

Contents

CONTRIBUTORS	v
PREFACE	vii
1. General and Theoretical Introduction	
D. J. G. IVES and G. J. JANZ	1
I. Preamble	1
II. The Concept of Electrode Potential	3
III. Reversible and Irreversible Electrodes	14
IV. Conventions	26
V. Standard Electrode Potentials	31
VI. Cells with Liquid Junctions	48
VII. Common Experimental Problems	56
VIII. Units and Numerical Constants	63
References	67
2. The Hydrogen Electrode	
G. J. HILLS and D. J. G. IVES	71
I. Introduction and Theory	71
II. Construction and Use	91
III. Applications and Limitations	117
References	121
3. The Calomel Electrode and Other Mercury—Mercurous Salt Electrodes	
G. J. HILLS and D. J. G. IVES	127
I. Introduction	127
II. The Calomel Electrode of Variable Potential	128
III. Calomel Electrodes of Fixed Potential	154
IV. Other Mercury—Mercurous Halide Electrodes	162
V. Mercury—Mercurous Salt Electrodes, other than Halides	168
References	174
4. Silver—Silver Halide Electrodes	
G. J. JANZ	179
I. Introduction and Theory	179
II. Standard Electrode Potentials	188
III. Preparation of Chemicals and Electrodes	198
IV. Properties	213

CONTENTS

V. Applications	224
References	226
5. The Glass Electrode	
R. G. BATES	231
I. Introduction	231
II. Theory of the Glass Electrode	233
III. pH Concept	237
IV. Limitations of the Glass Electrode	239
V. Composition of Electrode Glasses	246
VI. Chemical Properties of Glass Electrodes	249
VII. Physical Properties of Glass Electrodes	252
VIII. Glass Electrode Half-Cells	257
IX. Glass Electrode Techniques	263
References	267
6. The Quinhydrone Electrode	
G. J. JANZ and D. J. G. IVES	270
I. Introduction	270
II. Theory of the Quinhydrone Electrode	276
III. The Nonideality of the Quinhydrone Electrode	289
IV. Experimental Procedures	304
V. Numerical Data and Applications	311
VI. Alternative Systems	314
References	316
7. Oxide, Oxygen, and Sulfide Electrodes	
D. J. G. IVES	322
I. Introduction	322
II. Metal-Metal Oxide Reference Electrodes	333
III. The Oxygen Electrode	360
IV. Summarizing Comments	377
V. Metal-Metal Sulfide Electrodes	379
References	384
8. Electrode Reversible to Sulfate Ions	
D. J. G. IVES and F. R. SMITH	393
I. Introduction	393
II. The Lead-Lead Sulfate Electrode	396
III. The Lead Dioxide-Lead Sulfate Electrode	399
IV. The Mercury-Mercurous Sulfate Electrode	403
V. General Comments	407
References	407

9. Membrane Electrodes

G. J. HILLS	411
I. Introduction	411
II. The Development of Membrane Electrodes	412
III. The Theory of Membrane Electrode Potentials	413
IV. The Measurement of Membrane Potentials	419
V. Applications of Membrane Electrodes	427
VI. The Development of Specific Membrane Electrodes	428
References	430

10. Reference Electrodes in Nonaqueous Solutions

G. J. HILLS	433
I. Introduction	433
II. General Considerations Relating to Nonaqueous Systems	435
III. Reference Electrodes in Individual Solvent Systems	440
IV. Conclusions	460
References	460

11. Microelectrodes and Electrodes Used in Biology

D. B. CATER and I. A. SILVER	464
I. Introduction	465
II. Capillary Microelectrodes for Measuring Resting Potentials	467
III. Capillary Microelectrodes for Detection of Action Potentials	472
IV. Design of Electrodes for Stimulation	476
V. Electrodes for Measuring Oxidation-Reduction Potentials	478
VI. Electrodes for Measurement of pH	493
VII. The Oxygen Cathode	503
VIII. Bioelectric Potentials	516
References	519

12. Electrodes in Fused Salt Systems

R. W. LAITY	524
I. Introduction	524
II. Theoretical Considerations	526
III. Electromotive Force Measurements at High Temperatures	568
IV. Survey of Reference Electrodes	585
V. Appendix: Tables of emf Values	599
References	603

AUTHOR INDEX

607

SUBJECT INDEX

633