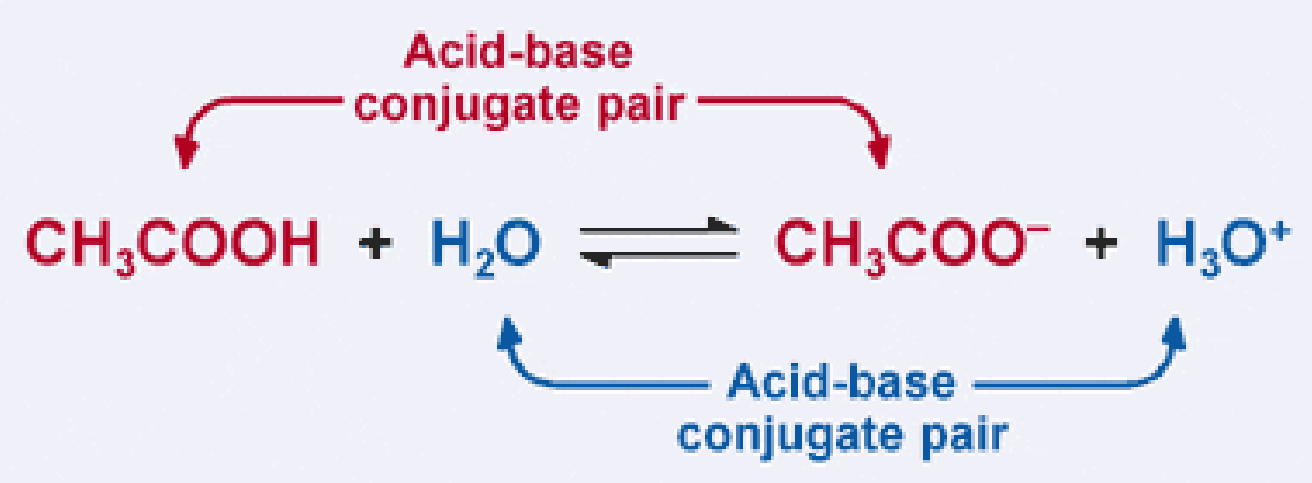
Determining Conjugate Pairs…



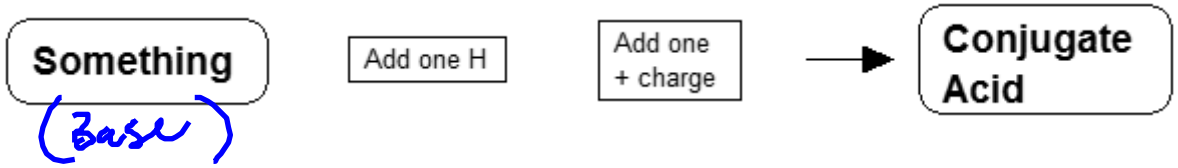
Outcomes:

- Write acid/base chemical equations. Include conjugate pairs, amphoteric behaviour.

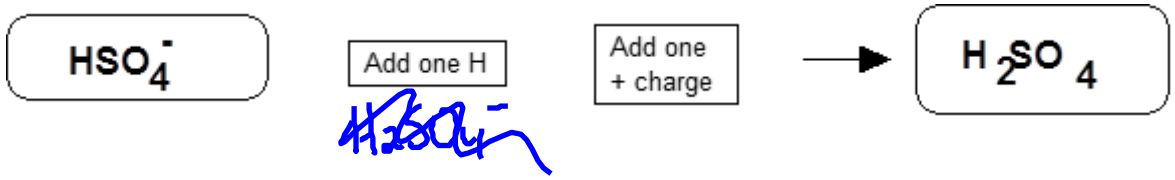
Determining Conjugate Pairs

One of the things you'll be required to do is, **given an <u>ION</u> or <u>MOLECULE</u>**, write the formula for its **<u>CONJUGATE</u> <u>ACID</u>** or **<u>BASE</u>**.

To find the **<u>CONJUGATE</u> <u>ACID</u>** of something:



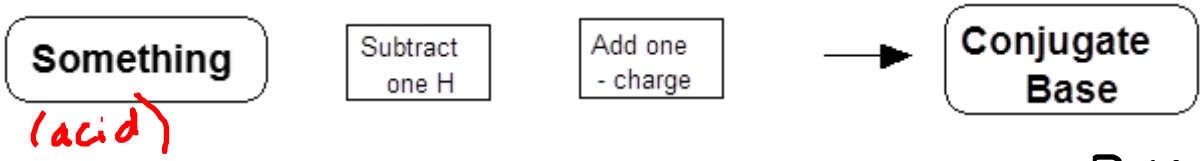
For example, let's say we want to find the conjugate acid of ***HSO_4^-***



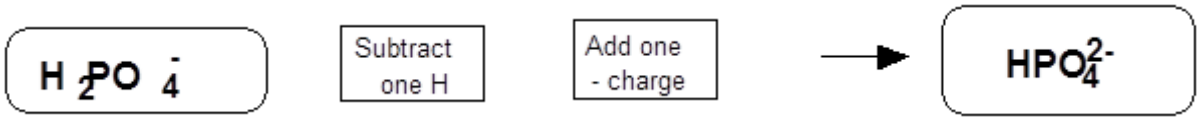
Remember, adding **<u>ONE (+) CHARGE</u>** to something that has a **<u>(-) CHARGE</u>**, brings the charge to "**<u>0</u>**".

Determining Conjugate Pairs

To find the **CONJUGATE BASE** of something:

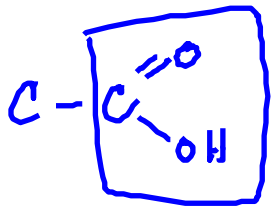


For example, let's say we want to find the conjugate ~~acid~~ base of $H_2PO_4^-$



Now, here's a few of these to try on your own....

Try these ones…



1. Find the ***conjugate acid*** of each of the following.

a) CH_3COO^- conjugate acid is CH_3COOH or $HC_2H_3O_2$

b) SO_4^{2-} conjugate acid is HSO_4^-

c) H_2O conjugate acid is H_3O^+

d) O^{2-} conjugate acid is OH^-

e) OH^- conjugate acid is H_2O

f) HPO_4^{2-} conjugate acid is $H_2PO_4^-$

g) $H_2PO_4^-$ conjugate acid is H_3PO_4

h) NH_3 conjugate acid is NH_4^+

Try these ones…

2. Find the ***conjugate base*** of each of the following.

a) HNO_3 conjugate base is NO_3^-

b) $H_2C_2O_4$ conjugate base is $HC_2O_4^-$

c) H_2SO_3 conjugate base is HSO_3^-

d) HNO_2 conjugate base is NO_2^-

e) $HClO_3$ conjugate base is ClO_3^-

f) H_2O conjugate base is OH^-

g) OH^- conjugate base is O^{2-}

h) NH_4^+ conjugate base is NH_3

Acid & Base Reactions:

Neutralization Reactions:

- A **DOUBLE DISPLACEMENT** reaction of an **ACID** and a **BASE** to produce a **SALT** and **WATER**.
- Acids and bases are **OPPOSITES**. Acids contain **H+** ions, bases contain **OH-** ions, and when they are in **EQUAL PROPORTION**, they combine to form **H_2O** (**NEUTRAL**).
- Therefore, if: **$mol_{acid} = mol_{base}$** , we get **pH=7** (**NEUTRAL**).
- The resulting solution still **CONDUCTS ELECTRICITY**.

Example: $NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$

Base **Acid** **Salt** **Water**

Acid & Base Reactions:

These reactions will occur in a series of steps :

Step 1: $NaOH_{(aq)} + HCl_{(aq)} \rightarrow Na^{+}_{(aq)} + Cl^{-}_{(aq)} + H^{+}_{(aq)} + OH^{-}_{(aq)}$

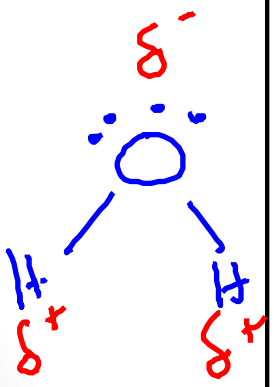
Step 2: $H^{+}_{(aq)} + OH^{-}_{(aq)} \rightarrow H_2O_{(l)}$

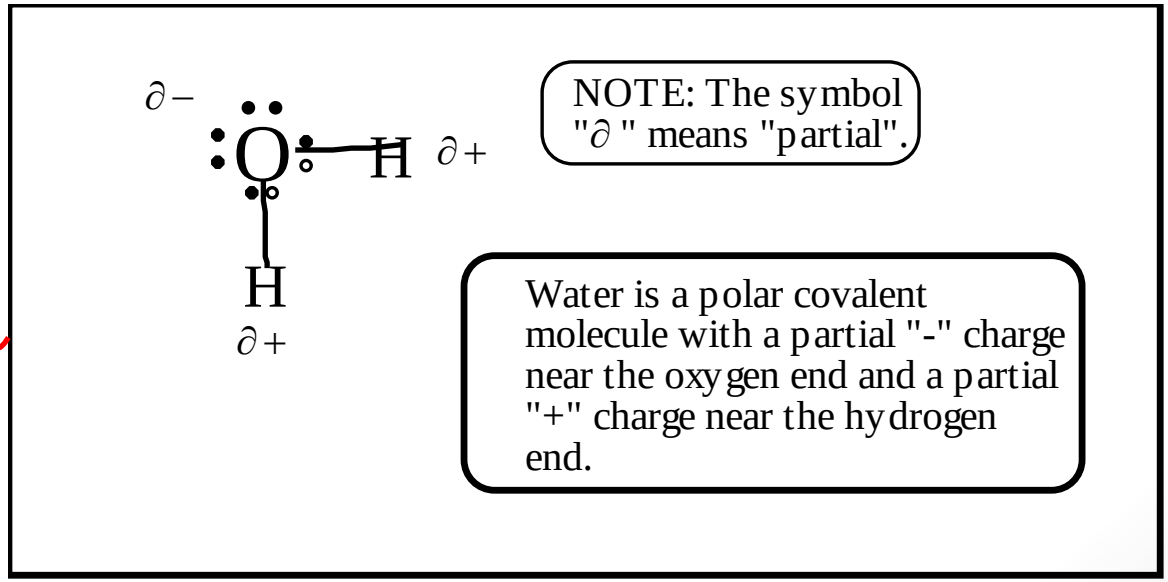
Net: $NaOH_{(aq)} + HCl_{(aq)} \rightarrow Na^{+}_{(aq)} + Cl^{-}_{(aq)} + H_2O_{(l)}$

Reactions of Acids With Water:

In Science 20F, we learned that acids produce **H^+** ions in **WATER**, but this is not **ENTIRELY** true…

- An acid **DOES** produce **H^+** ions in water, but they do not float around on their **OWN**.
- Since **H^+** is simply a **PROTON**, it has a very **STRONG POSITIVE CHARGE**, and will attract to anything remotely **NEGATIVE**.
- **WATER** is a **POLAR** molecule, with a **PARTIAL NEGATIVE** charge on the oxygen.



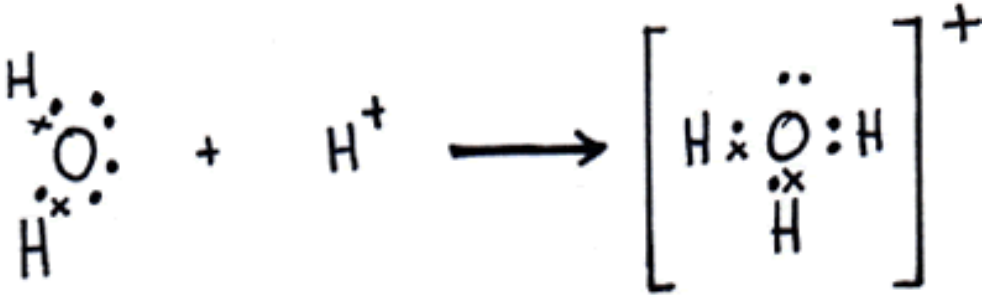


Reactions of Acids With Water:

Since acids will release H+ ions in water…

- The H^+ will attract to the open electron pairs on the oxygen, creating **H_3O^+**, called a **HYDRONIUM ION.**

i.e.)



Therefore,

All acid solutions contain hydronium (H3O+) ions. It is the hydronium ion which gives all acids their properties *(like sour taste, indicator colours, reactivity with metals etc.)*

$H_3O^+ = H^+_{(aq)}$

Reactions of Acids With Water:

Recall that earlier in the course, when HCl gas dissolved in water, we wrote:

$$HCl_{(g)} \rightarrow H^{+}_{(aq)} + Cl^{-}_{(aq)}$$

Now, we will write the following:

$$HCl_{(g)} + H2O_{(l)} \rightarrow H3O^{+}_{(aq)} + Cl^{-}_{(aq)}$$

The proton (H+) has been **TRANSFERRED** from the **HCl** molecule to a **WATER** molecule, to form a **HYDRONIUM** (**H3O+**) ion and a **Cl-** ion.

This type of reaction is called **IONIZATION** (because ions are being formed)

Reactions of Bases With Water:

- Bases will produce **OH$^-$** ions in water.
- They can do this by either **DISSOCIATING**, or "**ACCEPTING**" a **PROTON** from a **WATER** molecule.

Ex) $NaOH + \cancel{H_2O} \rightarrow Na^+_{(aq)} + OH^-_{(aq)}$

$NH_3 + H_2O \rightarrow NH^+_{4(aq)} + OH^-_{(aq)}$