

# Thermodynamics · supported focus

International Baccalaureate · IB Diploma · Physics · HL

## Scope and prerequisites

Supported HL focus. First assessment 2025; full Physics guide acquired (84 PDF pages). Remaining guide, assessment and practical requirements retain their recorded holds.

Prerequisites: read the stated quantities and units, use arithmetic and the model conditions below. Each lesson develops its own method before independent transfer.

These are original or explicitly fictional teaching examples, not actual measurements or completed assessed learner investigations.

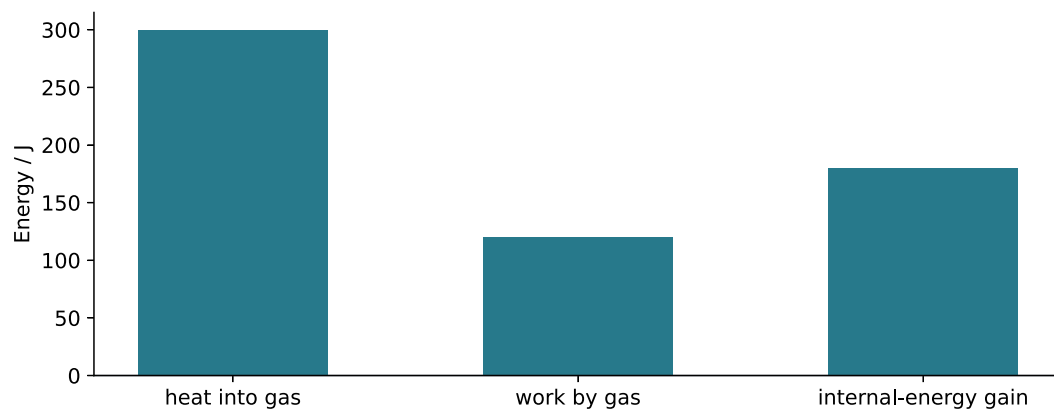
## Thermodynamic systems and energy accounts

### ■ What would explain this observation?

- Compressing a gas can warm it even without a heater. Work is another path for energy transfer into the system.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

### ■ Build the model

- Internal energy** is a property of the chosen system. Heat and work describe energy transfer across its boundary. For an ideal monatomic gas, internal energy depends on temperature and amount.
- adiabatic** : A process with no heat transfer; internal energy: Total microscopic kinetic and potential energy of a system.



### ■ Choose evidence that can test it

- State a sign convention before using the first law. Here change in internal energy equals heat into the system minus work done by the system. Expansion work can reduce internal energy when no heat enters.
- Identify whether a process is isothermal, adiabatic or at constant volume. On a pressure-volume graph, area under the process curve gives work done by the gas. The path matters for work even when endpoints match.

### ■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: gas gains 300 J by heating and does 120 J of work. With  $\Delta U = Q - W$ ,  $\Delta U = 300 - 120 = 180$  J. For adiabatic compression,  $Q=0$  and work done by the gas is negative, so  $\Delta U$  is positive.

### Example:

A gas gains 500 J of heat and does 200 J work. Find internal-energy change. Use the same sequence: known quantities → model → relation → substitution → unit and interpretation.

### ■ Check the conclusion and its limits

- Adiabatic does not mean constant temperature. Use the stated sign convention; some courses write work done on the gas with the opposite sign.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

### Warn:

Every adiabatic process has constant temperature. This claim is false: Adiabatic does not mean constant temperature. Use the stated sign convention; some courses write work done on the gas with the opposite sign.

### Key:

Thermodynamic systems and energy accounts: State a sign convention before using the first law. Here change in internal energy equals heat into the system minus work done by the system. Expansion work can reduce internal energy when no heat enters.