Thermodynamics Cheatsheet

Introduction to Thermodynamics

Thermodynamics is the study of heat, work, and energy. It describes how energy moves within a system and between the system and its surroundings.

Key Concepts

- System & Surroundings: System is the part under study; surroundings are everything else.
- State Functions: Properties that depend only on the current state (e.g., Pressure, Temperature, Volume, Internal Energy).
- Process: Transformation from one state to another.

Laws of Thermodynamics

Zeroth Law: If A = B and B = C in thermal equilibrium, then A = C.

First Law: ?U = Q - W

Second Law: Entropy always increases: ?S ? 0

Third Law: As T ? 0, entropy approaches zero.

Useful Formulas

Ideal Gas Law: PV = nRT

Work: W = -?PdV

Heat Capacity: Cv = (?Q/?T)v, Cp = (?Q/?T)p

Enthalpy: H = U + PV

Gibbs Free Energy: G = H - TS

Helmholtz Free Energy: F = U - TS

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Tables

Specific Heat Capacities of Gases:

Helium: Cv=12.5, Cp=20.8

Nitrogen: Cv=20.8, Cp=29.1

Oxygen: Cv=21.0, Cp=29.4

CO2: Cv=28.5, Cp=37.1

Common Processes:

Isothermal: W=nRTln(Vf/Vi)

Adiabatic: Q=0

Isochoric: W=0

Isobaric: W=P?V

Applications

Engines and Refrigerators

Phase Change Studies

Chemical Thermodynamics

Energy Conversion Systems

Tips for Problem Solving

- Identify system and process.

- List knowns and unknowns.

- Apply appropriate laws and formulas.

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- Keep track of units and sign conventions.

References

- Atkins Physical Chemistry

- Engineering Thermodynamics by Cengel

- NIST Chemistry WebBook