

Contents

1	Biological Materials	1
1.1	Introduction	1
1.2	Proteins and Polypeptides	2
1.3	Polynucleotides	8
1.4	Polysaccharides	10
1.5	Fats, Lipids and Detergents	11
1.6	Water	13
1.7	Foams, Surfactants and Emulsions	17
1.8	Acids, Bases, Buffers and Polyelectrolytes	18
1.9	A Note about Units	21
	Problems	23
	References	24
	Further Reading	24
2	Spectroscopy	25
2.1	Electromagnetic Waves and their Interactions	25
2.2	UV/Visible Spectroscopy	33
2.3	Circular Dichroism	46
2.4	Fluorescence	51
2.5	Vibrational Spectroscopy: IR and Raman	63
2.6	NMR (Brief Overview)	69
	Problems	76
	References	78
	Further Reading	79
3	Mass Spectrometry	80
3.1	Introduction	80
3.2	Ion Sources	81
3.3	Ionization Methods	82
3.4	Mass Analysers	84
3.5	Detection	86
3.6	Applications of MS	87
	Problems	91
	References	92
	Further Reading	92

Contents

4	Hydrodynamics	93
4.1	Density and Molecular Volume	93
4.2	Analytical Ultracentrifugation	98
4.3	Sedimentation Equilibrium	99
4.4	Sedimentation Rate	100
4.5	Diffusion and Brownian Motion	102
4.6	Dynamic Light Scattering (DLS)	106
4.7	Viscosity	106
	Problems	109
	References	110
	Further Reading	110
5	Thermodynamics and Interactions	111
5.1	A Bluffer's Guide to Molecular Thermodynamics	111
5.2	Differential Scanning Calorimetry	116
5.3	Isothermal Titration Calorimetry	119
5.4	Binding Equilibrium	122
5.5	General Methods for Determining Thermodynamic Properties	123
5.6	Thermal Shift Assays	128
5.7	Equilibrium Dialysis	130
5.8	Protein Solubility and Crystallization	131
	Problems	135
	References	137
	Further Reading	138
6	Kinetics	139
6.1	Basic Kinetics	139
6.2	Rapid Reaction Techniques	144
6.3	Relaxation Methods	146
6.4	Hydrogen Exchange	149
6.5	Surface Plasmon Resonance	150
6.6	Enzyme Kinetics	152
	Problems	157
	References	158
	Further Reading	159
7	Chromatography and Electrophoresis	160
7.1	Chromatography	160
7.2	Electrophoresis	166
	Problems	171
	References	172
	Further Reading	172

8 Imaging	173
8.1 Waves and Particles	173
8.2 Lenses or No Lenses: Reconstructing the Image	174
8.3 X-ray Diffraction and Protein Crystallography	178
8.4 Fibre Diffraction and Small-angle Scattering	185
8.5 Neutron Diffraction and Scattering	186
8.6 Electron Microscopy	187
Problems	190
References	191
Further Reading	191
9 Single Molecules	192
9.1 How Many Molecules can Stand on the Head of a Pin?	192
9.2 Thermodynamic Fluctuations and the Ergodic Hypothesis	194
9.3 Atomic Force Microscopy	196
9.4 Optical Tweezers and Traps	199
9.5 Single Molecule Fluorescence	201
Problems	203
References	204
Further Reading	204
Answers to Problems	206
Subject Index	218