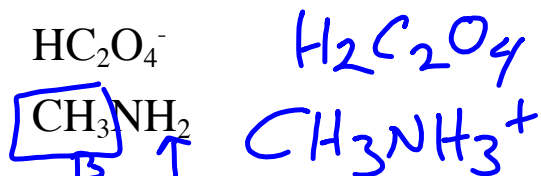
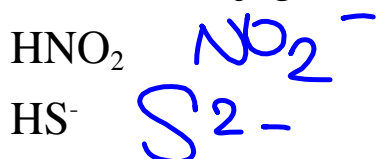


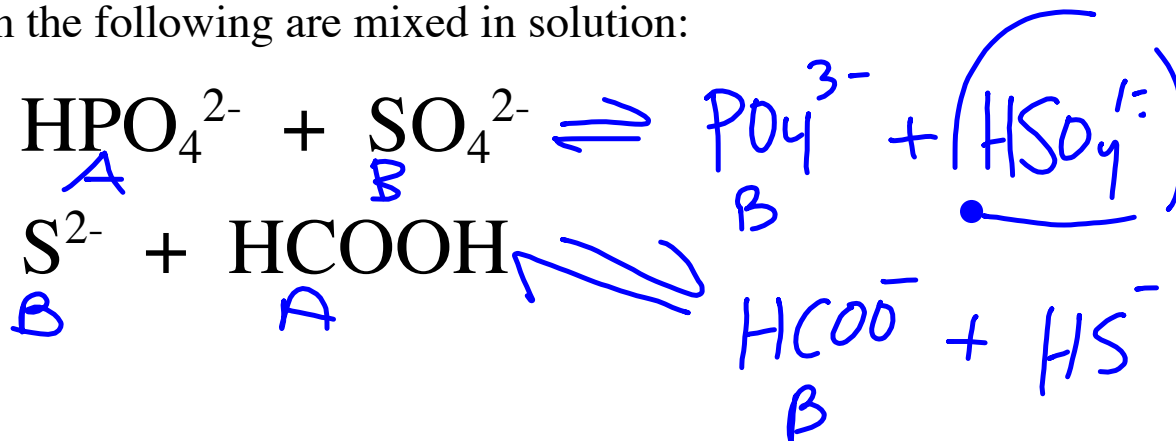
1. Write the conjugate acid of the following:



2. Write the conjugate base of the following:



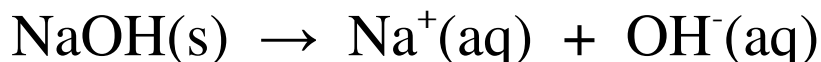
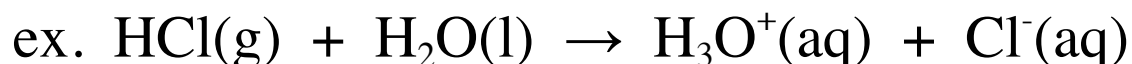
3. Write the Brønsted-Lowry acid-base equilibria which occur when the following are mixed in solution:



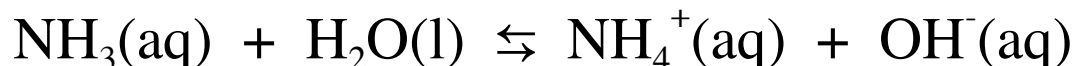
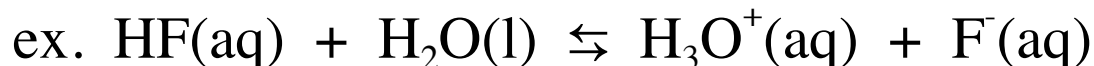
Strengths of Acids and Bases

The relative strength of an acid or a base depends on how well it ionizes in water to produce ions.

- **STRONG** acids and bases ionize completely (100% ionized)



- **WEAK** acids and bases do not ionize completely (< 100% ionized)
- Weak acids are better represented by an equilibrium system where the conjugate acid and base pairs both exist



the terms strong or weak refer to the degree of ionization of the acid or base NOT the molar concentration

0.0010 M HCl is a **STRONG** acid
6.0 M HF is a **WEAK** acid

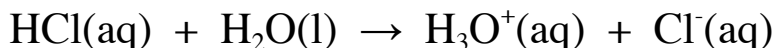
Refer to the Data Booklet "Relative Strengths of Acids and Bases" table.

a) STRONG ACIDS

- the strong acids are the **top six acids** on the **left side** of the table



- all six reactions have **one-way reaction** arrows pointing to the right. This means that aqueous molecules of the acid do not exist and the **conjugate bases cannot accept a proton from water.**

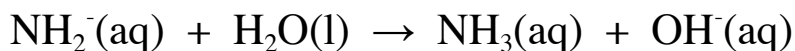
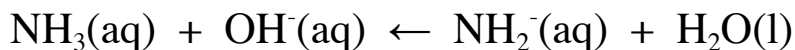


b) STRONG BASES

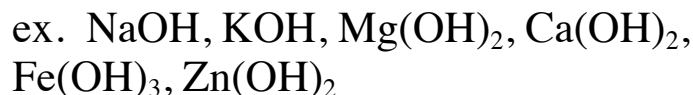
- the strong bases are the **bottom two bases** listed on the **right side** of the table



- once again, these two reactions have one-way reaction arrows pointing to the left. This means that aqueous molecules of the base do not exist and the **conjugate acids cannot donate a proton from water.**

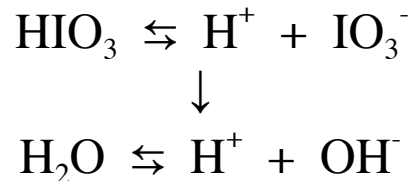


- in addition to these two strong bases, **soluble metal hydroxides are also strong bases**



c) WEAK ACIDS

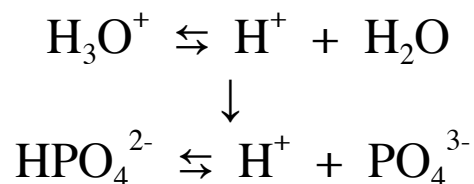
- the weak acids are the species on the **left side of the table** from HIO_3 down to H_2O
- aqueous molecules of the conjugate acid and base coexist in solution



- the last two species on the left, O^{2-} and NH_2^- , can not act as acid in aqueous solutions

d) WEAK BASES

- the weak bases are the species on the **right side of the table** from H_2O down to PO_4^{3-}
- aqueous molecules of the conjugate base and acid coexist in solution



- the top six species on the right, HSO_4^- , NO_3^- , Cl^- , Br^- , I^- , ClO_4^- , can not act as bases in aqueous solutions

LEVELLING EFFECT = all **strong acids** have **identical strengths** in water because they are **100% ionized in aqueous solutions**

Additional things to note . . .

1. Although all of the reactions are written as ionization equations, they are all occurring in aqueous solutions.
 - > When a substance acts as an acid, water accepts the proton to become H_3O^+ , so **all acid solutions will produce H_3O^+** .
 - > When a substance acts as a base, water donates the proton to become OH^- , so **all base solutions will produce OH^-** .
2. Since **strong acids and bases** ionize completely, they will have a **higher electrical conductivity** than weak acids and bases. This property can be used to distinguish between strong and weak acids and bases.
3. The six strong acids, HBr , HCl , HI , HNO_3 , HClO_4 and H_2SO_4 , can not exist as molecules in aqueous solutions because they ionize completely to produce H_3O^+ and an anion. Hence, **H_3O^+ is the strongest acid** that can exist in aqueous solutions.

In the same way, O^{2-} and NH_2^- , can not exist as molecules in aqueous solutions because they ionize completely to produce OH^- . Hence, **OH^- is the strongest base** that can exist in aqueous solutions.