

CLASS 11 PHYSICS • THERMODYNAMICS

The Isobaric Process

Understanding thermodynamic expansion at constant pressure.

Chapter 11.8.5 • Based on NCERT Framework



ISO (Same) + BARIC (Pressure)



DEFINITION

Pressure Remains Constant

An isobaric process is a thermodynamic process in which the pressure of the system stays completely fixed ($P = \text{constant}$) while other variables change.

- Volume (V) and Temperature (T) are free to change.
- The gas remains in thermal and mechanical equilibrium.
- Common in open containers or cylinders with freely moving, weighted pistons.

EQ. (11.17)

The Work Done Formula

$W = P(V_2 - V_1) = \mu R(T_2 - T_1)$

P : Constant external pressure

W : Work done by the gas

$(V_2 - V_1)$: Change in volume (ΔV)

μ : Number of moles

R : Universal gas constant

$(T_2 - T_1)$: Change in temperature (ΔT)



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$$E=mc^2$$



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Key Highlights

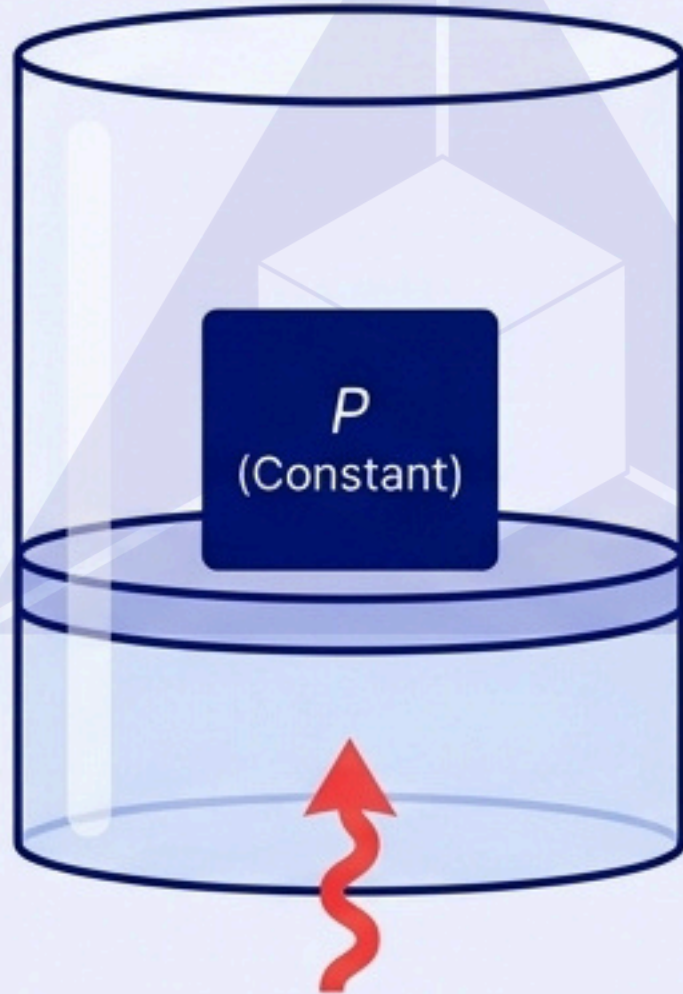
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Isobaric Expansion in Action

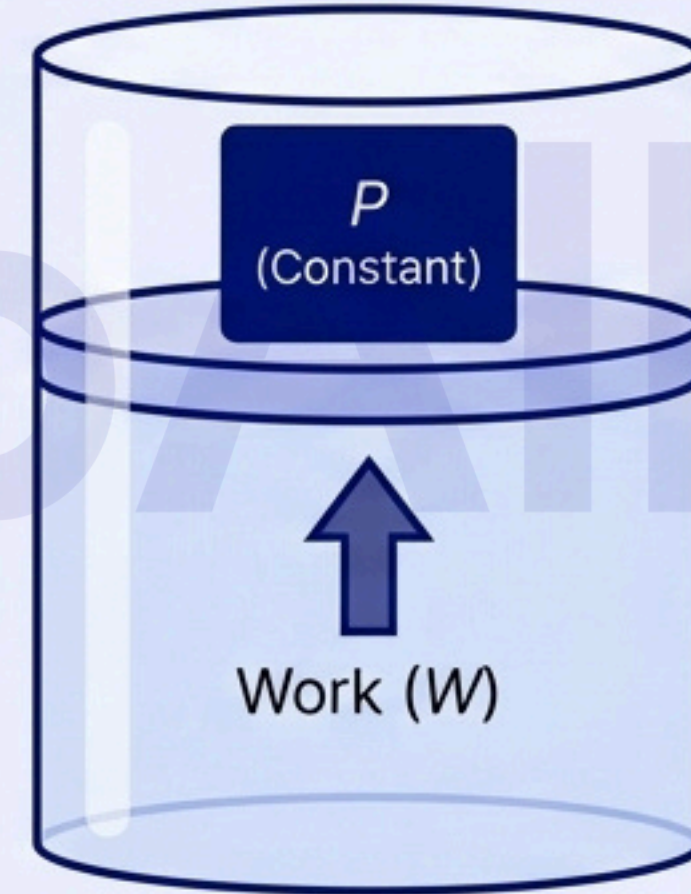
- Constant Weight = Constant Pressure (P)
- Upward Movement = Work Done ($W > 0$)

Cylinder 1



State 1: Initial Volume (V_1), Initial Temp (T_1)

Cylinder 2



State 2: Final Volume (V_2), Final Temp (T_2)

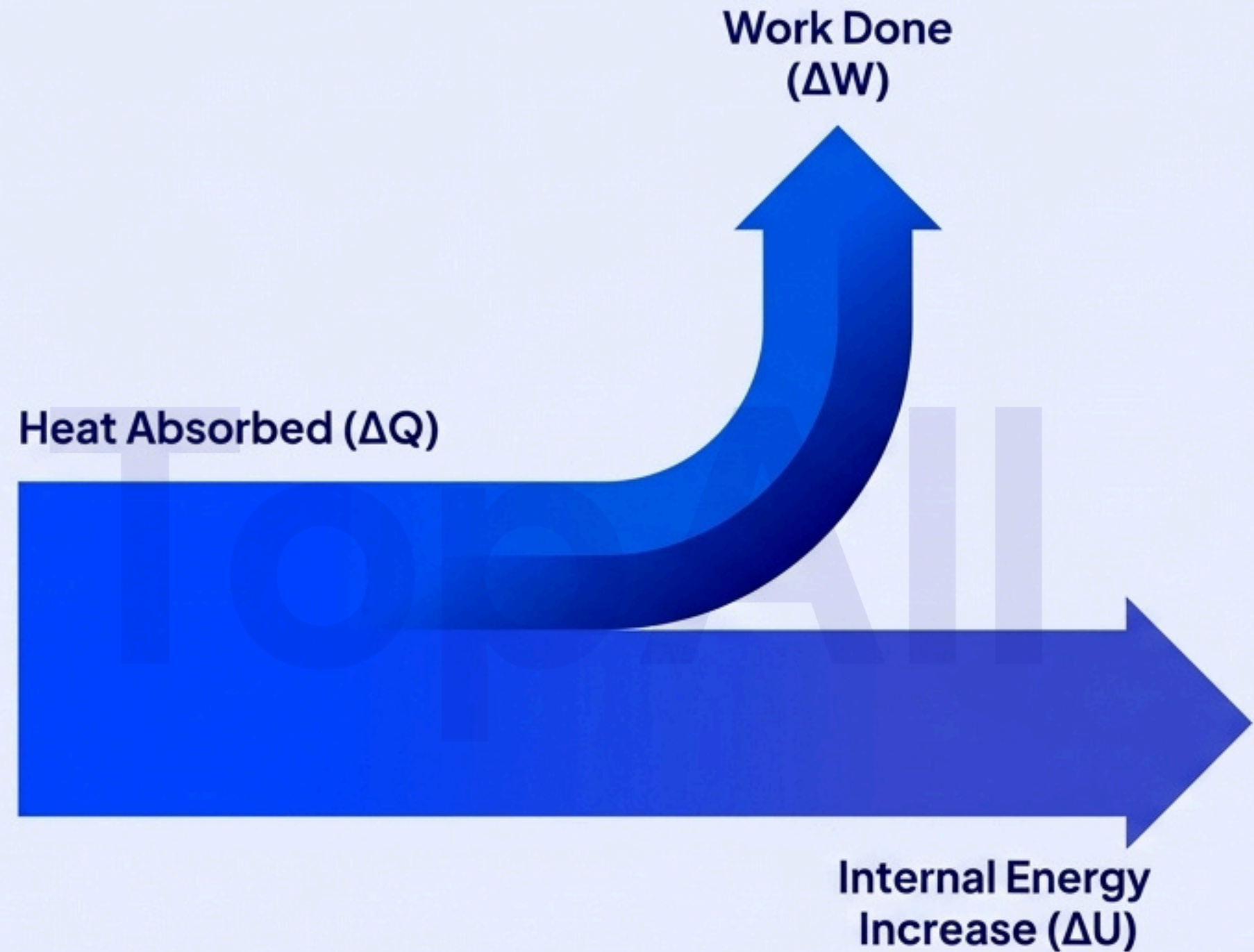
ENERGY DYNAMICS

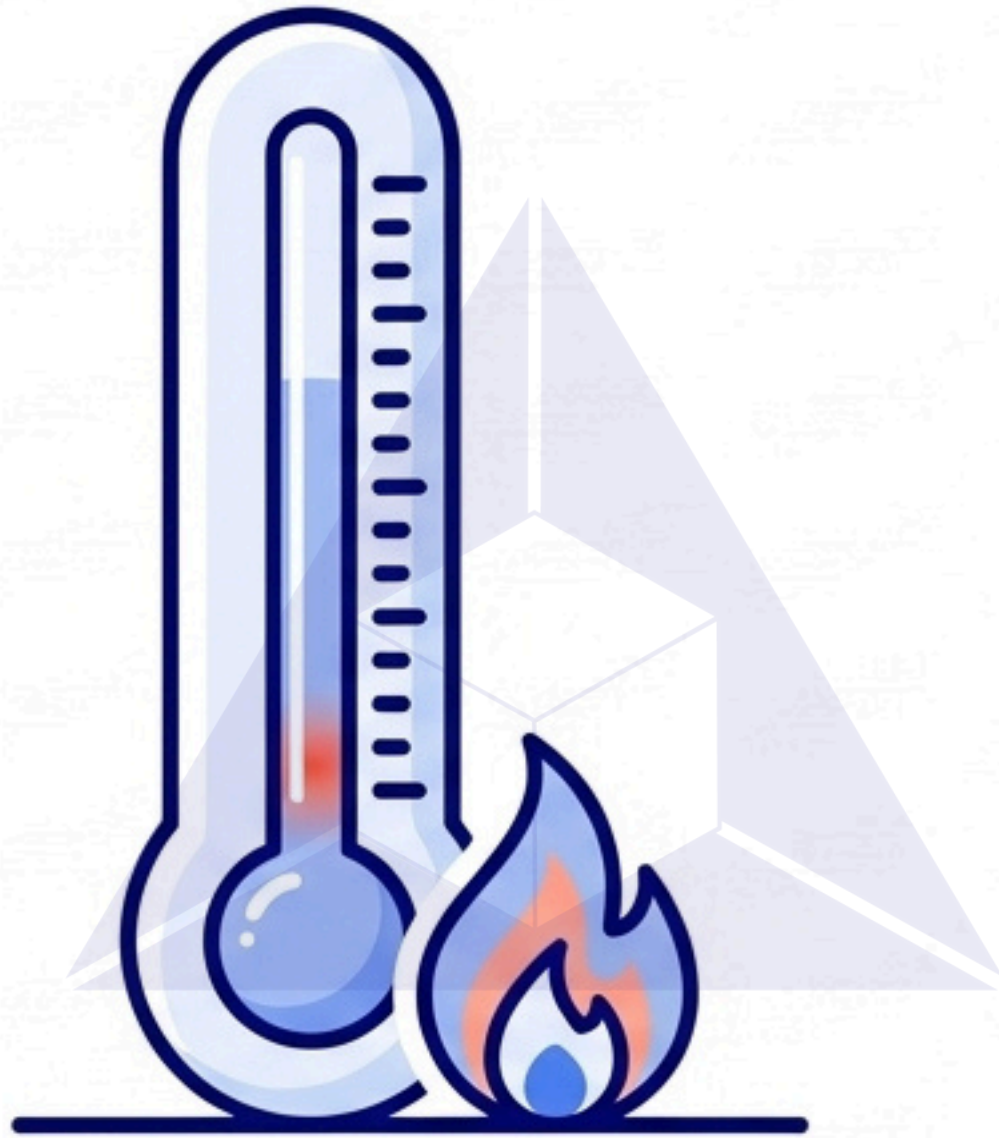
The First Law Application

In an isobaric process, the heat absorbed by the gas performs two distinct jobs simultaneously.

- **Part 1:** It increases the internal energy (ΔU), which raises the temperature.
- **Part 2:** It does mechanical work (ΔW) on the environment by expanding the volume.

$$\Delta Q = \Delta U + \Delta W$$





THERMAL PROPERTY

Specific Heat at Constant Pressure

The change in temperature for a given amount of heat in this process is determined by the specific heat of the gas at constant pressure (C_p).

$$\Delta Q = \mu C_p \Delta T$$

- ✓ C_p dictates the heat energy required to raise the temperature of 1 mole of the gas by 1 Kelvin at a fixed pressure.
- ✓ Because some heat is "lost" to doing work, C_p is always greater than C_v (specific heat at constant volume).

Key Takeaways

- ✓ **Constant P :** An isobaric process occurs at a strictly constant pressure.
- ✓ **Work Calculation:** Work done is $W = P(V_2 - V_1) = \mu R(T_2 - T_1)$.
- ✓ **Energy Split:** Absorbed heat (ΔQ) goes partly into raising internal energy (ΔU) and partly into doing work (W).
- ✓ **Thermal Property:** Temperature change is governed by C_p .

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