CBSE Class 9 Science (Physics) — Exploration Book

Academic Session: 2026–2027 | **Chapter 7:** Work, Energy, and Simple Machines

1. Chapter Introduction

In our daily lives, terms like "working hard" or "studying for hours" are often associated with physical or mental fatigue. However, in Physics, **Work** has a very specific, strict scientific meaning. A person holding a heavy suitcase for hours may feel exhausted, but in Physics, **zero work** is done if the object does not move!

Along with Work, this chapter explores **Energy** (the capacity to do work) and **Simple Machines** (devices that make our work easier). By the end of this chapter, you will understand energy transformations, simple machines, and how to solve numerical problems based on the Law of Conservation of Energy.

2. Learning Objectives

- Define **Work** scientifically and identify conditions necessary for work to be done.
- Calculate work done by a constant force using $W = F \cdot s$.
- Differentiate between **Positive**, **Negative**, and **Zero Work**.
- Define **Energy** and distinguish between Kinetic and Potential Energy.
- State and apply the **Law of Conservation of Energy**.
- Understand **Power** and compute the rate of doing work.

3. All Important Definitions

- **Work:** Said to be done when a force acts on an object and the object is displaced in the direction of the applied force.
- **Energy:** The capacity or ability of a body to do work.
- **Kinetic Energy:** The energy possessed by an object due to its state of motion.
- **Potential Energy:** The energy possessed by an object due to its position, shape, or configuration.
- **Power:** The rate of doing work or the rate of transfer of energy.
- **1 Watt (W):** The power of an agent that does work at the rate of 1 Joule per second.

4. Important Formula Box

Physical Quantity	Symbol	Formula	SI Unit
Work	W	$W = F \cdot s$	Joule (J) or $\text{N}\cdot \text{m}$
Kinetic Energy	E_k	$E_k = \frac{1}{2}mv^2$	Joule (J)
Potential Energy	E_p	$E_p = mgh$	Joule (J)
Power	P	$P = \frac{W}{t}$	Watt (W)

5. Formula Derivations

Derivation of Kinetic Energy ($E_k = rac{1}{2}mv^2$)

Let an object of mass m be at rest ($u = 0$). A constant force F acts on it, producing acceleration a, and the velocity becomes v after displacement s.

$$v^2 - u^2 = 2as \implies s = rac{v^2}{2a}$$

$$W = F imes s = (ma) imes \left(rac{v^2}{2a} ight) = rac{1}{2}mv^2 \implies E_k = rac{1}{2}mv^2$$

6. Solved Numerical Problem

Problem: Find the work done when a force of $20 ext{ N}$ displaces an object by $5 ext{ m}$ in the direction of the force.

Solution:
Given: $F = 20 ext{ N}$, $s = 5 ext{ m}$
Formula: $W = F imes s$
Calculation: $W = 20 imes 5 = 100 ext{ J}$
Answer: $100 ext{ Joules}$

7. Exam Tips & Common Mistakes

- TIP Always write formulas first, substitute values with proper SI units, and underline final answers.
- MISTAKE Assuming work is done whenever a person feels physically tired. Remember: physics requires physical displacement!