Section 2: Friction

Friction is needed to move. Without friction, a car would sit in one spot spinning its tires, and a person would not be able to step forward. However, the motion of an object along a surface with friction, causes the production of heat, loss of mechanical energy, and general wear and tear on the object.

Two objects in contact make microscopic connections at various points on their surface. Because the contact points are so close to each other, intermolecular forces form **microscopic welds** that must be broken in order for objects to move. As the object moves, these welds form and break along the length of the path.

Frictional forces are forces that act to oppose the direction of motion. These forces act parallel to the surface. The **magnitude of the frictional force** is determined by the types of materials in contact and by the normal force exerted by one object on the other.

There are two main types of friction:

1. **Static friction or starting friction** - It is this force which must be overcome just before an object starts to move.

2. **Kinetic friction** - It is this force which must be overcome for any object to continue to move.

   There are three type of kinetic friction:

   A Sliding friction - This is the force that makes it difficult to slide one object over another.

   B Rolling friction - This is the force that opposes the rolling motion of one surface over another.

   C Fluid friction - Air and water resistance that opposes the motion of boats and planes.

The theory of frictional forces states that an object at rest experiences more friction than when it is already moving. Thus, **static friction is greater than kinetic friction.**

Coefficient of Friction

It is a number used to calculate the force of friction acting on a sliding object.

$$\mu = \frac{F_f}{F_N}$$

where: μ is the coefficient of friction (no units)
F_f is the force of friction in Newtons
F_N is the normal force in Newtons

μ is determined by the two materials in contact and their smoothness and cleanness and by the force pushing the two surfaces together (normal force).

Since there are two types of friction, there are two types of coefficients for friction. The **coefficient of static friction (μ_s)** is larger than the **coefficient of kinetic friction (μ_k)**. Although both μ_s and μ_k can be substituted in the same equation, $F_f = \mu F_N$.