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# Inorganic Chemistry (Quickstudy: Academic)

**BarCharts, Inc.®**

**Quick Study Academic**

**WORLD'S #1 ACADEMIC OUTLINE**

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**Inorganic Chemistry**

What is inorganic chemistry? All of the chemistry not covered in carbon-centered organic and biochemistry—the remaining 70 or so elements!

**PERIODIC TABLE OF THE ELEMENTS**

**REACTIONS**

**Inorganic** – many types of reactions

**Acid-Base reactions**

**Oxidation** – loss of electrons, and oxygen

**Reduction** – gain of electrons, reduce oxygen

**LEWIS Acceptor** – the acceptor,  $\text{BF}_3\text{OH}_2$

**Precipitation** – dissolved ions form solids

**Hydrolysis** – water reacts with a compound

**Decomposition** – compounds to elements

**4.2nd & 3rd Transition Series: Zr-Pu**

**Zr** **Sc** **Ta** **W** **Tc** **Ru** **Os** **Pt** **Ag**  
**Hf** **Ta** **W** **Tc** **Ru** **Os** **Pt** **Ag**

**a.** Configuration comparable to the 4th transition series  
**b.** Trends in acidic “tenthander contraction”

**c.** 3d-3d overlap  
**d.** 3d-3d overlap, delta bond and delta-acceptor compounds, delta g雁 bond, face- $\delta$ -face overlaps

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**CHEMISTRY OF THE METALS**

**1. Elemental Forms**

- a. **Metals** – Non-Green metals, more, oxygen, hydride, sulfur, carbon, non-reactive
- b. **Nonmetals**
- c. **Hydrogen** – metallic, hydrogen, oxygen, nitrogen
- d. **Liquid** – metallic, sulfur, carbon
- e. **Crystalline solid** – carbon (diamond, graphite)
- f. **Metals** – more common type of elements
- High coordination numbers, very dense
- Delocalized electrons from energy bands

**2. Types of Compounds** – large variety due to
 

- a. **Ionic** – “electron transfer” range
- b. **Ionic** – electron exchange
- c. **Covalent** – shared electrons
- d. **Hydrogen** – covalent sharing
- e. **Transition metal compounds**
  - Conductivity, covalent, non-bonding ligands
  - Intermediate, metal-C bond
  - Complex intermetallic, metal-oxygen and -sulfur

**3. Periodicity** – chemical properties of an element depend on valence electrons

**Family of elements** – column in Periodic Table

**Periodic Trends**

- a. Chemistry determined by valence electrons
- b. Atoms or ions get a bit larger as you go down the column; electron shells are added
- c. Valence and inner valence charge increase as one goes down the column
- d. **Metals** – elements in the groups are the most metallic; metals are the easiest to reduce; electron rehybridizing becomes  $d$ -effort as orbital energy
- e. **Acidic & basic radii** – not properties; derive from structural data, divalent metal radius using a covalent radius
- Based on properties (acidic, basic, covalent, ionic and amphotropic (metallic type))
- f. **AIonic radius** – based on that size or ionic radius

**4. Development of the Periodic Table:** missing elements were predicted using periodicity

**5. Group I: Alkali Metals**

- a. Configuration:  $n$ th shell, only valence  $+1$
- b. Small interatomic distance
- c. Ionic radii
- d. Covalent properties: strong base
- e.  $\text{LiAl}_4$ ,  $\text{Li}_2\text{O}$  ionic salts ( $\text{NaCl}$ ),  $\text{Li}_2\text{O}$  soluble carbonate, silicate, sulfide
- f. Reactivity: pure metals react entirely with water, never found in nature as pure metal
- $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2\text{↑}$
- g. Syndicate electrolysis of molten salts
- h. Solvation: water forms cage  $\text{M}+\text{H}_2\text{O}$
- i. Hydration:  $\text{R}_2\text{O} + \text{H}_2\text{O} \rightarrow \text{R}_2\text{OH}$
- j. Hydration energy: varies from ion and water

**6. Group II: Alkaline Earth Metals**

- a. Configuration:  $n$ th shell, only valence  $+2$
- b. Small interatomic distance
- c. Ionic radii
- d. Reactivity: similar to alkali metals
- e. Solvation: water forms cage  $\text{M}^{2+} + 2\text{H}_2\text{O}$
- f. Hydration:  $\text{R}_2\text{O} + 2\text{H}_2\text{O} \rightarrow \text{R}_2\text{OH}_2 + \text{H}_2\text{↑}$

**7. 1st Transition Series: Ti-Cu**

**Ti** **V** **Cr** **Mn** **Fe** **Co** **Ni** **Cu**

**a.** Configuration partially filled  $d$ -subshell; divalent cation, ionic radius decreases

**b.** Periodic Trends: electronegativity, ionic radius, electron density, ionic radius increases with  $Z$

**c.** Ligand Field Effects: split  $d$ -orbital stability complex; alters physical & chemical properties

**d.** Ionic radius: size smaller than expected due to electron screening effects

**e.** Hydration: enhanced stability

**f. Chemical Properties**

- Metallic Ti and Cu less reactive than Mn and Fe
- g. Oxidation states: large variety
- h. Form aqua complexes, giving a variety of coordination numbers (1, 2, 3, 4, 5, 6, 7, 8)
- i. Ligand field stabilization energy

**8. Titanium Chemistry:  $d^1$  &  $d^2$**

**Ti** **Titanium Chemistry:  $d^1$  &  $d^2$**

**9. 2nd Transition Series: Zr-Pu**

**Zr** **Sc** **Ta** **W** **Tc** **Ru** **Os** **Pt** **Ag**  
**Hf** **Ta** **W** **Tc** **Ru** **Os** **Pt** **Ag**

**a.** Configuration comparable to the 4th transition series

**b.** Trends in acidic “tenthander contraction”

**c.** 3d-3d overlap

**d.** 3d-3d overlap, delta bond and delta-acceptor compounds, delta g雁 bond, face- $\delta$ -face overlaps

**e.** Trends of  $\text{Mn}$ ,  $\text{Ti}$  &  $\text{Ta}$

**f.** Complex molecular structures:  $\text{Mn}_2^{+}$ ,  $\text{Ti}_2^{+}$ ,  $\text{Ta}_2^{+}$

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## Synopsis

Our 3-panel (6-page) guide is jam-packed with chemistry information not covered in organic chemistry and biochemistry. Perfect for science students who want to focus on the aspects of chemistry that go beyond what is covered in material that deals with organic topics, this guide covers the key concepts, principles, figures and formulas that inorganic chemistry students will need to know in order to succeed. Tables, images and graphic elements further enhance the text.

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Fantastic easy access guide for quick review of inorganic chemistry principles!

Comprehensive review sheet, makes a great reference

Helped me ace the class. A good study tool.

Awesome !!!

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