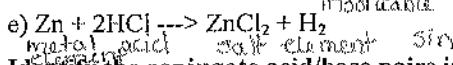
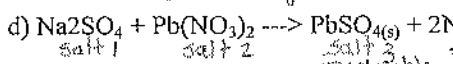
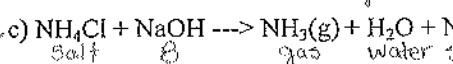
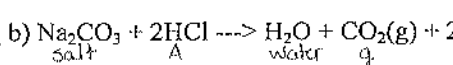
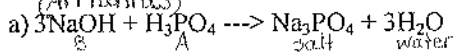
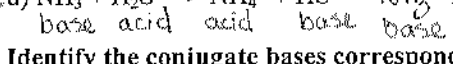
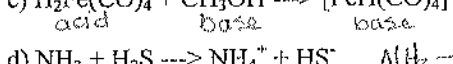
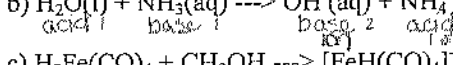
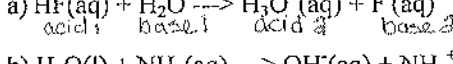


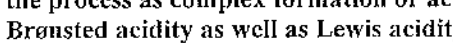
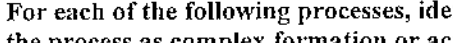
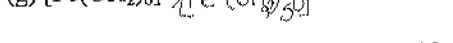
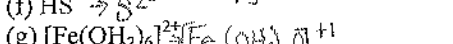
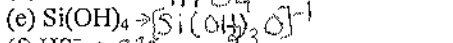
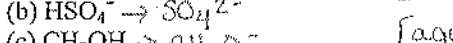
Figure out the driving force for following reactions. [formation of insoluble salt that pull out from the solution]



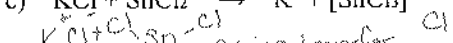
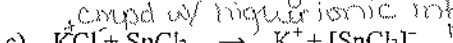
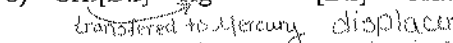
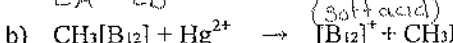
2. Identify the conjugate acid/base pairs in following reactions. [Bronsted/Lowery]



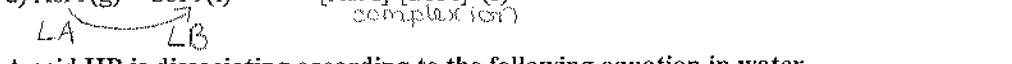
3. Identify the conjugate bases corresponding to the following acids:



4. For each of the following processes, identify the acids and bases involved and characterize the process as complex formation or acid-base displacement. Identify the species that exhibit Brønsted acidity as well as Lewis acidity.



5. A acid HB is dissociating according to the following equation in water.



A solution of HB was prepared by dissolving 1.00 mol of HB in 1 liter of water. After the equilibrium is established HB was found to be 20% dissociated. Calculate K_a and pK_a for the acid HB.

HB	+ H ₂ O	⇌	B ⁻	+ H ₃ O ⁺
I	1		0	0
C	-x		x	x
E	1-x		x	x

1 mole = 0.8
 20% = 0.2
 80% = left over

$K_a = \frac{(0.2)^2}{0.8} = 0.05$
 $pK_a = -\log K_a = -\log(0.05) = 1.30$

formation of H₂O or insoluble gas forms a liq.

weak base → strong acid combinator

electron happy or proton

relatable through proton a/b

acids → conj bases

removal of proton

electronic (24e⁻)

HSO₄⁻

formation of H₂O (water)

formation of gas (CO₂)

formation of gas (NH₃)

salt-salt precipitation (double displacement)

formation of insoluble salt (PbSO₄) (solid)

formation of redox E_{cell} = +

acid conj base base conj acid

H₂O → OH⁻ NH₃ → NH₄⁺

acid conj base base conj acid

H₂Fe(CO)₄ → [FeH(CO)₄]⁻

acid conj base

CH₃OH → CH₃OH₂⁺

base conj acid

[aqua acids - acid coming fr H₂O molecule]

CH₃-hard base, Hg²⁺-harder acid

Cl- & SnCl₂ (softer) bonds formation

complexation

no clear e⁻ donor/acceptor

calc pKa

14 - pH = pOH

X = √(K_aM)

drop x for weak acid

calc pKa

lower pKa = stronger acid
 Ka - larger stronger acid

6. Arrange the following compounds in order of increasing acidity:

HI (pKa = -11), H₂CO₃ (pKa = 6.37), H₂SO₃ (pKa = 1.81), HCN (pKa = 9.31)



7. Explain the trend shown by following binary acids in water:

	HF	HCl	HBr	HI
pKa	+3	-7	-9	-11
	NH ₃	H ₂ O	HF	
pKa	+33	+14	+3	

↓ pKa value HF weaker than HI
 bond energy in H-I (larger atom)
 bond dissociation

a large → lower pKa

HF
 HCl
 HBr
 HI
 ↑ increase
 ↓ down

8. Which acids of the following pairs of acids is the stronger acid?

a) [Fe(OH₂)₆]³⁺ / [Fe(OH₂)₆]²⁺ aqua acids (hexaqua Fe³⁺) (hexaqua Fe²⁺)
 Fe³⁺ stronger (go for charge)

b) Al(OH₂)₆³⁺ / Ga(OH₂)₆³⁺ aqua acids Al smaller than Ga

c) Si(OH)₄ / Ge(OH)₄ aqua acids EN of Al > EN Ga Si(OH)₄ more acidic

d) HClO₃ / HClO₄ oxy acids HClO₄ more acidic

e) H₂CrO₄ / HMnO₄ oxy acids HMnO₄ more acidic

f) H₃PO₄ / H₂SO₄ H₂SO₄ more acidic

g) H₂SO₄ / H₂SeO₄ H₂SO₄ more acidic

h) HIO₃ / HClO₄ Cl smaller higher electronegativity (pull of e⁻ in bond)
 HClO₄ - stronger acid

higher ON or charge more acidic

9. Which of the following elements form oxide polyanions and which forms oxide polycations?

Al, As, Cu, Mo, Si, B, Ti Al, Cu, Ti - cation As, Mo, Si, B - anion (also P)

Al(H₂O)₆³⁺ → Al-O-Al polyoxocations
 Al-O-Al polyoxoanions
 polyoxocations & polyoxoanions are chemical species containing more than one charged particle

poly cation - more than 1 c
 poly anion - more than 1 a

10. Identify the Lewis acids and bases in following reactions:

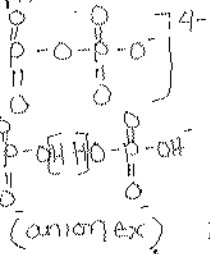
a) BrF₃ + F⁻ → BF₄⁻ Lewis A/B adduct K_f = [BF₄⁻] / [BrF₃][F⁻] higher means stronger

b) BF₃ + NH₃ → F₃B-NH₃ B - electron deficiency N - lone pair acceptor

c) FeCl₃ + Cl⁻ → FeCl₄⁻

d) I⁻ + I₂ → I₃⁻

e) (SnCl₂)₂ + (CO)₅MnCl → (CO)₅Mn-SnCl₂ + Cl⁻
 K_{f1} < K_{f2} soft → kicks out harder Cl



11. Explain why Na⁺ prefers F⁻ to I⁻ where as Cu⁺ prefers I⁻ to F⁻.

Na⁺ + F⁻ → NaF Cu⁺ ionic radius is larger than Na⁺ and I⁻ ionic radius is larger than F⁻. F⁻ is a harder base and I⁻ is a softer base. Na⁺ is a harder acid and Cu⁺ is a softer acid.

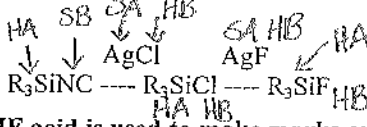
12. Consider the Lewis acids (CH₃)₃Al and (CH₃)₃Ga and the Lewis bases (CH₃)₃N, (CH₃)₃P, and (CH₃)₃As.

(CH₃)₃Al will react most favorably with (CH₃)₃N (hard acid)

(CH₃)₃Ga will react most favorably with (CH₃)₃P (soft acid)

larger ionic radius - softer
 smaller ionic radius - harder

13. Explain the reaction sequence given below in terms of hard and soft Lewis acid-base behavior:



hard - predom having e⁻ in outer shell
 borderline - intermediate
 soft - e⁻ in outer shell similar to Ni⁰, Pb⁰, Pt⁰

increase ionic radii on periodic table
 - accepts e⁻
 - donates e⁻

14. Explain why HF acid is used to make marks and dissolve glass.

because it breaks the Silicon bonds HF - hard acid - dissolve outer layer of bond formation

15. Which of the following metal expected to be found in aluminosilicate minerals and which in sulfides? Cd, Rb, Cr, Pb, Sr, Pd

aluminosilicate minerals = hard acids; sulfides = soft acids
 CuS + O₂ → SO₂ + Cu AuS - gold not reactive

Al + CuF → AlF + CuI
 K_f values higher

Cd, Pb, Pd - softer acids
 Rb, Cr, Sr - harder acids

NaF has a higher K_f value > K_f value of NaI
 stronger ionic bond formation
 K_f CuI larger > K_f CuF smaller
 density lower
 both are weak
 F = a² / r
 sm cation lg anion
 preferably NaF over NaI & CuI over CuF.