INORGANIC CHEMISTRY

Comprehensive Quick-Review Cheat Sheet

1. Atomic Structure Periodicity

Quantum Numbers:
n: Principal $(1, 2, 3, \dots)$ → Size/Energy l: Azimuthal (0 to $n-1$) → Shape (s, p, d, f) m_l: Magnetic ($-l$ to $+l$) → Orientation m_s: Spin ($\pm\frac{1}{2}$) → Electron Spin

Periodic Trends (Across / Down):

- **Atomic Radius:** Decreases → / Increases ↓
- **Ionization Energy (IE):** Increases → / Decreases ↓
- **Electron Affinity (EA):** Becomes more negative → / Less negative ↓
- **Electronegativity:** Increases → / Decreases ↓

2. Chemical Bonding VSEPR

VSEPR Theory Geometries (Steric Number - SN):

- **SN = 2:** Linear (180°, e.g., $BeCl_2$)
- **SN = 3:** Trigonal Planar (120°, e.g., BF_3)
- **SN = 4:** Tetrahedral (109.5°, e.g., CH_4)
- **SN = 5:** Trigonal Bipyramidal (90°, 120°, PCl_5)
- **SN = 6:** Octahedral (90°, e.g., SF_6)

Formal Charge:
FC = $V - N - \frac{B}{2}$ where V = valence electrons, N = non-bonding valence electrons, B = bonding electrons.

3. Coordination Chemistry

IUPAC Naming Rules:

- Name cation before anion.
- Ligands in alphabetical order before the metal.
- Anionic ligands end in '-o' (e.g., chloro, cyano).
- Neutral ligands: NH_3 (ammine), H_2O (aqua), CO (carbonyl).
- Metal oxidation state in Roman numerals in parentheses.

Crystal Field Stabilization Energy (CFSE):

$$\text{CFSE} = -0.4n_{t_{2g}} + 0.6n_{e_g}\Delta_0 + \text{P}$$

(where P is pairing energy).

4. Acids, Bases Redox

HSAB Principle:
Hard Acids prefer Hard Bases; Soft Acids prefer Soft Bases.

- **Hard Acids:** $H^+, Li^+, Na^+, Mg^{2+}, Al^{3+}, Ti^{4+}$
- **Soft Acids:** $Cuk, Ag^+, Hg^{2+}, Pd^{2+}, Pt^{2+}$
- **Hard Bases:** $H_2O, OH^-, F^-, Cl^-, NH_3$
- **Soft Bases:** $I^-, CN^-, CO, S_2O_3^{2-}$

5. Main Group Chemistry

Boranes (B_nH_m):

- **Closo:** $[B_nH_n]^{2-}$ ($2n + 2$ skeletal electrons)
- **Nido:** $[B_nH_{n+4}]$ ($2n + 4$ skeletal electrons)
- **Arachno:** $[B_nH_{n+6}]$ ($2n+6$ skeletal electrons)

Silicates Basic Unit: $[extSiO_4]^{4-}$ tetrahedron, linked in chains, sheets, and 3D frameworks.

6. Organometallics Catalysis

18-Electron Rule: Stable transition metal complexes tend to have 18 valence electrons.

Total Electrons = $d^n + 2$(ligands donated pairs)

Key Catalytic Cycles:

- **Hydroformylation:** Alkene + CO + H_2 → Aldehyde (using $HCo(CO)_4$ or rhodium catalysts).
- **Wacker Process:** Ethylene + 1/2 O_2 → Acetaldehyde ($PdCl_2/CuCl_2$).