

Physical Sciences, Grade 10, Mechanical Energy

1. Introduction to Mechanical Energy

Mechanical energy is the total energy possessed by an object due to its motion (kinetic energy) and position (potential energy). It is a scalar quantity and plays a key role in the study of motion and conservation laws.

2. Kinetic Energy (E)

Kinetic energy is the energy an object has because of its motion.

Formula: $E = \frac{1}{2}mv^2$

Where:

- m: mass in kilograms (kg)
- v: velocity in meters per second (m/s)

The faster an object moves, the more kinetic energy it has.

3. Gravitational Potential Energy (E)

Potential energy is the stored energy of position possessed by an object.

Gravitational potential energy depends on the object's height above a reference point.

Formula: $E = mgh$

Where:

- m: mass in kilograms (kg)
- g: gravitational acceleration (9.8 m/s² on Earth)

- h: height in meters (m)

4. Mechanical Energy (E)

Mechanical energy is the sum of kinetic and potential energy:

$$E = E_k + E_p$$

This energy can transform from one form to another, but the total remains constant in a closed system.

5. Conservation of Mechanical Energy

“In the absence of friction or external forces, the total mechanical energy of an object remains constant.”

Formula:

$$E_m (\text{initial}) = E_m (\text{final})$$

$$E_k (\text{initial}) + E_p (\text{initial}) = E_k (\text{final}) + E_p (\text{final})$$

This principle allows us to solve problems involving free fall, pendulums, or rollercoasters.

6. Real-World Examples and Scenarios

- A falling apple: loses potential energy, gains kinetic energy.
- A ball thrown upward: loses kinetic energy, gains potential energy.
- A pendulum: swings back and forth, energy shifts between forms.
- A child on a swing: kinetic at the bottom, potential at the top.