

Energy Flow in Technological Systems: Identifying Forms and Transformations

30 minutes, 3 stages

Energy exists in many forms and moves through technological systems in predictable ways. Understanding how energy transforms from one form to another helps you explain how devices work and describe the measurable changes in motion, shape, or temperature they produce ([Outcome](#), [Outcome](#)). This homework builds your ability to identify energy forms and trace their movement through real technologies.

Stage 1: Energy Forms in Devices (10 min)

For each technological system below, identify the primary energy forms present at the start and end of the process. Write the energy form (mechanical, chemical, thermal, electrical, or solar) next to each arrow.

Example: A car engine

Input: chemical energy (gasoline) !' Output: mechanical energy (motion) + thermal energy (heat)

Input: gravitational potential energy (mechanical) !' Output: electrical energy + some thermal energy (loss)

2. A solar heating panel

Input: _____ energy !' Output: _____ energy

Input: mechanical (kinetic) energy !' Output: thermal energy (from friction)

Input: electrical energy !' Output: light energy + thermal energy (waste heat)

Stage 2: Calculating Kinetic and Potential Energy (12 min)

Use the formulas provided to solve these problems. Show your work.

Kinetic energy: $E_k = \frac{1}{2} mv^2$

Gravitational potential energy: $E_p = mgh$

(Use $g = 10 \text{ m/s}^2$ for simplicity)

Problem 1: A 1500 kg car travels at 20 m/s. Calculate its kinetic energy.

$$E_k = \frac{1}{2} \times 1500 \times (20)^2$$

$$E_k = \underline{\hspace{2cm}}$$

Problem 2: A 2 kg object is lifted 5 m above the ground. Calculate its gravitational potential energy.

$$E_p = 2 \times 10 \times 5$$

$$E_p = \underline{\hspace{2cm}}$$

Problem 3: A 0.5 kg ball is dropped from a height of 8 m. Using energy conservation, calculate the kinetic energy the ball has just before it hits the ground. (Assume no air resistance.)

The potential energy at the top converts to kinetic energy at the bottom.

$$E_p = mgh = 0.5 \times 10 \times 8 = \underline{\hspace{2cm}}$$

$$\text{Therefore, } E_k \text{ at impact} = \underline{\hspace{2cm}}$$

Stage 3: Efficiency and Energy Loss (8 min)

Read this scenario, then answer the questions.

A coal-burning power plant converts chemical energy from coal into electrical energy. The plant burns coal worth 100 joules of chemical energy. The plant produces 35 joules of useful electrical energy. The remaining 65 joules is lost as heat to the atmosphere and cooling water.

1. Calculate the efficiency of this power plant using the formula:
Efficiency = (useful energy output ÷ total energy input) × 100%

Efficiency = $(35 \div 100) \times 100\% =$ _____ %

2. Explain why the efficiency is not 100%. Use the second law of thermodynamics: energy conversions always result in some energy being converted to forms that are less useful ([Outcome](#)).

Write one sentence: _____

Self-check

1. Name two forms of energy that appear in a car engine and explain which one is "useful" from a technological perspective.
2. If you increase the mass of an object, does its kinetic energy increase, decrease, or stay the same (assuming velocity is constant)? Explain using the kinetic energy formula.
3. Why is it impossible for a technological device to convert energy with 100% efficiency?