

First Law: Closed System

Mechanical Engineering

Heat in, work out, and the internal energy left over, with the sign rule.

Heat added minus work done by the system equals the rise in its internal energy.

$$\Delta U = Q - W \cdot \text{per unit mass: } \Delta u = q - w$$

$$Q = 500 \text{ J}, W = 200 \text{ J}$$

The gas heats up.

$$\Delta U = 300 \text{ J}$$

Adiabatic compression

$Q = 0$, W negative.

$$\Delta U = -W$$

Rigid vessel heated

No boundary work.

$$Q = m c_v \Delta T$$

THE COMMON MISTAKE

✗ Taking W as work done on the system

✓ W is work done BY the system

In the engineering convention heat in and work out are positive. Mixing it with the chemistry convention flips the sign of every answer.

Applies to a fixed mass with no flow across the boundary. Flow devices need the steady-flow form.