# What is the First Law of Thermodynamics?

Worksheet

The first law states that the change in a system's internal energy equals the heat added to it minus the work done by it: U = Q W.

**@Delta U = Q - W**

## Questions

1. What does the first law of thermodynamics state?

A) Heat always flows from cold to hot
B) U = Q W (energy is conserved)
C) Entropy always increases
D) Work can be created from nothing

2. A system absorbs 400 J of heat and does 150 J of work. What is U?

A) 550 J
B) 250 J
C) 250 J
D) 400 J

3. In an adiabatic process, Q = 0. What follows?

A) U = 0
B) U = W
C) U = W
D) W = 0

4. Over one full thermodynamic cycle, U equals:

A) Q
B) W
C) Zero
D) Infinity

5. A gas absorbs 500 J of heat and does 200 J of work on its surroundings as it expands. Find the change in internal energy.

6. A gas is compressed adiabatically (Q = 0) and 150 J of work is done ON the gas (so W = 150 J by the gas). Find U.

7. During one stroke of an engine cycle, 1000 J of heat is added and the gas does 650 J of work on the piston. Find U for that stroke.

8. Define: What is the first law of thermodynamics?

9. Define: What sign convention does U = Q W use?

10. Define: What is an adiabatic process?

# Answer Key

1. B) U = Q W (energy is conserved) - The first law is energy conservation: U = Q W.
2. B) 250 J - U = Q W = 400 150 = 250 J.
3. C) U = W - With Q = 0, U = Q W becomes U = W.
4. C) Zero - Internal energy is a state function; after a full cycle the system returns to its initial state, so U = 0.
5. U = Q W U = 500 200 U = 300 J
6. U = Q W U = 0 (150) U = 150 J
7. U = Q W U = 1000 650 U = 350 J
8. Energy is conserved: the change in a system's internal energy equals heat added minus work done by the system, U = Q W.
9. Q is positive when heat flows into the system; W is positive when the system does work on its surroundings.
10. A process with no heat transfer (Q = 0), so U = W.