

CONTENTS

PREFACE, ix

ACKNOWLEDGEMENTS, xi

PART I ATOMIC AND PHYSICAL CHEMISTRY

- 1 ATOMIC THEORY, 3
 - 1.1 Atoms, 3
 - 1.2 Sub-atomic particles, 3
 - 1.3 Atomic mass and isotopes, 5
 - 1.4 The Periodic Table, Part 1, 6
 - 1.5 Shell filling—the arrangement of electrons in atoms, 7
 - 1.6 The Periodic Table, Part 2, 12
 - 1.7 Radioactive isotopes, 14
 - Exercises, 15
 - Further reading, 15
- 2 CHEMICAL BONDS, 16
 - 2.1 Ionic or electrovalent bonds, 16
 - 2.2 Covalent bonds, 17
 - 2.3 Some common ionic and covalent compounds, 18
 - 2.4 Polarized covalent bonds and hydrogen bonds, 19
 - 2.5 Properties of ionic and covalent compounds, 21
 - 2.6 Other bond types, 23
 - 2.7 The shapes of molecules, 24
 - 2.8 Valency, 26
 - Exercises, 26
- 3 STATES OF MATTER, 27
 - 3.1 Changes of state, 27
 - 3.2 Temperature, temperature scales and thermometers, 29
 - Exercise, 31
 - Further reading, 31
- 4 THE SOLID STATE, 32
 - 4.1 Crystal structures, 32
 - 4.2 Crystal structures and mechanical properties. 1. The allotropes of carbon, 34
 - 4.3 Crystal structures and mechanical properties. 2. Metals, 35
 - 4.4 Silicate minerals in rocks and soils, 39

- 4.5 The weathering of silicate minerals, 45
 - Exercises, 46
 - Further reading, 47

- 5 THE LIQUID STATE, 48
 - 5.1 Solution concentration expressions, 49
 - 5.2 Solubility, 51
 - 5.3 The solubility product, 52
 - 5.4 Diffusion and osmosis, 54
 - Exercises, 58
 - Further reading, 59

- 6 THE GAS STATE, 60
 - 6.1 The gas laws, 60
 - 6.2 The liquefaction of gases, 62
 - 6.3 Methods of expressing the composition of gas mixtures, 63
 - Exercise, 66
 - Further reading, 66

- 7 CHEMICAL REACTIONS, 67
 - 7.1 Chemical reactions and equations, 67
 - 7.2 Redox reactions, 69
 - 7.3 The corrosion of metals, 70
 - 7.4 Reactions and energy, 74
 - 7.5 Catalysts, 77
 - 7.6 Reversible reactions, 79
 - Exercises, 83
 - Further reading, 83

- 8 ACIDS AND BASES, 84
 - 8.1 Acidity, alkalinity and pH, 84
 - 8.2 The strength of acids and bases, 89
 - 8.3 Equivalent weights and normality, 93
 - 8.4 Buffers, 95
 - 8.5 Amphoteric substances, 97
 - Exercises, 98
 - Further reading, 98

- 9 WATER, 100
 - 9.1 The structure of liquid water, 100
 - 9.2 The thermal properties of water, 102
 - 9.3 Other properties of water, 104
 - 9.4 The purification of water, 108
 - 9.5 Ion exchange in soils and in the purification of water, 109
 - Exercises, 111
 - Further reading, 111

- 10 SURFACE AND COLLOID CHEMISTRY, 112
 - 10.1 Surface tension, 112

- 10.2 The wetting of surfaces—detergents, 113
- 10.3 Interactions between soil surfaces and water, 117
- 10.4 The colloidal state, 119
- 10.5 Colloidal systems, 120
 - Exercises, 123
 - Further reading, 123

PART 2
ORGANIC CHEMISTRY

- 11 INTRODUCTION TO ORGANIC CHEMISTRY, 127
 - 11.1 The uniqueness of carbon, 127
 - 11.2 Homologous series and functional groups, 129
 - Exercises, 130
 - Further reading, 130
- 12 THE HYDROCARBONS, 132
 - 12.1 The alkanes, 132
 - 12.2 The alkenes, 137
 - 12.3 The alkynes, 141
 - 12.4 The arenes (aromatic hydrocarbons), 143
 - Exercises, 147
 - Further reading, 148
- 13 ORGANIC COMPOUNDS CONTAINING OXYGEN, 149
 - 13.1 The alcohols, 149
 - 13.2 The phenols, 155
 - 13.3 The ethers, 157
 - 13.4 Aldehydes and ketones, 158
 - 13.5 Carbohydrates, 164
 - 13.6 Carboxylic acids and lipids, 170
 - Exercises, 178
 - Further reading, 179
- 14 ORGANIC COMPOUNDS CONTAINING NITROGEN,
SULPHUR AND PHOSPHORUS, 180
 - 14.1 The amines and amides, 180
 - 14.2 Amino acids, peptides and proteins, 187
 - 14.3 The thiols, 194
 - 14.4 Organic compounds containing phosphorus, 197
 - Exercises, 201
 - Further reading, 202

PART 3
AGRICULTURAL CHEMICALS

- 15 FERTILIZERS, 205
 - 15.1 Nitrogen fertilizers, 206

- 15.2 Phosphorus fertilizers, 208
- 15.3 Potassium fertilizers, 211
- 15.4 Liming materials, 212
- 15.5 Compound fertilizers, 213
 - Further reading, 214

- 16 PESTICIDES, 215
 - 16.1 Insecticides for crop protection, 215
 - 16.2 Fungicides for crop protection, 220
 - 16.3 Weedkillers/herbicides, 222
 - 16.4 Other agricultural pesticides, 224
 - Further reading, 225

- APPENDIX: EXERCISE SOLUTIONS, 226

- INDEX, 233