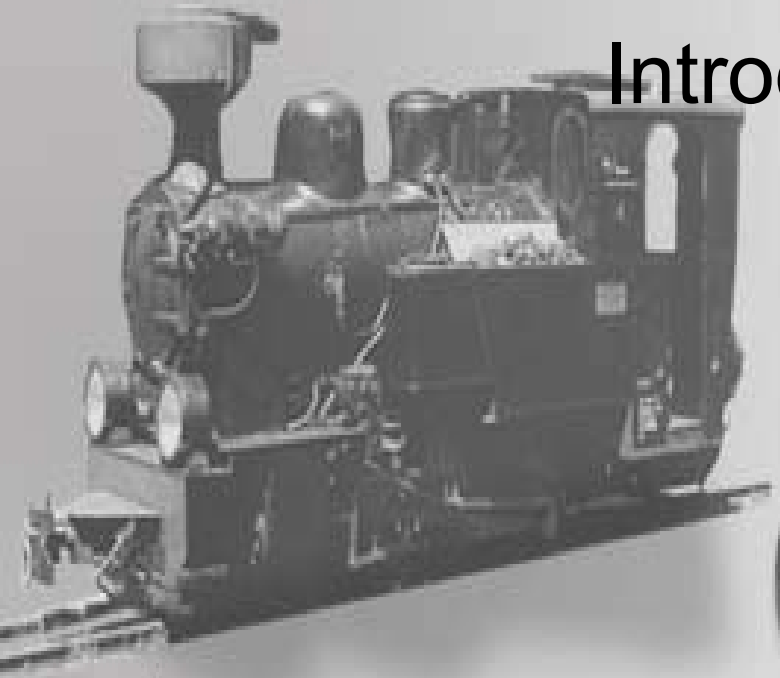
Equilibrium and Dynamics of Chemical Systems

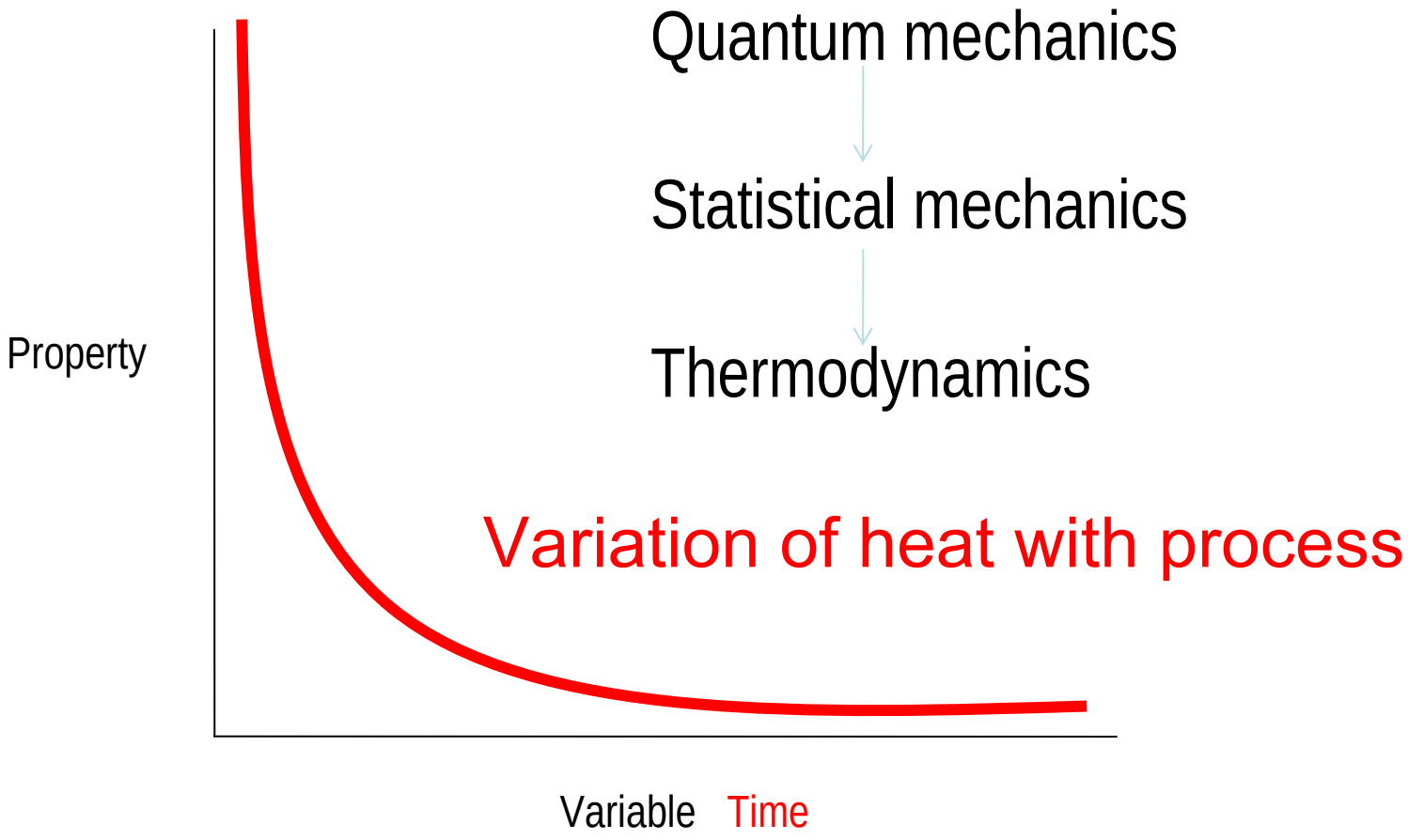


Introduction to thermodynamics

http://courses.cc.iitm.ac.in:8900

CY 102 : Chemistry II

Department of Chemistry


Quantum mechanics
Statistical mechanics
Thermodynamics
Property
Variation of heat with process
Variable Time

What is unique about Thermodynamics?

Independent of atomic and molecular theory.

In chemical systems, thermodynamics helps to keep a record of energy flow.

Equilibrium state of a chemical system can be understood from thermodynamics.

It is a logical science, three statements describe thermodynamics; deductions from these laws constitute the equations.

Validity of thermodynamic laws depends only on the basic laws and the logical deductions which follow from them.

Since thermodynamics is itself a science, not dependent upon the foundations of other branches, it has an existence of its own.

A theory is the more impressive the greater the simplicity of its premises, the more different kinds of things it relates, and the more extended its area of applicability. Hence the deep impression that classical thermodynamics made upon me. It is the only physical theory of universal content concerning which I am convinced that, within the framework of the applicability of its basic concepts, it will never be overthrown.

Albert Einstein

1. Chemical thermodynamics
2. Statistical thermodynamics
3. Kinetics
4. Surface science

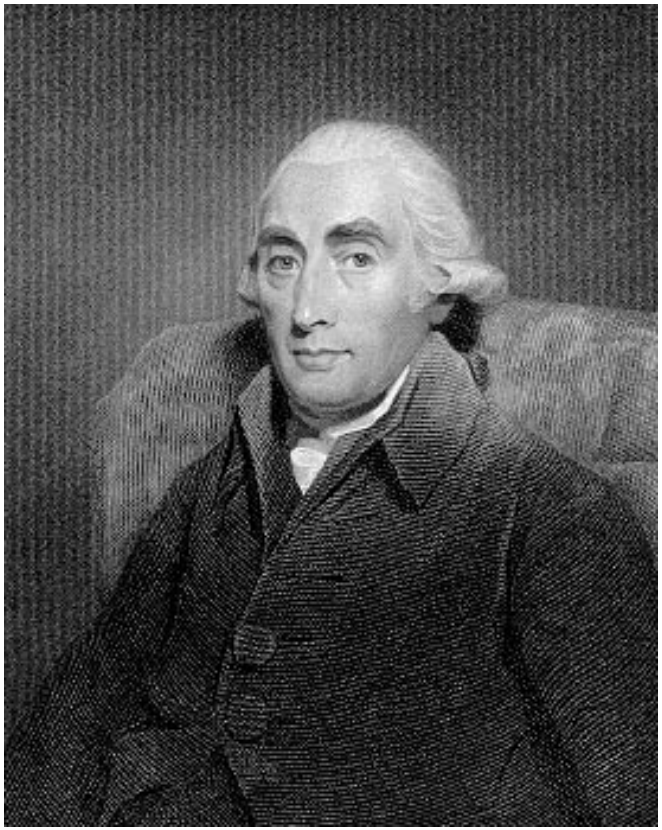
Books:

1. G. W. Castellan, Physical Chemistry, 3rd Edition, Narosa, New Delhi, 1995.
2. P. W. Atkins, Physical Chemistry, 8th Edition, Oxford University Press, Oxford, 1998.
3. Silbey, Alberty, Bawendi, Physical Chemistry, 4th Ed.

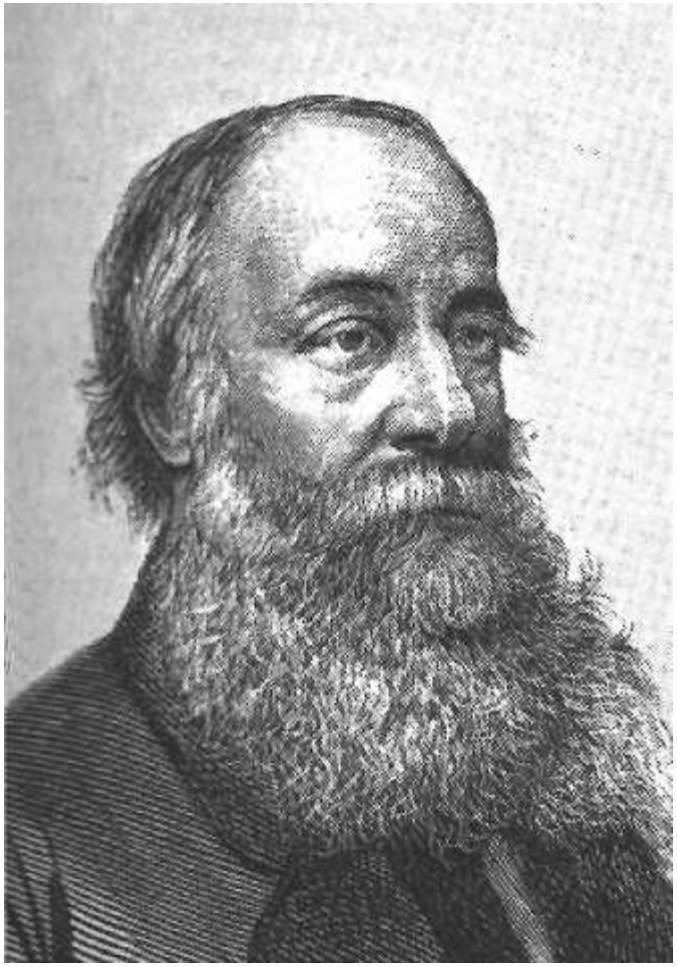
Lecture schedule
Tutorials
Evaluation

It is all about heat….

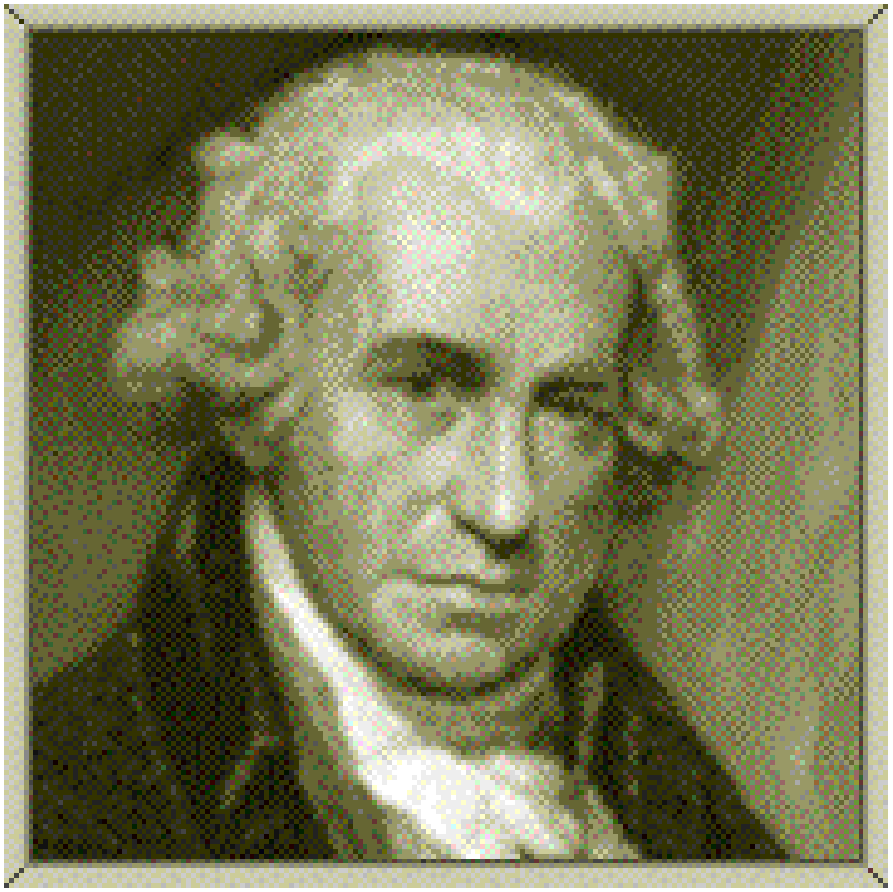
Galileo Galilei 1564-1642



Francis Bacon 1561-1626 Joseph Black, 1728 - 1799



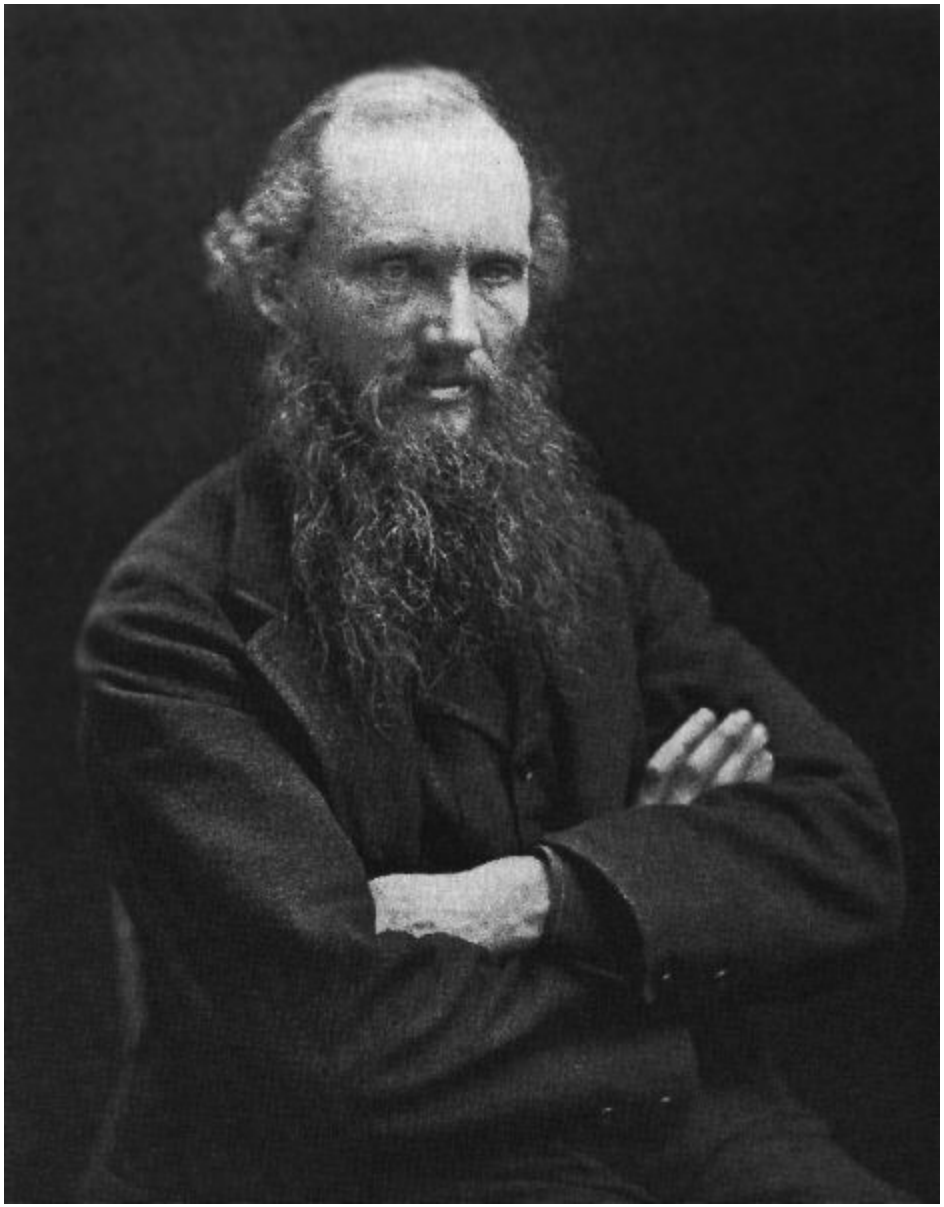
James Prescott Joule 1818-1889



James Watt 1736 - 1819

Sadi Carnot 1796-1832

Rudolf Clausius 1822 - 1888

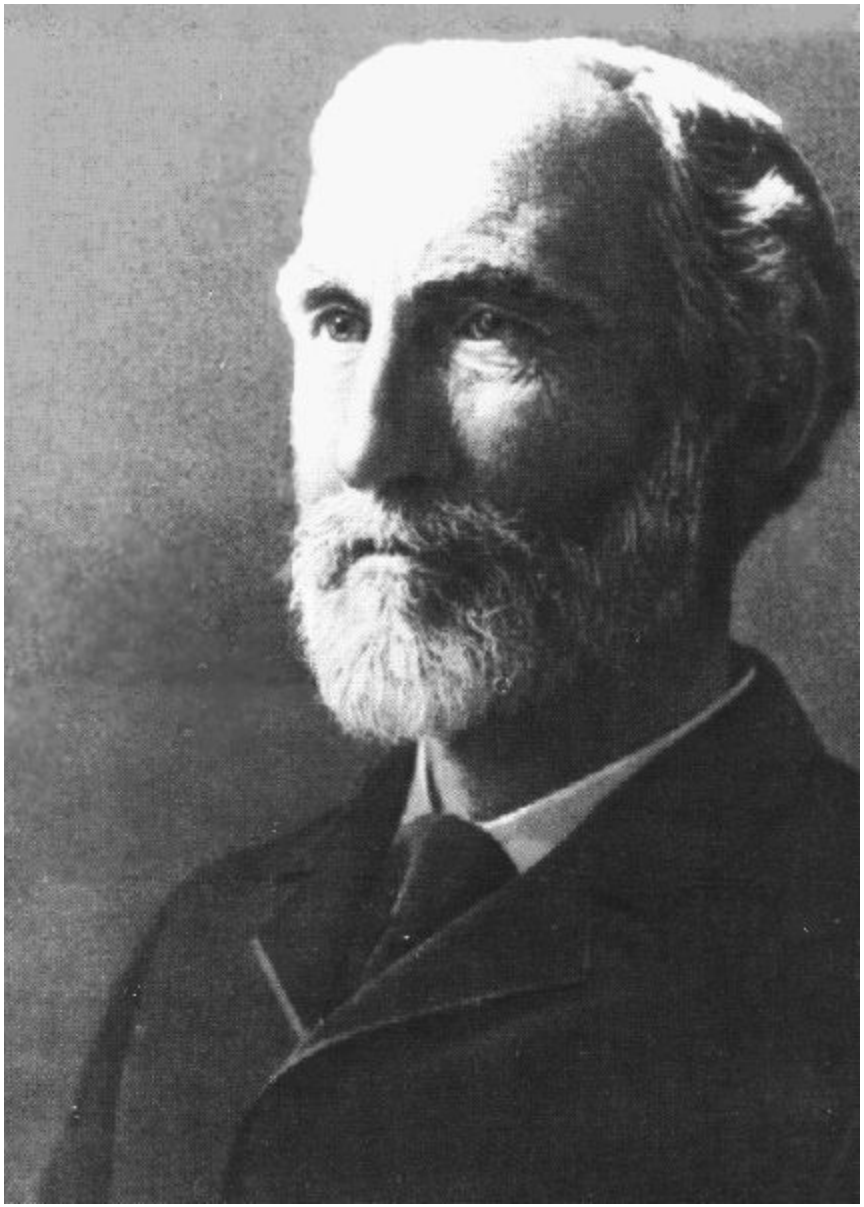


Lord Kelvin (William Thomson) 1824-1907

Lectures of T. Pradeep

Ludwig Boltzmann 1844-1906

Lectures of T. Pradeep



Josiah Willard Gibbs 1839-1903

Jacobus Henricus van 't Hoff 1852-1911

Lectures of T. Pradeep

Walther Hermann Nernst 1864 - 1941

Gilbert Newton Lewis 1875-1946

System

Surroundings

Characterization of a system

Based on properties

(1) intensive properties and (2) extensive properties

Types of systems

(1) open, (2) closed, and (3) isolated systems.

(1) homogeneous or (2) heterogeneous

Chemical system

Phase, Component

Process, Path

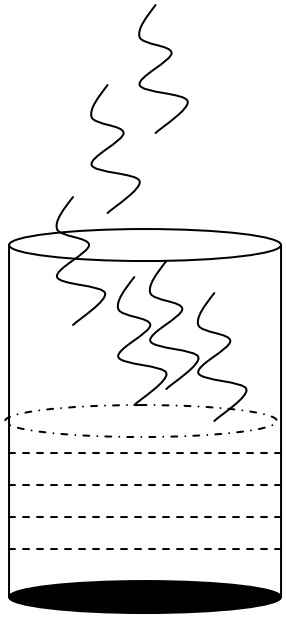
State function, Path function

Exact and inexact differentials

Work, heat

Exothermic, endothermic

First Law



$$dU = dq - dw$$

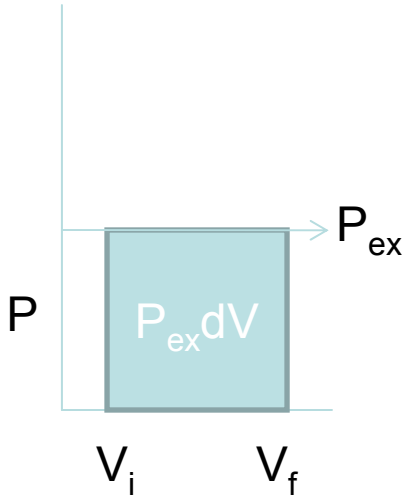
Internal energy of an isolated system is constant

$$Work = -P_{ex}dV$$

$$Free\ expansion = 0$$

$$Isothermal\ work = \int -(nRT/V)\,dV = -nRT \ln V_f/V_i$$

(reversible)



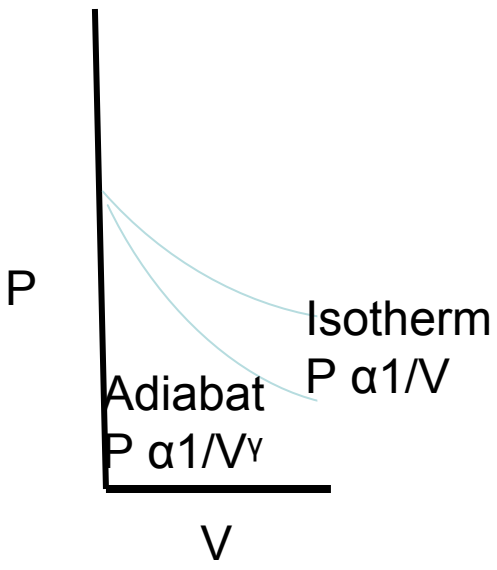
Indicator diagram

James Watt

Enthalpy, H = U + PV

Calorimetry

Isotherm and adiabat



Thermochemistry

Heat of formation, $\Delta_f H^o$

Hess's Law

Born-Haber Cycle

Joule experiment $\Pi_T = (\partial U/\partial V)_T$

Joule-Thomson Experiment

$\mu = (\partial T/\partial P)_H$

Kirchhoff's equation

$$\Delta_r H^o(T_2) = \Delta_r H^o(T_1) + \int \Delta_r C_p^o \, dT$$

Equipartition principle