

Frictional Force

Frictional force is the resistance force that occurs when two surfaces interact as they move or attempt to move past each other. We classify friction forces into two main types. They are static friction and kinetic friction.

1. Static Friction: Prevents motion between two surfaces that are not moving relative to each other.

2. Kinetic (Sliding) Friction: Acts between surfaces in relative motion.

Properties

- Dependent on the nature of the surfaces and the normal force pressing them together.
- Converts kinetic energy into thermal energy (heat).

Examples:

- Pushing a book across a table.
- Car tires gripping the road.

Concept of Mechanical Work

Mechanical work is done when a force applied to an object causes displacement in the direction of the force. Work is a scalar quantity. The SI unit of work is the Joule (J), where 1 Joule is equivalent to 1 Newton-meter (N·m). Mathematically, work (W) is defined as the product of the force (F) and the displacement (S) in the direction of the force.

- The formula is $W = F \cdot S \cdot \cos(\theta)$,

where θ is the angle between the force and the direction of displacement.

- If the force and displacement are in the same direction, $\theta = 0$ and $\cos(0) = 1$, so $W = F \cdot S$
- If the force is perpendicular to the direction of displacement, no work is done because ($\theta = 90^\circ$) and $\cos(90^\circ) = 0$ so $W = 0$.

Example: A person pushes a 10 kg box with a force of 20 N across a floor for a distance of 5 meters in the direction of the force.

given values:

- Force, $F = 20\text{N}$
- Displacement, $S = 5$
- Angle, $\theta = 0^\circ$ (since the force and displacement are in the same direction)

Required values: $W=?$

Solution: $W=F \cdot S \cdot \cos(\theta)$

- $\cos(0^\circ)=1$
- $W=20\text{N} \cdot 5\text{m} \cdot 1$
- $W=100\text{J}$

Result:

- The person does 100 Joules of work in pushing the box.