

Chapter 10: Work and Energy

◆ 1. Work

Definition:

Work is said to be done when a force is applied on an object and the object is displaced in the direction of the force.

Formula:

$$\text{Work} = \text{Force} \times \text{Displacement} \times \cos\theta$$

- $W = F \cdot d \cdot \cos\theta$
 - SI unit: **Joule (J)**
 - Work is **positive** if force and displacement are in the same direction.
 - Work is **zero** if displacement is zero or perpendicular to the force.
 - Work is **negative** if force and displacement are in opposite directions.
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◆ 2. Energy

Definition:

Energy is the capacity to do work.

- SI unit: **Joule (J)**

Types of Mechanical Energy:

1. **Kinetic Energy (K.E.):**
 - Energy possessed by a body due to its motion.
 - Formula: $KE = \frac{1}{2}mv^2$
 2. **Potential Energy (P.E.):**
 - Energy possessed by a body due to its position or configuration.
 - Formula: $PE = mgh$
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◆ 3. Work-Energy Theorem

- The work done by a force on an object is equal to the change in its kinetic energy:

$$W = \Delta KE$$

◆ 4. Power

Definition:

Power is the rate at which work is done or energy is transferred.

$$P=Wt$$

- SI unit: **Watt (W)**
- 1 Watt = 1 Joule/second

Larger Units:

- 1 kilowatt (kW) = 1000 W
 - 1 megawatt (MW) = 1,000,000 W
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◆ 5. Commercial Unit of Energy

- 1 kilowatt-hour (kWh) = 1000 watts \times 3600 seconds = **3.6×10^6 J**
 - Used by electricity boards to charge for power consumption.
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◆ 6. Law of Conservation of Energy

- Energy can neither be created nor destroyed; it can only be transformed from one form to another.
- Total energy remains constant.