

## Contents

|                                             |     |
|---------------------------------------------|-----|
| Acknowledgements                            | ix  |
| Preface                                     | vii |
| 1. General Chemistry                        | 1   |
| 1.1 Atomic Structure and the Periodic Table | 1   |
| 1.2 Chemical Bonding                        | 18  |
| 1.3 Gases                                   | 21  |
| 1.4 Solutions                               | 23  |
| 1.5 Acids and Bases                         | 24  |
| 1.6 Thermodynamics                          | 25  |
| 1.7 Equilibria                              | 28  |
| 1.8 Kinetics                                | 36  |
| 2. Inorganic Chemistry                      | 41  |
| 2.1 Group IA Elements                       | 42  |
| 2.2 Group IIA Elements                      | 43  |
| 2.3 Group IIIA Elements                     | 44  |
| 2.4 Group IVA Elements                      | 45  |
| 2.5 Group VA Elements                       | 45  |
| 2.6 Group VIA Elements                      | 46  |
| 2.7 Group VIIA Elements                     | 46  |
| 2.8 Group VIIIA Elements                    | 47  |
| 2.9 Transition Elements                     | 48  |

|                                         |     |
|-----------------------------------------|-----|
| 2.10 Ionic Solids                       | 49  |
| 2.11 Coordination Numbers               | 49  |
| 2.12 Ionic Crystal Systems              | 50  |
| 2.13 Crystal Lattice Packing            | 51  |
| 2.14 Crystal Lattice Types              | 52  |
| 2.15 Crystal Lattice Energy             | 53  |
| 2.16 Complexes                          | 56  |
| 3. Organic Chemistry                    | 59  |
| 3.1 Classification of Organic Compounds | 60  |
| 3.2 Alkanes                             | 62  |
| 3.3 Alkenes                             | 63  |
| 3.4 Dienes                              | 66  |
| 3.5 Alkynes                             | 68  |
| 3.6 Benzene                             | 69  |
| 3.7 Alkylbenzenes                       | 71  |
| 3.8 Alkenylbenzenes                     | 74  |
| 3.9 Alkyl Halides                       | 75  |
| 3.10 Aryl Halides                       | 79  |
| 3.11 Alcohols                           | 81  |
| 3.12 Phenols                            | 84  |
| 3.13 Ethers                             | 89  |
| 3.14 Epoxides                           | 91  |
| 3.15 Aldehydes and Ketones              | 92  |
| 3.16 Carboxylic Acids                   | 96  |
| 3.17 Acid Chlorides                     | 98  |
| 3.18 Acid Anhydrides                    | 100 |
| 3.19 Esters                             | 102 |
| 3.20 Amides                             | 104 |
| 3.21 Amines                             | 107 |
| 3.22 Alicyclic Compounds                | 110 |
| 3.23 Heterocyclic Compounds             | 111 |
| 3.24 Isomers                            | 115 |
| 3.25 Polymer Structures                 | 123 |
| 4. Instrumental Analysis                | 133 |
| 4.1 The Electromagnetic Spectrum        | 133 |
| 4.2 Ultraviolet-Visible Spectroscopy    | 135 |
| 4.3 Infrared Spectroscopy               | 138 |
| 4.4 Nuclear Magnetic Resonance          | 151 |
| 4.5 Mass Spectroscopy                   | 163 |

|                                    |     |
|------------------------------------|-----|
| 5. Units and Measurements          | 169 |
| 5.1 Fundamental Physical Constants | 169 |
| 5.2 Units                          | 170 |
| 5.3 Prefixes                       | 171 |
| 5.4 Conversion Factors             | 172 |
| 6. Mathematical Concepts           | 173 |
| 6.1 Algebraic Formulas             | 173 |
| 6.2 Plane Figure Formulas          | 175 |
| 6.3 Solid Figure Formulas          | 177 |
| Index                              | 179 |