

**Elements of Chemistry**  
Chemistry 030.100  
Johns Hopkins University

Summer 1995

Lectures: 9-11:15 AM MWF

Instructor: Dr. Peter Ramberg, Remsen 334

Office hours: Thursday afternoon, after class, or by appointment.

Text: William Brock, *The Norton History of Chemistry*

*The modern chemist, who knows exactly what a chemical compound looks like in its middle and its end, how the six carbon atoms of benzene are symmetrically linked together in a place, who then further purports by means of this hypothesis (which goes by the name of theory) to have a clear conception of the spatial arrangement of the atoms, of their ortho, meta, and para positions, who determines the positions of all the atoms in the compound, has long since abandoned the solid ground of exact science; the scientist has become a metaphysician.*

**Hermann Kolbe** (1818-84)

*Chemistry creates its own object.*

**Marcelin Berthelot** (1827-1907)

*Chemistry must become the astronomy of the molecular world.*

**Alfred Werner** (1866-1919)

The science of chemistry uses many concepts that are quite old. The familiar terms element and atom, for example, date back to the ancient Greeks. Modern definitions of these and other terms are quite different from the ancient definitions. This course is divided into four topics—elements, atoms, molecules, and affinity. We will look at these fundamental concepts of chemistry and arrive at definitions for these concepts by using those definitions that have already appeared during the last two hundred years and by looking at the actual practice of chemistry. Along the way, I hope you will gain an appreciation for chemistry as a science, and understand the fundamental concepts of modern chemistry a little better than you did before.

### Tentative Course Schedule

July	3		Introduction The aims of science and structure of theories
	5	Homework 1	The aims of chemistry Ancient element theory/Alchemy
	7		Boyle to Stahl—redefining “elementary” The gaseous state
	10		Priestley’s discovery of dephlogisticated air Lavoisier and oxygen
	12	Homework 2	Theories of Combustion: Dephlogisticated Air vs. Oxygen Element theory
	14	<b>Quiz I</b>	Ancient Atomism
	17		Boyle, Newton, Stahl John Dalton-how to weigh atoms
	19	Homework 3	Periodicity Isolation of the Noble Gases
	21	<b>Quiz II</b>	Molecules/Organic Analysis
	24		Organic Analysis, continued Electrochemical dualism, Isomerism, radicals and types
	26	Homework 4	Valence and Structure
	28	<b>Quiz III</b>	Chemical Affinity
	31		Protophysical chemistry The New Physical Chemistry
August	2	Homework 5	The Lewis Atom/Pauling and Resonance
	4	<b>Final Quiz</b>	

#### Course Evaluation:

Homework: 30%  
Quizzes: 40%  
Quiz 4: 30%

Quizzes will consist of short answer (one or two paragraph) questions and some multiple choice and true/false questions that derive from the lecture, your reading from Brock, and this and other handouts. Quiz 4 will cover only the last quarter of the course, but will include one or two cumulative questions.

## Required Reading

Introduction: all  
Chapter 1: pp. 1-32  
Chapter 2: pp. 41-54 (skim); 54-86  
Chapter 3: pp. 87-121; 124-127  
Chapter 4: pp. 128-147; 171-2  
Chapter 5: pp. 173-185; 194-209  
Chapter 6: all  
Chapter 7: all  
Chapter 9: pp. 311-340  
Chapter 10: all  
Chapter 13: all

The following books have been placed on reserve in the library:

William H. Brock, *The Norton History of Chemistry*, Norton, New York, 1993.  
Maurice Crosland, *Historical Studies in the Language of Chemistry*, 1978, Dover, New York, 1962.  
Thomas Hankins, *Science in the Enlightenment*, Cambridge, 1985  
Aaron J. Ihde, *The Development of Modern Chemistry*, Harper and Row, New York, 1964.  
David Knight, *Ideas in Chemistry*, Rutgers, 1992  
Antoine Lavoisier, *Elements of Chemistry*, 1789  
Henry M. Leicester, *The Historical Background of Chemistry*, Wiley, New York, 1956.