AP CHEMISTRY CHEAT SHEET

Unit 1: Atomic Structure & Properties

Quick Overview

- **Focus:** structure of atoms, isotopes, electron configuration, periodic trends.

- **Exam Lens:** connect atomic structure → electron energy → periodic properties.

Atomic Basics

- **Atom = protons (+), neutrons (0), electrons (-).**
- **Atomic number (Z) = protons.**
- **Mass number (A) = protons + neutrons.**
- **Isotopes:** same element, different neutrons → different mass.
- **Average atomic mass = Σ(isotope mass × fractional abundance).**
- **Ion:** atom with unequal protons/electrons.
  - **-Cation (+):** lost electrons; smaller radius.
  - -**Anion (-):** gained electrons; larger radius.

Mini formula box

Average atomic mass = $(m_1 \times f_1) + (m_2 \times f_2) + \ldots$

Electromagnetic Radiation & Energy

- **Light behaves as both wave and particle.**
- **$E = h\nu = hc/\lambda$ (h = Planck's constant, c = speed of light).**
- **ν (frequency) ∝ E; λ (wavelength) ∝ 1/E.**
- **Photoelectric Effect:** light ejects electrons if E ≥ threshold.
- **Photoelectron Spectroscopy (PES):**
  - -Peaks = electrons in each subshell.
  - -Height = # of electrons; position = ionization energy.

Mnemonic: "Shorter λ → higher ν → higher E."

Common exam pitfalls

- **Mixing up mass number and atomic mass.**
- **Forgetting that IE increases with each electron removed.**
- **Misreading PES graphs (height = count, not energy).**
- **Writing electron configuration for ions incorrectly.**
- **Thinking E and λ increase together (they're inversely related).**

Integrated Tutor Tip

On FRQs or multiple choice, always connect structure to property.

Example: "Mg has higher IE than Na because it has more protons and smaller radius."

Population Ecology

- **Aufbau:** fill lowest energy first.
- **Pauli:** 2 electrons/orbital, opposite spins.
- **Hund:** fill singly before pairing.
- **Noble gas shortcut:** $[Ne]3s^2 3p^5$ = Cl.
- **Valence electrons = outermost shell; determine reactivity.**
- **Ions lose/gain e^- from outer shell first.**
  Example: $Na \rightarrow Na^+ + e^-$ $(1s^2 2s^2 2p^6)$.

Mini formula box

$E = h\nu = hc/\lambda$
$c = \lambda\nu$

Periodic Trends

- **Atomic Radius:** ↓ across (↑ nuclear charge), ↑ down (↑ shells).
- **Ionization Energy (IE):** ↑ across, ↓ down.
- **Electron Affinity:** becomes more negative across.
- **Electronegativity:** ↑ across, ↓ down (F most EN).
- **Isoelectronic ions:** more protons = smaller size.

Mnemonic: "Rabbits Down, Energy Across" → Radius ↓, IE ↑, EN ↑.

Subatomic Relationships

- **Protons define element;** neutrons change isotope; electrons control charge.
- **Removing electrons requires energy → successive ionization increases.**
- **Sudden IE jump = new shell (useful on AP graphs).**

Example: IE jumps after removing valence → core electrons.

Models & Theories

- **Bohr Model:** electrons orbit nucleus in fixed paths; quantized energy.
- **Quantum Mechanical Model:** orbitals = regions of high probability (s, p, d, f).
- **Heisenberg Uncertainty:** can't know position & momentum exactly.
- **Schrödinger Equation:** predicts probability density of electrons.

Mnemonic: "Bohr orbits, Schrödinger clouds."