

SINDH TEXTBOOK BOARD • UNIT 8

Energy Sources and Transfer of Energy

Comprehensive study of work, mechanical energy forms, conservation laws, and regional power sources in Sindh.

Key Learning Objectives



Work & Mechanical Energy

Master force-displacement relations, kinetic energy, and potential energy calculations.



Renewable Power

Evaluate solar, wind, biomass, and geothermal energy harnessing techniques across Sindh.



Efficiency & Power

Compute system power ratings, conversion losses, and real-world numerical problems.

Work and Energy Fundamentals

Definition of Work (\$W\$)

Work is done when a force applied on an object displaces it in the direction of the applied force.

Capacity for Work

Energy is fundamentally defined as the internal capacity of a physical body to perform work.

MATHEMATICAL FORMULA

$$W = F \times S \times \cos(\theta)$$

S.I. Unit:

Joule (J)

Quantity Type:

Scalar Quantity

Dimensions:

$[ML^2T^{-2}]$

Mechanical Energy Forms



Kinetic Energy (K.E.)

Energy possessed by a body due to its active state of motion.

$$K.E. = \frac{1}{2} m v^2$$



Potential Energy (P.E.)

Energy stored within a body due to its positional elevation or structural configuration.

$$P.E. = m \cdot g \cdot h$$

Major Forms of Energy



Thermal Energy

Total kinetic motion of atoms and molecules within matter.



Electrical Energy

Directed flow of electric charge carriers through conductors.



Radiant Energy

Electromagnetic waves emitted by luminous solar sources.



Sound Energy

Longitudinal mechanical pressure waves traveling through media.



Nuclear Energy

Binding energy stored deep within subatomic atomic nuclei.



Chemical Energy

Potential energy stored within intermolecular chemical bonds.

Conservation of Energy

Universal Law

"Energy can neither be created nor destroyed, but it can be transformed from one form into another, keeping the total energy of an isolated system constant."

Example 1: Freely Falling Body

At maximum height, P.E. is 100%. During descent, gravitational potential energy steadily converts into kinetic energy.

Example 2: Hydroelectric Power Station

Water P.E. in reservoirs converts to turbine K.E., subsequently driving generators to output electrical energy.

Classification of Energy Sources



Renewable Sources

Inexhaustible natural resources that replenish continuously.

- ✓ Solar radiation harnessing
- ✓ Wind turbines (e.g., Jhimpir, Sindh)
- ✓ Geothermal and Biomass fuels



Non-Renewable Sources

Finite fossil reserves that take millions of years to form.

- ✗ Coal reserves (Thar coalfields)
- ✗ Petroleum and natural gas
- ✗ Nuclear fission fuels (Uranium)

Solar and Wind Technologies



Photovoltaic & Thermal

Solar panels utilize semiconductor silicon wafers to convert incident photon radiation directly into direct current (DC) electricity.



Wind Turbine Generators

Air masses moving due to differential thermal heating drive massive turbine blades, turning internal electromagnetic generators.

Power and System Efficiency

Power Definition

Power is defined as the time rate at which work is executed.

$$P = W / t = F \cdot v$$

Efficiency Formula

Ratio of useful energy output relative to total energy input.

$$\eta = (\text{Output} / \text{Input}) \times 100\%$$

Board Exam Numerical Practice

Problem 1: Kinetic Energy

Calculate the K.E. of a vehicle with mass 1000 kg moving at 20 ms^{-1} . **Ans: 200,000 J**

Problem 2: Potential Energy

A mass of 5 kg is hoisted to a height of 10 m . Compute its P.E. ($g = 10\text{ ms}^{-2}$). **Ans: 500 J**

Problem 3: Engine Power

An engine performs 5000 J of work in 10 seconds . Find its operating power rating. **Ans: 500 W**

Unit Review Summary

✓ Work & Mechanical Energy

Mastered definitions of work, scalar nature, kinetic energy, and potential energy formulations.

✓ Conservation Laws

Understood total energy constancy and interconversion in dynamic mechanical systems.

✓ Energy Sources

Evaluated renewable solar/wind solutions versus finite non-renewable fossil fuel reserves.

✓ Power & Efficiency

Practiced calculating practical wattage ratings and useful system conversion efficiencies.



Questions & Discussion

Prepare your review questions for the upcoming Karachi Edu
Physics board examination coaching session.

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