

Redox Reactions

- Most redox reactions are simple
 - Synthesis (metal + non metal)
 - Single Replacement
 - Combustion
- Some are more complex
- We will call these non simple redox

| MEMORIZE! | | | | |
|---|--------------------------------|--|-----------------------------------|--|
| Oxidizing Agent | Turns into | Reducing Agent | Turns into | |
| helles - | Mn +2 | Free metals | Metal Cations | |
| (in acid) | | | | |
| MnO ₄ - (in neutral or base) | MnO ₂ | Halide ions | Free Halogens | |
| MnO ₂ (in acid) | Mn +2 | Free halogens (in dilute basic) | Hypohalite ions | |
| Cr ₂ O ₇ ²⁻ (in acid) | Cr +3 | Free halogens (in conc. basic) | Halite ions | |
| HNO ₃ (Concentrated) | NO ₂ | NO ₂ · | NO ₃ - | |
| HNO ₃ (dilute) | NO | S ₂ O ₃ -2 | S406 -2 | |
| H ₂ SO ₄ (hot & conc) | SO ₂ | SO ₃ ⁻² or SO ₂ | SO4 -2 | |
| Highly charged metal cations | Lower charged metal cations | Lower charged metal cations | Highly charged metal cations | |
| Free Halogens | Halide ions | H ₂ | H+ | |
| H ₂ O ₂ (in acid) | H ₂ O | H ₂ O ₂ (in basic) | H ₂ O + O ₂ | |

Redox Reaction Types

- Watchout for:
- Keywords "acidified solution" or an acid included in the reactants.
- Anytime you see a <u>neutral element</u>, Cu°, O₂, H₂, etc. it <u>must</u> be redox.
- When you recognize great $\underline{oxidizers}$ like $Cr_2O_7{}^2{}^{\text{-}},\ MnO_4{}^{\text{-}},$ and MnO_2

Reaction Example 1

Solid copper reacts with *dilute* nitric acid solution

Reaction Example 2

 A solution of potassium permanganate is mixed with an *alkaline solution* of sodium sulfite

Reaction Example 3

 Hydrogen peroxide is added to a solution of iron (II) sulfate

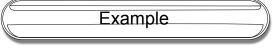
Naming Complex lons

 Although the names of complex ions can look crazy, the formula are simply knowing the patterns, much like naming hydrocarbons

| Naming Ligands | | | | |
|----------------|-------------------|----------|--|--|
| | H ₂ O | aqua | | |
| | NH ₃ | ammine | | |
| | OH - | hydroxo | | |
| | CI - | chloro | | |
| | F - | fluoro | | |
| | CN - | cyano | | |
| | CO | carbonyl | | |
| | NO ₂ - | nitrito | | |
| | NO | nitrosyl | | |

Prefixes for Ligands

| 2 | di |
|---|-------|
| 3 | tri |
| 4 | tetra |
| 5 | penta |
| 6 | hexa |



- Name [Cu(H₂O)₆] ²⁺
- hexaaquacopper(II)
- The (II) is the charge of the copper NOT the charge on the complex ion!

- Example
- Name [Al(H₂O)₆] ³⁺
- hexaaquaaluminium

Negative Complex lons

- A negatively charged complex ion is called an *anionic complex*.
- In this case the name of the metal is modified to show that it has ended up in a negative ion.
- This is shown by the ending -ate.

Negative Names

| cobalt | cobaltate |
|----------|-----------|
| aluminum | aluminate |
| chromium | chromate |
| vanadium | vanadate |
| copper | cuprate |
| Iron | ferrate |
| silver | argenate |



- [CuCl₄] ²⁻
- tetrachlorocuprate(II)

- Example
- [AI(H₂O)₂(OH)₄] -
- diaquatetrahydroxoaluminate

Name these compounds

- [Fe(H₂O)₆]Cl₂
- hexaquoiron (II) chloride
- [Cr(H2O)3(OH)3]
- triaquotrihydroxochromium (III)
- K₂[CoCl₄]
- potassium tetrachlorocobaltate (II)

| Colors | | |
|--|----------------|--|
| Formula | Color | |
| [Cr(H ₂ O) ₈] ²⁺ | Blue | |
| [Cr(H ₂ O) ₈] ³⁺ | Blue/Violet | |
| $[Mn(H_2O)_8]^{2+}$ | Very pale pink | |
| [Fe(H ₂ O) ₈] ²⁺ | Pale green | |
| [Fe(H ₂ O) ₆] ³⁺ | Yellow/brown | |
| [Co(H ₂ O) _e] ²⁺ | Pink | |
| [Ni(H ₂ O) ₈] ²⁺ | Green | |
| [Cu(H ₂ O) ₆] ²⁺ | Blue | |

Reactions

• Be on the lookout for the words concentrated, NH₃ with transition metals, and aluminum

Complexation Reactions

- a solution of Nickel (II) ions reacts with excess or *concentrated* ammonia
- Ni ²⁺ + 4NH₃ → [Ni(NH₃)₄] ²⁺
- Use twice the number of ligands as the charge

Another Reaction

- tetraamminecopper (II) sulfate is added to hydrochloric acid.
- $[Cu(NH_3)_4]^{2+}$ + H⁺ \rightarrow NH₄⁺ + Cu²⁺
- Balance
- $[Cu(NH_3)_4]^{2+} + 4H^+ \rightarrow 4NH_4^+ + Cu^{2+}$

On the test last year!!!

- Aqueous sodium hydroxide is added to a saturated solution of aluminum hydroxide, forming a complex ion
- AI(OH)₃ + 3 OH⁻ → [AI(OH)₆] ³⁻