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Chemistry 222

Key Equations for CH 222

This may not include all the important equations from CH 222, but most of them are included here, separated by chapter.

Good luck!

Important Equations, Constants, and Handouts from Chapter 7:

- *know how to determine if* **ionic, covalent** *or* **metallic bonds** *are present*
- **ionic bond strength** *determined by* **Coulomb's Law**
- **# valence electrons = group number** *(US periodic table!)*
- *know the relationship between* **bond order, bond length** *and* **bond energy**
- *see* **Geometry and Polarity Guide** *and* **Bond Enthalpies and Electronegativities** *(handouts)*

Formal Charge = Group Number - bonds - lone pair electrons
FC = GN - bonds - lpe

ΔH_{rxn} **= bonds broken - bonds formed**

Lewis Structures / VSEPR: bonding pairs, lone pairs, valence electrons, core electrons, total electrons, sigma bond, pi bond, VSEPR names (EPG & MG), formal charge, bond angles, polar, nonpolar, paramagnetic, diamagnetic, resonance structures, isomers

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bond order (resonance) = $\frac{\#\ of\ e^-\ pairs\ used\ for\ a\ type\ of\ bond}{\#\ of\ bonds\ of\ that\ type}$

Important Equations, Constants, and Handouts from Chapter 8:

- *the* **bond order, bond energy and bond length** *relationships still apply to both theories*
- *know the advantages and disadvantages of the Valence Bond and Molecular Orbital theories*
- *see the* **Geometry and Polarity Guide** *and the two* **Molecular Orbital Theory** *diagrams* **(NBC** *and* **FONe)** *(handouts)*

Valence Bond / Hybridization Theory: *types of* **hybridization (sp, sp^2, etc.), sigma and pi bonds**

Molecular Orbital Theory: bonding *and* **antibonding orbitals, sigma bonds** *and* **pi bonds, paramagnetic** *and* **diamagnetic,** *the* **"NBC" vs. "FONe"** *diagrams*

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bond order (MO theory) = $\frac{1}{2}(\#\ bonding\ e^- - \#\ antibonding\ e^-)$

Important Equations, Constants, and Handouts from Chapter 20:

- *be able to* **name organic compounds** *using the* **functional group** *along with the* **"longest chain, shortest number"** *concept*
- **recognize some common organic chemistry reactions**
- *see the* **Organic Chemistry Nomenclature Guide** *(handout)*

Organic Chemistry: alkyl group, alkane, cycloalkane, alkyl halide, alcohol, ether, ketones, aldehydes, alkynes, alkenes, aromatic compounds, carboxylic acids, amines, isomers

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Important Equations, Constants, and Handouts from Chapter 9:

- **know how to use the gas laws, desired units for the gas law, STP uses, Dalton's Law of Partial Pressure, etc.**
- **understand pressure**
- **know how to use gases in stoichiometry problems**
- **know how the KMT (Kinetic Molecular Theory) describes gases**

- **PV = nRT**
- **PM = dRT**
- **mole = 6.022 x 10^{23}**
- **760 mm Hg = 1 atm**
- **1013 mbar = 1 atm**
- *metric prefixes* **(m, k,** *etc.***)**
- **STP = 1 atm, 273.15 K**

R = 0.082057 L atm mol^{-1} K^{-1} *(the "gas R")*
R = 8.3145 J mol^{-1} K^{-1} *(the "energy R")*

KE = $^1/_2mv^2 = {}^3/_2RT$

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Important Equations, Constants, and Handouts from Chapter 10:

Intermolecular (IM) Forces: *know* **when** *they apply,* **strength** *(strongest to weakest)*:
- **metallic/ion-ion**
- **ion-dipole**
- **dipole-dipole (***with* **Hydrogen bonding** *for* **O, F** *and* **N** *to* **H)**
- **dipole-induced dipole**
- **induced dipole-induced dipole (ID-ID)**

States of Matter: solids, liquids, gases, phase diagrams, triple point, "normal" boiling and freezing points, the slope of the solid-liquid line in a phase diagram, q = mCΔT and q = "mass*heat", vapor pressure

Solids: *unit cell type:*
- **simple cubic (SC)**
- **body centered cubic (BCC)**
- **face centered cubic (FCC)**

sc: 1 atom, $d_0 = 2r$
bcc: 2 atoms, $d_0 = 4r/\sqrt{3}$
fcc: 4 atoms, $d_0 = 4r/\sqrt{2}$
mole = 6.022 x 10^{23}

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r ⇔ d_0 ⇔ Volume < *density* > **mass** < *molar mass* > **mols** < *avogadro's number* > **atoms/molecules**

Important Equations, Constants, and Handouts from Chapter 11:

- **solution = solute + solvent**
- **see <u>Concentration Units Handout</u>**

Solution Concentrations:

$$Molarity\ (M) = \frac{mol\ Solute}{L\ Solution}$$

$$molality(m)\ = \frac{mol\ Solute}{kg\ Solvent}$$

$$weight\ \% = \frac{mass\ Solute}{Total\ mass}$$

$$mole\ fraction\ (\chi) = \frac{mol\ A}{total\ mol}$$

$$ppm = \frac{1.0\ g\ of\ substance}{1.0\ million\ g\ sample}$$

Henry's Law:

$$S_g = k \bullet P_g$$

Raoult's Law / Vapor Pressure Depression:

$$P_{solvent} = \chi_{solvent} \bullet P^o_{solvent}$$

Boiling Point Elevation / Freezing Point Depression:

$$\Delta T_{BP/FP} = K_{BP/FP} \bullet \left(\frac{mol\ Solute}{kg\ Solvent}\right) \bullet i$$

Osmosis:

$$\pi = i\left(\frac{mol\ Solute}{L\ Solvent}\right)RT$$

R = 0.082057 L atm mol^{-1} K^{-1}
i = van't Hoff factor

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Important Equations, Constants, and Handouts from Chapter 12:

The Rate Law:

$$Rate = k[A]^p[B]^m[C]^n \ldots$$

m, n, p = 0, 1 or 2 only (in our classes)

1st Order Integrated Rate Law;

$$ln\frac{[R]}{[R_0]} = -kt$$

$$t_{\frac{1}{2}} = \frac{0.693}{k}$$

The Arrhenius Equation:

$$ln(k) = -\left(\frac{E_a}{R}\right)\left(\frac{1}{T}\right) + ln(A)$$

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- **R = 8.3145 J/mol·K**
- **"Kinetics Cheat Sheet"** *handout*
- **"Reactions Mechanisms"** *handout*

Kinetics: rate, rate law, orders of reaction, the rate constant (k), 1st vs. 2nd. vs. zero order, half life, mechanism, elementary reaction, bimolecular (and uni- ***and*** **ter-molecular), Arrhenius equation, activation energy, frequency factor, mechanism, intermediate, catalyst, rds (rate determining step)**

Important Equations, Constants, and Handouts from Chapter 21:

- **all** *of the* **first order kinetics** *equations apply. See the* **Nuclear Chemistry Guide** *(handout)*
- **decay** *or* **emission = product**
- **capture = reactant**
- **know how to balance nuclear reactions**

$$-E_b = \Delta E = \Delta mc^2$$

c = *speed of light* = **2.998 x 10^8 m/s**
use **kg/mol** *for* **Δm**

1st Order Integrated Rate Law;

$$ln\frac{[R]}{[R_0]} = -kt$$

$$t_{\frac{1}{2}} = \frac{0.693}{k}$$

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