

物理化學一-熱力學 (PHYSICAL CHEMISTRY I-Thermodynamics)

(課號 203 33160)

□ 學分：三學分（一學期，大三上學期開課）

□ 預修課程：普通化學、普通物理、微積分

□ 開授對象：化學系大三學生之基礎必修課。

□ 課程內容：

授課時數

一、狀態方程、熱力學變數與氣體行為(Equations of state, thermodynamic variables and gas behavior)：

4 h

系統的狀態(State of a system)

熱力學第零定律(The zeroth law of thermodynamics)

理想氣體(The ideal gases)

真實氣體與凡得瓦方程(The real gases and van der Waals equation)

維劉方程(The Virial equation)

二、能量、功與熱力學第一定律(Energy, work, heat and the first law of thermodynamics)：3 h

功與熱(Work and heat)

熱力學第一定律與內能(The first law of thermodynamics and internal energy)

氣體的可逆等溫膨脹(Reversible isothermal expansion of gas)

焓(Enthalpy)

焦耳-湯姆生膨脹(Joule-Thomson expansion)

熱容、理想氣體的 C_v 與 C_p (Heat capacities, the relation between C_v and C_p for an ideal gas)

氣體的絕熱過程(Adiabatic processes with gases)

熱化學(Thermochemistry)

溶液反應的焓變化(Enthalpy changes of solution reactions)

三、自發過程、平衡、與熱力學第二定律(Spontaneity, equilibrium, entropy and the second law of thermodynamics)：

6 h

自發與非自發變化(Spontaneous and nonspontaneous changes)

熱力學第二定律(The second law of thermodynamics)

孤立體系平衡的準則(Criteria of equilibrium for isolated systems)

可逆與不可逆過程的熵變化(Entropy changes in reversible and irreversible processes)

理想氣體的混合 (Entropy of mixing ideal gases)

「微觀狀態」與「巨觀狀態」

或然率與統計

熵與統計機率(Entropy and statistical probability)

四、穩定性、自由能與熱力學位能(Stability, free energy and thermodynamic potential)：3 h
平衡的準則

Helmholtz 與 Gibbs 自由能 (Helmholtz energy and Gibbs energy)

Maxwell 關係 (Maxwell relations)

熱力學狀態方程(Thermodynamic equations of state)

溫度與壓力對 Gibbs 自由能的影響(Effect of temperature and pressure on the Gibbs energy: Le Chatelier's Principle revisited)

逸散壓(Fugacity)	
五、相平衡(Phase equilibrium) :	4 h
相平衡的準則(Criteria of phase equilibrium)	
單組成體系的相平衡(Phase diagram of one-component systems)	
Clausius-Clapeyron 方程(Clausius-Clapeyron equation)	
相圖(Phase diagram)	
六、溶液與雙組成體系的相平衡 (Solutions and two-component phase equilibrium) :	6 h
兩元混和液體的氣液平衡(Vapor-liquid equilibria of binary liquid mixtures)	
理想混和液體的沸點(Boiling point diagrams for ideal liquid mixtures)	
分餾(Fractional distillation)	
化學位能(Chemical potential)	
Gibbs-Duhem 方程(Gibbs-Duhem equation)	
活性(Activities)	
理想混和液體的熱力學性質(Thermodynamic properties of ideal liquid mixtures)	
依數性質:Henry 定律、Raoult 定律、滲透壓、凝固點下降與沸點上升(Colligative properties: Henry's law, Raoult's law, Osmotic pressure, freezing point depression and boiling point elevation)	
包含固相與液相的雙組成系統(Two-component systems consisting of solid and liquid phases)	
相圖(Phase diagrams)	
Debye-Huckel 理論(Debye-Huckel theory)	
七、化學平衡(Chemical equilibrium) :	3 h
一般性的平衡表示(General equilibrium expression)	
氣體反應的平衡常數(Equilibrium constant expressions for gas reactions)	
溫度對化學反應的影響(Effect of temperature on the equilibrium constant : Le Chatelier's Principle revisited in quantitative form)	
分均項化學反應(Heterogeneous chemical reactions)	
電化學平衡(Electrochemical equilibrium)	
八、統計熱力學(Statistical Thermodynamics)	6 h
Molecular Partition function	
Canonical Ensemble	
Translational partition function	
Rotational Partition function	
Vibrational partition function	
Third law and Absolute entropy	
Heat capacity and entropy	
Chemical Equilibrium in ideal gas reaction	
九、表面與介面的熱力學(Thermodynamics of surfaces and interfaces) :	4 h
表面張力(Surface tension)	
Laplace 方程(Laplace equation)	
小液滴與泡泡(Small drops and bubbles)	
凝聚現象(Nucleation)	
濕潤與毛細現象(Wetting and capillarity)	

十、熱力學的應用 (熱力學真的有用)

5 h

Case Studies.

合計 **44 h**