Week 8 Worksheet: Chapter 10 Acids and Bases

I. Identifying acid/base theories. For each molecule or ion in the table, identify whether it can act as an acid or a base and put a checkmark under each theory or theories that describe it.

Molecule/Ion	Acid or Base	Arrhenius	Bronsted-Lowry	Lewis
Br^-	base			x
CN^-	base			x
H_2CO_3	acid	x	x	
NH_3	base			x
HNO_2	acid	x	x	
$Ba(OH)_2$	base	x		
HCl	acid	x	x	
$AlCl_3$	acid			x
Cl^-	base			x
KOH	base	x		
IO_3^-	base			x
CH_3COOH	acid	x		
HNO_2	acid	x		

II. Conjugate Acids and Bases. In each reaction, identify the acid, base, conjugate acid, and conjugate base. Then, write which acid/base theory or theories describe the reaction.

(a) $NH_3 + H_2O \_ NH_4^+ + OH^-$
base acid conj. Acid conj.base

Theory: Bronsted

(b) $NH_4^+ + H_2O \_ NH_3 + H_3O^+$
acid base conj.base conj acid

Theory: Bronsted

(c) $2NaOH + H_2SO_4 \_ 2H_2O + Na_2SO_4$
base acid conj. Acid, base

Theory: Bronsted, Arrhenius

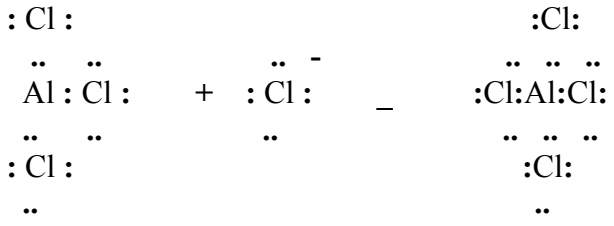
(d) $HSO_3^- + CN^- \_ HCN + SO_3^{2-}$
acid base conj. Acid conj. base

Theory: Bronsted

(e) $NH_2^- + H_2O \_ NH_3 + OH^-$
base acid conj. Acid conj. base

Theory: Bronsted

(f) Draw Lewis structures depicting the reaction
$AlCl_3 + Cl^- \_ AlCl_4^-$
and identify the acid/base theory that best describes the reaction.
Lewis acid/base theory

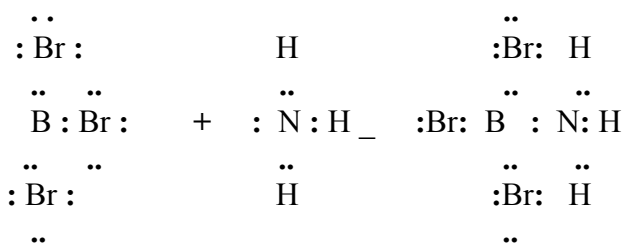


(g) Draw Lewis structures depicting the reaction

$BBr_3 + NH_3 \_ Br_3B\text{-}NH_3$

and identify the acid/base theory that best describes the reaction.

Lewis acid/base theory



III. Acid/Base Strength

(a) What property do all strong acids and strong bases have in common? Write a reaction for HCl and water to illustrate your explanation.

They dissociate completely in water

$HCl \_ H^+ + Cl^-$

(b) Circle the stronger acid in each pair:

NH_4^+	NH_3
H_2O	**H_3O^+**
HXO	**HXO_3** (X is an unknown element)

(c) Circle the weaker base in each pair:

NH_4^+	NH_3
Cl^-	F^-
NaOH	**NH_4OH**
NaOH	**$NaHCO_3$**

IV. Ternary Acids/Bases

Explain the order of increasing or decreasing acid strength and conjugate base strength for the following groups:

(a) H_2SO_3, H_2SO_4 **The more oxygens there are in an oxyacid, the more e^- density is pulled from**

(b) HNO_2, HNO_3 **the protons, making them more likely to leave the molecule.**