Chemistry 1A   EXAM 2 STUDY GUIDE
Chemistry – Molecular Approach Nivaldo Tro, 4ᵗʰ ed

Chapter 7 – The Quantum-Mechanical Model of the Atom

Electromagnetic Radiation -know names and approximate relationship of energy and wavelength for the different regions, Use the equation relating wavelength (λ), frequency (ν) and the speed of light ($E = h\nu$; $E = hc/\lambda$).
Quantum Theory, The Bohr Atom, Discrete Energy levels, Energy of photons using ($E_n = -2.18 \times 10^{-18}$ J $(1/n^2)$, n=1,2,3…), Planck's Equation, line spectra, emission spectra.
Contributions of de Broglie, Heisenberg - Uncertainty principle.
Quantum mechanics: the allowed values for quantum numbers (n, ℓ, m_ℓ, m_s)

Shape and meaning of atomic orbitals.

Suggested Exercises for Chapter 7: Self-Assessment Quiz (p. 328)
Problems: 35, 37, 39 (a, c), 41, 45, 59, 61, 66, 67, 69, 70, 81, 91, 100, 104.

Chapter 8 - Periodic Properties of the Elements

Electron configurations of atoms (ground state and excited state) and ions.
Pauli exclusion principle, Coulomb's Law, Effective nuclear charge.
Aufbau's principle, Hund's rule, valence electrons, diamagnetism and paramagnetism.
Relating Electron configuration to position of the element on the Periodic Table.
Development of the Periodic Table. Periodic Trends in Physical and Chemical Properties
Valence electrons. Periodic Variation in Specific Physical Properties: Atomic Radius, Ionic Radius, Ion size in an isoelectronic series. Ionization Energy.
Understand Electron Affinity and meaning of sign associated with its value. Metallic properties.
Periodic chemical behavior of alkali metals, halogens and noble gases.

Suggested Exercises for Chapter 8: Self-Assessment Quiz (p. 372-373)
Problems: 45, 46, 47, 49, 51,53, 55, 57, 63, 64, 65,67, 69, 71, 75, 77, 78, 79, 83, 99, 113, 127.

Chapter 9 - Chemical Bonding I – The Lewis Model.

Types of Chemical Bond – ionic bond and covalent bond.
Lewis Dot Symbols for elements and ions. Lewis structures for ionic compounds.
Lattice Energy of ionic compounds: Born-Haber Cycle, trends in lattice energy (ion size and ion charge).
Lewis structures for molecular compounds (covalent bonding) and polyatomic ions.
Single, double and triple bonds: bond length and bond energy.
Bonding and nonbonding electrons (lone pair electrons).
Electronegativity (as a periodic property) and as a measure of bond polarity. Dipole moment, percent ionic character.
Formal Charge and Resonance. Octet Rule, Exceptions to the Octet Rule – incomplete and expanded octet. Bond Dissociation Energy and calculation of ΔH.

Suggested Exercises for Chapter 9: Self-Assessment Quiz (p. 417-418)
Problems: 37, 39, 41, 45, 47, 48, 53, 54, 55, 61, 62, 63, 65, 67, 71, 75, 77, 78, 79, 81, 83, 87, 91, 95, 97, 116, 120, 123.

Chapter 10- Chemical Bonding I – Molecular Shapes, Valence Bond and MO Theory

Valence Shell Electron Pair Repulsion Model (VSEPR).
Predict Electron Geometry and Molecular Geometry (see Table 10.1 p 436),
Bonding electron groups and nonbonding electrons or lone pairs – Role in geometry of molecule.
Electron Geometry vs Molecular Geometry;
Molecular shape and Polarity of molecules - Polar and Nonpolar molecules. Dipole Moments of molecules.
Valence Bond Theory –Orbital overlap as chemical bond, Hybridization of Atomic orbitals sp^3, sp^2 and sp hybridization. Sigma (σ) and pi (π) bonds.
Molecular Orbital Theory – Linear combination of atomic orbitals.
bonding molecular orbital, anti-bonding orbital, bond order. Constructing molecular orbitals for homonuclear diatomic molecules. Paramagnetism and diamagnetism.

Suggested Exercises for Chapter 10: Self-Assessment Quiz (p. 473)
Problems: 16, 33, 35, 39, 45, 49, 51, 53,63, 65, 67, 75, 77, 79, 86, 87, 92, 103.

Laboratory Experiments: Questions from the Spectrophotometry Experiment (Expt 4) Nanomaterials Experiment (Exp5) are not on the exam. Problems on Molecular Geometry and Hybridization like those in SA-4 and SA-5 are on the exam.

Additional Problems on Lattice Energy

1.   Calculate the lattice energy of $CaCl_2$ from the following data.

Reactions	Energies (kJ/mol)
Ca (s) $\rightarrow$ Ca (g)	178.0
Ca (g) $\rightarrow$ Ca$^+$ (g) + e-	590.0
Ca$^+$ (g) $\rightarrow$ Ca^{2+} (g) + e-	1145
Cl$_2$ (g) $\rightarrow$ 2 Cl (g)	242.6
Cl (g) + e- $\rightarrow$ Cl$^-$ (g)	-348.7
Ca (s) + Cl$_2$ $\rightarrow$ CaCl$_2$ (s) ΔH°_f = -795.0	

2.   Calculate the lattice energy of Fe_2O_3(s) at 25°C from the following data.

Process	Enthalpy (ΔH) kJ/mol
Lattice Energy of Fe$_2$O$_{3(s)}$	?
First ionization energy of Fe$_{(g)}$	+759
Second ionization energy of Fe$_{(g)}$	+1561
Third ionization energy of Fe$_{(g)}$	+2957
Enthalpy of formation of Fe$_{(g)}$	+415
Enthalpy of formation of O$_{2(g)}$	0
Bond energy of O$_{2(g)}$	+498
Electron affinity of O$_{(g)}$	-141
Electron affinity of O$^-$ $_{(g)}$	+844
Enthalpy of formation of Fe$_2$O$_3$ (s)	-826

Answers: 1. -2253.2kJ/mol   2. -15,066 kJ/mol