Survey of Physical Chemistry
Supplemental to Power Point Class
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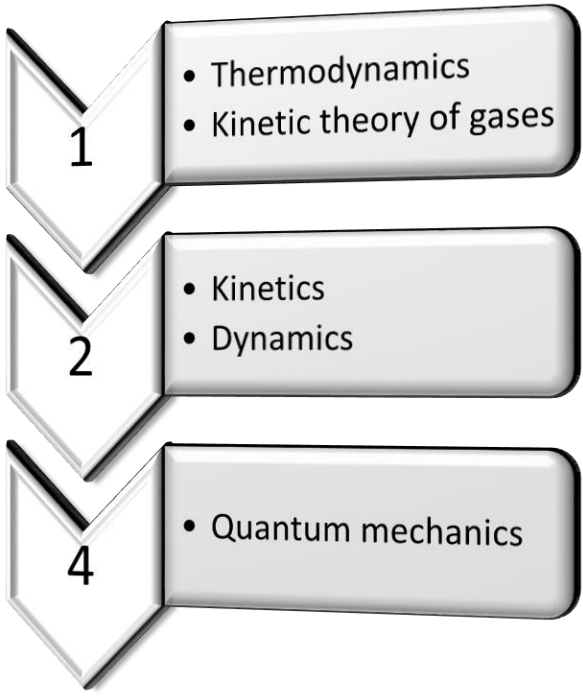
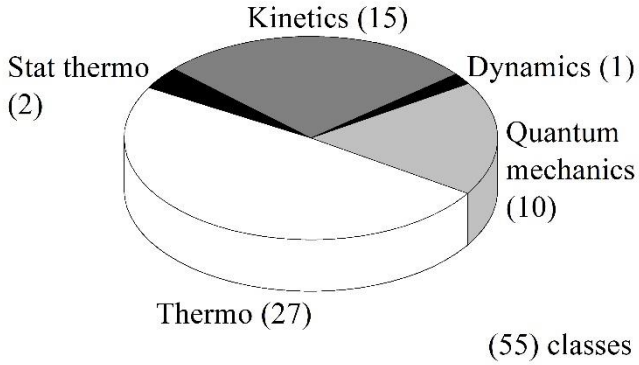
Survey of Physical Chemistry

Quick Glance




Kinetics (15)
Stat thermo (2)
Dynamics (1)
Quantum mechanics (10)
Thermo (27)
(55) classes

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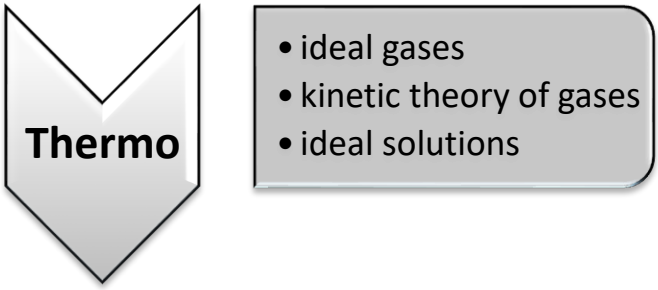
Survey of Physical Chemistry



19: Phase equilibria, chemical potential

Thermodynamics of liquids

20: Liquid solutions

21&22: Rault's law

23: Vapor pressure lowering

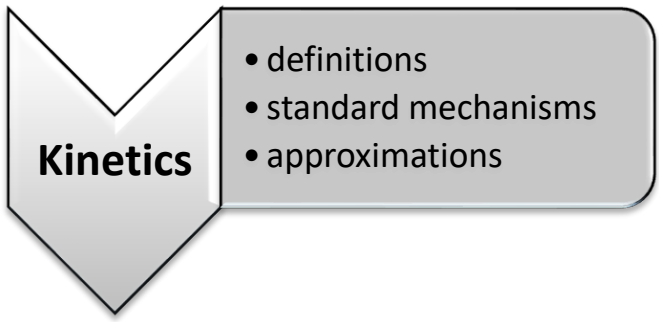
24: Boiling / freezing point of solutions

25: Osmotic pressure

Misc.

26: Equilibrium constant

27: van't Hoff equation and Le Chatelier's principle



Segment two: basic chemical kinetics (10 classes)

28&29: Basics

Reaction rate definition, writing differential equations, 0^{th} order kinetics

30: 1^{st} order kinetics

31: 2^{nd} order kinetics

32: Tricks & approximations I

3^{rd} order reactions, pseudo 1^{st} order reactions, method of isolation, steady state approx., van't Hoff (/initial rate) method

33: Mechanisms I

Lindemann mechanism, reversible reactions

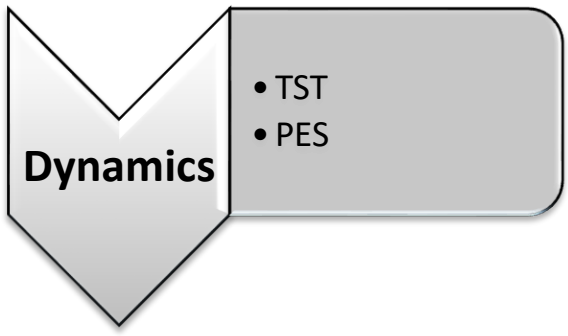
34: Mechanisms II

Consecutive / sequential reactions, analytical / computational solution

35 & 36: Tricks & approximations II

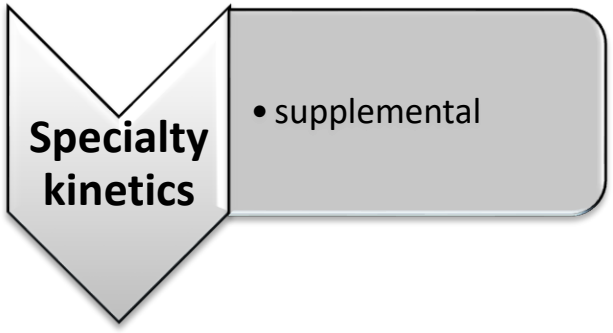
Pre-equilibrium, rate determining step approx., mass balance eq.

37: Arrhenius eq. & summary



Mini segment: reaction dynamics (1 class)

38: Transition state theory (TST) & potential energy surfaces (PES)



Supplemental segment: specialty kinetics (5 classes)

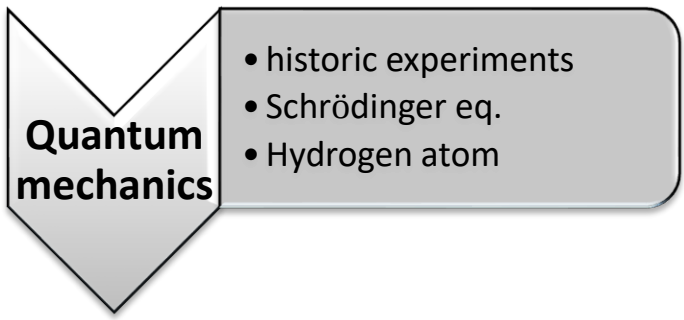
(No specific order required, optional, may move to end of class)

38+: Kinetic isotope effect (15-20 min segment)

39 & 40: Michaelis-Menten enzyme kinetics

41: Chain reactions & explosions & polymerization

42: Mass transport (diffusion), membranes & kinetics



Segment three: basic quantum mechanics (10 classes)

43: Introduction

X-ray scattering, waves, Blackbody radiation, Rayleigh/Jeans law, Plank's 1918 energy quantization, Mather/Smoot 2006 experiments

44: Photoelectric effect

Lennard Jones experiments, Albert Einstein's model, photoelectron spectroscopy

45: Bohr model & absorption spectroscopy

46: Practicable-wave duality

de Broglie's & Einstein's matter waves, Davisson & Germer's experiments, modern scattering experiments (LEED, molecular beam scattering), classical limit of QM

47: Heisenberg's uncertainty principle

Thought experiments, Heisenberg microscope

48: Schrödinger equation

49-50: Particle-in-a-box potential

The only QM example quantitatively discussed in this class, detailed discussion

51: Tunneling effect

Very qualitatively discussed, examples, atomic clock, α decay, tunneling microscope, kinetic isotope effect

52-53: Hydrogen atom

Very qualitatively discussed, idea of the solutions, results

Supplemental

54-56: Operators, postulates, eigenvalue equations; multi-electron systems; rotations and vibrations of molecules

CD/data DVD is included with this book.

Additionally, on the standard student CD/data DVD

A few example quizzes, exams, homework, demo software (kinetics), summaries for each class segment, can be customized

Additionally, on the instructor (verification required) CD/data DVD

Includes the student CD information, but additionally: editable text files (whiteboard sections), editable PowerPoints, more homework/exams/quizzes, results to most problems, demo software (kinetics), notes about demos, further notes for instructors

INTRODUCTION

In a nutshell

- One semester Pchem (Physical Chemistry) survey class
- Mostly (advanced) undergraduate level
- This is not a traditional textbook
- You get a CD (/data DVD) with PowerPoints covering the entire undergraduate physical chemistry (Pchem) curriculum as a one semester class (~56 classes)
- PDF/word files complement the PowerPoints (these may include derivations or further discussions)
- As a bonus, this booklet is included which provides a short summary of the classes/class segments and class overviews
- I taught the class for over 10 years to a diverse audience of mostly non-major chemistry undergraduate students (incl. biochemists, biotechnology, geology, biology, … students)
- It also was offered as a refresher class for 1st year graduate students (with deficiencies in Pchem) as a split-level class CHEM465/665
- This is not a Pchem class particularly setup for biosciences, this is the real deal, the class contents cover standard Pchem topics taught by a physicist/physical chemistry college prof.
- No general public web downloads, e.g., flash drive in exchange to the data DVD on request (at cost)

Bang for your bucks (notes for students & instructors)

As an **instructor**, the PowerPoint set will save you a lot of time, even if you modify the slides for your own students and stay with your current textbook choice (which is just fine). Exercises, homework, and exams also are included.

As a **student**, this class can complement any Pchem class you take. The included notes sections to the PowerPoints promote self-studying and exam preparations. Thus, this class is more than just a collection of PowerPoints. This class can be used for self-study more so than a traditional textbook.

Students and instructors usually want to have a "textbook". Therefore, I added this short and printed "supplemental" to the CD (/data DVD), it includes a brief summary of each class as well as the detailed outline of the entire class. Self-study questions (in-class homework) are part of each PowerPoint/class. Most homework, in-class homework, or exam solutions are not included on the standard student CD but are made available to instructors. Obviously, this is not a traditional textbook. You can find those by the dozen already, even for specialty topics. Do students today read textbooks? This is a better format, at least as a study guide/supplemental to a traditional class. I encourage students to use more than one resource, these PowerPoints here, a few textbooks, the

internet, a traditional class, a study group, etc. – "start to study" is my recommendation.

No specialty software is required. The PowerPoints should run at least on any Windows PC.

Why offering this commercially?

Well, why not? I do have a part-time small business since 2013 which makes a "commercialization" rather simple. Hundreds of private work hours went into this class. So, why not making it available to other colleagues, including students since I would have prepared this class anyway? In other words, the additional overhead for me for making a commercial product out of this class was moderate.

My own background

I am a physical chemist, a surface chemist, and a faculty member at North Dakota State University (NDSU), starting there in 2003. I got most of my own education in Physics in Germany, born in West-Berlin. After many years of postdoc positions (Italy, US, Italy, Germany …) and a habilitation in Germany (German tenure), I found a tenured faculty position at the Chemistry department at NDSU. More you can find here www.uweburghaus.us I have written several books, most of these about practical engineering topics. I sell those books in the meanwhile by myself, i.e., I do own a part-time small business. Details are here www.LatheCity.com Why I market this myself? I did publish and edit books/reviews together with big and traditional publishers and probably also could have found one for this project, but simply put, why should the publisher get most of the profit? The compensation publisher typically provide to authors are rather ridicules.

Conflict of interest

The PowerPoints and associated texts were written in my private time with no other resources used besides my own and own business resources. I do not require the use of my own books etc. in my own college classes.

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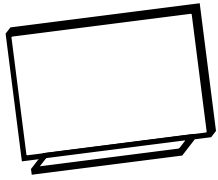
How to contact "us"

Any meaningful comment is very well-come, write to sales@LatheCity.com Note that we cannot solve your homework problems for you, sorry ☺ Other books and original publications cited should be available through your university's library system, we cannot provide these.

NOTES FOR INSTRUCTORS

I taught this class the 1st time in 2008 and ever since almost every year until now (I write the year 2020 while finishing this note). Every year I did change a little something up to the point where I thought it's now good enough to offer it to other colleagues. Certainly, it takes more than a few runs to "finish" that kind of class. In particular, because I did not follow a single textbook, but over the years, came up with my own outline. However, most traditional undergraduate textbooks cover the same topics in similar order, i.e., whatever textbook you use, this PowerPoint collection will save you a lot of prep time.

Each PowerPoint for one class is an about 50 min presentation. The PowerPoints are numbered according to classes but obviously one can change the order of class segments or even classes. A regular term in the US has 15 weeks. The ~56 PowerPoints/classes include more than enough material for a four-credit class (four 50 minutes classes per week) including some supplemental classes.



Most of my classes are a mix of PowerPoint and whiteboard sections. What I use to put on the whiteboard is included as word files as well as supplemental slides. Thus, meanwhile these are complete PowerPoint classes. It will be your choice what teaching style you prefer. You can follow my mixed PowerPoint / whiteboard presentation style or show the supplemental slides in class as part of your PowerPoint presentation. These supplemental slides are included on the standard student CD, but I can customize the info provided to your students. E.g. not to provide a complete PowerPoint package to students motivates them to come to class and/or study and/or write their own notes. Also, the whiteboard/PowerPoint mix slows down the presentation

and helps to engage the audience. Often the main concepts of the supplemental slides are also included as summary slides – repetitions may help some students.

The PowerPoints include extended text sections in their notes boxes and are therefore also useful for self-study. For the kinetics section a demo program is included that solves computationally a standard kinetics example. No specialty software is required. Everything should run on Windows 7, 8, 10.

Each PowerPoint includes (self-study) questions (in-class homework). Additionally, some exams and quizzes are also on the student CD but not the in-class homework. Again, this can or cannot be included on the student CD – contact us. In fact, I do not provide in-class homework to my students ahead of time, but rather grade their responses for a few extra credit percent. In-class homework are also provided in a format that allows for complete on-line and paperless teaching.

Initially, I have had quizzes every other week, 3 midterms evenly spaced in time (every 5 weeks), and a finals exam. In that format, the exams cover more than one class segment which is not ideal. In the meanwhile, I don't have a cumulative finals exam anymore, but one exam for each class segment (which is easier on the students) and quizzes to help prepare for the exams. I usually don't overdo it with homework assignments.

If you are an instructor, contact "us" and we send you an instructor CD with most solutions to problems, more exams, editable word text files, all instructors love to have. Ask for current prices – use your grants. Please provide verification that you are an instructor.

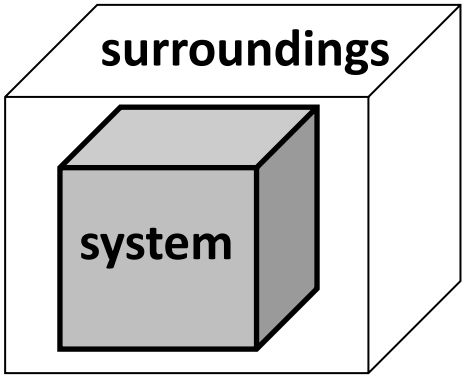
Please note that also the PowerPoints are copyright protected. E.g., you cannot e-mail the PowerPoints to your students or a friend. If your students need a copy, they will need to purchase this book + CD. We can customize student CDs.

THERMODYNAMICS

1&2

Introduction and basic definitions

At the undergraduate level, thermodynamics describes the relationship between macroscopic properties of a system at equilibrium. I will start by discussing basic terms such as what does a model system look like in thermodynamics?; what are closed, open, and isolated systems?; what are the properties of different walls of thermodynamic systems; what are extensive and intensive parameters; what is the definition of temperature and equilibrium? Most PowerPoints have a study guide at the end and more literature recommendations.



In the second class, becides some small left-over basic notes, I will start with the general ideal gas law one has seen before in general chemistry classes: PV = nRT. But, probably most students have not seen quite all of what I plugged in this class. I do briefly describe the historic experiments that verify that gas equation, as I will teach most of this survey class from an experimental perspective. Next, what is the connection of the 0^{th} law of thermodynamics and Boyle's law? I will briefly discuss the limitations of the ideal gas assumptions and describe the basics of real gasses such as the compressibility factor, the van der Waals equation, etc.

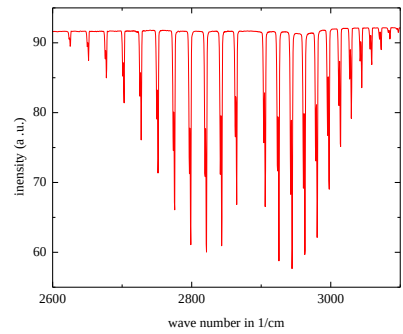
54 - 56 Supplemental quantum mechanics

I usually have time left at the end of the term to address some topics which may usually not be covered in a non-major undergraduate Pchem class including the following.

54) Operator algebra used to write the Schrödinger eq. as an eigenvalue equation. This is closely related to the postulates in quantum mechanics. To show that is not just a math exercise I do discuss the Stern-Gerlach experiment and relate it to commutators and the Heisenberg uncertainty principle.

55) A very brief introduction to multi-electron systems, the symmetry requirement of the wave function, and Hund's rules (all three).

56) The classical mechanics and quantum mechanics description of molecular rotations and vibrations including the related spectroscopies.



There is also a supplemental PowerPoint describing kinetic isotope effects which is a topic in-between kinetics and quantum mechanics. Sometimes I place this at the end of kinetics or sometimes at the end of QM section, respectively. Also, topics such as nanoscience, energy economy, or surface science are appropriate for a supplemental class, in my opinion.