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~~What Happens
when Stuff
Dissolves?~~

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~~Reactions And
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aqueous solutions—~~

~~Question 8.6~~

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~~4 Aqueous~~
~~Reactions And~~
Chapter 4 Aqueous
Reactions and
Solution
Stoichiometry.

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Solutions:

□ Homogeneous mixtures of two or more pure

substances. □ The solvent is usually present in greatest

abundance. □ Or, the solvent is the liquid when a solid

is dissolved □ All other substances are solutes.

Dissociation.

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Aqueous

~~Chapter 4 Aqueous
Reactions And
Solution~~

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Aqueous Reactions.

Solutions: □

Homogeneous
mixtures of two or
more pure

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substances. □ The solvent is usually present in greatest abundance. □ Or, the solvent is the liquid when a solid is dissolved □ All other substances are solutes.

Aqueous Reactions.

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Chapter 4.
Reactions in
Aqueous Solution.
James F. Kirby.

Quinnipiac
University.

Hamden, CT.

Solutions. Solutions
are defined as
homogeneous
mixtures of two or
more pure
substances. The
solvent. is present

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in greatest abundance. All other substances are solutes. When water is the solvent, the solution is called an aqueous solution.

~~Chapter 4 Aqueous
Reactions and
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Stoichiometry~~
Section 4.4 – Oxidation-Reduction

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Aqueous
Reduction
Reactions.

Oxidation-
Solution
reduction reactions
(redox reactions)

are reactions in
which electrons are
transferred
between reactants.
Oxidation is loss of
electrons.

Reduction is gain of
electrons.

Oxidation and

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reduction always
occur together.

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Aqueous Reactions
and Solution
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Chapter 4.
Aqueous Reactions
and Solution
Stoichiometry 4.1
General Properties
of Aqueous
Solutions □ A

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Aqueous solution is a homogeneous mixture of two or more substances. □

A solution is made when one substance (the solute) is dissolved in another (the solvent). □ The solute is the substance that is present in the smallest amount.

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Aqueous

~~Brown LeMay
Chapter 4.pdf~~

~~Chapter 4 Aqueous
Reactions ...~~

Chemistry Chapter
4: Aqueous
Reactions and
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Stoichiometry.

Elemental form of
atom is 0 because
it has not gained or
lost anything;

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monatomic ions are equal to their charge; nonmetals in compounds are negative [F is always -1 and O is always -2; H can be positive or negative]; sum of all numbers in a neutral compound is 0 and in a polyatomic ion it is the overall charge

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of the ion.
Aqueous

Reactions And
~~Chemistry Chapter~~
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~~4: Aqueous~~
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Aqueous Reactions And

Solution Chapter 4:

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~~Stoichiometry ...~~

The acidity or
basicity of an
aqueous solution is
described
quantitatively
using the pH scale.

4.9: Oxidation-

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Reduction
Reactions
Oxidation-reductio
n reactions are
balanced by
separating the
overall chemical
equation into an
oxidation equation
and a reduction
equation.

~~4: Chemical
Reactions and~~

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~~Aqueous Reactions
Chemistry ...~~

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and Solution
Stoichiometry

Stoichiometry
Common Student
Misconceptions □
Molarity is moles of
solute per liter of
solution, not per
liter of solvent. □
Students
sometimes use

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moles instead of
molarity in $M_{\text{initial}} V_{\text{initial}} = M_{\text{final}} V_{\text{final}}$. □ Students
sometimes think
that water is a
good conductor.

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~~Aqueous Reactions~~
~~and Solution~~
~~Stoichiometry~~
Larson-Foothill
College 1 Chapter
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Chapter 4

4: Aqueous Reactions and Solution

Stoichiometry The topics in this chapter will further our knowledge of types of chemical reactions and our abilities to predict the products of and write balanced chemical equations for a variety of

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Aqueous reactions.

Reactions And

~~Chapter 4a~~

~~Chapter 4 Aqueous
Reactions and
Solution ...~~

Home assignment:

Chapter 4:

Aqueous Reactions
and Solution

Stoichiometry 7) In

which species does
sulfur have the

highest oxidation

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number? A)S,
(elemental form of
sulfur) B)H₂S C)SO₂
D) H₂SO₄ E)K₂SO₄

One method for
removal of metal
ions from a
solution is to
convert the metal
to its elemental
form so it can be
filtered out as a
solid.

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~~Solved: Home~~

~~Assignment:~~

~~Chapter 4:~~

~~Aqueous Reactions~~

~~And ...
Stoichiometry~~

Chemistry, The

Central Science,

10th edition

Theodore L. Brown;

H. Eugene LeMay,

Jr.; and Bruce E.

Bursten Chapter 4

Aqueous Reactions

and Solution

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Stoichiometry –
PowerPoint PPT
presentation.

Water is the
dissolving medium,
or solvent. Water is
bent or V-shaped.
The O-H bonds are
covalent.

~~PPT Chapter 4~~
~~Aqueous Reactions~~
~~and Solution ...~~

Chapter 4 Aqueous

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Chapter 4

Reactions And
Chapter 4 Aqueous
Reactions and
Solution

Stoichiometry.

Solutions:

□ Homogeneous mixtures of two or more pure substances. □ The solvent is usually present in greatest abundance. □ Or, the solvent is the

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liquid when a solid is dissolved. All other substances are solutes.

Dissociation.
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Reactions and
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Aqueous Reactions
Solutions □

Solutions are defined as homogeneous mixtures of two or more pure substances. □ The solvent is present in greatest abundance. □ All

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other substances
are solutes. Spring
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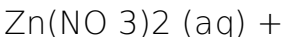
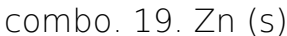
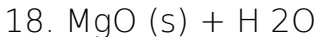
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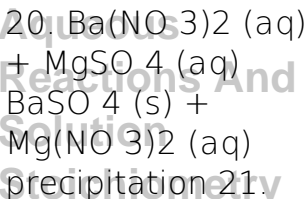
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Worksheet Spring
2007 page 4 of 4
Complete, balance,
and identify the
reaction type for
each of the
following

equations: Type



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Aqueous Solutions
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Types of Chemical
Reactions and
Solution~~

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aerosol (SOA) is formed and transformed in atmospheric aqueous phases (e.g., cloud and fog droplets and deliquesced airborne particles containing small amounts of water) through a multitude of chemical and

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physical processes. Understanding the formation and transformation processes of SOA via aqueous-phase reactions is important for properly presenting its atmospheric evolution pathways in models and for elucidating its climate and health

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effects. Phenolic compounds, which are emitted in significant amounts from biomass burning, can undergo fast reactions in atmospheric aqueous phases to form secondary organic aerosol (aqSOA). In this study, we

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investigate the formation and evolution of phenol (C_6H_6O), guaiacol ($C_7H_8O_2$, 2-methoxyphenol) and syringol ($C_8H_{10}O_3$; 2,6-dimethoxyphenol) and with two major aqueous phase oxidants -- the triplet excited state of an aromatic

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carbonyl ($3C^*$) and hydroxyl radical ($\cdot OH$) - and interpret the reaction mechanisms. In addition, given that dissolved organic matter (DOM) is an important component of fog and cloud water and that it can undergo aqueous

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reactions to form more oxidized, less volatile species, we further investigate the photochemical processing of DOM in fog water to gain insights into the aqueous-phase processing of organic aerosol (OA) in the atmosphere. In Chapter 2, we

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thoroughly
characterize the
bulk chemical and
molecular

compositions of
phenolic aqSOA
formed at half-life
($t_{1/2}$),
and interpret the
formation

mechanisms. We
find that phenolic
aqSOA formed at
 $t_{1/2}$ is

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Chapter 4

highly oxygenated
with atomic oxygen-
to-carbon ratio
(O/C) in the range
of 0.85-1.23.

Dimers, higher
oligomers (up to
hexamers),
functionalized
monomers and
oligomers with
carbonyl, carboxyl,
and hydroxyl
groups, and small

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organic acids are detected.

Compared with $\cdot\text{OH}$ -mediated

reactions, reactions mediated by 3C^*

are faster and produce more

oligomers and hydroxylated

species at

$t_{1/2}$. We

also find that

aqSOA shows

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Chapter 4

enhanced light absorption in the UV-vis region, suggesting that aqueous-phase reactions of phenols are an important source of secondary brown carbon in the atmosphere, especially in regions impacted by biomass

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burning. In Chapter 3, we investigate the chemical evolution of phenolic aqSOA via aqueous-phase reactions on the molecular level and interpret the aging mechanisms. Our results indicate that oligomerization is an important

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Aqueous reaction pathway for phenols, especially during the initial stage of photooxidation.

Functionalization and fragmentation become dominant at later stages, forming a variety of functionalized aromatic and ring-opening products

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with higher carbon oxidation states. Fragmentation reactions eventually dominate the photochemical evolution of phenolic aqSOA, forming a large number of highly oxygenated ring-opening molecules. In addition,

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phenolic aqSOA has a wide range of saturation vapor pressures (C^*), varying from $10-20 \text{ } \mu\text{g m}^{-3}$ for functionalized phenolic oligomers to $10 \text{ } \mu\text{g m}^{-3}$ for ring-opening species with number of carbon less than 6. The detection of

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abundant extremely low volatile organic compounds (ELVOC) indicates that aqueous reactions of phenolic compounds are likely an important source of ELVOC in the atmosphere.

Chapter 3 investigates the

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Aqueous
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Stoichiometry

molecular transformation with aging based on the characterization of three aqSOA filter samples collected at the defined time intervals of the photoreaction. However, the chemical evolution of aqSOA products with hours of illumination at a

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higher time resolution is largely unknown. In Chapter 4, we investigate the chemical evolution of aqSOA at a 1-min time resolution based on high-resolution aerosol mass spectrometer (AMS) analysis. This is important

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for understanding the continuous evolution of phenolic aqSOA with aging as well as for elucidating the formation and transformation of different generations of products. Our results suggest that dimer and higher-order

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oligomers (trimers, tetramers, etc.) are formed

continuously during the first 1-2 hours of photoreaction but show a gradual decrease afterwards.

Functionalized derivatives grow at a later time and then gradually decrease. Highly

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oxidized ring-opening species continuously increase over the course of reactions. Positive matrix factorization (PMF) analysis of the AMS spectra of phenolic aqSOA identifies multiple factors, representing different generations of

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products. The 1st-generation products include dimers, higher-order oligomers and their oxygenated derivatives. The 2nd-generation products include oxygenated monomeric derivatives. The 3rd-generation

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products include highly oxidized ring-opening species. In Chapter 5, we investigate the evolution of dissolved organic matter (DOM) in fog water. Our results show that the mass concentration of DOM_[subscript OA] (i.e., low-volatility

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DOM in fog water) is enhanced over the course of illumination, with continuous increase of O/C and atomic nitrogen-to-carbon ratio (N/C). The increase of DOM_{OA} is due to the incorporation of oxygen- and nitrogen-containing

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functional groups into the molecules. The aqueous aging of DOM_{OA} can be modeled as a linear combination of the dynamic variations of 3 factors using PMF analysis. Factor 1 is chemically similar to the DOM_{OA}

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before illumination,
which is quickly
reacted away.

Factor 2 is
representative of
an intermediate
component, which
is first formed and
then transformed,
and O/C of Factor 2
is intermediate
between that of
Factor 1 and Factor
3. Factor 3

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represents highly oxidized final products, which is continuously formed during illumination. Fog DOM absorbs significantly in the tropospheric sunlight wavelengths, but this absorption behavior stays almost constant

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over the course of illumination, despite the significant change in chemical composition.

Full solutions to all of the red-numbered exercises in the text are provided.

Recent advances in
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free radical
chemistry in water
have expanded the
versatility and
flexibility of
homolytic bond
formations in
aqueous media.
This textbook
highlights the
substantial
progress which has
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leader and
standard in general
chemistry, this text
maintains its
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strong exercises,
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Matter and
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Atoms, Molecules,
and Ions. Chemical
formulas and
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bonding. Gases.
Intermolecular
forces, liquids, and
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emphasizes the
fundamental
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and the application of these equations to systems of biochemical reactions. This emphasis leads to new thermodynamic potentials that provide criteria for spontaneous change and equilibrium under the conditions in a

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living cell.

Reactions And

The first
comprehensive
resource on the

chemistry of
vanadium,

Vanadium:

Chemistry,

Biochemistry,

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A quarter century of research that concentrated on delineating the aqueous coordination reactions that characterize the vanadium(V) oxidation state. The authors distill information on biological processes needed

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to understand vanadium effects in biological systems and make this information accessible to a wide range of readers, including chemists without extensive biological training. Building a hierarchy of complexity, the book provides a

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discussion of some basic principles of ^{51}V NMR spectroscopy followed by a description of the self-condensation reactions of vanadate itself. The authors delineate reactions with simple monodentate ligands and then

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proceed to more complicated systems such as diols, α -hydroxy acids, amino acids, peptides, to name just a few. They revisit aspects of this sequence later, but first highlight the influence the electronic properties of ligands have on

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coordination and reactivity. They then compare and contrast the influences of ligands, particularly those of hydrogen peroxide and hydroxylamine, on heteroligand reactivity. The book includes coverage of vanadium-dependent

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haloperoxidases and model systems, vanadium in the environment, and technological applications. It also briefly covers the catalytic reactions of peroxovanadate and haloperoxidase model compounds. It contains a discussion of the vanadium

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haloperoxidases and the biological and biochemical activities of vanadium(V) including potential pharmacological applications. The last chapters step outside these boundaries by introducing some aspects of the future of vanadium

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in nanotechnology, the recyclable redox battery, and the lithium/silver vanadium oxide battery. Primary sources documented after each chapter minimize the need to search the literature, 80 illustrations provide structural

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information, reaction schemes, spectra, speciation diagrams, and biochemical schemes, and 22 tables present detailed information with references to primary sources. Packed with current and authoritative

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information, the book covers aqueous reactions and solution chemistry and bioinorganic vanadium chemistry in a broad and systematic manner that engenders comprehensive understanding.

Dinitrogen
pentoxide (N_2O_5)

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is a naturally occurring gas-phase nitrating agent that acts as a nocturnal NO_x reservoir (NO_x ⇌ NO + NO₂) in the atmosphere. The heterogeneous reaction of N₂O₅ at aqueous interfaces can serve as a chain terminating reaction in the

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Aqueous
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Solution
Stoichiometry

catalytic cycling of
NO_x radicals that
generate ozone in
the lower
atmosphere. A
molecular
mechanism for the
heterogeneous
reaction of N₂O₅
has remained
elusive but is
generally thought
to proceed through
hydrolysis forming

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nitrate in the condensed phase. It has been shown previously that N_2O_5 can also react with aqueous chloride, forming nitryl chloride (ClNO_2). Upon evaporation to the gas phase, ClNO_2 can photolyze, regenerating NO_2 and a chlorine

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radical. The fraction of N_2O_5 that is converted to ClNO_2 following reactive uptake to aqueous interfaces (Φ_{ClNO_2}) depends strongly on the chloride concentration. Although well established for aqueous solutions

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Aqueous only
chloride, recent
field observations
indicate that
parameterizations
of [uppercase
Phi]ClNO₂ based
on laboratory
measurements
uniformly
overpredict
[uppercase
Phi]ClNO₂ for more
chemically

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Chapter 4

complex interfaces.

In this thesis, I

expand upon

existing studies of

N_2O_5 reaction with

chloride in water to

investigate

alternative solutes

and solvents as

well as mixed salt

solutions that are

more relevant

proxies for

atmospheric

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interfaces. In chapters 2 and 3, I report and interpret measurements of the nitryl chloride (ClNO_2) branching fraction following reactive uptake of N_2O_5 to mixed organic and inorganic solutions representative of atmospheric

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interfaces. For solutions containing 0.5 M NaCl, [uppercase Phi]ClNO₂ is reduced from 0.85 +/- 0.03 to 0.32 +/- 0.14 upon the addition of 2.0 M Na₂SO₄, and to 0.18 +/- 0.03 upon the addition of 0.5 M NaAc. The results indicate

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that anions ubiquitous in atmospheric aerosol, commonly considered to be unreactive, may regulate the production of reactive gases such as ClNO_2 . In chapter 4, I investigate the parallel reaction of N_2O_5 with bromide

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(sodium bromide, NaBr, and tetrahexylammonium bromide, THABr)

and compare the observed product branching fractions with those observed for aqueous chloride solutions. In the second part of chapter 4, I explore the product

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branching fractions for Br_2 in a new solvent, glycerol, to represent the organic component of aerosol.

This monograph is intended to provide a systematic presentation of theories concerning the adsorption of metal ions from

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Aqueous solutions
onto surfaces of
natural and
synthetic
substances and to
outline methods
and procedures to
estimate the extent
and progress
of adsorption. As
heavy metals and
the problems
associated with
their transport and

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distributions are of serious concern to human health and the environment, the materials presented in this volume have both theoretical and practical significance. In writing this monograph, one of our goals was to prepare a book

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useful to
environmental
workers and
practicing
engineers. For this
reason, our
presentation relies
heavily on
concepts
commonly used in
the environmental
engineering
literature. In fact,
the volume was

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prepared for readers with a basic understanding of environmental engineering principles and some knowledge of adsorption processes. No prior familiarity with the ionic solute adsorption at solid-solution interfaces

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is assumed.
Instead,
introduction of the
necessary
background
information was
included. Generally
speaking, metal ion
adsorption may be
studied in terms of
three distinct but
interrelated
phenomena:
surface ionization,

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complex formation, and the formation and presence of an electrostatic double layer adjacent to adsorbent surfaces.

Analyses of these phenomena with various degrees of sophistication are

xviii ADSORPTION
OF METAL IONS
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SOLUTIONS
presented, and
their various
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