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PROPERTIES OF AQUEOUS SOLUTIONS OF ELECTROLYTES IS A HANDBOOK THAT SYSTEMATIZES THE INFORMATION ON PHYSICO CHEMICAL PARAMETERS OF MULTICOMPONENT AQUEOUS ELECTROLYTE SOLUTIONS THIS IMPORTANT DATA COLLECTION WILL BE INVALUABLE FOR DEVELOPING NEW METHODS FOR MORE EFFICIENT CHEMICAL TECHNOLOGIES CHOOSING OPTIMAL SOLUTIONS FOR MORE EFFECTIVE METHODS OF USING RAW MATERIALS AND ENERGY RESOURCES AND OTHER SUCH ACTIVITIES THIS EDITION THE FIRST AVAILABLE IN ENGLISH HAS BEEN SUBSTANTIALLY REVISED AND AUGMENTED MANY NEW TABLES HAVE BEEN ADDED BECAUSE OF A SIGNIFICANTLY LARGER LIST OF ELECTROLYTES AND THEIR PROPERTIES ELECTRICAL CONDUCTIVITY BOILING AND FREEZING POINTS PRESSURE OF SATURATED VAPORS ACTIVITY AND DIFFUSION COEFFICIENTS THE BOOK IS DIVIDED INTO TWO SECTIONS THE FIRST SECTION PROVIDES TABLES THAT LIST THE PROPERTIES OF BINARY AQUEOUS SOLUTIONS OF ELECTROLYTES WHILE THE SECOND SECTION DEALS WITH THE METHODS FOR CALCULATING THEIR PROPERTIES IN MULTICOMPONENT SYSTEMS ALL VALUES ARE GIVEN IN PSI UNITS OR FRACTIONAL AND MULTIPLE UNITS METROLOGICAL CHARACTERISTICS OF THE EXPERIMENTAL METHODS USED FOR THE DETERMINATION OF PHYSICO CHEMICAL PARAMETERS ARE INDICATED AS A RELATIVE ERROR AND THOSE OF THE COMPUTATIONAL METHODS AS A RELATIVE ERROR OR A ROOT MEAN SQUARE DEVIATION J E ENDERBY AT THE LAST NATO ASI ON LIQUIDS HELD IN CORSICA AUGUST 1977 PROFESSOR DE GENNES IN HIS SUMMARY OF THAT MEETING SUGGESTED THAT THE NEXT ASI SHOULD CONCENTRATE ON SOME SPECIFIC ASPECT OF THE SUBJECT AND MENTIONED EXPLICITLY IONIC SOLUTIONS AS ONE POSSIBILITY THE CHALLENGE WAS TAKEN UP BY MARIE CLAIRE BELLISSENT FUNEL AND GEORGE NEILSON I AM SURE THAT ALL THE PARTICIPANTS WOULD WISH TO CONGRATULATE OUR TWO COLLEAGUES FOR PUTTING TOGETHER AN OUTSTANDING PROGRAMME OF LECTURES ROUND TABLES AND POSTER SESSION THE THEORY WHICH UNDERLIES THE SUBJECT WAS COVERED BY FOUR LEADING AUTHORITIES J P HANSEN PARIS SET OUT THE GENERAL FRAMEWORK IN TERMS OF THE STATISTICAL MECHANICS OF BULK AND SURFACE PROPERTIES H L FRIEDMAN STONY BROOK FOCUSED ATTENTION ON IONIC LIQUIDS AT EQUILIBRIUM AND J B HUBBARD CONSIDERED NON EQUILIBRIUM PROPERTIES SUCH AS THE ELECTRICAL CONDUCTIVITY AND IONIC FRICTION COEFFICIENTS FINALLY THE BASIC THEORY OF POLYELECTROLYTES TREATED AS CHARGED LINEAR POLYMERS IN AQUEOUS SOLUTION WAS PRESENTED BY J M VICTOR PARIS THE CHAPTERS MAKING UP THIS VOLUME HAD ORIGINALLY BEEN PLANNED TO FORM PART OF A SINGLE VOLUME COVERING SOLID HYDRATES AND AQUEOUS SOLUTIONS OF SIMPLE MOLECULES AND IONS HOWEVER DURING THE PREPARATION OF THE MANUSCRIPTS IT BECAME APPARENT THAT SUCH A VOLUME WOULD TURN OUT TO BE VERY UNWIELDY AND I RELUCTANTLY DECIDED TO RECOMMEND THE PUBLICATION OF SEPARATE VOLUMES THE MOST SENSIBLE WAY OF DIVIDING THE SUBJECT MATTER SEEMED TO LIE IN THE SEPARATION OF SIMPLE IONIC SOLUTIONS THE EMPHASIS IN THE PRESENT VOLUME IS PLACED ON ION SOLVENT EFFECTS SINCE A NUMBER OF EXCELLENT TEXTS COVER THE MORE GENERAL ASPECTS OF ELECTROLYTE SOLUTIONS BASED ON THE CLASSICAL THEORIES OF DEBYE HUCKEL ON SAGER AND FUOSS IT IS INTERESTING TO SPECULATE AS TO WHEN A THEORY BECOMES CLASSICAL PERHAPS THIS OCCURS WHEN IT HAS BECOME WELL KNOWN WELL LIKED AND MUCH ADAPTED THE ABOVE MENTIONED THEORIES OF IONIC EQUILIBRIA AND TRANSPORT CERTAINLY FULFILL THESE CRITERIA THERE COMES A TIME WHEN THE REFINEMENTS AND MODIFICATIONS CAN NO LONGER BE RELATED TO PHYSICAL SIGNIFICANCE AND CAN NO LONGER HIDE THE FACT THAT CERTAIN FUNDAMENTAL ASSUMPTIONS MADE IN THE DEVELOPMENT OF THE THEORY ARE UNTENABLE ESPECIALLY IN THE LIGHT OF INFORMATION OBTAINED FROM THE APPLICATION OF SOPHISTICATED MOLECULAR AND THERMODYNAMIC TECHNIQUES AN INTRODUCTION TO AQUEOUS ELECTROLYTE SOLUTIONS IS A COMPREHENSIVE COVERAGE OF THE SUBJECT INCLUDING THE DEVELOPMENT OF KEY CONCEPTS AND THEORY THAT FOCUS ON THE PHYSICAL RATHER THAN THE MATHEMATICAL ASPECTS IMPORTANT LINKS ARE MADE BETWEEN THE STUDY OF ELECTROLYTE SOLUTIONS AND OTHER BRANCHES OF CHEMISTRY BIOLOGY AND BIOCHEMISTRY MAKING IT A USEFUL CROSS REFERENCE TOOL FOR STUDENTS STUDYING THIS IMPORTANT AREA OF ELECTROCHEMISTRY CAREFULLY DEVELOPED THROUGHOUT EACH CHAPTER INCLUDES INTENDED LEARNING OUTCOMES AND WORKED PROBLEMS AND EXAMPLES TO ENCOURAGE STUDENT UNDERSTANDING OF THIS MULTIDISCIPLINARY SUBJECT A COMPREHENSIVE INTRODUCTION TO AQUEOUS ELECTROLYTE SOLUTIONS INCLUDING THE DEVELOPMENT OF KEY CONCEPTS AND THEORIES EMPHASISES THE CONNECTION BETWEEN OBSERVABLE MACROSCOPIC EXPERIMENTAL PROPERTIES AND INTERPRETATIONS MADE AT THE MOLECULAR LEVEL KEY DEVELOPMENTS IN CONCEPTS AND THEORY EXPLAINED IN A DESCRIPTIVE MANNER TO ENCOURAGE STUDENT UNDERSTANDING INCLUDES WORKED PROBLEMS AND EXAMPLES THROUGHOUT AN INVALUABLE TEXT FOR STUDENTS TAKING COURSES IN CHEMISTRY AND CHEMICAL ENGINEERING THIS BOOK WILL ALSO BE USEFUL FOR BIOLOGY BIOCHEMISTRY AND BIOPHYSICS STUDENTS REQUIRED TO STUDY ELECTROCHEMISTRY ADSORPTION FROM AQUEOUS SOLUTIONS IS IMPORTANT IN MANY TECHNOLOGICAL AREAS LIKE WATER PURIFICATION MINERAL BENEFICIATION SOIL CONSERVATION DETERGENCY AND MANY AREAS OF BIOLOGY RECENTLY ADSORPTION OF RADIONUCLIDES FROM AQUEOUS SOLUTIONS HAS BECOME THE FOCUS OF ATTENTION IN ASSESSING THE MOVEMENT OF RADIONUCLIDES THROUGH A GEOLOGIC MEDIUM FROM UNDERGROUND RADIOACTIVE WASTE REPOSITORIES THIS VOLUME PROVIDES A MULTIDISCIPLINARY OVERVIEW OF CURRENT WORK IN THE AREA OF ADSORPTION FROM AQUEOUS SOLUTIONS AND REVIEWS THE PROGRESS THAT HAS BEEN MADE IN THE THEORETICAL MODELS FOR ASSESSING ADSORPTION ADSORPTION OF HEAVY METAL IONS AND THE EFFECT OF COMPLEX FORMATION IS TREATED EXTENSIVELY AS ARE THE EFFECTS OF SURFACE CHEMICAL PROPERTIES OF THE ADSORBENT SOLUTION PH AND THERMODYNAMIC PARAMETERS IMPORTANT IN THE ADSORPTION PROCESS ADSORPTION OF PESTICIDES AND ORGANIC POLYMERIC SPECIES ON DIFFERENT ADSORBENTS ARE INCLUDED AND IMPLICATIONS OF ADSORPTION OF IONS ON DENTAL MATERIALS ARE DISCUSSED ALSO INCLUDED ARE STUDIES OF THE ADSORPTION OF RADIONUCLIDES BY GEOLOGIC MEDIA UNDER ENVIRONMENTAL CONDITIONS THE STUDY OF THE CHEMICAL NATURE OF THE ADSORBED SPECIES AT THE SURFACE BY X RAY PHOTOELECTRON SPECTROSCOPY WHICH OFTEN PROVIDES MECHANISTIC INFORMATION FOR THE ADSORPTION PROCESS IS INCLUDED FOR ADSORBED METAL IONS ON CLAY AND MINERAL SURFACES THE AIM OF THIS BOOK IS TO EXPLAIN THE UNUSUAL PROPERTIES OF BOTH PURE LIQUID WATER AND SIMPLE AQUEOUS SOLUTIONS IN TERMS OF THE PROPERTIES OF SINGLE MOLECULES AND INTERACTIONS AMONG SMALL NUMBERS OF WATER MOLECULES IT IS MOSTLY THE RESULT OF THE AUTHOR'S OWN RESEARCH SPANNING OVER 40 YEARS IN THE FIELD OF AQUEOUS SOLUTIONS JACKET WITH THE INFORMATION COLLECTED AND DISCUSSED IN THIS VOLUME MAY HELP TOWARD THE ACHIEVEMENT OF SUCH AN OBJECTIVE I SHOULD LIKE TO EXPRESS MY DEBT OF GRATITUDE TO THE AUTHORS WHO HAVE CONTRIBUTED TO THIS VOLUME EDITING A WORK OF THIS NATURE CAN STRAIN LONG ESTABLISHED PERSONAL RELATIONSHIPS AND I THANK MY VARIOUS COLLEAGUES FOR BEARING WITH ME AND RESPONDING SOONER OR LATER TO ONE OR SEVERAL LETTERS OR TELEPHONE CALLS MY SPECIAL THANKS ONCE AGAIN GO TO MRS JOYCE JOHNSON WHO BORE THE MAIN BRUNT OF THIS SEEMINGLY ENDLESS CORRESPONDENCE AND WITHOUT WHOSE HELP THE EDITORIAL AND REFERENCING WORK WOULD HAVE TAKEN SEVERAL YEARS F FRANKS BIOPHYSICS DIVISION UNILEVER RESEARCH LABORATORY COLWORTH WELWYN COLWORTH HOUSE SHARNBROOK BEDFORD JANUARY 1973

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AQUEOUS SOLUTIONS AN UNDERSTANDING OF THE PROPERTIES OF LIQUID WATER IS A PRELUDE TO THE UNDERSTANDING OF THE ROLE OF WATER IN BIOLOGICAL SYSTEMS AND FOR THE EVOLVEMENT OF LIFE THE BOOK IS TARGETED AT ANYONE WHO IS INTERESTED IN THE OUTSTANDING PROPERTIES OF WATER AND ITS ROLE IN BIOLOGICAL SYSTEMS IT IS ADDRESSED TO BOTH STUDENTS AND RESEARCHERS IN CHEMISTRY PHYSICS AND BIOLOGY THE MOLECULAR THEORY OF WATER AND AQUEOUS SOLUTIONS HAS ONLY RECENTLY EMERGED AS A NEW ENTITY OF RESEARCH ALTHOUGH ITS ROOTS MAY BE FOUND IN AGE OLD WORKS THE PURPOSE OF THIS BOOK IS TO PRESENT THE MOLECULAR THEORY OF AQUEOUS FLUIDS BASED ON THE FRAMEWORK OF THE GENERAL THEORY OF LIQUIDS THE STYLE OF THE BOOK IS INTRODUCTORY IN CHARACTER BUT THE READER IS PRESUMED TO BE FAMILIAR WITH THE BASIC PROPERTIES OF WATER FOR INSTANCE THE TOPICS REVIEWED BY EISENBERG AND KAUFMANN 1969 AND THE ELEMENTS OF CLASSICAL THERMODYNAMICS AND STATISTICAL MECHANICS E G DENBIGH 1966 HILL 1960 AND TO HAVE SOME ELEMENTARY KNOWLEDGE OF PROBABILITY E G FELLER 1960 PAPULIS 1965 NO OTHER FAMILIARITY WITH THE MOLECULAR THEORY OF LIQUIDS IS PRESUMED FOR THE CONVENIENCE OF THE READER WE PRESENT IN CHAPTER 1 THE FUNDAMENTALS OF STATISTICAL MECHANICS THAT ARE REQUIRED AS PREREQUISITES TO AN UNDERSTANDING OF SUBSEQUENT CHAPTERS THIS CHAPTER CONTAINS A BRIEF AND CONCISE SURVEY OF TOPICS WHICH MAY BE ADOPTED BY THE READER AS THE FUNDAMENTAL RULES OF THE GAME AND FROM HERE ON THE DEVELOPMENT IS VERY SLOW AND DETAILED THE CHAPTERS MAKING UP THIS VOLUME HAD ORIGINALLY BEEN PLANNED TO FORM PART OF A SINGLE VOLUME COVERING SOLID HYDRATES AND AQUEOUS SOLUTIONS OF SIMPLE MOLECULES AND IONS HOWEVER DURING THE PREPARATION OF THE MANUSCRIPTS IT BECAME APPARENT THAT SUCH A VOLUME WOULD TURN OUT TO BE VERY UNWIELDY AND I RELUCTANTLY DECIDED TO RECOMMEND THE PUBLICATION OF SEPARATE VOLUMES THE MOST SENSIBLE WAY OF DIVIDING THE SUBJECT MATTER SEEMED TO LIE IN THE SEPARATION OF SIMPLE IONIC SOLUTIONS THE EMPHASIS IN THE PRESENT VOLUME IS PLACED ON ION SOLVENT EFFECTS SINCE A NUMBER OF EXCELLENT TEXTS COVER THE MORE GENERAL ASPECTS OF ELECTROLYTE SOLUTIONS BASED ON THE CLASSICAL THEORIES OF DEBYE HUCKEL ON SAGER AND FUOSS IT IS INTERESTING TO SPECULATE AS TO WHEN A THEORY BECOMES CLASSICAL PERHAPS THIS OCCURS WHEN IT HAS BECOME WELL KNOWN WELL LIKED AND MUCH ADAPTED THE ABOVE MENTIONED THEORIES OF IONIC EQUILIBRIA AND TRANSPORT CERTAINLY FULFILL THESE CRITERIA THERE COMES A TIME WHEN THE REFINEMENTS AND MODIFICATIONS CAN NO LONGER BE RELATED TO PHYSICAL SIGNIFICANCE AND CAN NO LONGER HIDE THE FACT THAT CERTAIN FUNDAMENTAL ASSUMPTIONS MADE IN THE DEVELOPMENT OF THE THEORY ARE UNTENABLE ESPECIALLY IN THE LIGHT OF INFORMATION OBTAINED FROM THE APPLICATION OF SOPHISTICATED MOLECULAR AND THERMODYNAMIC TECHNIQUES IONISATION CONSTANTS OF INORGANIC ACIDS AND BASES IN AQUEOUS SOLUTION SECOND EDITION PROVIDES A COMPILATION OF TABLES THAT SUMMARIZE RELEVANT DATA RECORDED IN THE LITERATURE UP TO THE END OF 1980 FOR THE IONIZATION CONSTANTS OF INORGANIC ACIDS AND BASES IN AQUEOUS SOLUTION THIS BOOK INCLUDES REFERENCES TO ACIDITY FUNCTIONS FOR STRONG ACIDS AND BASES AS WELL AS DETAILS ABOUT THE FORMATION OF POLYNUCLEAR SPECIES THIS TEXT THEN EXPLAINS THE DETAILS OF EACH COLUMN OF THE TABLES WHEREIN COLUMN 1 GIVES THE NAME OF THE SUBSTANCE AND THE NEGATIVE LOGARITHM OF THE IONIZATION CONSTANT AND COLUMN 2 GIVES THE TEMPERATURE OF MEASUREMENTS IN DEGREE CELSIUS THIS BOOK PRESENTS AS WELL THE METHOD OF MEASUREMENT AND THE LITERATURE REFERENCES THAT ARE LISTED ALPHABETICALLY AT THE END OF THE TABLES CHEMISTS WILL FIND THIS BOOK USEFUL NON AQUEOUS SOLUTIONS 5 IS A COLLECTION OF LECTURES PRESENTED AT THE FIFTH INTERNATIONAL CONFERENCE ON NON AQUEOUS SOLUTIONS HELD IN LEEDS ENGLAND ON JULY 5 9 1976 THE PAPERS EXPLORE REACTIONS IN NON AQUEOUS SOLUTIONS AS WELL AS THE THERMODYNAMIC AND KINETIC PROPERTIES OF NON AQUEOUS SOLUTIONS EXAMPLES OF THE USE OF SPECTROSCOPIC TECHNIQUES ARE PRESENTED AND SOLUTIONS IN MOLTEN SALTS ARE GIVEN METALS IN SOLUTION AND LIQUID METAL SOLUTIONS ARE ALSO CONSIDERED THIS BOOK IS COMPRISED OF 12 CHAPTERS AND BEGINS WITH A REVIEW OF A GENERAL SCHEME WHICH CONSIDERS THE SPECIES FORMED BY CATION ELECTRON AND ELECTRON ELECTRON INTERACTIONS AT DILUTE TO MODERATE CONCENTRATIONS ALONG WITH THE INFLUENCE OF THE SOLVENT AND THE METAL ON THESE INTERACTIONS THE DISCUSSION THEN SHIFTS TO THE APPLICATION OF ELECTRON SPIN RESONANCE SPECTROSCOPY TO THE STUDY OF SOLVATION THE INFLUENCE OF SOLVENT PROPERTIES ON LIGAND SUBSTITUTION MECHANISMS OF LABILE COMPLEXES AND THE EFFECT OF ACIDITY ON CHEMICAL REACTIONS IN MOLTEN SALTS SUBSEQUENT CHAPTERS DEAL WITH THE CHEMISTRY OF SOLUTIONS OF SALTS IN LIQUID ALKALI METALS PREFERENTIAL SOLVATION IN KINETICS AND THE USE OF NON AQUEOUS SOLVENTS FOR PREPARATION AND REACTIONS OF NITROGEN HALOGEN COMPOUNDS RESULTS OF RAMAN SPECTROSCOPIC STUDIES OF NON AQUEOUS SOLUTIONS AND SPECTROSCOPIC STUDIES OF COORDINATION COMPOUNDS FORMED IN MOLTEN SALTS ARE ALSO PRESENTED THIS MONOGRAPH WILL BE OF INTEREST TO CHEMISTS SOLUTION THERMODYNAMICS AND ITS APPLICATION TO AQUEOUS SOLUTIONS A DIFFERENTIAL APPROACH SECOND EDITION INTRODUCES A DIFFERENTIAL APPROACH TO SOLUTION THERMODYNAMICS APPLYING IT TO THE STUDY OF AQUEOUS SOLUTIONS THIS VALUABLE APPROACH REVEALS THE MOLECULAR PROCESSES IN SOLUTIONS IN GREATER DEPTH THAN THAT GAINED BY SPECTROSCOPIC AND OTHER METHODS THE BOOK CLARIFIES WHAT A HYDROPHOBE OR A HYDROPHILE AND IN TURN AN AMPHIPHILE DOES TO H₂O BY APPLYING THE SAME METHODOLOGY TO IONS THAT HAVE BEEN RANKED BY THE HOFMEISTER SERIES THE AUTHOR SHOWS THAT THE KOSMOTROPES ARE EITHER HYDROPHOBES OR HYDRATION CENTERS AND THAT CHAOTROPES ARE HYDROPHILES THIS UNIQUE APPROACH AND IMPORTANT UPDATES MAKE THE NEW EDITION A MUST HAVE REFERENCE FOR THOSE ACTIVE IN SOLUTION CHEMISTRY UNIQUE DIFFERENTIAL APPROACH TO SOLUTION THERMODYNAMICS ALLOWS FOR EXPERIMENTAL EVALUATION OF THE INTERMOLECULAR INTERACTION INCORPORATES RESEARCH FINDINGS FROM OVER 40 ARTICLES PUBLISHED SINCE THE PREVIOUS EDITION NUMERICAL OR GRAPHICAL EVALUATION AND DIRECT EXPERIMENTAL DETERMINATION OF THIRD DERIVATIVES ENTHALPIC AND VOLUMETRIC AL AL INTERACTIONS AND AMPHIPHILES ARE NEW TO THIS EDITION FEATURES NEW CHAPTERS ON SPECTROSCOPIC STUDY IN AQUEOUS SOLUTIONS AS WELL AS ENVIRONMENTALLY FRIENDLY AND HOSTILE WATER AQUEOUS SOLUTIONS THIS BOOK PROVIDES A THOROUGH DISCUSSION OF THE THERMODYNAMICS OF AQUEOUS SOLUTIONS AND PRESENTS TOOLS FOR ANALYZING AND SOLVING SCIENTIFIC AND PRACTICAL PROBLEMS ARISING IN THIS AREA IT ALSO PRESENTS METHODS THAT CAN BE USED TO DEAL WITH IONIC AND NONIONIC AQUEOUS SOLUTIONS UNDER SUB OR SUPERCRITICAL CONDITIONS ILLUSTRATIONS AND TABLES GIVE EXAMPLES OF PROCEDURES EMPLOYED TO PREDICT THERMODYNAMIC QUANTITIES OF THE SOLUTIONS AND AN APPENDIX

SUMMARIZING STATISTICAL MECHANICAL EQUATIONS USED TO DESCRIBE THE SYSTEMS IS ALSO PROVIDED HIGH TEMPERATURE AQUEOUS SOLUTIONS THERMODYNAMIC PROPERTIES CONTAINS ESSENTIAL INFORMATION FOR PHYSICAL CHEMISTS GEOCHEMISTS GEOPHYSICISTS CHEMICAL TECHNICIANS AND SCIENTISTS INVOLVED IN ELECTRIC POWER GENERATION IONIC SURFACTANTS AND AQUEOUS SOLUTIONS BIOMOLECULES METALS AND NANOPARTICLES COVERS A WIDE RANGE OF SUBJECTS RELATED TO AQUEOUS SYSTEMS FROM REVERSE MICELLES AS ION EXCHANGERS TO THE STUDY OF MICELLAR PHASE TRANSFER CATALYSIS FOR NUCLEOPHILIC SUBSTITUTION REACTIONS THE DIVERSE BACKGROUND EXPERTISE AND PROFESSIONAL INTERESTS OF THE CONTRIBUTORS TO THIS BOOK GIVE TO IT A UNIQUE RICHNESS OF APPROACH IN TOPICS OF RELEVANCE FOR BIOTECHNOLOGY AND ENVIRONMENTAL STUDIES OVER SIXTY PUBLICATIONS PRESENTING RESEARCH RESULTS ARE COMBINED AND EXPANDED IN THIS BOOK BY SOME OF THE ORIGINAL RESEARCHERS AT A MATURE AGE AND AT THE SUMMIT OF SUCCESSFUL PROFESSIONAL CAREERS THEY HAVE TAKEN A SECOND LOOK TO THE STATE OF THE ART IN THE FIELDS THAT THEY HAD PIONEERED EVA RODIL AND ANA SOTO WHO HAD THEIR RESEARCH FORMATION IN THE GROUP OF PROFESSOR ALBERTO ARCE AT UNIVERSIDADE DE SANTIAGO DE COMPOSTELA SPAIN ARE PRESENTLY PROFESSORS AT THAT UNIVERSITY MAEN HUSEIN IS A PROFESSOR AT UNIVERSITY OF CALGARY CANADA REMY DUMORTIER MOHAMMAD KHOSKBARCHI HAMID RABIE AND YOUNOK DUMORTIER SHIN ARE PRESENTLY ACTIVE LEADERS IN THE INDUSTRIAL WORLD IN CANADA AND THE USA THE EDITORS ARE RETIRED ACADEMICS FROM MCGILL UNIVERSITY MONTREAL CANADA AND COAUTHORS OF THE BOOK CLASSICAL THERMODYNAMICS OF FLUID SYSTEMS THIS MONOGRAPH IS INTENDED TO PROVIDE A SYSTEMATIC PRESENTATION OF THEORIES CONCERNING THE ADSORPTION OF METAL IONS FROM 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 DISTRIBUTION 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 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 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 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 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 FROM AQUEOUS SOLUTIONS PRESENTED AND THEIR VARIOUS COMBINATIONS YIELD DIFFERENT MODELS THAT DESCRIBE METAL ION ADSORPTION CONSIDERABLE ATTENTION HAS BEEN FOCUSED ON NON AQUEOUS CHEMISTRY IN THE LAST DECADE AND THIS SITUATION HAS ARISEN NO DOUBT FROM A REALIZATION OF THE VAST APPLICATION OF THIS BRANCH OF CHEMISTRY WITHIN THIS FIELD MUCH ENERGETIC WORK HAS BEEN CHANNELLED INTO THE DETERMINATION OF THE COORDINATION CHEMISTRY OF TRANSITION METALS IN THESE SOLVENT SYSTEMS ELABORATE EXPERIMENTAL TECHNIQUES HAVE BEEN DEVELOPED TO DISCOVER IN PARTICULAR THE MAGNETIC AND SPECTRAL PROPERTIES OF COMPLEX COMPOUNDS AND THE THEORETICAL BACKGROUND OF SUCH SYSTEMS HAS BEEN EXPANDED TO CORROBORATE AS FAR AS POSSIBLE THE EXPERIMENTAL RESULTS THIS TEXT HAS HOWEVER A DIFFERENT BIAS FROM MANY BOOKS CURRENTLY AVAILABLE ON THIS BRANCH OF CHEMISTRY AND IS DESIGNED TO BE A SURVEY OF KNOWN FACTS ON MANY OF THE NON AQUEOUS SOLVENTS CURRENTLY IN USE MAINLY IN THE FIELD OF HALOGEN CHEMISTRY TOGETHER WITH A DISCUSSION OF THESE FACTS IN THE LIGHT OF ACCEPTED PRINCIPLES AS SUCH IT IS HOPED TO CLOSE A GAP IN THE LITERATURE OF WHICH MANY WORKERS AND ADVANCED STUDENTS IN THIS FIELD WILL BE AWARE THE TREATMENT IS MEANT TO BE SELECTIVE RATHER THAN COMPLETELY COMPREHENSIVE AND MUST UNEVITABLY REFLECT SOME OF THE SPECIAL INTERESTS OF THE AUTHOR THIS VOLUME THE LAST OF THE SERIES IS DEVOTED TO WATER IN ITS METASTABLE FORMS ESPECIALLY AT SUB ZERO TEMPERATURES THE PAST FEW YEARS HAVE WITNESSED AN INCREASING INTEREST IN SUPERCOOLED WATER AND AMORPHOUS ICE IF THE PROPERTIES OF LIQUID WATER IN THE NORMAL TEMPERATURE RANGE ARE ALREADY ECCENTRIC THEN THEY BECOME EXCEEDINGLY SO BELOW THE NORMAL FREEZING POINT IN THE METASTABLE TEMPERATURE RANGE WATER CAN BE SUPERCOOLED TO 39 C WITHOUT TOO MUCH EFFORT AND MOST OF ITS PHYSICAL PROPERTIES SHOW A REMARKABLE TEMPERATURE DEPENDENCE UNDER THESE CONDITIONS ALTHOUGH ADEQUATE EXPLANATIONS ARE STILL LACKING THE TIME HAS COME TO REVIEW AVAILABLE KNOWLEDGE THE STUDY OF AMORPHOUS ICE THAT IS THE SOLID FORMED WHEN WATER VAPOR IS CONDENSED ON A VERY COLD SURFACE IS OF LONGER STANDING IT HAS ACHIEVED RENEWED INTEREST BECAUSE IT MAY SERVE AS A MODEL FOR THE LIQUID STATE THERE IS CURRENTLY A DEBATE WHETHER OR NOT A CLOSE STRUCTURAL RELATIONSHIP EXISTS BETWEEN AMORPHOUS ICE AND SUPERCOOLED WATER THE NUCLEATION AND GROWTH OF ICE IN SUPERCOOLED WATER AND AQUEOUS SOLUTIONS IS ALSO STILL ONE OF THOSE GREY AREAS OF RESEARCH ALTHOUGH THESE TOPICS HAVE RECEIVED CONSIDERABLE ATTENTION FROM CHEMISTS AND PHYSICISTS OVER THE PAST TWO DECADES EVEN NOW THE RELATIONSHIPS BETWEEN DEGREE OF SUPERCOOLING NUCLEATION KINETICS CRYSTAL GROWTH KINETICS COOLING RATE AND SOLUTE CONCENTRATION ARE SOMEWHAT OBSCURE NEVERTHELESS AT THE EMPIRICAL LEVEL MUCH PROGRESS HAS BEEN MADE BECAUSE THESE TOPICS ARE OF CONSIDERABLE IMPORTANCE TO BIOLOGISTS TECHNOLOGISTS ATMOSPHERIC PHYSICISTS AND GLACIOLOGISTS THE BEST AVAILABLE COLLECTION OF THERMODYNAMIC DATA THE FIRST OF ITS KIND IN OVER THIRTY YEARS THIS UP TO DATE BOOK PRESENTS THE CURRENT KNOWLEDGE ON STANDARD POTENTIALS IN AQUEOUS SOLUTION WRITTEN BY LEADING INTERNATIONAL EXPERTS AND INITIATED BY THE IUPAC COMMISSIONS ON ELECTROCHEMISTRY AND ELECTROANALYTICAL CHEMISTRY THIS REMARKABLE WORK BEGINS WITH A THOROUGH REVIEW OF BASIC CONCEPTS AND METHODS FOR DETERMINING STANDARD ELECTRODE POTENTIALS BUILDING UPON THIS SOLID FOUNDATION THIS CONVENIENT SOURCE PROCEEDS TO DISCUSS THE VARIOUS REDOX COUPLES FOR EVERY KNOWN ELEMENT THE CHAPTERS OF THIS PRACTICAL TIME SAVING GUIDE ARE ORGANIZED IN ORDER OF THE GROUPS OF ELEMENTS ON THE PERIODIC TABLE FOR EASY REFERENCE TO VITAL MATERIAL AND EACH CHAPTER ALSO CONTAINS THE FUNDAMENTAL CHEMISTRY OF ELEMENTS NUMEROUS EQUATIONS OF CHEMICAL REACTIONS EASY TO READ TABLES OF THERMODYNAMIC DATA AND USEFUL OXIDATION STATE DIAGRAMS STANDARD POTENTIALS IN AQUEOUS SOLUTION IS AN IDEAL HANDY REFERENCE FOR ANALYTICAL AND PHYSICAL CHEMISTS ELECTROCHEMISTS ELECTROANALYTICAL CHEMISTS CHEMICAL ENGINEERS BIOCHEMISTS INORGANIC AND ORGANIC CHEMISTS AND SPECTROSCOPISTS NEEDING INFORMATION ON REACTIONS AND THERMODYNAMIC DATA IN INORGANIC CHEMISTRY AND IT IS A VALUABLE SUPPLEMENTARY TEXT FOR UNDERGRADUATE AND GRADUATE LEVEL CHEMISTRY STUDENTS FIRST PUBLISHED IN 2018 ROUTLEDGE IS AN IMPRINT OF TAYLOR FRANCIS AN INFORMA COMPANY FIRST PUBLISHED IN 2018 ROUTLEDGE IS AN IMPRINT OF TAYLOR FRANCIS AN INFORMA COMPANY THIS BOOK IS THE FIRST TO BE ENTIRELY DEVOTED TO THE CHALLENGING ART OF HANDLING MEMBRANE PROTEINS OUT OF THEIR NATURAL ENVIRONMENT A KEY PROCESS IN BIOLOGICAL AND PHARMACEUTICAL RESEARCH BUT ONE PLAGUED WITH DIFFICULTIES AND PITFALLS WRITTEN BY ONE OF THE FOREMOST EXPERTS IN THE FIELD MEMBRANE PROTEINS IN AQUEOUS SOLUTIONS IS ACCESSIBLE TO ANY MEMBER OF A MEMBRANE BIOLOGY LABORATORY AFTER PRESENTING THE

STRUCTURE FUNCTIONS DYNAMICS SYNTHESIS NATURAL ENVIRONMENT AND LIPID INTERACTIONS OF MEMBRANE PROTEINS THE AUTHOR DISCUSSES THE PRINCIPLES OF EXTRACTING THEM WITH DETERGENTS THE MECHANISMS OF DETERGENT INDUCED DESTABILIZATION COUNTERMEASURES AND RECENT PROGRESS IN DEVELOPING DETERGENTS WITH WEAKER DENATURING PROPERTIES NON CONVENTIONAL ALTERNATIVES TO DETERGENTS INCLUDING BICELLES NANODISCS AMPHIPATHIC PEPTIDES FLUORINATED SURFACTANTS AND AMPHIPOLS ARE DESCRIBED AND THEIR RELATIVE ADVANTAGES AND DRAWBACKS ARE COMPARED THE SYNTHESIS AND SOLUTION PROPERTIES OF THE VARIOUS TYPES OF AMPHIPOLS ARE PRESENTED AS WELL AS THE FORMATION AND PROPERTIES OF MEMBRANE PROTEIN AMPHIPOL COMPLEXES AND THE TRANSFER OF AMPHIPOL TRAPPED PROTEINS TO DETERGENTS NANODISCS LIPIDIC MESOPHASES OR LIVING CELLS THE FINAL CHAPTERS OF THE BOOK DEAL WITH APPLICATIONS MEMBRANE PROTEIN IN VITRO FOLDING AND CELL FREE EXPRESSION SOLUTION STUDIES NMR CRYSTALLOGRAPHY ELECTRON MICROSCOPY MASS SPECTROMETRY AMPHIPOL MEDIATED IMMOBILIZATION OF MEMBRANE PROTEINS AND BIOMEDICAL APPLICATIONS IMPORTANT FEATURES OF THE BOOK INCLUDE INTRODUCTORY SECTIONS DESCRIBING FOUNDATIONS AS WELL AS THE STATE OF THE ART FOR EACH OF THE BIOPHYSICAL TECHNIQUES DISCUSSED AND TOPICAL TABLES WHICH ORGANIZE A WIDELY DISPERSED LITERATURE BOXES AND ANNEXES THROUGHOUT THE BOOK EXPLAIN TECHNICAL ASPECTS AND TWELVE DETAILED EXPERIMENTAL PROTOCOLS RANGING FROM IN VITRO FOLDING OF MEMBRANE PROTEINS TO SINGLE PARTICLE ELECTRON CRYOMICROSCOPY HAVE BEEN CONTRIBUTED BY AND COMMENTED ON BY EXPERIENCED USERS MEMBRANE PROTEINS IN AQUEOUS SOLUTIONS OFFERS A CONCISE ACCESSIBLE INTRODUCTION TO MEMBRANE PROTEIN BIOCHEMISTRY AND BIOPHYSICS AS WELL AS COMPREHENSIVE COVERAGE OF THE PROPERTIES AND USES OF CONVENTIONAL AND NON CONVENTIONAL SURFACTANTS IT WILL BE USEFUL BOTH IN BASIC AND APPLIED RESEARCH LABORATORIES AND AS A TEACHING AID FOR STUDENTS INSTRUCTORS RESEARCHERS AND PROFESSIONALS WITHIN THE FIELD AS THE TITLE SUGGESTS WE INTRODUCE A NOVEL DIFFERENTIAL APPROACH TO SOLUTION THERMODYNAMICS AND USE IT FOR THE STUDY OF AQUEOUS SOLUTIONS WE EVALUATE THE QUANTITIES OF HIGHER ORDER DERIVATIVE THAN THE NORMAL THERMODYNAMIC FUNCTIONS WE ALLOW THESE HIGHER DERIVATIVE DATA SPEAK FOR THEMSELVES WITHOUT RESORTING TO ANY MODEL SYSTEM WE THUS ELUCIDATE THE MOLECULAR PROCESSES IN SOLUTION REFERRED TO IN THIS BOOK MIXING SCHEME TO THE DEPTH EQUAL TO IF NOT DEEPER THAN THAT GAINED BY SPECTROSCOPIC AND OTHER METHODS WE SHOW THAT THERE ARE THREE COMPOSITION REGIONS IN AQUEOUS SOLUTIONS OF NON ELECTROLYTES EACH OF WHICH HAS A QUALITATIVELY DISTINCT MIXING SCHEME THE BOUNDARY BETWEEN THE ADJACENT REGIONS IS ASSOCIATED WITH AN ANOMALY IN THE THIRD DERIVATIVES OF G THE LOCI OF THE ANOMALIES IN THE TEMPERATURE COMPOSITION FIELD FORM THE LINE SOMETIMES REFERRED AS KOGA LINE WE THEN TAKE ADVANTAGE OF THE ANOMALY OF A THIRD DERIVATIVE QUANTITY OF 1 PROPANOL IN THE TERNARY AQUEOUS SOLUTION 1 PROPANOL SAMPLE SPECIES H_2O WE USE ITS INDUCED CHANGE AS A PROBE OF THE EFFECT OF A SAMPLE SPECIES ON H_2O IN THIS WAY WE CLARIFIED WHAT A HYDROPHOBE OR A HYDROPHILE AND IN TURN AN AMPHIPHILE DOES TO H_2O WE ALSO APPLY THE SAME METHODOLOGY TO IONS THAT HAVE BEEN RANKED BY THE HOFMEISTER SERIES WE SHOW THAT THE KOSMOTROPES SALTING OUT OR STABILIZING AGENTS ARE EITHER HYDROPHOBES OR HYDRATION CENTRES AND THAT CHAOTROPES SALTING IN OR DESTABLIZING AGENTS ARE HYDROPHILES A NEW DIFFERENTIAL APPROACH TO SOLUTION THERMODYNAMICS A PARTICULARLY CLEAR ELUCIDATION OF THE MIXING SCHEMES IN AQUEOUS SOLUTIONS A CLEAR UNDERSTANDINGS ON THE EFFECTS OF HYDROPHOBES HYDROPHILES AND AMPHIPHILES TO H_2O A CLEAR UNDERSTANDINGS ON THE EFFECTS OF IONS ON H_2O IN RELATION TO THE HOFMEISTER EFFECT A NEW DIFFERENTIAL APPROACH TO STUDIES IN MUTI COMPONENT AQUEOUS SOLUTIONS STABILITY CONSTANTS ARE FUNDAMENTAL TO UNDERSTANDING THE BEHAVIOR OF METAL IONS IN AQUEOUS SOLUTION SUCH UNDERSTANDING IS IMPORTANT IN A WIDE VARIETY OF AREAS SUCH AS METAL IONS IN BIOLOGY BIOMEDICAL APPLICATIONS METAL IONS IN THE ENVIRONMENT EXTRACTION METALLURGY FOOD CHEMISTRY AND METAL IONS IN MANY INDUSTRIAL PROCESSES IN SPITE OF THIS IMPORTANCE IT APPEARS THAT MANY INORGANIC CHEMISTS HAVE LOST AN APPRECIATION FOR THE IMPORTANCE OF STABILITY CONSTANTS AND THE THERMODYNAMIC ASPECTS OF COMPLEX FORMATION WITH ATTENTION FOCUSED OVER THE LAST THIRTY YEARS ON NEWER AREAS SUCH AS ORGANOMETALLIC CHEMISTRY THIS BOOK IS AN ATTEMPT TO SHOW THE RICHNESS OF CHEMISTRY THAT CAN BE REVEALED BY STABILITY CONSTANTS WHEN MEASURED AS PART OF AN OVERALL STRATEGY AIMED AT UNDERSTANDING THE COMPLEXING PROPERTIES OF A PARTICULAR LIGAND OR METAL ION THUS FOR EXAMPLE THERE ARE NUMEROUS CRYSTAL STRUCTURES OF THE LI ION WITH CROWN ETHERS WHAT DO THESE INDICATE TO US ABOUT THE CHEMISTRY OF LI WITH CROWN ETHERS IN FACT MOST OF THESE CRYSTAL STRUCTURES ARE IN A SENSE MISLEADING IN THAT THE LI ION FORMS NO COMPLEXES OR AT BEST VERY WEAK COMPLEXES WITH FAMILIAR CROWN ETHERS SUCH AS L₂ CROWN 4 IN ANY KNOWN SOLVENT THUS WITHOUT THE STABILITY CONSTANTS OUR UNDERSTANDING OF THE CHEMISTRY OF A METAL ION WITH ANY PARTICULAR LIGAND MUST BE REGARDED AS INCOMPLETE IN THIS BOOK WE ATTEMPT TO SHOW HOW STABILITY CONSTANTS CAN REVEAL FACTORS IN LIGAND DESIGN WHICH COULD NOT READILY BE DEDUCED FROM ANY OTHER PHYSICAL TECHNIQUE THIS MONOGRAPH IS INTENDED TO PROVIDE A SYSTEMATIC PRESENTATION OF THEORIES CONCERNING THE ADSORPTION OF METAL IONS FROM 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 DISTRIBUTION 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 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 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 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 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 FROM AQUEOUS SOLUTIONS PRESENTED AND THEIR VARIOUS COMBINATIONS YIELD DIFFERENT MODELS THAT DESCRIBE METAL ION ADSORPTION

PROPERTIES OF AQUEOUS SOLUTIONS OF ELECTROLYTES 1992-08-24 PROPERTIES OF AQUEOUS SOLUTIONS OF ELECTROLYTES IS A HANDBOOK THAT SYSTEMATIZES THE INFORMATION ON PHYSICO CHEMICAL PARAMETERS OF MULTICOMPONENT AQUEOUS ELECTROLYTE SOLUTIONS THIS IMPORTANT DATA COLLECTION WILL BE INVALUABLE FOR DEVELOPING NEW METHODS FOR MORE EFFICIENT CHEMICAL TECHNOLOGIES CHOOSING OPTIMAL SOLUTIONS FOR MORE EFFECTIVE METHODS OF USING RAW MATERIALS AND ENERGY RESOURCES AND OTHER SUCH ACTIVITIES THIS EDITION THE FIRST AVAILABLE IN ENGLISH HAS BEEN SUBSTANTIALLY REVISED AND AUGMENTED MANY NEW TABLES HAVE BEEN ADDED BECAUSE OF A SIGNIFICANTLY LARGER LIST OF ELECTROLYTES AND THEIR PROPERTIES ELECTRICAL CONDUCTIVITY BOILING AND FREEZING POINTS PRESSURE OF SATURATED VAPORS ACTIVITY AND DIFFUSION COEFFICIENTS THE BOOK IS DIVIDED INTO TWO SECTIONS THE FIRST SECTION PROVIDES TABLES THAT LIST THE PROPERTIES OF BINARY AQUEOUS SOLUTIONS OF ELECTROLYTES WHILE THE SECOND SECTION DEALS WITH THE METHODS FOR CALCULATING THEIR PROPERTIES IN MULTICOMPONENT SYSTEMS ALL VALUES ARE GIVEN IN PSI UNITS OR FRACTIONAL AND MULTIPLE UNITS METROLOGICAL CHARACTERISTICS OF THE EXPERIMENTAL METHODS USED FOR THE DETERMINATION OF PHYSICO CHEMICAL PARAMETERS ARE INDICATED AS A RELATIVE ERROR AND THOSE OF THE COMPUTATIONAL METHODS AS A RELATIVE ERROR OR A ROOT MEAN SQUARE DEVIATION

WATER AND AQUEOUS SOLUTIONS 2014-09-01 J E ENDERBY AT THE LAST NATO ASI ON LIQUIDS HELD IN CORSICA AUGUST 1977 PROFESSOR DE GENNES IN HIS SUMMARY OF THAT MEETING SUGGESTED THAT THE NEXT ASI SHOULD CONCENTRATE ON SOME SPECIFIC ASPECT OF THE SUBJECT AND MENTIONED EXPLICITLY IONIC SOLUTIONS AS ONE POSSIBILITY THE CHALLENGE WAS TAKEN UP BY MARIE CLAIRE BELLISSANT FUNEL AND GEORGE NEILSON I AM SURE THAT ALL THE PARTICIPANTS WOULD WISH TO CONGRATULATE OUR TWO COLLEAGUES FOR PUTTING TOGETHER AN OUTSTANDING PROGRAMME OF LECTURES ROUND TABLES AND POSTER SESSION THE THEORY WHICH UNDERLIES THE SUBJECT WAS COVERED BY FOUR LEADING AUTHORITIES J P HANSEN PARIS SET OUT THE GENERAL FRAMEWORK IN TERMS OF THE STATISTICAL MECHANICS OF BULK AND SURFACE PROPERTIES H L FRIEDMAN STONY BROOK FOCUSED ATTENTION ON IONIC LIQUIDS AT EQUILIBRIUM AND J B HUBBARD CONSIDERED NON EQUILIBRIUM PROPERTIES SUCH AS THE ELECTRICAL CONDUCTIVITY AND IONIC FRICTION COEFFICIENTS FINALLY THE BASIC THEORY OF POLYELECTROLYTES TREATED AS CHARGED LINEAR POLYMERS IN AQUEOUS SOLUTION WAS PRESENTED BY J M VICTOR PARIS

THE PHYSICS AND CHEMISTRY OF AQUEOUS IONIC SOLUTIONS 2012-12-06 THE CHAPTERS MAKING UP THIS VOLUME HAD ORIGINALLY BEEN PLANNED TO FORM PART OF A SINGLE VOLUME COVERING SOLID HYDRATES AND AQUEOUS SOLUTIONS OF SIMPLE MOLECULES AND IONS HOWEVER DURING THE PREPARATION OF THE MANUSCRIPTS IT BECAME APPARENT THAT SUCH A VOLUME WOULD TURN OUT TO BE VERY UNWIELDY AND I RELUCTANTLY DECIDED TO RECOMMEND THE PUBLICATION OF SEPARATE VOLUMES THE MOST SENSIBLE WAY OF DIVIDING THE SUBJECT MATTER SEEMED TO LIE IN THE SEPARATION OF SIMPLE IONIC SOLUTIONS THE EMPHASIS IN THE PRESENT VOLUME IS PLACED ON ION SOLVENT EFFECTS SINCE A NUMBER OF EXCELLENT TEXTS COVER THE MORE GENERAL ASPECTS OF ELECTROLYTE SOLUTIONS BASED ON THE CLASSICAL THEORIES OF DEBYE HUCKEL ON SAGER AND FUOSS IT IS INTERESTING TO SPECULATE AS TO WHEN A THEORY BECOMES CLASSICAL PERHAPS THIS OCCURS WHEN IT HAS BECOME WELL KNOWN WELL LIKED AND MUCH ADAPTED THE ABOVE MENTIONED THEORIES OF IONIC EQUILIBRIA AND TRANSPORT CERTAINLY FULFILL THESE CRITERIA THERE COMES A TIME WHEN THE REFINEMENTS AND MODIFICATIONS CAN NO LONGER BE RELATED TO PHYSICAL SIGNIFICANCE AND CAN NO LONGER HIDE THE FACT THAT CERTAIN FUNDAMENTAL ASSUMPTIONS MADE IN THE DEVELOPMENT OF THE THEORY ARE UNTENABLE ESPECIALLY IN THE LIGHT OF INFORMATION OBTAINED FROM THE APPLICATION OF SOPHISTICATED MOLECULAR AND THERMODYNAMIC TECHNIQUES

AQUEOUS SOLUTIONS 1976 AN INTRODUCTION TO AQUEOUS ELECTROLYTE SOLUTIONS IS A COMPREHENSIVE COVERAGE OF THE SUBJECT INCLUDING THE DEVELOPMENT OF KEY CONCEPTS AND THEORY THAT FOCUS ON THE PHYSICAL RATHER THAN THE MATHEMATICAL ASPECTS IMPORTANT LINKS ARE MADE BETWEEN THE STUDY OF ELECTROLYTE SOLUTIONS AND OTHER BRANCHES OF CHEMISTRY BIOLOGY AND BIOCHEMISTRY MAKING IT A USEFUL CROSS REFERENCE TOOL FOR STUDENTS STUDYING THIS IMPORTANT AREA OF ELECTROCHEMISTRY CAREFULLY DEVELOPED THROUGHOUT EACH CHAPTER INCLUDES INTENDED LEARNING OUTCOMES AND WORKED PROBLEMS AND EXAMPLES TO ENCOURAGE STUDENT UNDERSTANDING OF THIS MULTIDISCIPLINARY SUBJECT A COMPREHENSIVE INTRODUCTION TO AQUEOUS ELECTROLYTE SOLUTIONS INCLUDING THE DEVELOPMENT OF KEY CONCEPTS AND THEORIES EMPHASIZES THE CONNECTION BETWEEN OBSERVABLE MACROSCOPIC EXPERIMENTAL PROPERTIES AND INTERPRETATIONS MADE AT THE MOLECULAR LEVEL KEY DEVELOPMENTS IN CONCEPTS AND THEORY EXPLAINED IN A DESCRIPTIVE MANNER TO ENCOURAGE STUDENT UNDERSTANDING INCLUDES WORKED PROBLEMS AND EXAMPLES THROUGHOUT AN INVALUABLE TEXT FOR STUDENTS TAKING COURSES IN CHEMISTRY AND CHEMICAL ENGINEERING THIS BOOK WILL ALSO BE USEFUL FOR BIOLOGY BIOCHEMISTRY AND BIOPHYSICS STUDENTS REQUIRED TO STUDY ELECTROCHEMISTRY

AQUEOUS SOLUTIONS OF SIMPLE ELECTROLYTES 2012-12-06 ADSORPTION FROM AQUEOUS SOLUTIONS IS IMPORTANT IN MANY TECHNOLOGICAL AREAS LIKE WATER PURIFICATION MINERAL BENEFICIATION SOIL CONSERVATION DETERGENCY AND MANY AREAS OF BIOLOGY RECENTLY ADSORPTION OF RADIONUCLIDES FROM AQUEOUS SOLUTIONS HAS BECOME THE FOCUS OF ATTENTION IN ASSESSING THE MOVEMENT OF RADIONUCLIDES THROUGH A GEOLOGIC MEDIUM FROM UNDERGROUND RADIOACTIVE WASTE REPOSITORIES THIS VOLUME PROVIDES A MULTIDISCIPLINARY OVERVIEW OF CURRENT WORK IN THE AREA OF ADSORPTION FROM AQUEOUS SOLUTIONS AND REVIEWS THE PROGRESS THAT HAS BEEN MADE IN THE THEORETICAL MODELS FOR ASSESSING ADSORPTION ADSORPTION OF HEAVY METAL IONS AND THE EFFECT OF COMPLEX FORMATION IS TREATED EXTENSIVELY AS ARE THE EFFECTS OF SURFACE CHEMICAL PROPERTIES OF THE ADSORBENT SOLUTION PH AND THERMODYNAMIC PARAMETERS IMPORTANT IN THE ADSORPTION PROCESS ADSORPTION OF PESTICIDES AND ORGANIC POLYMERIC SPECIES ON DIFFERENT ADSORBENTS ARE INCLUDED AND IMPLICATIONS OF ADSORPTION OF IONS ON DENTAL MATERIALS ARE DISCUSSED ALSO INCLUDED ARE STUDIES OF THE ADSORPTION OF RADIONUCLIDES BY GEOLOGIC MEDIA UNDER ENVIRONMENTAL CONDITIONS THE STUDY OF THE CHEMICAL NATURE OF THE ADSORBED SPECIES AT THE SURFACE BY X RAY PHOTOELECTRON SPECTROSCOPY WHICH OFTEN PROVIDES MECHANISTIC INFORMATION FOR THE ADSORPTION PROCESS IS INCLUDED FOR ADSORBED METAL IONS ON CLAY AND MINERAL SURFACES

COMPLEX IONS IN AQUEOUS SOLUTIONS 1914 THE AIM OF THIS BOOK IS TO EXPLAIN THE UNUSUAL PROPERTIES OF BOTH PURE LIQUID WATER AND SIMPLE AQUEOUS SOLUTIONS IN TERMS OF THE PROPERTIES OF SINGLE MOLECULES AND INTERACTIONS AMONG SMALL NUMBERS OF WATER MOLECULES IT IS MOSTLY THE RESULT OF THE AUTHOR'S OWN RESEARCH SPANNING OVER 40 YEARS IN THE FIELD OF AQUEOUS SOLUTIONS JACKET

AN INTRODUCTION TO AQUEOUS ELECTROLYTE SOLUTIONS 2007-06-05 VI THE INFORMATION COLLECTED AND DISCUSSED IN THIS VOLUME MAY HELP TOWARD THE ACHIEVEMENT OF SUCH AN OBJECTIVE I SHOULD LIKE TO EXPRESS MY DEBT OF GRATITUDE TO THE AUTHORS WHO HAVE CONTRIBUTED TO THIS VOLUME EDITING A WORK OF THIS NATURE CAN STRAIN LONG ESTABLISHED PERSONAL RELATIONSHIPS AND

I THANK MY VARIOUS COLLEAGUES FOR BEARING WITH ME AND RESPONDING SOONER OR LATER TO ONE OR SEVERAL LETTERS OR TELEPHONE CALLS MY SPECIAL THANKS ONCE AGAIN GO TO MRS JOYCE JOHNSON WHO BORE THE MAIN BRUNT OF THIS SEEMINGLY ENDLESS CORRESPONDENCE AND WITHOUT WHOSE HELP THE EDITORIAL AND REFERENCING WORK WOULD HAVE TAKEN SEVERAL YEARS F FRANKS BIOPHYSICS DIVISION UNILEVER RESEARCH LABORATORY COLWORTH WELWYN COLWORTH HOUSE SHARNBROOK BEDFORD JANUARY 1973 CONTENTS CONTENTS OF VOLUME 1 XV CONTENTS OF VOLUME 3 XVI CONTENTS OF VOLUME 4 XVII CHAPTER 1 THE SOLVENT PROPERTIES OF WATER F FRANKS 1 WATER THE UNIVERSAL SOLVENT THE STUDY OF AQUEOUS SOLUTIONS 2 AQUEOUS SOLUTIONS OF NONELECTROLYTES 5 2 1 APOLAR SOLUTES 6 2 2 POLAR SOLUTES 19 2 3 IONIC SOLUTES CONTAINING ALKYL RESIDUES APOLAR ELECTROLYTES 38 3 3 AQUEOUS SOLUTIONS OF ELECTROLYTES 42 3 1 SINGLE ION PROPERTIES 42 3 2 ION WATER INTERACTIONS 43 3 3 INTERIONIC EFFECTS 47 4 COMPLEX AQUEOUS MIXTURES 48 CHAPTER 2 WATER IN STOICHIOMETRIC HYDRATES M FALK AND O KNOP 1 INTRODUCTION 55 2 SYMMETRY AND TYPES OF ENVIRONMENT OF THE H₂O MOLECULE 2 IN CRYSTALS 57 VII CONTENTS VIII 2 1 SITE SYMMETRY 57

Water A Comprehensive Treatise 2013-04-17 THE AIM OF THIS BOOK IS TO EXPLAIN THE UNUSUAL PROPERTIES OF BOTH PURE LIQUID WATER AND SIMPLE AQUEOUS SOLUTIONS IN TERMS OF THE PROPERTIES OF SINGLE MOLECULES AND INTERACTIONS AMONG SMALL NUMBERS OF WATER MOLECULES IT IS MOSTLY THE RESULT OF THE AUTHOR'S OWN RESEARCH SPANNING OVER 40 YEARS IN THE FIELD OF AQUEOUS SOLUTIONS AN UNDERSTANDING OF THE PROPERTIES OF LIQUID WATER IS A PRELUDE TO THE UNDERSTANDING OF THE ROLE OF WATER IN BIOLOGICAL SYSTEMS AND FOR THE EVOLVEMENT OF LIFE THE BOOK IS TARGETED AT ANYONE WHO IS INTERESTED IN THE OUTSTANDING PROPERTIES OF WATER AND ITS ROLE IN BIOLOGICAL SYSTEMS IT IS ADDRESSED TO BOTH STUDENTS AND RESEARCHERS IN CHEMISTRY PHYSICS AND BIOLOGY

Adsorption From Aqueous Solutions 2012-12-06 THE MOLECULAR THEORY OF WATER AND AQUEOUS SOLUTIONS HAS ONLY RECENTLY EMERGED AS A NEW ENTITY OF RESEARCH ALTHOUGH ITS ROOTS MAY BE FOUND IN AGE OLD WORKS THE PURPOSE OF THIS BOOK IS TO PRESENT THE MOLECULAR THEORY OF AQUEOUS FLUIDS BASED ON THE FRAMEWORK OF THE GENERAL THEORY OF LIQUIDS THE STYLE OF THE BOOK IS INTRODUCTORY IN CHARACTER BUT THE READER IS PRESUMED TO BE FAMILIAR WITH THE BASIC PROPERTIES OF WATER FOR INSTANCE THE TOPICS REVIEWED BY EISENBERG AND KAUZMANN 1969 AND THE ELEMENTS OF CLASSICAL THERMODYNAMICS AND STATISTICAL MECHANICS E G DENBIGH 1966 HILL 1960 AND TO HAVE SOME ELEMENTARY KNOWLEDGE OF PROBABILITY E G FELLER 1960 PΑPOULIS 1965 NO OTHER FAMILIARITY WITH THE MOLECULAR THEORY OF LIQUIDS IS PRESUMED FOR THE CONVENIENCE OF THE READER WE PRESENT IN CHAPTER 1 THE RUDIMENTS OF STATISTICAL MECHANICS THAT ARE REQUIRED AS PREREQUISITES TO AN UNDERSTANDING OF SUBSEQUENT CHAPTERS THIS CHAPTER CONTAINS A BRIEF AND CONCISE SURVEY OF TOPICS WHICH MAY BE ADOPTED BY THE READER AS THE FUNDAMENTAL RULES OF THE GAME AND FROM HERE ON THE DEVELOPMENT IS VERY SLOW AND DETAILED

MOLECULAR THEORY OF WATER AND AQUEOUS SOLUTIONS: THE ROLE OF WATER IN PROTEIN FOLDING, SELF-ASSEMBLY AND MOLECULAR RECOGNITION 2009 THE CHAPTERS MAKING UP THIS VOLUME HAD ORIGINALLY BEEN PLANNED TO FORM PART OF A SINGLE VOLUME COVERING SOLID HYDRATES AND AQUEOUS SOLUTIONS OF SIMPLE MOLECULES AND IONS HOWEVER DURING THE PREPARATION OF THE MANUSCRIPTS IT BECAME APPARENT THAT SUCH A VOLUME WOULD TURN OUT TO BE VERY UNWIELDY AND I RELUCTANTLY DECIDED TO RECOMMEND THE PUBLICATION OF SEPARATE VOLUMES THE MOST SENSIBLE WAY OF DIVIDING THE SUBJECT MATTER SEEMED TO LIE IN THE SEPARATION OF SIMPLE IONIC SOLUTIONS THE EMPHASIS IN THE PRESENT VOLUME IS PLACED ON ION SOLVENT EFFECTS SINCE A NUMBER OF EXCELLENT TEXTS COVER THE MORE GENERAL ASPECTS OF ELECTROLYTE SOLUTIONS BASED ON THE CLASSICAL THEORIES OF DEBYE HUCKEL ON SAGER AND FUOSS IT IS INTERESTING TO SPECULATE AS TO WHEN A THEORY BECOMES CLASSICAL PERHAPS THIS OCCURS WHEN IT HAS BECOME WELL KNOWN WELL LIKED AND MUCH ADAPTED THE ABOVE MENTIONED THEORIES OF IONIC EQUILIBRIA AND TRANSPORT CERTAINLY FULFILL THESE CRITERIA THERE COMES A TIME WHEN THE REFINEMENTS AND MODIFICATIONS CAN NO LONGER BE RELATED TO PHYSICAL SIGNIFICANCE AND CAN NO LONGER HIDE THE FACT THAT CERTAIN FUNDAMENTAL ASSUMPTIONS MADE IN THE DEVELOPMENT OF THE THEORY ARE UNTENABLE ESPECIALLY IN THE LIGHT OF INFORMATION OBTAINED FROM THE APPLICATION OF SOPHISTICATED MOLECULAR AND THERMODYNAMIC TECHNIQUES

WATER IN CRYSTALLINE HYDRATES AQUEOUS SOLUTIONS OF SIMPLE NONELECTROLYTES 2013-04-18 IONISATION CONSTANTS OF INORGANIC ACIDS AND BASES IN AQUEOUS SOLUTION SECOND EDITION PROVIDES A COMPILATION OF TABLES THAT SUMMARIZE RELEVANT DATA RECORDED IN THE LITERATURE UP TO THE END OF 1980 FOR THE IONIZATION CONSTANTS OF INORGANIC ACIDS AND BASES IN AQUEOUS SOLUTION THIS BOOK INCLUDES REFERENCES TO ACIDITY FUNCTIONS FOR STRONG ACIDS AND BASES AS WELL AS DETAILS ABOUT THE FORMATION OF POLYNUCLEAR SPECIES THIS TEXT THEN EXPLAINS THE DETAILS OF EACH COLUMN OF THE TABLES WHEREIN COLUMN 1 GIVES THE NAME OF THE SUBSTANCE AND THE NEGATIVE LOGARITHM OF THE IONIZATION CONSTANT AND COLUMN 2 GIVES THE TEMPERATURE OF MEASUREMENTS IN DEGREE CELSIUS THIS BOOK PRESENTS AS WELL THE METHOD OF MEASUREMENT AND THE LITERATURE REFERENCES THAT ARE LISTED ALPHABETICALLY AT THE END OF THE TABLES CHEMISTS WILL FIND THIS BOOK USEFUL

The Oxidation States of the Elements and Their Potentials in Aqueous Solutions 1959 NON AQUEOUS SOLUTIONS 5 IS A COLLECTION OF LECTURES PRESENTED AT THE FIFTH INTERNATIONAL CONFERENCE ON NON AQUEOUS SOLUTIONS HELD IN LEEDS ENGLAND ON JULY 5 9 1976 THE PAPERS EXPLORE REACTIONS IN NON AQUEOUS SOLUTIONS AS WELL AS THE THERMODYNAMIC AND KINETIC PROPERTIES OF NON AQUEOUS SOLUTIONS EXAMPLES OF THE USE OF SPECTROSCOPIC TECHNIQUES ARE PRESENTED AND SOLUTIONS IN MOLTEN SALTS ARE GIVEN METALS IN SOLUTION AND LIQUID METAL SOLUTIONS ARE ALSO CONSIDERED THIS BOOK IS COMPRISED OF 12 CHAPTERS AND BEGINS WITH A REVIEW OF A GENERAL SCHEME WHICH CONSIDERS THE SPECIES FORMED BY CATION ELECTRON AND ELECTRON ELECTRON INTERACTIONS AT DILUTE TO MODERATE CONCENTRATIONS ALONG WITH THE INFLUENCE OF THE SOLVENT AND THE METAL ON THESE INTERACTIONS THE DISCUSSION THEN SHIFTS TO THE APPLICATION OF ELECTRON SPIN RESONANCE SPECTROSCOPY TO THE STUDY OF SOLVATION THE INFLUENCE OF SOLVENT PROPERTIES ON LIGAND SUBSTITUTION MECHANISMS OF LABILE COMPLEXES AND THE EFFECT OF ACIDITY ON CHEMICAL REACTIONS IN MOLTEN SALTS SUBSEQUENT CHAPTERS DEAL WITH THE CHEMISTRY OF SOLUTIONS OF SALTS IN LIQUID ALKALI METALS PREFERENTIAL SOLVATION IN KINETICS AND THE USE OF NON AQUEOUS SOLVENTS FOR PREPARATION AND REACTIONS OF NITROGEN HALOGEN COMPOUNDS RESULTS OF RAMAN SPECTROSCOPIC STUDIES OF NON AQUEOUS SOLUTIONS AND SPECTROSCOPIC STUDIES OF COORDINATION COMPOUNDS FORMED IN MOLTEN SALTS ARE ALSO PRESENTED THIS MONOGRAPH WILL BE OF INTEREST TO CHEMISTS

MOLECULAR THEORY OF WATER AND AQUEOUS SOLUTIONS 2009 SOLUTION THERMODYNAMICS AND ITS APPLICATION TO AQUEOUS SOLUTIONS A DIFFERENTIAL APPROACH SECOND EDITION INTRODUCES A

DIFFERENTIAL APPROACH TO SOLUTION THERMODYNAMICS APPLYING IT TO THE STUDY OF AQUEOUS SOLUTIONS THIS VALUABLE APPROACH REVEALS THE MOLECULAR PROCESSES IN SOLUTIONS IN GREATER DEPTH THAN THAT GAINED BY SPECTROSCOPIC AND OTHER METHODS THE BOOK CLARIFIES WHAT A HYDROPHOBE OR A HYDROPHILE AND IN TURN AN AMPHIPHILE DOES TO H₂O BY APPLYING THE SAME METHODOLOGY TO IONS THAT HAVE BEEN RANKED BY THE HOFMEISTER SERIES THE AUTHOR SHOWS THAT THE KOSMOTROPES ARE EITHER HYDROPHOBES OR HYDRATION CENTERS AND THAT CHAOTROPES ARE HYDROPHILES THIS UNIQUE APPROACH AND IMPORTANT UPDATES MAKE THE NEW EDITION A MUST HAVE REFERENCE FOR THOSE ACTIVE IN SOLUTION CHEMISTRY UNIQUE DIFFERENTIAL APPROACH TO SOLUTION THERMODYNAMICS ALLOWS FOR EXPERIMENTAL EVALUATION OF THE INTERMOLECULAR INTERACTION INCORPORATES RESEARCH FINDINGS FROM OVER 40 ARTICLES PUBLISHED SINCE THE PREVIOUS EDITION NUMERICAL OR GRAPHICAL EVALUATION AND DIRECT EXPERIMENTAL DETERMINATION OF THIRD DERIVATIVES ENTHALPIC AND VOLUMETRIC AL AL INTERACTIONS AND AMPHIPHILES ARE NEW TO THIS EDITION FEATURES NEW CHAPTERS ON SPECTROSCOPIC STUDY IN AQUEOUS SOLUTIONS AS WELL AS ENVIRONMENTALLY FRIENDLY AND HOSTILE WATER AQUEOUS SOLUTIONS

WATER AND AQUEOUS SOLUTIONS 2012-12-06 THIS BOOK PROVIDES A THOROUGH DISCUSSION OF THE THERMODYNAMICS OF AQUEOUS SOLUTIONS AND PRESENTS TOOLS FOR ANALYZING AND SOLVING SCIENTIFIC AND PRACTICAL PROBLEMS ARISING IN THIS AREA IT ALSO PRESENTS METHODS THAT CAN BE USED TO DEAL WITH IONIC AND NONIONIC AQUEOUS SOLUTIONS UNDER SUB OR SUPERCRITICAL CONDITIONS ILLUSTRATIONS AND TABLES GIVE EXAMPLES OF PROCEDURES EMPLOYED TO PREDICT THERMODYNAMIC QUANTITIES OF THE SOLUTIONS AND AN APPENDIX SUMMARIZING STATISTICAL MECHANICAL EQUATIONS USED TO DESCRIBE THE SYSTEMS IS ALSO PROVIDED HIGH TEMPERATURE AQUEOUS SOLUTIONS THERMODYNAMIC PROPERTIES CONTAINS ESSENTIAL INFORMATION FOR PHYSICAL CHEMISTS GEOCHEMISTS GEOPHYSICISTS CHEMICAL TECHNICIANS AND SCIENTISTS INVOLVED IN ELECTRIC POWER GENERATION

AQUEOUS SOLUTIONS OF SIMPLE ELECTROLYTES 2012-07-15 IONIC SURFACTANTS AND AQUEOUS SOLUTIONS BIOMOLECULES METALS AND NANOPARTICLES COVERS A WIDE RANGE OF SUBJECTS RELATED TO AQUEOUS SYSTEMS FROM REVERSE MICELLES AS ION EXCHANGERS TO THE STUDY OF MICELLAR PHASE TRANSFER CATALYSIS FOR NUCLEOPHILIC SUBSTITUTION REACTIONS THE DIVERSE BACKGROUND EXPERTISE AND PROFESSIONAL INTERESTS OF THE CONTRIBUTORS TO THIS BOOK GIVE TO IT A UNIQUE RICHNESS OF APPROACH IN TOPICS OF RELEVANCE FOR BIOTECHNOLOGY AND ENVIRONMENTAL STUDIES OVER SIXTY PUBLICATIONS PRESENTING RESEARCH RESULTS ARE COMBINED AND EXPANDED IN THIS BOOK BY SOME OF THE ORIGINAL RESEARCHERS AT A MATURE AGE AND AT THE SUMMIT OF SUCCESSFUL PROFESSIONAL CAREERS THEY HAVE TAKEN A SECOND LOOK TO THE STATE OF THE ART IN THE FIELDS THAT THEY HAD PIONEERED EVA RODIL AND ANA SOTO WHO HAD THEIR RESEARCH FORMATION IN THE GROUP OF PROFESSOR ALBERTO ARCE AT UNIVERSIDADE DE SANTIAGO DE COMPOSTELA SPAIN ARE PRESENTLY PROFESSORS AT THAT UNIVERSITY MAEN HUSEIN IS A PROFESSOR AT UNIVERSITY OF CALGARY CANADA REMY DUMORTIER MOHAMMAD KHOSHBARCHI HAMID RABIE AND YOUNOK DUMORTIER SHIN ARE PRESENTLY ACTIVE LEADERS IN THE INDUSTRIAL WORLD IN CANADA AND THE USA THE EDITORS ARE RETIRED ACADEMICS FROM MCGILL UNIVERSITY MONTREAL CANADA AND COAUTHORS OF THE BOOK CLASSICAL THERMODYNAMICS OF FLUID SYSTEMS

IONISATION CONSTANTS OF INORGANIC ACIDS AND BASES IN AQUEOUS SOLUTION 2016-09-14 THIS MONOGRAPH IS INTENDED TO PROVIDE A SYSTEMATIC PRESENTATION OF THEORIES CONCERNING THE ADSORPTION OF METAL IONS FROM 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 DISTRIBUTION 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 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 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 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 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 FROM AQUEOUS SOLUTIONS PRESENTED AND THEIR VARIOUS COMBINATIONS YIELD DIFFERENT MODELS THAT DESCRIBE METAL ION ADSORPTION

Non-Aqueous Solutions - 5 2013-10-22 CONSIDERABLE ATTENTION HAS BEEN FOCUSED ON NON AQUEOUS CHEMISTRY IN THE LAST DECADE AND THIS SITUATION HAS ARISEN NO DOUBT FROM A REALIZATION OF THE VAST APPLICATION OF THIS BRANCH OF CHEMISTRY WITHIN THIS FIELD MUCH ENERGETIC WORK HAS BEEN CHANNELLED INTO THE DETERMINATION OF THE COORDINATION CHEMISTRY OF TRANSITION METALS IN THESE SOLVENT SYSTEMS ELABORATE EXPERIMENTAL TECHNIQUES HAVE BEEN DEVELOPED TO DISCOVER IN PARTICULAR THE MAGNETIC AND SPECTRAL PROPERTIES OF COMPLEX COMPOUNDS AND THE THEORETICAL BACKGROUND OF SUCH SYSTEMS HAS BEEN EXPANDED TO CORROBORATE AS FAR AS POSSIBLE THE EXPERIMENTAL RESULTS THIS TEXT HAS HOWEVER A DIFFERENT BIAS FROM MANY BOOKS CURRENTLY AVAILABLE ON THIS BRANCH OF CHEMISTRY AND IS DESIGNED TO BE A SURVEY OF KNOWN FACTS ON MANY OF THE NON AQUEOUS SOLVENTS CURRENTLY IN USE MAINLY IN THE FIELD OF HALOGEN CHEMISTRY TOGETHER WITH A DISCUSSION OF THESE FACTS IN THE LIGHT OF ACCEPTED PRINCIPLES AS SUCH IT IS HOPED TO CLOSE A GAP IN THE LITERATURE OF WHICH MANY WORKERS AND ADVANCED STUDENTS IN THIS FIELD WILL BE AWARE THE TREATMENT IS MEANT TO BE SELECTIVE RATHER THAN COMPLETELY COMPREHENSIVE AND MUST UNEVITABLY REFLECT SOME OF THE SPECIAL INTERESTS OF THE AUTHOR

SOLUTION THERMODYNAMICS AND ITS APPLICATION TO AQUEOUS SOLUTIONS 2017-03-28 THIS VOLUME THE LAST OF THE SERIES IS DEVOTED TO WATER IN ITS METASTABLE FORMS ESPECIALLY AT SUB ZERO TEMPERATURES THE PAST FEW YEARS HAVE WITNESSED AN INCREASING INTEREST IN SUPERCOOLED WATER AND AMORPHOUS ICE IF THE PROPERTIES OF LIQUID WATER IN THE NORMAL TEMPERATURE RANGE ARE ALREADY ECCENTRIC THEN THEY BECOME EXCEEDINGLY SO BELOW THE NORMAL FREEZING POINT IN THE METASTABLE TEMPERATURE RANGE WATER CAN BE SUPERCOOLED TO 39 C WITHOUT TOO MUCH EFFORT AND MOST OF ITS PHYSICAL PROPERTIES SHOW A REMARKABLE TEMPERATURE DEPENDENCE UNDER THESE CONDITIONS ALTHOUGH ADEQUATE EXPLANATIONS ARE STILL LACKING THE TIME HAS COME TO REVIEW AVAILABLE KNOWLEDGE THE STUDY OF AMORPHOUS ICE THAT IS THE SOLID FORMED WHEN WATER VAPOR IS CONDENSED ON A VERY COLD SURFACE IS OF LONGER STANDING IT HAS ACHIEVED RENEWED INTEREST BECAUSE IT MAY SERVE AS A MODEL FOR THE LIQUID STATE THERE IS CURRENTLY A DEBATE WHETHER OR NOT A CLOSE STRUCTURAL RELATIONSHIP EXISTS BETWEEN AMORPHOUS ICE AND SUPERCOOLED WATER

THE NUCLEATION AND GROWTH OF ICE IN SUPERCOOLED WATER AND AQUEOUS SOLUTIONS IS ALSO STILL ONE OF THOSE GREY AREAS OF RESEARCH ALTHOUGH THESE TOPICS HAVE RECEIVED CONSIDERABLE ATTENTION FROM CHEMISTS AND PHYSICISTS OVER THE PAST TWO DECADES EVEN NOW THE RELATIONSHIPS BETWEEN DEGREE OF SUPERCOOLING NUCLEATION KINETICS CRYSTAL GROWTH KINETICS COOLING RATE AND SOLUTE CONCENTRATION ARE SOMEWHAT OBSCURE NEVERTHELESS AT THE EMPIRICAL LEVEL MUCH PROGRESS HAS BEEN MADE BECAUSE THESE TOPICS ARE OF CONSIDERABLE IMPORTANCE TO BIOLOGISTS TECHNOLOGISTS ATMOSPHERIC PHYSICISTS AND GLA CIOLOGISTS

HIGH-TEMPERATURE AQUEOUS SOLUTIONS 1991-12-19 THE BEST AVAILABLE COLLECTION OF THERMODYNAMIC DATA THE FIRST OF ITS KIND IN OVER THIRTY YEARS THIS UP TO DATE BOOK PRESENTS THE CURRENT KNOWLEDGEON STANDARD POTENTIALS IN AQUEOUS SOLUTION WRITTEN BY LEADING INTERNATIONAL EXPERTS AND INITIATED BY THE IUPAC COMMISSIONS ONELECTROCHEMISTRY AND ELECTROANALYTICAL CHEMISTRY THIS REMARKABLE WORK BEGINS WITH A THOROUGH REVIEW OF BASIC CONCEPTS AND METHODS FOR DETERMINING STANDARD ELECTRODEPOTENTIALS BUILDING UPON THIS SOLID FOUNDATION THIS CONVENIENT SOURCE PROCEEDS TO DISCUSSTHE VARIOUS REDOX COUPLES FOR EVERY KNOWN ELEMENT THE CHAPTERS OF THIS PRACTICAL TIME SAVING GUIDE ARE ORGANIZED IN ORDER OF THE GROUPS OF ELEMENTS ON THE PERIODIC TABLE FOR EASY REFERENCE TO VITAL MATERIAL AND EACH CHAPTER ALSO CONTAINS THE FUNDAMENTAL CHEMISTRY OF ELEMENTS NUMEROUS EQUATIONS OF CHEMICAL REACTIONS EASY TO READ TABLES OF THERMODYNAMIC DATA AND USEFUL OXIDATION STATE DIAGRAMS STANDARD POTENTIALS IN AQUEOUS SOLUTION IS AN IDEAL HANDY REFERENCE FOR ANALYTICAL AND PHYSICAL CHEMISTS ELECTROCHEMISTS ELECTROANALYTICAL CHEMISTS CHEMICAL ENGINEERS BIOCHEMISTS INORGANIC AND ORGANIC CHEMISTS AND SPECTROSCOPISTS NEEDING INFORMATION ON REACTIONS AND THERMODYNAMIC DATA IN INORGANIC CHEMISTRY AND IT IS A VALUABLE SUPPLEMENTARY TEXT FOR UNDERGRADUATE AND GRADUATE LEVEL CHEMISTRY STUDENTS

AQUEOUS SOLUTIONS 1978 FIRST PUBLISHED IN 2018 ROUTLEDGE IS AN IMPRINT OF TAYLOR FRANCIS AN INFORMA COMPANY

STRUCTURE OF WATER AND AQUEOUS SOLUTIONS 1974 FIRST PUBLISHED IN 2018 ROUTLEDGE IS AN IMPRINT OF TAYLOR FRANCIS AN INFORMA COMPANY

IONIC SURFACTANTS AND AQUEOUS SOLUTIONS 2018-07-09 THIS BOOK IS THE FIRST TO BE ENTIRELY DEVOTED TO THE CHALLENGING ART OF HANDLING MEMBRANE PROTEINS OUT OF THEIR NATURAL ENVIRONMENT A KEY PROCESS IN BIOLOGICAL AND PHARMACEUTICAL RESEARCH BUT ONE PLAGUED WITH DIFFICULTIES AND PITFALLS WRITTEN BY ONE OF THE FOREMOST EXPERTS IN THE FIELD MEMBRANE PROTEINS IN AQUEOUS SOLUTIONS IS ACCESSIBLE TO ANY MEMBER OF A MEMBRANE BIOLOGY LABORATORY AFTER PRESENTING THE STRUCTURE FUNCTIONS DYNAMICS SYNTHESIS NATURAL ENVIRONMENT AND LIPID INTERACTIONS OF MEMBRANE PROTEINS THE AUTHOR DISCUSSES THE PRINCIPLES OF EXTRACTING THEM WITH DETERGENTS THE MECHANISMS OF DETERGENT INDUCED DESTABILIZATION COUNTERMEASURES AND RECENT PROGRESS IN DEVELOPING DETERGENTS WITH WEAKER DENATURING PROPERTIES NON CONVENTIONAL ALTERNATIVES TO DETERGENTS INCLUDING BICELLES NANODISCS AMPHIPATHIC PEPTIDES FLUORINATED SURFACTANTS AND AMPHIPOLS ARE DESCRIBED AND THEIR RELATIVE ADVANTAGES AND DRAWBACKS ARE COMPARED THE SYNTHESIS AND SOLUTION PROPERTIES OF THE VARIOUS TYPES OF AMPHIPOLS ARE PRESENTED AS WELL AS THE FORMATION AND PROPERTIES OF MEMBRANE PROTEIN AMPHIPOL COMPLEXES AND THE TRANSFER OF AMPHIPOL TRAPPED PROTEINS TO DETERGENTS NANODISCS LIPIDIC MESOPHASES OR LIVING CELLS THE FINAL CHAPTERS OF THE BOOK DEAL WITH APPLICATIONS MEMBRANE PROTEIN IN VITRO FOLDING AND CELL FREE EXPRESSION SOLUTION STUDIES NMR CRYSTALLOGRAPHY ELECTRON MICROSCOPY MASS SPECTROMETRY AMPHIPOL MEDIATED IMMOBILIZATION OF MEMBRANE PROTEINS AND BIOMEDICAL APPLICATIONS IMPORTANT FEATURES OF THE BOOK INCLUDE INTRODUCTORY SECTIONS DESCRIBING FOUNDATIONS AS WELL AS THE STATE OF THE ART FOR EACH OF THE BIOPHYSICAL TECHNIQUES DISCUSSED AND TOPICAL TABLES WHICH ORGANIZE A WIDELY DISPERSED LITERATURE BOXES AND ANNEXES THROUGHOUT THE BOOK EXPLAIN TECHNICAL ASPECTS AND TWELVE DETAILED EXPERIMENTAL PROTOCOLS RANGING FROM IN VITRO FOLDING OF MEMBRANE PROTEINS TO SINGLE PARTICLE ELECTRON CRYOMICROSCOPY HAVE BEEN CONTRIBUTED BY AND COMMENTED ON BY EXPERIENCED USERS MEMBRANE PROTEINS IN AQUEOUS SOLUTIONS OFFERS A CONCISE ACCESSIBLE INTRODUCTION TO MEMBRANE PROTEIN BIOCHEMISTRY AND BIOPHYSICS AS WELL AS COMPREHENSIVE COVERAGE OF THE PROPERTIES AND USES OF CONVENTIONAL AND NON CONVENTIONAL SURFACTANTS IT WILL BE USEFUL BOTH IN BASIC AND APPLIED RESEARCH LABORATORIES AND AS A TEACHING AID FOR STUDENTS INSTRUCTORS RESEARCHERS AND PROFESSIONALS WITHIN THE FIELD

KINETICS OF METAL ION ADSORPTION FROM AQUEOUS SOLUTIONS 2013-11-27 AS THE TITLE SUGGESTS WE INTRODUCE A NOVEL DIFFERENTIAL APPROACH TO SOLUTION THERMODYNAMICS AND USE IT FOR THE STUDY OF AQUEOUS SOLUTIONS WE EVALUATE THE QUANTITIES OF HIGHER ORDER DERIVATIVE THAN THE NORMAL THERMODYNAMIC FUNCTIONS WE ALLOW THESE HIGHER DERIVATIVE DATA SPEAK FOR THEMSELVES WITHOUT RESORTING TO ANY MODEL SYSTEM WE THUS ELUCIDATE THE MOLECULAR PROCESSES IN SOLUTION REFERRED TO IN THIS BOOK MIXING SCHEME TO THE DEPTH EQUAL TO IF NOT DEEPER THAN THAT GAINED BY SPECTROSCOPIC AND OTHER METHODS WE SHOW THAT THERE ARE THREE COMPOSITION REGIONS IN AQUEOUS SOLUTIONS OF NON ELECTROLYTES EACH OF WHICH HAS A QUALITATIVELY DISTINCT MIXING SCHEME THE BOUNDARY BETWEEN THE ADJACENT REGIONS IS ASSOCIATED WITH AN ANOMALY IN THE THIRD DERIVATIVES OF G THE LOCI OF THE ANOMALIES IN THE TEMPERATURE COMPOSITION FIELD FORM THE LINE SOMETIMES REFERRED AS KOGA LINE WE THEN TAKE ADVANTAGE OF THE ANOMALY OF A THIRD DERIVATIVE QUANTITY OF 1 PROPANOL IN THE TERNARY AQUEOUS SOLUTION 1 PROPANOL SAMPLE SPECIES H₂O WE USE ITS INDUCED CHANGE AS A PROBE OF THE EFFECT OF A SAMPLE SPECIES ON H₂O IN THIS WAY WE CLARIFIED WHAT A HYDROPHOBE OR A HYDROPHILE AND IN TURN AN AMPHIPHILE DOES TO H₂O WE ALSO APPLY THE SAME METHODOLOGY TO IONS THAT HAVE BEEN RANKED BY THE HOFMEISTER SERIES WE SHOW THAT THE KOSMOTROPES SALTING OUT OR STABILIZING AGENTS ARE EITHER HYDROPHOBES OR HYDRATION CENTRES AND THAT CHAOTROPES SALTING IN OR DESTABILIZING AGENTS ARE HYDROPHILES A NEW DIFFERENTIAL APPROACH TO SOLUTION THERMODYNAMICS A PARTICULARLY CLEAR ELUCIDATION OF THE MIXING SCHEMES IN AQUEOUS SOLUTIONS A CLEAR UNDERSTANDINGS ON THE EFFECTS OF HYDROPHOBES HYDROPHILES AND AMPHIPHILES TO H₂O A CLEAR UNDERSTANDINGS ON THE EFFECTS OF IONS ON H₂O IN RELATION TO THE HOFMEISTER EFFECT A NEW DIFFERENTIAL APPROACH TO STUDIES IN MUTI COMPONENT AQUEOUS SOLUTIONS

COORDINATION CHEMISTRY IN NON-AQUEOUS SOLUTIONS 2012-12-06 STABILITY CONSTANTS ARE FUNDAMENTAL TO UNDERSTANDING THE BEHAVIOR OF METAL IONS IN AQUEOUS SOLUTION SUCH UNDERSTANDING IS IMPORTANT IN A WIDE VARIETY OF AREAS SUCH AS METAL IONS IN BIOLOGY BIOMEDICAL APPLICATIONS METAL IONS IN THE ENVIRONMENT EXTRACTION METALLURGY FOOD CHEMISTRY AND METAL IONS IN MANY INDUSTRIAL PROCESSES IN SPITE OF THIS IMPORTANCE IT APPEARS THAT MANY INORGANIC CHEMISTS HAVE LOST AN APPRECIATION FOR THE IMPORTANCE OF STABILITY CONSTANTS AND THE THERMODYNAMIC ASPECTS OF COMPLEX FORMATION WITH ATTENTION FOCUSED OVER THE LAST THIRTY YEARS ON NEWER AREAS SUCH AS ORGANOMETALLIC CHEMISTRY THIS BOOK IS AN ATTEMPT TO SHOW THE RICHNESS OF CHEMISTRY THAT CAN BE REVEALED BY STABILITY CONSTANTS WHEN MEASURED AS PART OF AN OVERALL STRATEGY AIMED AT UNDERSTANDING THE COMPLEXING PROPERTIES OF A PARTICULAR

LIGAND OR METAL ION. THUS FOR EXAMPLE THERE ARE NUMEROUS CRYSTAL STRUCTURES OF THE LI ION WITH CROWN ETHERS. WHAT DO THESE INDICATE TO US ABOUT THE CHEMISTRY OF LI WITH CROWN ETHERS. IN FACT MOST OF THESE CRYSTAL STRUCTURES ARE IN A SENSE MISLEADING IN THAT THE LI ION FORMS NO COMPLEXES OR AT BEST VERY WEAK COMPLEXES WITH FAMILIAR CROWN ETHERS SUCH AS L2 CROWN 4 IN ANY KNOWN SOLVENT. THUS WITHOUT THE STABILITY CONSTANTS OUR UNDERSTANDING OF THE CHEMISTRY OF A METAL ION WITH ANY PARTICULAR LIGAND MUST BE REGARDED AS INCOMPLETE. IN THIS BOOK WE ATTEMPT TO SHOW HOW STABILITY CONSTANTS CAN REVEAL FACTORS IN LIGAND DESIGN WHICH COULD NOT READILY BE DEDUCED FROM ANY OTHER PHYSICAL TECHNIQUE.

CHEMISTRY AND PHYSICS OF AQUEOUS GAS SOLUTIONS 1975. THIS MONOGRAPH IS INTENDED TO PROVIDE A SYSTEMATIC PRESENTATION OF THEORIES CONCERNING THE ADSORPTION OF METAL IONS FROM 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 DISTRIBUTION 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 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 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 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, 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 FROM AQUEOUS SOLUTIONS PRESENTED AND THEIR VARIOUS COMBINATIONS YIELD DIFFERENT MODELS THAT DESCRIBE METAL ION ADSORPTION.

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