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ADVANCED CHEMISTRY

INORGANIC CHEMISTRY - SPRING - WEEK 1

Chapter 6

one answer is sufficient for all problems.

1. (a) $BF_3 + 2ClF \rightarrow [Cl_2F]^+ + [BF_4^-]$

   acid base — solvent system / Lewis

   (b) $HClO_4 + CH_3CN \rightarrow CH_3CNH^+ + ClO_4^-$

   Bronsted acid, Bronsted base — Lewis

   (c) $PCl_5 + ICl \rightarrow [PCl_4]^+ + [ICl_2]^-$

   base acid — solvent system / Lewis

   (d) $NOF + ClF_3 \rightarrow [NO]^+ + [ClF_4]^-$

   base acid — solvent system

   (e) $2\,ClO_3^- + SO_2 \rightarrow 2\,ClO_2 + SO_4^{2-}$

   base acid — Lewis

   (f) $Pt + XeF_4 \rightarrow PtF_4 + Xe$

   acid base — Lewis

   (g) $XeO_3 + OH^- \rightarrow [HXeO_4]^-$

   acid base — Lewis

   (h) $2HF + SbF_5 \rightarrow [H_2F]^+ + [SbF_6]^-$

   base acid — solvent system

(i) $2\,NOCl + Sn \rightarrow SnCl_2 + 2\,NO$ (in N_2O_4 solvent)

base acid Lewis

(j) $PtF_5 + ClF_3 \rightarrow [ClF_2]^+ + [PtF_6]^-$

acid base solvent system

(k) $(benzyl)_3N + CH_3COOH \rightarrow (benzyl)_3NH^+ + CH_3COO^-$

base acid Lewis and Bronsted

(l) $BH_4^- + 8\,OH^- \rightarrow B(OH)_4^- + 4\,H_2O$

~~acid~~ ~~base~~ ~~Bronsted~~

Is there a typo here?

(2) ~~AgF and SnF_4 are ionic compounds that will add F^- ions to BrF_3~~

~~$BrF_3 \rightleftharpoons BrF_2^+ + BrF_4^-$~~

(3) Because there is an increase in conductivity this means that adding AgF and SnF_4 must promote the formation of ions.

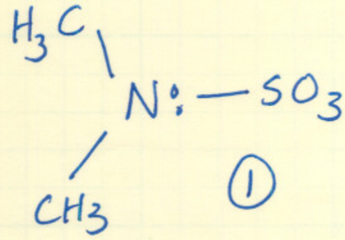
$BrF_3 + AgF \rightleftharpoons BrF_4^- + Ag^+$

$BrF_3 + SnF_4 \rightleftharpoons BrF_2^+ + SnF_5^-$

(6) $KF + IF_5 \rightleftharpoons K^+ + IF_6^-$

formation of these ions help conduct electricity.

(10)



(1)

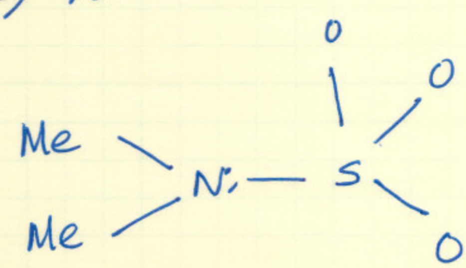
$H_3N:-SO_3$

(2)

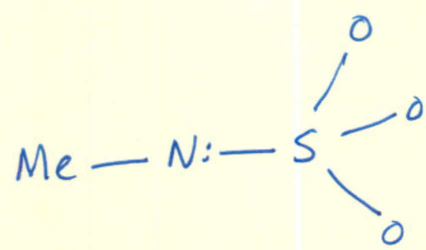
$(CH_3)_2N$ is a stronger base than NH_3 because of the electron donating ability of the CH_3 groups.

∴ N-S bond in (1) is stronger than that of (2)

⇒ N-S bond in (1) is shorter than that of (2)



(A)



(B)

The concentration of electrons on the N atom in (A) is greater than in (B) (because of the methyl groups in (A).

∴ Bond pair - bond pair repulsion is higher in (A) than (B), opening up the $N\hat{S}O$ bond ~~ang~~ angle in (A) d

(13) In the presence of NaF (Na^+ and F^-) the following reaction occurs

$$AlF_3 + F^- \rightarrow AlF_4^-$$

AlF_4^- then dissolves in HF.

When BF_3 is added, BF_3 has a stronger attraction for F^- than AlF_3.

$$BF_3 + F^- \rightarrow BF_4^-$$

$\therefore$ AlF_3 now precipitates.

(15) Zn, Cd, Hg ↓ as you go down the group, the cations become softer acids.

$\therefore$ Hg^+ prefers to bond with the softer bases (sulfide)

~~whereas the harder acids (Zn^{2+}, Cd^{2+}) will bond with the harder bases (oxide~~

Zn^{++} and Cd^{++} are borderline metal ions and will combine with softer and harder bases.

(23) (a) Te is more electronegative than Sn and Sb.

$\therefore$ The bond in TeH_2 is more polar compared with SnH_4 and SbH_3. $\therefore$ TeH_2 is more acidic.

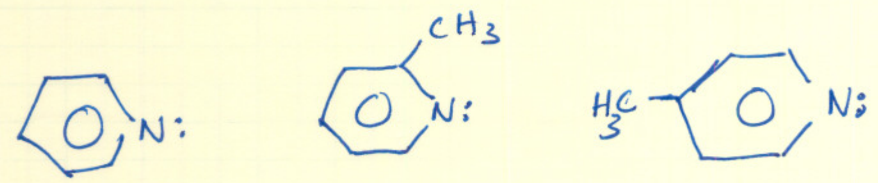
[illegible] electronegative

e

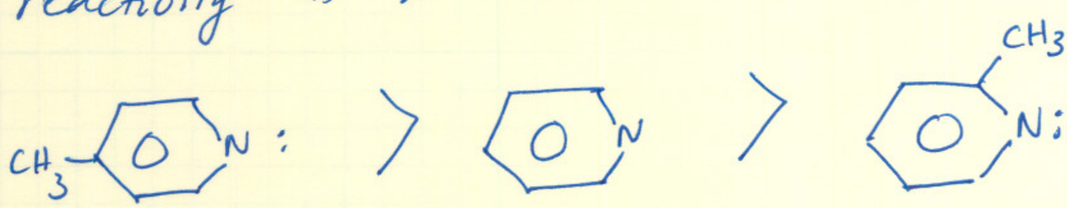
(c) $(CH_3)_3N$ is the stronger base

This is because the electron donating CH_3 groups make the N atom a rich electron center in $(CH_3)_3N$.

(d)



The methyl groups add electron density to the N atom. But due to steric hindrance when the CH_3 group is in the 2-position, the reactivity is less



(25) $CaH_2 + 2H_2O \rightarrow Ca^{2+} + 2OH^- + 2H_2(g)$ [CaH_2 is $Ca^{2+} + 2H^-$]

$HBr + H_2O \longrightarrow H_3O^+ + Br^-$
acid base

$H_2S + H_2O \rightleftharpoons HS^- + H_3O^+$
acid base

$CH_4 + H_2O \longrightarrow$ No reaction

(26) $BF_3 > B(CH_3)_3 > B(C_2H_5)_3 > B[C_6H_2(CH_3)_3]_3$

The methyl group are electron donating where as F attracts electrons away from B, making BF_3

f

the strongest Lewis acid (B is most electron deficient in BF_3).

The bulky groups in the last compound makes it difficult for NH_3 to approach it to form an acid-base adduct.

(27) (a) CH_3NH_2 because the CH_3 group is electron donating which makes the N atom rich in electrons (stronger base).

(b) pyridine (although 2-methyl pyridine is the stronger base, due to steric hindrance from trimethyl boron, pyridine becomes the stronger base)

(c) trimethyl boron Triphenyl boron is bulkier which makes it hard for NH_3 to approach to form the adduct.

(28) (a) $HMnO_4 > H_2SO_4 > H_2SO_3 > H_3AsO_4$

(b) $HClO_4 > HClO_3 > HClO_2 > HClO$