

# CONTENTS

|                        |           |
|------------------------|-----------|
| INTRODUCTION . . . . . | PAGE<br>1 |
|------------------------|-----------|

## UNIT I

### MATTER AND ENERGY. COMPOUNDS, ELEMENTS, AND MIXTURES

|             |   |    |
|-------------|---|----|
| <b>PART</b> |   |    |
| 1.          | THE NATURE OF MATTER . . . . .  | 7  |
| 2.          | COMPOUNDS, ELEMENTS, AND MIXTURES . . . . .                                 | 12 |
| 3.          | PROPERTIES OF MATTER AND ENERGY: CHEMICAL<br>AND PHYSICAL CHANGES . . . . . | 23 |

## UNIT II

### THE ATMOSPHERE, OXYGEN, HYDROGEN, AND WATER

|    |                                    |    |
|----|------------------------------------|----|
| 1. | THE ATMOSPHERE . . . . .           | 35 |
| 2. | OXYGEN . . . . .                   | 49 |
| 3. | HYDROGEN . . . . .                 | 64 |
| 4. | WATER; HYDROGEN PEROXIDE . . . . . | 78 |
| 5. | SOLUTIONS . . . . .                | 95 |

## UNIT III

### ATOMS; MOLECULES; THE ELECTRON THEORY; EQUATIONS

|    |  |     |
|----|--|-----|
| 1. | ATOMS; ATOMIC WEIGHTS; MOLECULAR WEIGHTS | 107 |
| 2. | THE ELECTRON THEORY . . . . .            | 111 |
| 3. | THE PERIODIC TABLE . . . . .             | 123 |
| 4. | CHEMICAL EQUATIONS . . . . .             | 137 |
| 5. | CHEMICAL CALCULATIONS . . . . .          | 148 |

## UNIT IV

### GROUP I OF THE PERIODIC TABLE

|    |  |     |
|----|--|-----|
| 1. | SODIUM . . . . .                                   | 161 |
| 2. | POTASSIUM, LITHIUM, RUBIDIUM, AND CESIUM . . . . . | 170 |
| 3. | THE PHOTOELECTRIC EFFECT; SPECTRUM ANALYSIS        | 174 |

## UNIT V

## THE HALOGENS AND HALOGEN ACIDS

| PART |  | PAGE |
|------|--|------|
| 1.   | CHLORINE . . . . .   | 183  |
| 2.   | FLUORINE, BROMINE, AND IODINE . . . . .                            | 191  |
| 3.   | HYDROCHLORIC ACID . . . . .  | 199  |
| 4.   | HYDROFLUORIC ACID; HYDROBROMIC ACID; HY-<br>DRIODIC ACID . . . . . | 205  |
| 5.   | OXYGEN ACIDS OF THE HALOGENS . . . . .                             | 211  |

## UNIT VI

## ACIDS, BASES, AND SALTS; IONIZATION

|    |  |     |
|----|--|-----|
| 1. | ACIDS, BASES, AND SALTS . . . . .                | 217 |
| 2. | IONIZATION . . . . .                             | 225 |
| 3. | EQUATIONS FOR REACTIONS INVOLVING IONS . . . . . | 234 |
| 4. | COLLOIDS . . . . .                               | 240 |
| 5. | STANDARD SOLUTIONS; TITRATIONS . . . . .         | 249 |

## UNIT VII

## PROPERTIES OF GASES

|    |  |     |
|----|--|-----|
| 1. | THE LAWS OF BOYLE AND CHARLES . . . . .                    | 257 |
| 2. | GAY-LUSSAC'S LAW; AVOGADRO'S LAW . . . . .                 | 263 |
| 3. | CALCULATIONS INVOLVING THE WEIGHTS OF GASES . . . . .      | 268 |
| 4. | CALCULATIONS INVOLVING GRAM-MOLECULAR<br>VOLUMES . . . . . | 273 |

## UNIT VIII

## NITROGEN AND ITS COMPOUNDS

|    |  |     |
|----|--|-----|
| 1. | NITROGEN . . . . .                     | 281 |
| 2. | AMMONIA . . . . .                      | 288 |
| 3. | OXIDES AND ACIDS OF NITROGEN . . . . . | 298 |

## UNIT IX

CARBON AND ITS OXIDES; SILICON AND  
ITS COMPOUNDS

|    |  |     |
|----|--|-----|
| 1. | CARBON . . . . .                             | 309 |
| 2. | CARBON MONOXIDE . . . . .                    | 319 |
| 3. | CARBON DIOXIDE . . . . .                     | 324 |
| 4. | SALTS OF CARBONIC ACID; HYDROLYSIS . . . . . | 336 |
| 5. | SILICON AND ITS COMPOUNDS . . . . .          | 342 |

## UNIT X

## SULFUR AND ITS COMPOUNDS

| PART |  | PAGE |
|------|--|------|
| 1.   | SULFUR . . . . .                         | 357  |
| 2.   | THE SULFIDES . . . . .                   | 363  |
| 3.   | SULFUR DIOXIDE; SULFUROUS ACID . . . . . | 368  |
| 4.   | SULFUR TRIOXIDE; SULFURIC ACID . . . . . | 372  |

## UNIT XI

## GROUP II OF THE PERIODIC TABLE

|    |   |     |
|----|---|-----|
| 1. | MAGNESIUM . . . . .                     | 381 |
| 2. | CALCIUM AND ITS COMPOUNDS . . . . .     | 385 |
| 3. | HARD WATER AND ITS SOFTENING . . . . .  | 391 |
| 4. | STRONTIUM, BARIUM, AND RADIUM . . . . . | 397 |

## UNIT XII

## BORON; ALUMINUM

|    |  |     |
|----|--|-----|
| 1. | BORON . . . . .                          | 405 |
| 2. | ALUMINUM . . . . .                       | 408 |
| 3. | AMPHOTERIC SUBSTANCES . . . . .          | 415 |
| 4. | STRUCTURE OF THE HEAVIER ATOMS . . . . . | 417 |

## UNIT XIII

PHOSPHORUS, ARSENIC, ANTIMONY,  
AND BISMUTH

|    |  |     |
|----|--|-----|
| 1. | PHOSPHORUS . . . . .                     | 423 |
| 2. | ACIDS OF PHOSPHORUS . . . . .            | 430 |
| 3. | ARSENIC, ANTIMONY, AND BISMUTH . . . . . | 435 |

## UNIT XIV

## COPPER, SILVER, AND GOLD

|    |   |     |
|----|---|-----|
| 1. | COPPER . . . . .  | 443 |
| 2. | SILVER . . . . .  | 452 |
| 3. | GOLD . . . . .  | 460 |
| 4. | COMPLEX IONS OF COPPER AND SILVER WITH<br>AMMONIA . . . . . | 465 |

## UNIT XV

## ZINC, CADMIUM, AND MERCURY

| PART |                               | PAGE |
|------|-------------------------------|------|
| 1.   | ZINC . . . . .                | 469  |
| 2.   | CADMIUM AND MERCURY . . . . . | 475  |

## UNIT XVI

ELECTROMOTIVE SERIES; ELECTRIC CELLS;  
STORAGE BATTERIES; ELECTROLYSIS;  
ELECTRODE POTENTIALS

|    |                                    |     |
|----|------------------------------------|-----|
| 1. | THE ELECTROMOTIVE SERIES . . . . . | 483 |
| 2. | ELECTRIC CELLS . . . . .           | 488 |
| 3. | THE STORAGE BATTERY . . . . .      | 494 |
| 4. | ELECTROLYSIS . . . . .             | 497 |
| 5. | ELECTRODE POTENTIALS . . . . .     | 501 |

## UNIT XVII

## TIN AND LEAD

|    |                |     |
|----|----------------|-----|
| 1. | TIN . . . . .  | 505 |
| 2. | LEAD . . . . . | 511 |

## UNIT XVIII

CHROMIUM, MOLYBDENUM, TUNGSTEN,  
AND URANIUM

|    |   |     |
|----|---|-----|
| 1. | CHROMIUM . . . . .                          | 519 |
| 2. | MOLYBDENUM, TUNGSTEN, AND URANIUM . . . . . | 523 |

## UNIT XIX

|                     |     |
|---------------------|-----|
| MANGANESE . . . . . | 529 |
|---------------------|-----|

## UNIT XX

## IRON, COBALT, AND NICKEL

|    |                               |     |
|----|-------------------------------|-----|
| 1. | IRON . . . . .                | 535 |
| 2. | COBALT AND NICKEL . . . . .   | 551 |
| 3. | THE PLATINUM METALS . . . . . | 553 |

## UNIT XXI

THE HYDROCARBONS AND THEIR DERIVATIVES;  
CARBOHYDRATES; FUELS

| PART |   | PAGE |
|------|---|------|
| 1.   | THE HYDROCARBONS . . . . .                | 561  |
| 2.   | DERIVATIVES OF THE HYDROCARBONS . . . . . | 573  |
| 3.   | FUELS . . . . .                           | 584  |

## SUPPLEMENT

|   |     |
|---|-----|
| THE BAROMETER; MORE ABOUT THE GAS LAWS . . . . .          | 591 |
| ELEMENTS ESSENTIAL TO PLANT LIFE . . . . .                | 599 |
| COMPOUNDS ESSENTIAL TO ANIMAL LIFE . . . . .              | 605 |
| RADIOACTIVITY AND THE TRANSMUTATION OF ELEMENTS . . . . . | 613 |
| THE METRIC SYSTEM . . . . .                               | 622 |
| APPENDIX . . . . .  | 627 |
| INDEX . . . . .   | 633 |