

List of Transparencies

Chemistry: The Molecular Nature of Matter and Change, 5th edition

By Martin S. Silberberg

- 1 The distinction between physical and chemical change Figure 1.1
- 2 The physical states of matter Figure 1.2
- 3 Potential energy is converted to kinetic energy Figure 1.3
- 4 The scientific approach to understanding nature Figure 1.6
- 5 Some volume relationships in SI Figure 1.8
- 6 Some interesting quantities of length (A), volume (B), and mass (C) Figure 1.10
- 7 Some interesting temperatures Figure 1.11
- 8 Precision and accuracy in a laboratory calibration Figure 1.16
- 9 End of chapter problems 1.1, 1.44, 1.46
- 10 End of chapter problems 1.70, 1.73, 1.74
- 11 End of chapter problems 1.75, 1.87
- 12 Elements, compounds, and mixtures on the atomic scale Figure 2.1
- 13 Experiments to determine the properties of cathode rays Figure 2.4
- 14 Millikan's oil-drop experiment for measuring an electron's charge Figure 2.5
- 15 Properties of the three key subatomic particles Table 2.2
- 16 The mass spectrometer and its data Figure B2.2
- 17 Factors that influence the strength of ionic bonding Figure 2.12
- 18 The relationship between ions formed and the nearest noble gas Figure 2.13
- 19 Formation of covalent bond between two H atoms Figure 2.14
- 20 Naming compounds from their depictions Sample Problem 2.16
- 21 The classification of matter from a chemical point of view Figure 2.21
- 22 End of chapter problems 2.110, 2.111, 2.113, 2.115
- 23 End of chapter problems 2.128, 2.135, 2.136
- 24 End of chapter problems 2.140, 2.142, 2.144, 2.148
- 25 Information contained in the chemical formula of glucose, $C_6H_{12}O_6$ ($M=180.16\text{g/mol}$) Table 3.2
- 26 Some compounds with empirical formula CH_2O (composition by mass: 40.0% C, 6.71% H, 53.3% O) Table 3.3
- 27 Information contained in a balanced equation Table 3.5
- 28 Analogy for limiting reactants Figure 3.10
- 29 Converting a concentrated solution to a dilute solution Figure 3.14
- 30 An overview of the key mole-mass-number stoichiometric relationships Figure 3.15
- 31 End of chapter problems 3.7, 3.50, 3.88, 3.92, 3.94, 3.124
- 32 End of chapter problems 3.130, 3.137, 3.145, 3.149
- 33 Electron distribution in molecules of H_2 and H_2O Figure 4.1
- 34 The dissolution of an ionic compound Figure 4.2
- 35 The electrical conductivity of ionic solutions Figure 4.3
- 36 A precipitation reaction and its equations Figure 4.4
- 37 An aqueous strong acid-strong base reaction on the atomic scale Figure 4.10
- 38 The redox process in compound formation Figure 4.12
- 39 Highest and lowest oxidation numbers of reactive main-group elements Figure 4.13
- 40 A summary of terminology for oxidation-reduction (redox) reactions Figure 4.14
- 41 Combining elements to form an ionic compound Figure 4.16
- 42 Decomposing a compound to its elements Figure 4.17
- 43 An active metal displacing hydrogen from water Figure 4.18
- 44 Displacing one metal with another Figure 4.20
- 45 The activity series of the metals Figure 4.21
- 46 The equilibrium state Figure 4.22
- 47 End of chapter problems 4.5, 4.6, 4.28, 4.38
- 48 End of chapter problems 4.116, 4.133, 4.137
- 49 Two types of manometer Figure 5.4
- 50 The relationship between the volume and pressure of a gas Figure 5.5
- 51 The relationship between the volume and temperature of a gas Figure 5.6
- 52 Standard molar volume Figure 5.8
- 53 Relationship between the ideal gas law and the individual gas laws Figure 5.10
- 54 Determining the molar mass of an unknown volatile liquid Figure 5.11
- 55 Summary of the stoichiometric relationships among the amount (mol, n) of gaseous reactant or product and the gas variables pressure (P), volume (V), and temperature (T) Figure 5.13
- 56 Distribution of molecular speeds at three temperatures Figure 5.14
- 57 A molecular description of Boyle's law Figure 5.15
- 58 A molecular description of Dalton's law of partial pressures Figure 5.16
- 59 A molecular description of Charles's law Figure 5.17
- 60 A molecular description of Avogadro's law Figure 5.18

- 61** Relationship between molar mass and molecular speed Figure 5.19
- 62** Variations in pressure, temperature, and composition of the Earth's atmosphere Figure B5.1
- 63** Molar volume of some common gases at STP (0°C and 1 atm) Table 5.4
- 64** The behavior of several real gases with increasing external pressure Figure 5.21
- 65** The effect of intermolecular attractions on measured gas pressure Figure 5.22
- 66** The effect of molecular volume on measured gas volume Figure 5.23
- 67** End of chapter problems 5.88, 5.111
- 68** Energy diagrams for the transfer of internal energy (E) between a system and its surroundings Figure 6.2
- 69** A system transferring energy as heat only Figure 6.3
- 70** Some interesting quantities of energy Figure 6.5
- 71** Two different paths for the energy change of a system Figure 6.6
- 72** Enthalpy diagrams for exothermic and endothermic processes Figure 6.8
- 73** The general process for determining $\Delta H^\circ_{\text{rxn}}$ from ΔH°_f values Figure 6.12
- 74** The trapping of heat by the atmosphere Figure B6.1
- 75** End of chapter problems 6.68, 6.90, 6.95
- 76** Frequency and wavelength Figure 7.1
- 77** Regions of the electromagnetic spectrum Figure 7.3
- 78** Different behaviors of waves and particles Figure 7.4
- 79** The Bohr explanation of three series of spectral lines Figure 7.11
- 80** Wave motion in restricted systems; the de Broglie wavelengths of several objects Figure 7.13, Table 7.1
- 81** Summary of the major observations and theories leading from classical theory to quantum theory Figure 7.15
- 82** Electron probability in the ground-state H atom Figure 7.16
- 83** The hierarchy of quantum numbers for atomic orbitals Table 7.2
- 84** The 1s, 2s, and 3s orbitals Figure 7.17
- 85** The 2p orbitals Figure 7.18
- 86** The 3d orbitals Figure 7.19
- 87** Summary of quantum numbers of electrons in atoms Table 8.2
- 88** The effect of nuclear charge on orbital energy; shielding; the effect of orbital shape on orbital energy Figures 8.3, 8.4, 8.5
- 89** Order for filling energy sublevels with electrons Figure 8.6
- 90** Partial orbital diagrams and electron configurations for the elements in Period 3 Table 8.3
- 91** Partial orbital diagrams and electron configurations for the elements in Period 4 Table 8.4
- 92** A periodic table of partial ground-state electron configuration Figure 8.11
- 93** The relation between orbital filling and the periodic table Figure 8.12
- 94** Atomic radii of the main-group and transition elements Figure 8.15
- 95** Periodicity of atomic radius Figure 8.16
- 96** Periodicity of first ionization energy (IE₁) Figure 8.17
- 97** First ionization energies of the main-group elements Figure 8.18
- 98** Successive ionization energies of the elements lithium through sodium Table 8.5
- 99** Trends in three atomic properties Figure 8.21
- 100** Trends in metallic behavior Figure 8.22
- 101** The change in metallic behavior in Group 5A (15) and Period 3 Figure 8.23 / The trend in acid-base behavior of element oxides Figure 8.24
- 102** Ionic vs. atomic radii Figure 8.29
- 103** A general comparison of metals and nonmetals Figure 9.1
- 104** The three models of chemical bonding Figure 9.2
- 105** Three ways to represent the formation of Li⁺ and F⁻ through electron transfer Figure 9.4
- 106** The Born-Haber cycle for lithium fluoride Figure 9.6
- 107** Trends in lattice energy Figure 9.7
- 108** Covalent bond formation in H₂ Figure 9.11
- 109** Using bond energies to calculate $\Delta H^\circ_{\text{rxn}}$ of methane Figure 9.17
- 110** Heats of reaction for the combustion (ΔH_{comb}) of some carbon compounds Table 9.4
- 111** The Pauling electronegativity (EN) scale Figure 9.20
- 112** Electronegativity and atomic size Figure 9.21
- 113** Percent ionic character as a function of electronegativity difference (ΔEN) Figure 9.24
- 114** Properties of the Period 3 chlorides Figure 9.25
- 115** Electron-group repulsions and the five basic molecular shapes Figure 10.1
- 116** Summary of molecular shapes Figure 10.9
- 117** The steps in determining a molecular shape Figure 10.10
- 118** *cis*-1,2-dichloroethylene and *trans*-1,2-dichloroethylene Page 389
- 119** End of chapter problems 10.3, 10.33, 10.38, 10.39

- 120** The sp hybrid orbitals in gaseous BeCl_2
Figure 11.2
- 121** The sp^2 hybrid orbitals in BF_3 Figure 11.3
- 122** The sp^3 hybrid orbitals in CH_4 Figure 11.4 /
The sp^3 hybrid orbitals in NH_3 and H_2O
Figure 11.5
- 123** The sp^3d hybrid orbitals in PCl_5
Figure 11.6
- 124** The sp^3d^2 hybrid orbitals in SF_6
Figure 11.7
- 125** Composition and orientation of hybrid orbitals Table 11.1
- 126** The σ bonds in ethane (C_2H_6) Figure 11.9
- 127** The σ and π bonds in ethylene (C_2H_4)
Figure 11.10
- 128** Contours and energies of σ and π MOs through combinations of $2p$ atomic orbitals
Figure 11.19
- 129** Relative MO energy levels for Period 2 homonuclear diatomic molecules
Figure 11.20
- 130** MO occupancy and molecular properties for B_2 through NE_2 Figure 11.21
- 131** Phase changes and their enthalpy changes Figure 12.2
- 132** A cooling curve for the conversion of gaseous water to ice Figure 12.3
- 133** Liquid-gas equilibrium Figure 12.4
- 134** The effect of temperature on the distribution of molecular speeds in a liquid
Figure 12.5 / Vapor pressure as a function of temperature and intermolecular forces
Figure 12.6
- 135** Phase diagrams for CO_2 and H_2O
Figure 12.9
- 136** Comparison of bonding and nonbonding (intermolecular) forces Table 12.2
- 137** Dipole moment and boiling point
Figure 12.13
- 138** Hydrogen bonding and boiling point
Figure 12.14
- 139** The macroscopic properties of water and their atomic and molecular "roots"
Figure 12.24
- 140** The three cubic unit cells Figure 12.27
- 141** Packing identical spheres Figure 12.28
- 142** Characteristics of the major types of crystalline solids Table 12.5
- 143** Sodium chloride, zinc blende, and fluorite structures Figures 12.32, 12.33, and 12.34
- 144** The band of molecular orbitals in lithium metal Figure 12.37
- 145** Electrical conductivity in a conductor, a semiconductor, and an insulator
Figure 12.38
- 146** Crystal structures and band representations of doped semiconductors
Figure 12.40
- 147** The random-coil shape of a polymer chain
Figure 12.47
- 148** The viscosity of a polymer in solution
Figure 12.49
- 149** The major types of intermolecular forces in solutions Figure 13.1
- 150** A portion of a polypeptide chain
Figure 13.6
- 151** The forces that maintain protein structure
Figure 13.7
- 152** Intermolecular forces acting within the cell membrane Figure 13.10
- 153** The double helix of DNA Figure 13.13
- 154** Solution cycles and the enthalpy components of the heat of solution
Figure 13.16
- 155** Trends in ionic heats of hydration
Table 13.4 / Dissolving ionic compounds in water Figure 13.17
- 156** The relation between solubility and temperature for several ionic compounds
Figure 13.21
- 157** The effect of pressure on gas solubility
Figure 13.23
- 158** The effect of the solute on the vapor pressure of a solution Figure 13.26
- 159** Phase diagrams of solvent and solution
Figure 13.27
- 160** The development of osmotic pressure
Figure 13.28
- 161** Nonideal behavior of electrolyte solutions
Figure 13.30 / An ionic atmosphere model for nonideal behavior of electrolyte solutions
Figure 13.31
- 162** Finding colligative properties from molecular scenes Sample and Follow-Up Problems 13.9
- 163** Types of colloids Table 13.7
- 164** Difference in ΔEN between the atoms in a bond greatly influences physical and chemical behavior Interchapter Topic 1, page 555
- 165** The continuum of bond types among all the Period 3 main-group elements
Interchapter Topic 2, page 556
- 166** Number of bonds and molecular shape
Interchapter Topic 2, page 557
- 167** Metals versus nonmetals Interchapter Topic 3, page 558
- 168** Oxide behavior Interchapter Topic 4, page 559 top
- 169** Periodic table of oxidation states
Interchapter Topic 5, page 560
- 170** Physical states of the elements
Interchapter Topic 6, page 562
- 171** Trends in atomic, physical, and chemical properties of the Period 2 elements
Table 14.1 (Part 1)
- 172** Trends in atomic, physical, and chemical properties of the Period 2 elements
Table 14.1 (Part 2)
- 173** Family Portrait Group 1A(1): The alkali metals

- 174** Family Portrait Group 2A(2): The alkaline Earth metals
- 175** The effect of transition elements on properties: Group 3B(3) vs. Group 3A(13) Figure 14.7
- 176** Family Portrait Group 3A(13): The boron family
- 177** Family Portrait Group 4A(14): The carbon family
- 178** Family Portrait Group 5A(15): The nitrogen family
- 179** Structures and properties of the nitrogen oxides Table 14.3
- 180** Family Portrait Group 6A(16): The oxygen family
- 181** Family Portrait Group 7A(17): The halogens
- 182** Family Portrait Group 8A(18): The noble gases
- 183** The chemical diversity of organic compounds Figure 15.2
- 184** Some five-carbon skeletons Figure 15.3
- 185** Adding the H-atom skin to the C-atom skeleton Figure 15.4
- 186** Rules for naming an organic compound Table 15.2
- 187** The constitutional isomers of C_4H_{10} and C_5H_{12} Table 15.3
- 188** Important functional groups in organic compounds Table 15.5
- 189** Some major addition polymers Table 15.6
- 190** The common amino acids Figure 15.28
- 191** The structural hierarchy of proteins Figure 15.29
- 192** Nucleic acid precursors and their linkage Figure 15.31
- 193** The double helix of DNA Figure 15.32
- 194** Key stages in protein synthesis Figure 15.33
- 195** Key stages in DNA replication Figure 15.34
- 196** Reaction rate: the central focus of chemical kinetics Figure 16.1
- 197** The concentration of O_3 vs. time during its reaction with C_2H_4 Figure 16.5
- 198** Initial rates for a series of experiments with the reaction between O_2 and NO Table 16.2
- 199** Integrated rate laws and reaction order Figure 16.7 / Graphical determination of the reaction order for the decomposition of N_2O_5 Figure 16.8
- 200** A plot of $[N_2O_5]$ vs. time for three half-lives Figure 16.9
- 201** An overview of zero-order, first-order, and simple second-order reactions Table 16.4
- 202** Information sequence to determine the kinetic parameters of a reaction Figure 16.12
- 203** The effect of temperature on the distribution of collision energies Figure 16.14 / The effect of E_a and T on the fraction (f) of collisions with sufficient energy to allow reaction Table 16.5
- 204** An energy-level diagram of the fraction of collisions exceeding E_a Figure 16.16
- 205** The importance of molecular orientation to an effective collision Figure 16.17
- 206** Reaction energy diagram for the reaction between CH_3Br and OH^- Figure 16.19
- 207** Reaction energy diagrams and possible transition states for two reactions Figure 16.20
- 208** Reaction energy diagram of a catalyzed and an uncatalyzed process Figure 16.22
- 209** Reaching equilibrium on the macroscopic and molecular levels Figure 17.1
- 210** The range of equilibrium constants Figure 17.2
- 211** The change in Q during the $N_2O_4-NO_2$ reaction Figure 17.3
- 212** Ways of expressing Q and calculating K Table 17.2
- 213** Reaction direction and the relative sizes of Q and K Figure 17.5
- 214** Steps in solving equilibrium problems Figure 17.6
- 215** The effect of added Cl_2 on the $PCl_3-Cl_2-PCl_5$ system Table 17.3 / The effect of a change in concentration Figure 17.7
- 216** The effect of pressure (volume) on system at equilibrium Figure 17.8
- 217** Effects of various disturbances on a system at equilibrium Table 17.4
- 218** Determining equilibrium parameter from molecular scenes Sample and Follow-Up Problems 17.15
- 219** The extent of dissociation for strong acids Figure 18.1 / The extent of dissociation for weak acids Figure 18.2
- 220** The relationship between $[H_3O^+]$ and $[OH^-]$ and the relative acidity of solutions Figure 18.4
- 221** The relations among $[H_3O^+]$, pH , $[OH^-]$, and pOH Figure 18.6
- 222** Proton transfer as the essential feature of a Brønsted-Lowry acid-base reaction Figure 18.8
- 223** The conjugate pairs in some acid-base reactions Table 18.4 / Strengths of conjugate acid-base pairs Figure 18.9
- 224** The effect of atomic and molecular properties on nonmetal hydride acidity Figure 18.11 / The relative strengths of oxoacids Figure 18.12
- 225** The behavior of salts in water Table 18.8
- 226** How a buffer works Figure 19.3

- 227** Curve for a strong acid-strong base titration Figure 19.7 / Curve for a weak acid-strong base titration Figure 19.8 / Curve for a weak base-strong acid titration Figure 19.9
- 228** Relationship between K_{sp} and solubility at 25°C Table 19.3
- 229** Formation of acidic precipitation Figure B19.3
- 230** The stepwise exchange of NH_3 for H_2O in $M(H_2O)_4^{2+}$ Figure 19.15
- 231** A qualitative analysis scheme for separating cation into five ion groups Figure 19.18
- 232** Entropy increase due to expansion of a gas Figure 20.3
- 233** Expansion of a gas and the increase in number of microstates Figure 20.4
- 234** Visualizing the effect of temperature on entropy Figure 20.6
- 235** The increase in entropy from solid to liquid to gas Figure 20.7
- 236** Components of ΔS_{univ} for spontaneous reactions Figure 20.12
- 237** Reaction spontaneity and the signs of ΔH , ΔS , and ΔG Table 20.1
- 238** The effect of temperature on reaction spontaneity Figure 20.11
- 239** The relationship between ΔG^0 and K at 298 K Table 20.2 / The relation between free energy and the extent of reaction Figure 20.15
- 240** General characteristics of voltaic and electrolytic cells Figure 21.3
- 241** A voltaic cell based on the zinc-copper reaction Figure 21.5
- 242** The interrelationship of ΔG^0 , E^0_{cell} , and K Figure 21.10; The relation between E_{cell} and $\log Q$ for the zinc-copper cell Figure 21.11
- 243** The corrosion of iron Figure 21.20
- 244** The tin-copper reaction as the basis of a voltaic and an electrolytic cell Figure 21.25
- 245** The processes occurring during the discharge and recharge of a lead-acid battery Figure 21.26
- 246** A summary diagram for the stoichiometry of electrolysis Figure 21.28
- 247** Cosmic and terrestrial abundances of selected elements (mass %) Figure 22.1
- 248** Geochemical differentiation of the elements Figure 22.2
- 249** Abundance of selected elements in the crust, its regions, and the human body as representative of the biosphere (mass %) Table 22.1
- 250** Sources of the elements Figure 22.4
- 251** The carbon cycle Figure 22.5
- 252** The nitrogen cycle Figure 22.6
- 253** The phosphorous cycle Figure 22.7
- 254** Steps in metallurgy Figure 22.9
- 255** The redox step in converting a mineral to the element Figure 22.13
- 256** The major reactions in a blast furnace Figure 22.16
- 257** Horizontal trends in key atomic properties of the Period 4 elements Figure 23.3
- 258** Vertical trends in key properties within the transition elements Figure 23.4
- 259** Oxidation states and d -orbital occupancy of the Period 4 transition metals Table 23.2
- 260** Components of a coordination compound Figure 23.9
- 261** Coordination numbers and shapes of some complex ions Table 23.6
- 262** Some common ligands in coordination compounds Table 23.7
- 263** Important types of isomerism in coordination compounds Figure 23.10
- 264** Optical isomerism in an octahedral complex ion Figure 23.12
- 265** The five d -orbitals in an octahedral field of ligands Figure 23.17
- 266** Splitting of d -orbital energies by an octahedral field of ligands Figure 23.18
- 267** The spectrochemical series Figure 23.22
- 268** Comparison of chemical and nuclear reactions Table 24.1
- 269** Three types of radioactive emissions in an electric field Figure 24.1
- 270** Modes of radioactive decay Table 24.2
- 271** A plot of neutrons vs. protons for the stable nuclides Figure 24.2
- 272** The ^{238}U decay series Figure 24.3 / Decrease in number of ^{14}C nuclei over time Figure 24.4
- 273** Typical radiation doses from natural and artificial sources Table 24.7
- 274** The variation in binding energy per nucleon Figure 24.12
- 275** A chain reaction of ^{235}U Figure 24.14
- 276** Diagram of an atomic bomb Figure 24.15 / Element synthesis in the life cycle of a star Figure B24.3