

3.S: First Law of Thermodynamics (Summary)

Learning Objectives

After mastering the material covered in this chapter, one will be able to:

1. Define the internal energy of a system as a measure of its capacity to do work on its surroundings.
2. Define work and heat and relate them to changes in the internal energy of a system.
3. Explain the difference between path dependent variables and path independent variables.
4. Define enthalpy in terms of internal energy, pressure, and volume.
5. Calculate First Law quantities such as q , w , ΔU and ΔH , for an ideal gas undergoing changes in temperature, pressure, and/or volume along isothermal, isobaric, isochoric, or adiabatic pathways.
6. Perform calculations using data collected using calorimetry (at either constant pressure or constant volume).
7. Write a formation reaction (the reaction for which the standard enthalpy of formation is defined) for any compound.
8. Use enthalpies of formation to calculate reaction enthalpies.
9. Estimate reaction enthalpies from average bond dissociation enthalpies.
10. Define and utilize enthalpies for phase changes such as ΔH_{fus} , ΔH_{sub} , and ΔH_{vap} to calculate the heat energy transferred in the corresponding phase change processes.
11. Define important thermodynamic functions such as ionization energy, electron affinity, bond dissociation energy, and lattice energy. Construct a Born-Haber cycle diagram using these values to describe the formation of an ionic crystalline compound.

Vocabulary and Concepts

- adiabatic
- Bomb calorimetry
- bond dissociation energy
- Born-Haber cycle
- calorimetry
- combustion reactions
- constant pressure heat capacity
- constant volume
- constant volume heat capacity
- electron affinity
- endothermic
- enthalpy
- enthalpy of combustion
- exothermic
- First Law of Thermodynamics
- heat
- heat capacity
- Hess' Law
- internal energy
- ionization potential
- isothermal
- maximum work
- Reaction enthalpies
- reversible
- reversibly
- specific heat
- standard enthalpy of formation
- standard formation reaction
- state variables
- work
- work of expansion

References

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2. Einstein, A. (1979). *Autobiographical Notes. A Centennial Edition*. Open Court Publishing Company.
3. Encyclopedia.com. (2008). *James Prescott Joule*. Retrieved March 30, 2016, from Complete Dictionary of Scientific Biography: <http://www.encyclopedia.com/doc/1G2-2830902225.html>

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