Chem 103 – lecture 3b addendum

Admin: PS158 8-8:50am

Continuation:
1 Lewis Acids and bases
2 you read up on antacids – that's your homework:
recitation will be on Wednesday.
3. start on buffers (Chapt 17)

Lecture:
1) Lewis acids and bases:
lewis acid = electron acceptor, to form bond
lewis base = electron donor, to form bond

lewis acid = has an empty e orbital
lewis base = has a pair of e's unshared

A + :B → A:B the A-B bond is a **coordinate covalent bond**. A is the acid, B is the base.

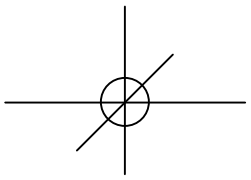
e.g. F_3B + :NCl_3 → F_3B-NCl_3
(which is the **Lewis acid** ? the **Lewis base**?)

All metal cations are potentially Lewis acids
(+ charge, empty orbitals)

Metal ions combine with ligands, (lewis bases), to form complex ions.

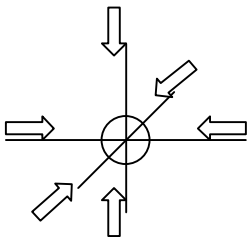
e.g. Cu^{2+} + 6 H_2O → $Cu(H_2O)_6^{2+}$
(light blue)

or Cu^{2+} + 6 NH_3 → $Cu(NH_3)_6^{2+}$
(dark blue)



sp^3d^2 hybrid orbitals are empty
(recall it's *octahedral* geometry)

sp^3d^2 is common but not the only one.
For this, there are 6 coordination sites.



There are many kinds of ligands possible. Some can form

Another ligand: oxalate: $C_2O_4^{2-}$ (contains 2 carboxylates)

Each oxalate ion can provide 2 coordination covalent bonds.
Complex becomes: Metal $(C_2O_4)_3$

When complexes form in solution, often the complex is also soluble, often it is also charged.

It turns out that the metal complexes can act as acids:
Even after they form the complex many of them still act as acids by releasing protons.

$Cu(H_2O)_6^{2+}$ === $Cu(H_2O)_5(OH)^+ + H^+$

Hydroxides are often the ligands

Can form **metal hydroxides**:

Metal hydroxides themselves can be **amphoteric**: act as acids or as bases:

For example:

$Al(OH)_3 + 3\ H^+ \rightarrow Al^{3+} + 3\ H_2O$

Or the same hydroxide can act differently:

$Al(OH)_3 + OH^- \rightarrow Al(OH)_4^-$

A Lewis base

OK Reading assignment: (graded recitation on Wednesday). On Lewis acids, applications 16.10. I'll ask questions at 430 pm. If called you will need to stand up from your seat**.**

OK next:

Chapter 17: additional aqueous equilibria
17.1 buffer solutions:
(1) what is a *buffer*?
A **buffer** is a solution consisting of:
(a) **weak acid** (b) **its conjugate base**.

Are the solutions containing the following solutes buffers?

a) NH_3 and NH_4^+

b) NH_4^+ and HCO_2H ?

c) $NaCO_2H$ and HCO_2H ?

(2) What does it do?
It *resists* pH change upon addition of strong acid or base. It maintains a *relatively constant* pH.

If have a buffer consisting of NaA and HA what is the equilibrium equation?

K_a equilibrium is most convenient to write:

$$HA \text{ ====== } A^- + H^+ \quad , \; K_a = \frac{[H^+][A^-]}{[HA]}$$