

Thermodynamics: State versus Path Functions

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Overview

When we talk about a given system, we say it is in a particular "thermodynamic state."

A particular thermodynamic state is characterized by a few "macroscopic observables," such as

Pressure, temperature, volume, color, altitude, etc.

Differences (Changes) in Macroscopic Observables

▢ Changes in Pressure (P), Volume (V), and Temperature (T):

$$\Delta P = P_f - P_i \quad \Delta V = V_f - V_i \quad \Delta T = T_f - T_i$$

What can we say about all of these?

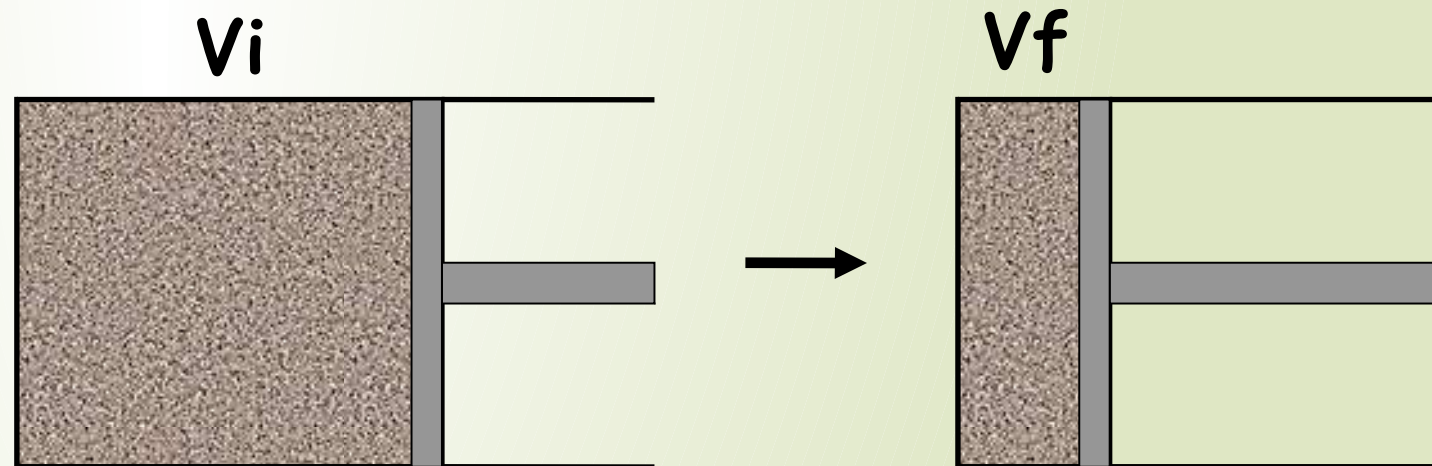
It doesn't matter how the system arrived at the final state from the initial state, the difference (or change) is the same.

A Thermodynamic "State Function"

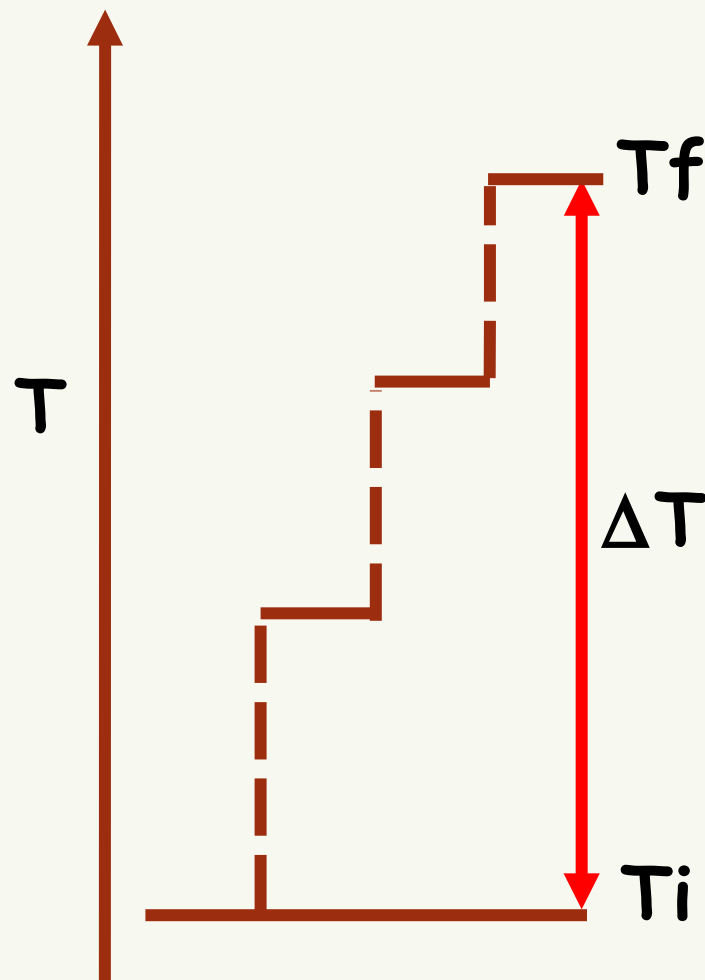
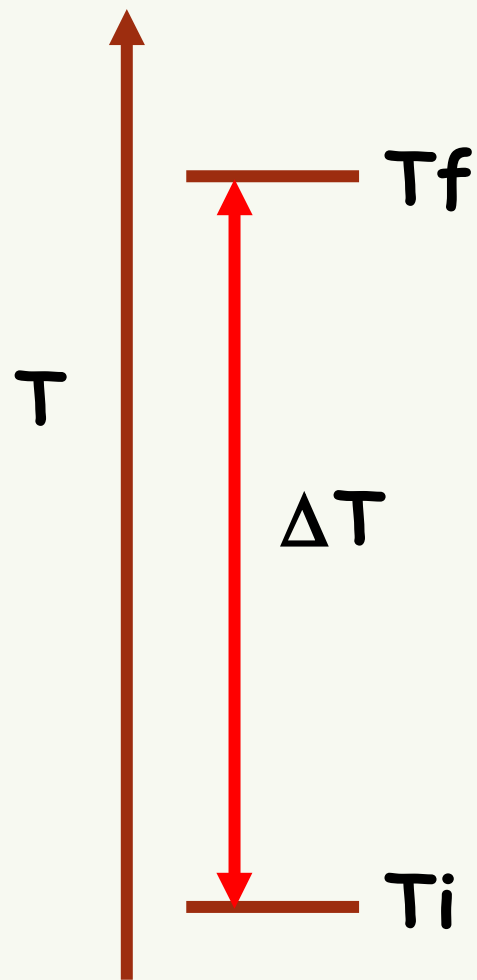
State Functions only depend on the current (thermodynamic) state of the system.

How the system attained that state does not matter!

Example: Compression of a gas inside a piston.



A Thermodynamic "State Function"



A State Function is defined as a property of a system that only depends on the initial and final state of the system,

and is independent of the path followed in getting from one to the other.

Examples of State Functions

ΔU is a state function.

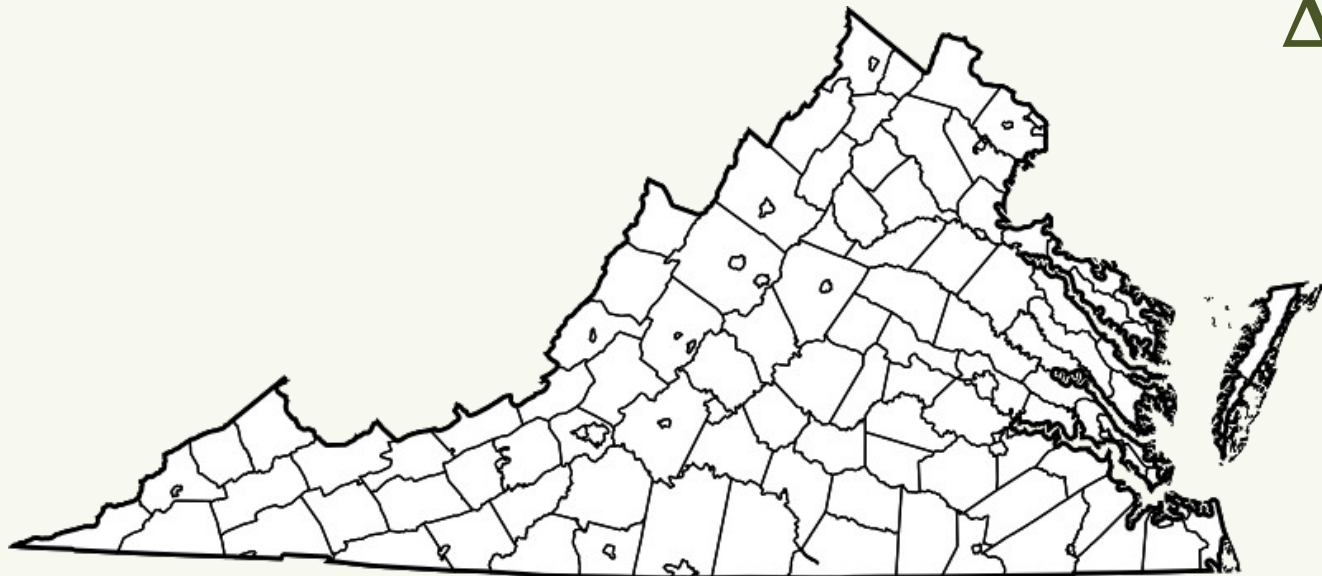
Some other state functions...

ΔH (Enthalpy, coming soon...)

ΔP ΔT ΔV

Altitude Mass

chemical composition



Path Functions



A path function does depend on the path followed in getting from the initial to the final state.

Path Functions


Work (w) and heat (q) are path functions.

Two rock climbers of equal mass scale the same cliff. One climbs straight up while the other backslides numerous times on the way up...

who did more work?

Cliffs along the Atlantic coastline of County Mayo, near Ballycastle, Ireland by Phil Armitage (public domain)






What You Should Be Able to Do (so far)

Define a state function

Recognize state functions from examples given.

Define a path function.

Recognize examples of path functions.



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