CONCEPT: ANALYTE OXIDATION STATE

It is common for the analyte to exist in multiple oxidation states while in solution, but to do any quantitative analysis it must first be converted to one oxidation state.

- For example, iron can exist in two forms, _____ or _____ , and utilizes the oxidizing agent Ce^{4+}.

Auxiliary Reducing Agent

An *auxiliary reducing agent* represents an easily oxidized metal such as Zn, Ag, Sn, or Cd that is part of *prereduction*.

- It is present as either a solid, powder or column that reduces the analyte to one oxidation state.
- Once the analyte has obtained a single oxidation state the reducing agent is removed before the titration begins.

In the _____ *reductor* the reduction column is filled with a zinc amalgam, Zn(Hg). In the process the Zn metal reduces the analyte while it is oxidized:

$$Zn(Hg)\,(s) \rightarrow Zn^{2+}\,(aq) + 2\,e^- + Hg\,(l)$$

In the _____ *reductor* the reduction column is filled with granules of solid silver metal, while the analyte solution is infused with HCl.

$$Ag\,(s) + Cl^-\,(aq) \rightarrow AgCl\,(s) + e^-$$

Auxiliary Oxidizing Agent

An *auxiliary oxidizing agent* will oxidize the analyte and in the process be reduced as part of the preoxidation stage. Peroxydisulfate represents a powerful oxidizing agent that works in conjunction with a silver catalyst:

$$S_2O_8^{2-}\,(aq) + Ag^+\,(aq) + 2e^- \rightarrow SO_4^{2-}\,(aq) + SO_4^-\,(aq) + Ag^+\,(aq)$$

- The oxidizing agent mixture can oxidize _____ to _____, _____ to _____, _____ to _____ and _____ to _____.

Hydrogen peroxide represents another powerful oxidizing agent that works in acidic or basic solutions.

$$H_2O_2\,(aq) + 2H^+\,(aq) + e^- \rightarrow 2H_2O\,(l)$$

- In basic solutions it oxidizes _____ to _____, _____ to _____and _____ to _____.
- In acidic solutions it reduces _____ to _____ and _____ to _____.

Other commonly used oxidizing agents include silver (II) oxide, AgO, and sodium bismuthate, $NaBiO_3$.

PRACTICE: ANALYTE OXIDATION STATE CALCULATIONS 1

EXAMPLE: Answer each of the following questions based on the following half reactions:

HALF REACTIONS			**E^o (V)**
Cl_2 (g) + 2 e$^-$	⟶	2 Cl^- (aq)	+ 1.36
I_2 (g) + 2 e$^-$	⟶	2 I^- (aq)	+ 0.535
Pb^{2+} (aq) + 2 e$^-$	⟶	Pb (s)	- 0.126
V^{2+} (aq) + 2 e$^-$	⟶	V (s)	- 1.18

a) Which is the strongest oxidizing agent?

b) Which is the strongest reducing agent?

c) Will I^- (aq) reduce Cl_2 (g) to Cl^- (g)?