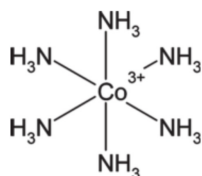


Complexation Reactions

Review terms: ligands, coordination numbers

Metals ions which often form complexes:

1. Fe^{3+}
2. silver
3. zinc hydroxide
4. aluminum hydroxide
5. copper(II)



Page 2

Complexes with Iron(III)

Case study:

Reactants: iron(III) chloride with ammonium thiocyanate

How do we know it's not a double replacement reaction?

How do I actually write the reaction? What does it look like?

Page 3

Silver ions / Zinc hydroxide / Aluminum hydroxide

special note about
coordination
numbers for Al

Page 4

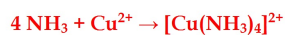
copper(II) solutions and concentration

Page 5

Summary of Complexation reactions

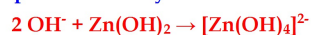
1. complexation of a soluble salt

e.g. a concentrated solution of ammonia is added to a solution of copper(II) chloride



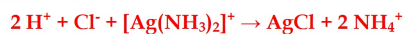
2. complexation of an insoluble salt

e.g. excess concentrated potassium hydroxide solution is added to a precipitate of zinc hydroxide



3. destruction of a complex by acid/base neutralization

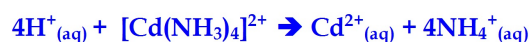
e.g. dilute hydrochloric acid is added to a solution of diamminesilver nitrate



Page 6

Example #1

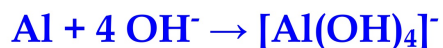
excess dilute nitric acid is added to a solution of tetramminecadmium(II) ion



Page 7

Example #2

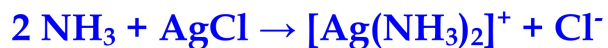
pellets of aluminum metal are added to a solution containing an excess of sodium hydroxide



Page 8

Practice #1

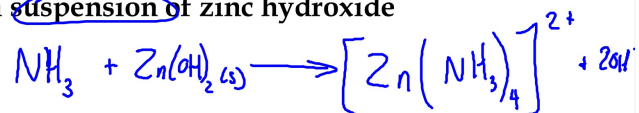
an excess of ammonia gas is bubbled through a solution saturated with silver chloride



Page 9

Warm-Up

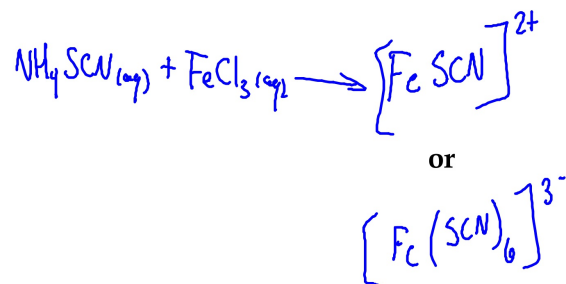
a concentrated solution of ammonia is added to a suspension of zinc hydroxide



Page 10

Practice #2

a solution of ammonium thiocyanate is added to a solution of iron(III) chloride



Page 11

Group Practice

AP Reaction Predictions Problem Set

Use years 1968, 1969, & 1970. Special notes:

There are 3 complexation reactions. Find them!

There are 3 you can't do just yet:

1. 1968-C
2. 1969-E
3. 1970-G


Page 12

Introduction to Redox Terms

REDOX: tandem reactions of **oxidation** and **reduction**.

reduction (OA)
oxidation (RA)

OILRIG

OXIDATION <ul style="list-style-type: none">• One reactant loses electrons.• Reducing agent is oxidized.• Oxidation number increases.	Zinc loses electrons. Zinc is the reducing agent and becomes oxidized . The oxidation number of Zn increases from 0 to +2.	
REDUCTION <ul style="list-style-type: none">• Other reactant gains electrons.• Oxidizing agent is reduced.• Oxidation number decreases.	Hydrogen ion gains electrons. Hydrogen ion is the oxidizing agent and becomes reduced . The oxidation number of H decreases from +1 to 0.	

(OA/RA, OILRIG, show reactions)

Page 13

Colors of Transition Metal ions in solution

Sc	Ti	V ²⁺	Cr ²⁺	Mn ²⁺	Fe ²⁺	Co ²⁺	Ni ²⁺	Cu ¹⁺	Zn
		V ³⁺	Cr ³⁺	Mn ³⁺	Fe ³⁺	Co ³⁺	Ni ³⁺	Cu ²⁺	
		V ⁴⁺	Cr ⁶⁺	Mn ⁷⁺					

Aqueous transition metal salts are colored due to movement of "d" shell electrons

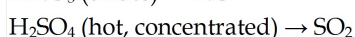
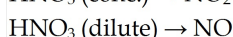
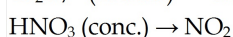
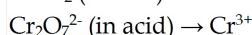
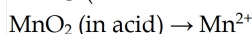
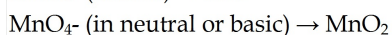
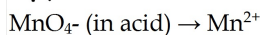
Element	Ionic Form	Color
V	+2	Violet
	+3	Blue-green
	+4	Blue
	+5	Yellow
Cr	+2	Yellow
	+3	Pale green
	+6	Orange
Mn	+2	Red-pink
	+4	Dark brown
	+7	Purple
Fe	+2	Brown-black
	+3	Pale yellow
Co	+2	Dark blue
	+3	Brown
Ni	+2	Emerald green
	+3	Turquoise
Cu	+1	Light green
	+2	Deep blue

Page 14

Oxidizers

[oxidizers will become reduced]

+7



[if not hot and conc., this acts like HCl or other normal acids]

metal cations → lower charge cations or (rarely) free metals

free halogens → halide ions

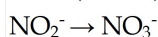
Page 15

Reducers

[reducers will become oxidized]

halide ions → free halogens

free metals → metal cations



free halogens (dil. basic) → hypohalite ions [like XO⁻]

free halogens (conc. basic) → halate ions [like XO₃⁻]

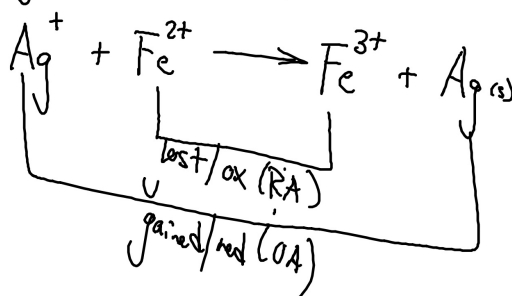
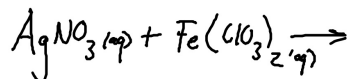
metal cations → higher charge cations

Page 16

How to spot REDOX reactions

OILRIG

aqueous solutions of silver nitrate and ferrous chlorate are mixed



Page 17

Example #1

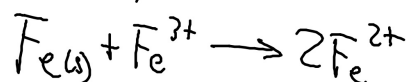
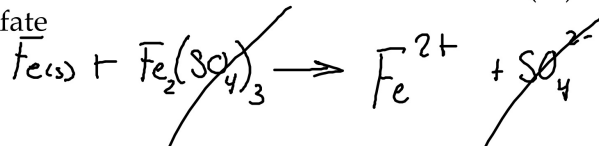
solutions of tin(II) chloride and iron(III) chloride are mixed



Page 18

Example #2

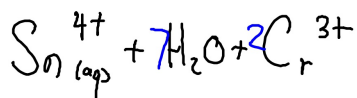
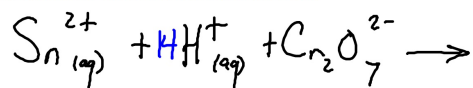
powdered iron is added to a solution of iron(III) sulfate



Page 19

Example #3

a solution containing tin(II) ions is added to acidified potassium dichromate solution



Page 20

Example #4

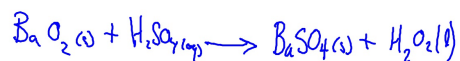
What about this hot and concentrated business?

" H_2SO_4 (hot, concentrated) \rightarrow SO_2 "

[if not hot and conc., this acts like HCl or other normal acids]"

Example from 1970 AP test -- "B":

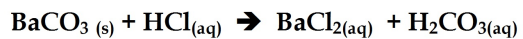
solid barium peroxide is added to **cold dilute** sulfuric acid
(or hot and concentrated)



Page 21

A final word about writing the "best" products

solid barium carbonate is added to a 2M solution of hydrochloric acid



carbonic acid is nothing more than aqueous carbon dioxide. Therefore the carbonic acid decomposes to water and carbon dioxide in aqueous solution.

Better choice:



Practice Problems

Work on these problems and we will discuss in about 15 mins
1968-C, 1969-E, and 1970-G