.

Examples of Fluid Friction

1. To avoid creaking sounds from doors, we lubricate the door hinges, which leads to the smooth functioning of door hinges.
2. When you drop the ball in a full bucket of water, water splashes out of the bucket, and this is all because of the buoyancy of fluid.

Problems on Frictional Force

1. A large block of ice is being pulled across a frozen lake. The block of ice has a mass of 300 kg. The coefficient of friction between two ice surfaces is small: $\mu_k = 0.05$. What is the force of friction that is acting on the block of ice?

Solution: On a flat surface, the normal force on an object is given by $N = mg$.

With this, we can find the force of friction as follows:

$$F_f = \mu N$$

$$F_f = \mu mg$$

Substituting the values in the above equation we get,

$$F_f = 0.05 \times 300 \text{ kg} \times 9.8 \text{ m/s}^2$$

$$= 147 \text{ kg-m/s}^2 \text{ or } 147 \text{ N.}$$

The friction force acting in the opposite direction as the block of ice is pulled across the lake is 147 N.

2. A man has to push his boat on the shore across the mud to get to the water. The coefficient of friction between the boat and the mud is given by $\mu = 0.400$. If the boat has a mass of 40 kg, calculate the magnitude of the force of friction acting on the boat.

Solution: On a flat surface, the normal force on an object is $N = mg$.

Using this, we can calculate the force of friction as follows:

$$F = \mu N \quad F = \mu mg \quad \text{Substituting the values in the equation, we get } F = (0.400)(40.0 \text{ kg})(9.80 \text{ m/s}^2)$$

$$F = 156.8 \text{ N}$$

The frictional force acting on the boat is 156.8 N.

Frequently Asked Questions – FAQs

Q1

State true or false: Surface texture affects the friction force.

True.

Q2

What is the formula to calculate the frictional force?

The frictional force is given by the formula: $F = \mu N$

Q3

What is fluid friction?

The friction that takes place between fluids and gases is known as fluid friction.

Q4

What is static friction?

The friction experienced when individuals try to move a stationary object on a surface without actually triggering any relative motion between the body, and the surface is known as static friction.

Q5

Is frictional force a scalar or a vector?

The frictional force is a vector since it involves both magnitude and direction.

Veerapandian.K

Assistant Professor/Mech

www.pandianprabu.weebly.com