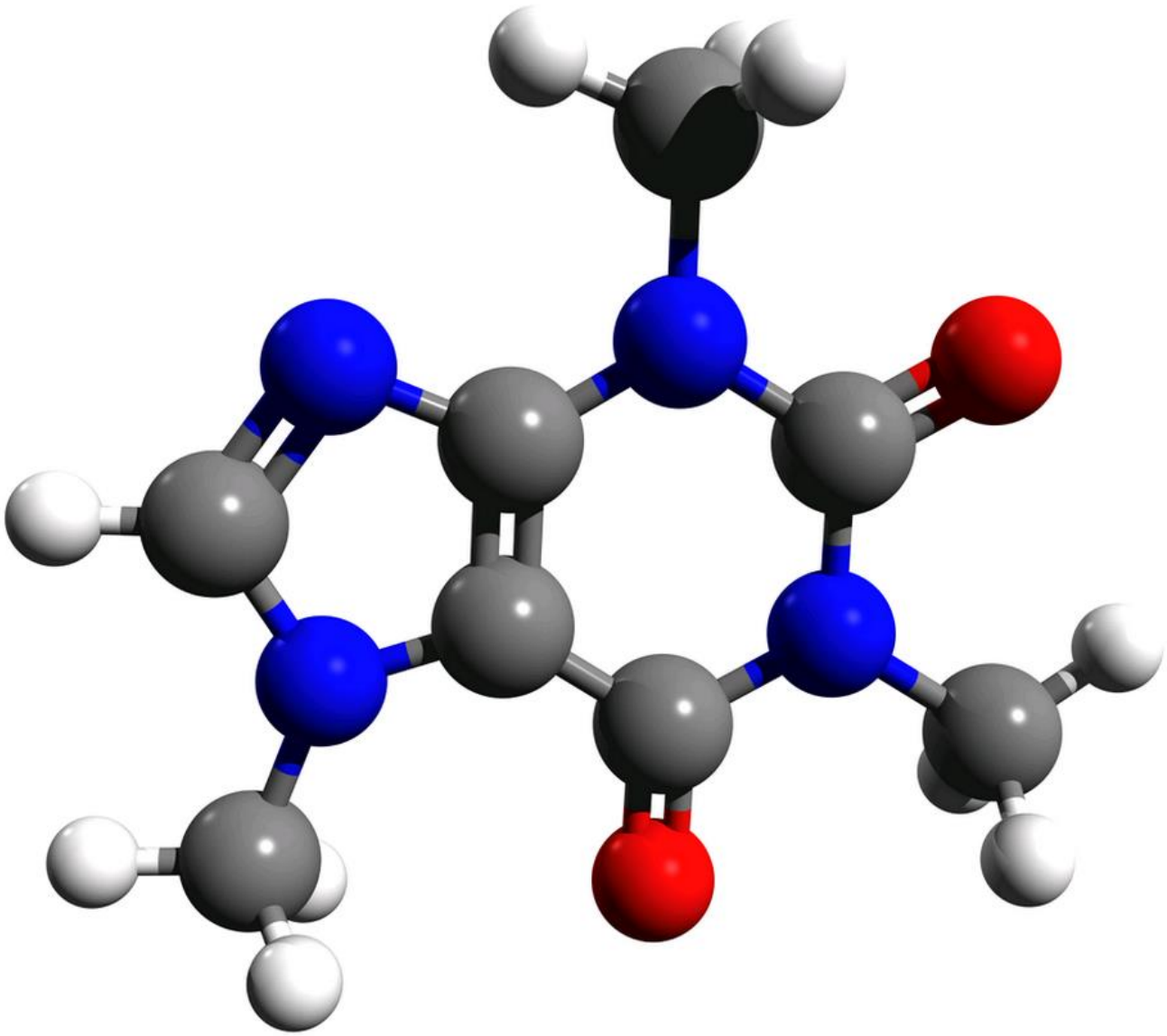
Chemistry 112

Course Outcomes and Reference Material



Mr. P. MacDonald

Semester 2, 2023

Preface

This booklet contains the outcomes you will be assessed on, the assessment grading scheme, and reference material for concepts covered in Chemistry 112. A printout of this document will be provided for assessments. Most review questions will be from the chemistry textbook (Prentice Hall Chemistry 2008). You can be issued a physical copy if you like, however, the teacher's edition (with all the answers) will be provided digitally on Teams. Use your book as a learning resource, not just where to get your questions. Many mathematical problems will be solved in OneNote for simplified student access. Every outcome will have a practice test.

Review: Classification of Matter, Chapter 2: Suggested reading. This unit serves as a review and reminder of the structure of matter, its physical states, and the difference between elements, compounds, and molecules.

- Properties of Matter, Page 42 #s 1 – 8
- Mixtures, Page 47 #s 11 – 17
- Elements and Compounds, Page 52 #s 20 – 27
- Outcome Review, Pages 58 – 59 #s 35 – 50, 60 – 63

1. **Compound Names and Formulas, Chapter 9**: Identify, name, and write formulas for ionic, molecular, acidic, and basic compounds.
    - Naming Ions, Page 256 #s 1, 2
    - Ionic Compounds, Pages 258 - 266 #s 6 – 13, 17 – 19
    - Molecular Compounds, Page 270 #s 22 – 25
    - Acids and Bases, Page 273 #s 29 – 33
    - Outcome Review: Pages 281 – 283 #s 42 – 44, 46, 53, 55, 57 – 61, 65 – 70

2. **Moles, Chapter 10**: Apply Avogadro's number in calculations of representative particles. This includes molar mass, volume of a gas at STP and percent composition calculations.
    - The Mole and Molar Mass, Pages 291 – 296 #s 3 – 8, 13 – 15
    - Mole-Mass and Mole Volume, Pages 298 – 303 #s 16 – 23, 26 – 31
    - Percent Composition and Chemical Formulas, Pages 306 – 312, #s 32 – 37, 43 – 46
    - Outcome Review, Pages 315 – 316 #s 49 – 54, 58 – 69, 74, 75, 79, 81, 82

3. **Stoichiometry, Chapter 12**: Students should be able calculate chemical quantities from a balanced chemical reaction, determine the limiting reagent and calculate percentage yield.
    - Chemical Calculations, Pages 360 – 366 #s 11 – 20, 24
    - Limiting Reagent, Pages 370 – 375 #s 25 – 35
    - Outcome Review, Pages 379 – 380 #s 40 – 42, 44 – 54, 60, 61

4. **Behaviour of Gases, Chapter 14**: Students will come to understand properties of gasses, including compressibility, and mathematical relationships among temperature, pressure, volume, and the number of particles. These concepts are combined in the ideal gas section. Students will know the difference between an ideal and a real gas.
    - Properties of Gases, Page 417 #s 1 – 6
    - The Gas Laws, Pages 419 – 425 #s 7 – 22
    - Ideal Gases, Pages 427 – 429 #s 23 – 29
    - Outcome Review, Pages 439 – 441 #s 39 – 44, 46 – 49, 51, 53 – 58, 72.

5. **Atomic Structure, Chapter 5**: Describe the discovery of the nucleus, the Bohr model of the atom, and compare them to the current quantum mechanical model. Explain and write electron configurations using Hund's rule, the Pauli exclusion principle and the Aufbau principle.
    - Structure of the Nuclear Atom (chapter 4.3), Page 108 #s 13, 14
    - Models of the Atom, Page 132 #s 2 – 7
    - Electron Arrangement in Atoms, Pages 135 – 136 #s 8 – 13
    - Outcome Review, Page 149 #s 23, 26, 27, 29 – 39

6. **Covalent Bonding, Chapters 8.1 & 8.2**: Define, explain, and model molecules, molecular compounds, and the different types of covalent bonds with electron dot and structural diagrams. *For each question asking for the dot structure, also draw the structural diagram.
    - Molecular Compounds, Page 216 #s 1 – 3, 6
    - Covalent Bonding, Pages 220 – 229 #s 7 – 16, 20, 21
    - Outcome Review, Pages 247 – 249 #s 39 – 47, 63, 64, 70a, 73, 79, 80

7. **Bonding Theories and Polarity, Chapters 8.3 & 8.4**: Define, explain, identify, and apply sigma and pi bonds, molecular shapes using VSEPR theory, polar and nonpolar bonds, and the different types of intermolecular forces.
    - Bonding Theories, Page 236 #s 23, 24, 27, 29
    - Polarity, Pages 239 – 244 #s 30 – 38
    - Outcome Review, Pages 247 – 249 #s 53, 54, 57 – 61, 70, 72, 74, 75

8. **Ionic Compounds, Chapter 7**: Explain the formation, structure, and properties of ionic and metallic compounds.
    - Ions, Page 193 #s 1 – 11
    - Ionic Bonds and Compounds, Pages 196 – 199 #s 12 – 17, 20 – 22
    - Bonding in Metals, Page 203 #s 23, 25 – 28
    - Outcome Review, Pages 207 – 208 #s 30 – 40, 43, 44, 46 – 49, 53, 55 – 60, 67, 70, 73, 76, 78, 79, 81

Strong Work Ethic and Skills for Success

- On task during class
    - This is the only time I can help you learn. Use it.
- Proper use of technology
    - Turn off your notifications, like completely. This is the main reason student work suffers.
- Time/task management
- Problem solving skills
    - Not just math, but the approach to any problem.
- Reflection
    - No big write up necessary. "Did I work to your best today?"
- Take initiative with your learning.
    - You have all the course materials for the entire semester. Use them.
- Personal workspace (outside of class)
- Goal setting
- Ask questions during class lessons.
    - Seek your own answers before asking the teacher during work time.
- Ask for feedback
- Use of course resources
    - It is all there. Everything. Go forth, learn.
- Embrace mistakes
    - Then address them

Assessment and Evaluation

Most outcomes will be graded from 1 to 6. That grade will be based on evidence from multiple sources including all or some of the following: observations, conversations, formative, and summative assessments.

Expert: Demonstration of a deep/thorough understanding of the concept	**6**	• Chose an appropriate strategy. • Successfully applied the necessary background skills and concepts to complete solutions. • Solutions contained no minor mistakes, or a summative contains at most one. • Clearly and concisely explained a concept using appropriate vocabulary, diagrams, etc. • Evaluated the reasonableness of my answer. "Does this make sense for the situation?" • Concept understood to a high degree to teach it to someone else. • **Concept(s) can be applied to new situations/problems.**
	5	• Chose an appropriate strategy. • Solutions contained no minor mistakes, or a summative contains at most two. • Solution(s) contained an error(s) related to a background skill. • Clearly and concisely explained a concept using appropriate vocabulary, diagrams, etc. • **Concept(s) can be applied successfully to known situations/problems.**
Apprentice: Good/Satisfactory understanding of the concept	**4**	• Chose an appropriate strategy. • A solution contained a concept error. A summative contained at most two such errors. • Minor mistakes and background skill errors are common. • Explanations of a problem contained *mostly* appropriate terminology. • Help from an expert is required for some concepts. • **More practice is needed to correctly apply concept(s) to known situations/problems**.
	3	• Chose an appropriate strategy. • Solution(s) contained a combination of concept errors, errors related to background skills and minor mistakes. • A lack of necessary background skills to solve problems. • Notes, examples, or help was needed to solve many problems. • Explanations did not contain proper terminology. • **Help from an expert is required to correctly apply concept to known situations/problems**.
Novice: Minimal-to-no understanding of the concept	**2**	• Incorrect strategy(ies) chosen for a problem(s). • Step-by-step instructions are required to solve problems. • Tasks could not be performed to an acceptable standard. • **Consistent extra help from an expert is required**.
	1	• Basics of what was needed to solve the problem was not known. • Solution left blank; first step not known. • **Teaching by an expert is required**.

Learning Category	**Classification Level**	**Only shortly before report cards will a percentage mark be determined**		
Expert	6	95 – 100		
	5	86	90	94
Apprentice	4	73	80	85
	3	60	66	72
Novice	2	50	56	59
	1	0	25	49

Students will log their grades on the next page. The overall grade is guided with the calculation of the *median* and *mean* of all grades.

*Reassessing outcomes is encouraged
*No traditional final exam
*Open resource test is possible, but a unit grade of 3 (60%) is the highest possible score.

Course Outcome Tracking

Unit	Description	Grade	Concept(s) to Improve	Retest Grade
1	Compound Names and Formulas		○ Naming Ions ○ Ionic Compounds ○ Molecular Compounds ○ Acids and Bases	
2	Moles		○ The Mole and Molar Mass ○ Mole-Mass and Molar Volume ○ Percent Composition and Chemical Formulas	
3	Stoichiometry		○ Chemical Calculations ○ Limiting Reagent	
4	Behaviour of Gases		○ Properties of Gases ○ The Gas Laws ○ Ideal Gases	
5	Atomic Structure		○ Structure of the Nuclear Atom ○ Models of the Atom ○ Electron Arrangement in Atoms	
6	Covalent Bonding		○ Molecular Compounds ○ Covalent Bonding	
7	Bonding Theories and Polarity		○ Bonding Theories ○ Polarity	
8	Ionic Compounds		○ Ions ○ Ionic Bonds and Compounds ○ Bonding in Metals	

Overall Course Grade

- Calculate your *median* by arranging your grades from lowest to highest. The grade in the middle is likely your overall grade. If there is no exact middle number, average the two middle numbers.
- Calculate your mean by adding all the grades up and divide by how many there are.
- Use a pencil, if you are writing your calculations here, grades will fluctuate over the semester.

Median = _____ Mean = _____

Example Percent Determinations

Median	Mean	Percent	Reason
4	3.8 – 4.2	80 %	Median and mean match or are close
4	4.3 or higher	85 %	Mean is much higher than median
4	3.7 or lower	73 %	Mean is much lower than median

Lists of Ions, Prefixes, Acid Naming, and Common Hydrocarbons

Cations	
Al^{3+}	Aluminum
NH_4^{1+}	Ammonium
Sb^{3+}	Antimony (III)
Sb^{5+}	Antimony (V)
Ba^{2+}	Barium
Be^{2+}	Beryllium
Bi^{3+}	Bismuth (III)
Bi^{5+}	Bismuth (V)
Cd^{2+}	Cadmium
Ca^{2+}	Calcium
Cs+	Cesium
Cr^{2+}	Chromium (II)
Cr^{3+}	Chromium (III)
Cu^{1+}	Copper (I)
Cu^{2+}	Copper (II)
Co^{2+}	Cobalt (II)
Co^{3+}	Cobalt (III)
H^{1+}	Hydrogen
Fe^{2+}	Iron (II)
Fe^{3+}	Iron (III)
Pb^{2+}	Lead (II)
Pb^{4+}	Lead (IV)
Li^{1+}	Lithium
Mg^{2+}	Magnesium
Mn^{2+}	Manganese (II)
Mn^{3+}	Manganese (III)
Hg^{2+}	Mercury
K^{1+}	Potassium
Ag^{1+}	Silver
Na^{1+}	Sodium
Sr^{2+}	Strontium
Sn^{2+}	Tin (II)
Sn^{4+}	Tin (IV)
Zn^{2+}	zinc

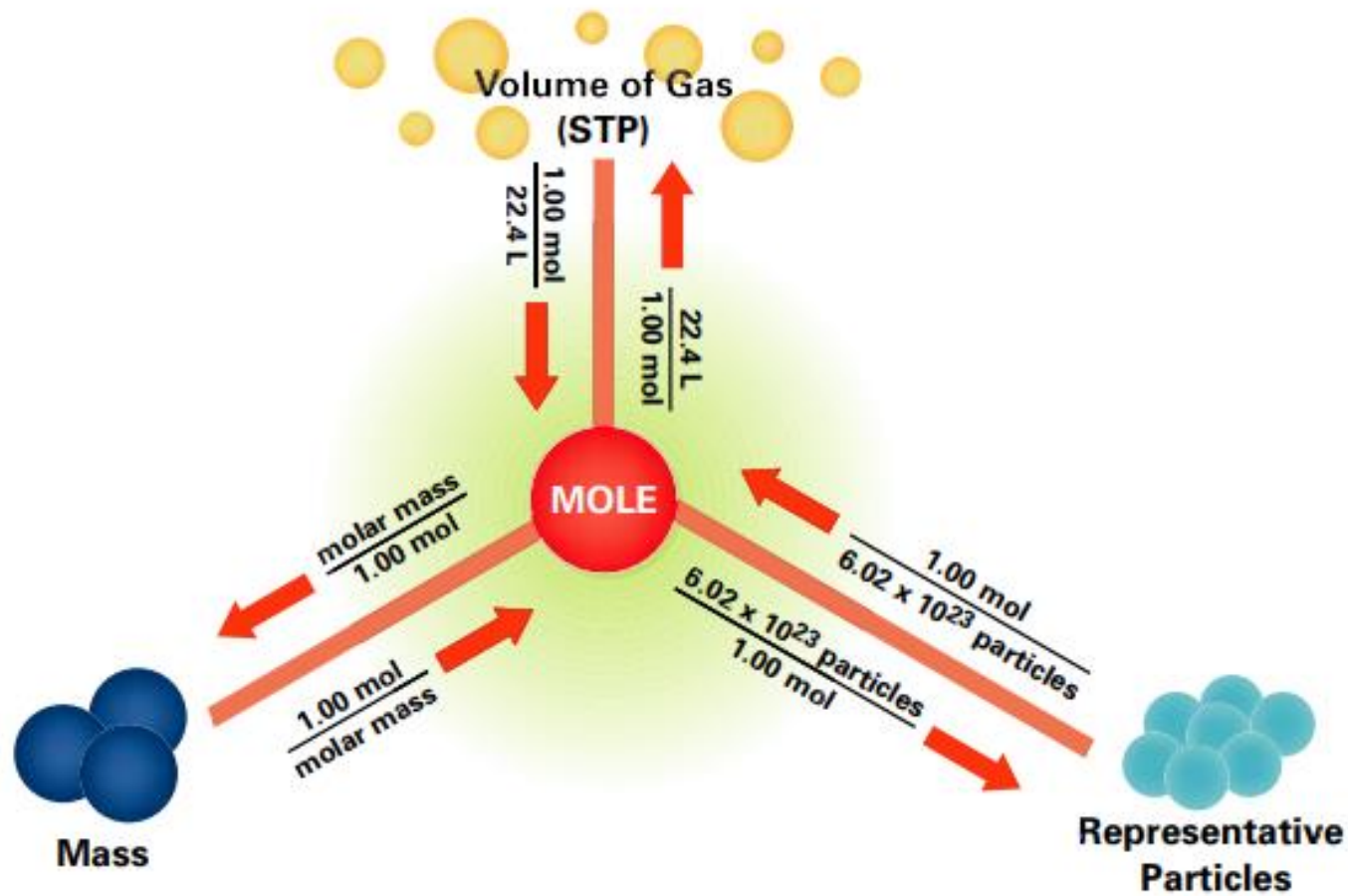
Anions	
$CH_3CO_2^{1-}$	Acetate
HCO_3^{1-}	Bicarbonate
Br^{1-}	Bromide
CO_3^{2-}	Carbonate
ClO_3^{1-}	Chlorate
Cl^{1-}	Chloride
ClO_2^{-}	Chlorite
CrO_4^{2-}	Chromate
CN^{1-}	Cyanide
NCO^{1-}	Cyanate
$Cr_2O_7^{2-}$	Dichromate
$H_2PO_4^{1-}$	Dihydrogen Phosphate
F^{1-}	Fluoride
OH^{1-}	Hydroxide
ClO^{1-}	Hypochlorite
I^{1-}	Iodide
NO_3^{1-}	Nitrate
N^{3-}	Nitride
NO_2^{1-}	Nitrite
O^{2-}	Oxide
$C_2O_4^{2-}$	Oxalate
ClO_4^{1-}	Perchlorate
MnO_4^{1-}	Permanganate
O_2^{2-}	Peroxide
PO_4^{3-}	Phosphate
P^{3-}	Phosphide
PO_3^{3-}	Phosphite
Se^{2-}	Selenide
SO_4^{2-}	Sulfate
S^{2-}	Sulfide
SO_3^{2-}	Sulfite
SCN^{1-}	Thiocyanate

Prefix	Name
1	Mono
2	Di
3	Tri
4	Tetra
5	Penta
6	Hexa
7	Hepta
8	Octa
9	Nona
10	Deca

Common Hydrocarbons	
Formula	**Name**
CH_4	Methane
C_2H_2	Ethene
C_2H_6	Ethane
C_3H_8	Propane
C_4H_{10}	Butane
C_5H_{12}	Pentane
C_6H_6	Benzene
C_6H_{14}	Hexane
C_7H_{16}	Heptane
C_8H_{18}	Octane
$C_6H_{12}O_6$	Glucose
$C_{12}H_{22}O_{11}$	Table Sugar

Normal ending	Acid name is…
_____-ide	hydro-___-ic acid
_____-ate	_____-ic acid
_____-ite	_____-ous acid

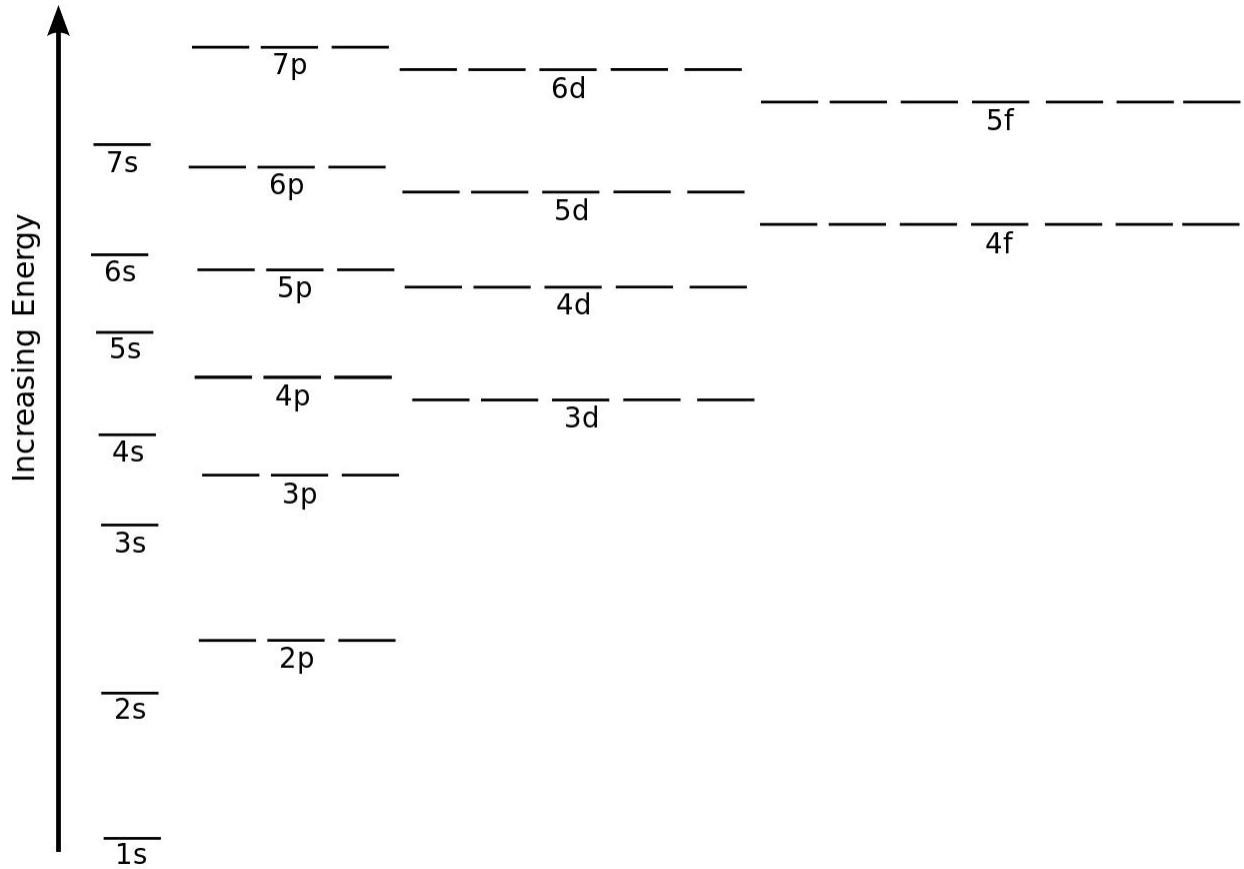
Mole Calculations

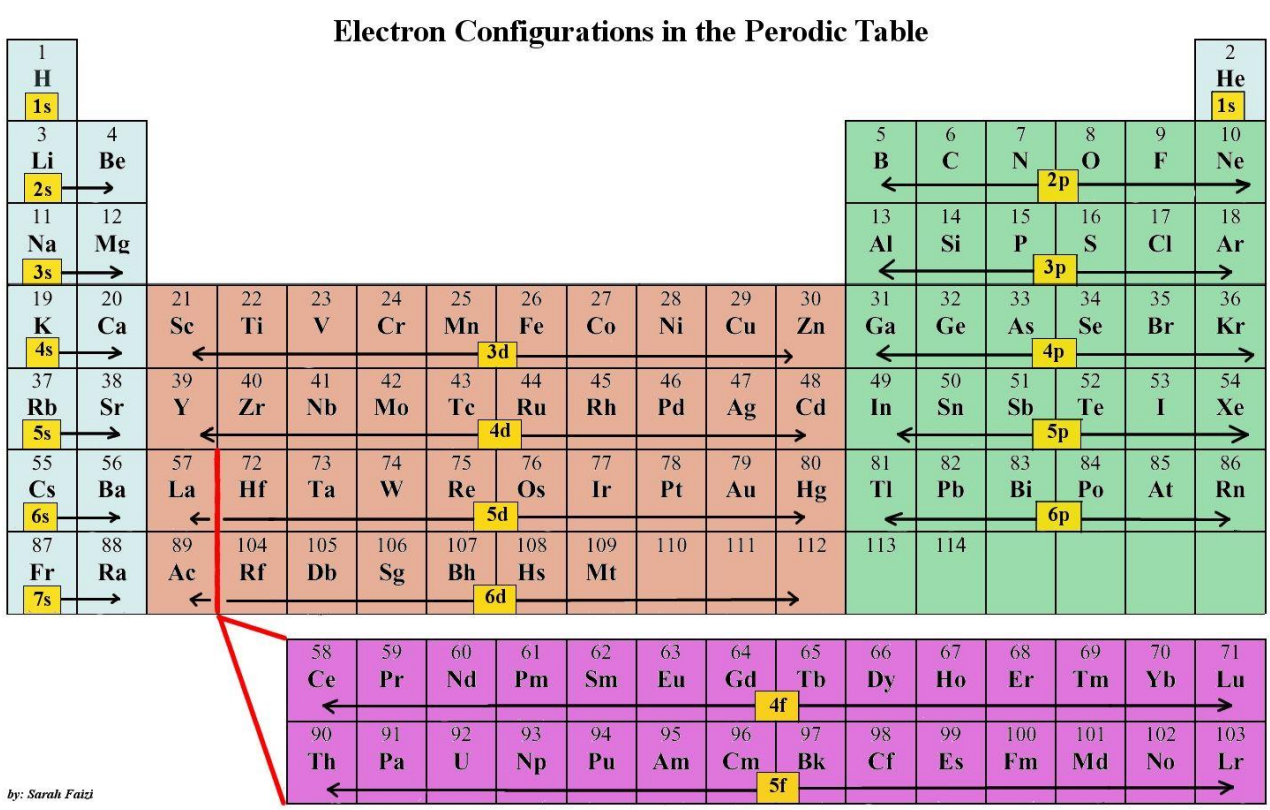


Gas Laws

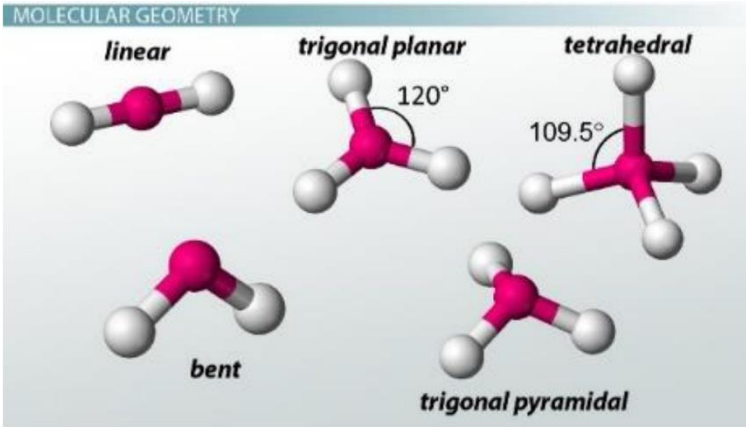
- Boyle's law: $P_1 \times V_1 = P_2 \times V_2$
- Charles's law: $\frac{V_1}{T_1} = \frac{V_2}{T_2}$
- Gay-Lussac's law: $\frac{P_1}{T_1} = \frac{P_2}{T_2}$
- Combined gas law: $\frac{P_1 \times V_1}{T_1} = \frac{P_2 \times V_2}{T_2}$
- Ideal gas law: $P \times V = n \times R \times T$ or $PV = nRT$
- Dalton's law: $P_{\text{total}} = P_1 + P_2 + P_3 + \ldots$
- Graham's law: $\frac{\text{Rate}_A}{\text{Rate}_B} = \sqrt{\frac{\text{molar mass}_B}{\text{molar mass}_A}}$

Aufbau Diagram





Simple Molecule Shapes



Electronegativity Differences & Bond Type

Electronegativity Difference Range	Most Probable Type of Bond	Example
0.0 – 0.3	Nonpolar covalent	H-H (0.0)
0.4 – 0.9	Moderately Polar Covalent	H-Cl (0.9)
1.0 – 1.9	Very Polar Covalent	H-F (1.9)
≥ 2.0	Ionic	$Na^{+}Cl^{-}$ (2.1)

Periodic Table of Electronegativities

H 2.1																	He
Li 1.0	Be 1.5											B 2.0	C 2.5	N 3.0	O 3.5	F 4.0	Ne
Na 0.9	Mg 1.2											Al 1.5	Si 1.8	P 2.1	S 2.5	Cl 3.0	Ar
K 0.8	Ca 1.0	Sc 1.3	Ti 1.5	V 1.6	Cr 1.6	Mn 1.5	Fe 1.8	Co 1.9	Ni 1.8	Cu 1.9	Zn 1.6	Ga 1.6	Ge 1.8	As 2.0	Se 2.4	Br 2.8	Kr
Rb 0.8	Sr 1.0	Y 1.2	Zr 1.4	Nb 1.6	Mo 1.8	Tc 1.9	Ru 2.2	Rh 2.2	Pd 2.2	Ag 1.9	Cd 1.7	In 1.7	Sn 1.8	Sb 1.9	Te 2.1	I 2.5	Xe
Cs 0.7	Ba 0.9	Lu	Hf 1.3	Ta 1.5	W 1.7	Re 1.9	Os 2.2	Ir 2.2	Pt 2.2	Au 2.4	Hg 1.9	Tl 1.8	Pb 1.9	Bi 1.9	Po 2.0	At 2.2	Rn
Fr 0.7	Ra 0.9	Lr	Rf	Db	Sg	Bh	Hs	Mt	Ds	Uuu	Uub	Uut	Uuq	Uup	Uuh	Uus	Uuo