Acid/Base/Spectator Primer

I. Acid:

Substance that produces H_3O^+ ion in water (Arrhenius Definition)
Species that donates a H^+ (Bronstead-Lowery Definition)
* Look for: anion that is bonded to H

(a) Strong Acid (SA)

(dissociates 100% to H_3O^+ and A^-, strong electrolyte)

Major Species in solution: H_3O^+ and A^-

Look for:
HCl, HBr, HI,
HNO_3, $HClO_4$, $HClO_3$, H_2SO_4*

(b) Weak Acid (WA)

(dissociates <100%, weak electrolytes)

Major Species in solution: HA
(only small amounts of H_3O^+ and A^-)

Look for:
Any acid that is **not strong**!
Ammonium Ion, NH_4^+

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II. Base

Substance that produces OH^- ion in water (Arrhenius Definition)
Species that accepts a H^+ (Bronstead-Lowery Definition)
* Look for anion that is not a spectator

(a) Strong Bases (SB)

(dissociate 100% into OH^-, strong electrolytes)

Major Species in solution: M^{n+} and OH^-

Look for:
Group I or II Hydroxides (soluble hydroxides)
LiOH, NaOH, KOH, RbOH, CsOH
$Ca(OH)_2$, $Sr(OH)_2$, $Ba(OH)_2$

(b) Weak Bases (WB)

(dissociate <100%, weak electrolytes)

Major species in solution: A^- or molecule

Look for:
Any anion that is **not spectator**
Ammonia, NH_3

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II. Spectator Species (SI)

Substance that is neither acidic or basic (neutral)
Will NOT react with acids or bases

* Look for ion/molecule that is not acidic or basic

(a) Spectator Cations (SI)

Look for:
Group I or II metal ions:
Li^+, Na^+, K^+, Rb^+, Cs^+
Ca^{2+}, Sr^{2+}, Ba^{2+}

(b) Spectator Anions (SI)

Look for:
Anion of Strong Acid
Cl^-, Br^-, I^-
NO_3^-, ClO_4^-, ClO_3^-

Questions to Ask to Determine SA/WA/SB/WB/SI

First **write out** Major Species
(break ionic compounds into ions, leave molecules as molecules)

1. Does it "contain H bond to an anion"? then **ACID**

   (a) **Strong Acid** (see list)

   (b) **Weak Acid** (not on SA list)

2. Does it have a **Negative Charge (anion)**? then

   (a) **Spectator Ion** (see list)

   (b) **Weak Base** (not on spectator list)

3. Does it have a **Positive Charge (cation)**? then

   (a) **Spectator Ion** (group I or II)

   (b) **Weak Acid** (NH_4^+ or other metal ion)

4. Is it NH_3 (Nitrogen with 3-bonds)? **Weak Base**

Order of acid/base strength
place compounds into 5 categories

(most Acidic) SA, WA, SI's Only, WB, SB (most Basic)

All SA have same strength (sulfuric slightly more acidic)
WA will have different strengths within the category
SI's only will have same strength
WB will have different strength within the category
SB Group II hydroxide more basic than Group I