

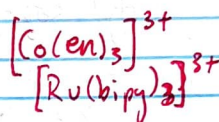
## Week 7 Discussion Worksheet Answers

1) Let's practice naming these compounds. Give the IUPAC name of the following complexes:

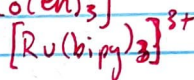
- a)  $[\text{Cr}(\text{OH}_2)_6]^{2+}$  Hexaqua chromium (III)  
 b)  $\text{K}[\text{FeCl}_4]$  Potassium tetrachloroferrate (III)  
 c)  $[\text{Ag}(\text{NH}_3)_2]^+$  Diammine silver (I)  
 d)  $[\text{Ni}(\text{CN})_4]^{2-}$  Tetra cyanonickelate (II)  
 e)  $\text{Ru}(\text{py})_4 \text{Cl}_2$  Tetrapyridine dichloro ruthenium (II)

For the following give the complex formula.

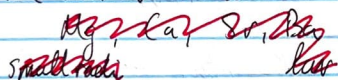
a) Tris (1,2-diaminoethane) cobalt (III)



b)  $\text{Tris} (2,2' \text{- bipyridyl})$  ruthenium (II)

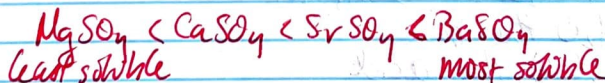


2) Predict the order of solubility in water of the following series, and explain the factors involved.



$\text{Mg} < \text{Ca} < \text{Sr} < \text{Ba}$  regarding radii

$\text{SO}_4^{2-}$  is hard base. Hard acids tend to be smaller. Hence we assume  $\text{Mg} > \text{Ca} > \text{Sr} > \text{Ba}$  is hardness relations, so  $\text{MgSO}_4 > \text{CaSO}_4 > \text{SrSO}_4 > \text{BaSO}_4$  order of solubility. Hence



3) Is  $\text{OH}^-$  or  $\text{S}^{2-}$  more likely to form insoluble salts with a 3+ transition metal ion? Which is more likely to form insoluble salts with a 2+ transition metal ion?

$\text{OH}^-$  is hard,  $\text{S}^{2-}$  soft.  $\text{OH}^-$  more likely to form insoluble salts with 3+ ion;  $\text{S}^{2-}$  more likely to form insoluble salts with 2+ ion.

4) Using HSAB characteristics, answer the following questions.

a) Will  $\text{Co}^{2+}$  react more strongly with  $\text{OH}^-$  or  $\text{NH}_3$ ? With  $\text{O}^{2-}$  or  $\text{S}^{2-}$ ?

$\text{Co}^{2+}$  closer to soft acid due to charge.  
 $\text{OH}^-$  harder than  $\text{NH}_3$

$O^{2-}$  harder than  $S^{2-}$   
 So  $Cu^{2+}$  reacts stronger to  $NH_3$  ;  $S^{2-}$

b) Will  $Fe^{3+}$  react more strongly to  $OH^-$  or  $NH_3$ ? with  $O^{2-}$  or  $S^{2-}$ ?  
 $Fe^{3+}$  harder  $\Rightarrow$  with  $OH^-$  ;  $O^{2-}$

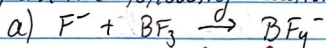
c) Will  $Ag^+$  react more strongly to  $NH_3$  or  $PH_3$ ?  
 $PH_3$  larger than  $NH_3 \Rightarrow$  softer.

$Ag^+$  soft acid. so  $Ag^+$  prefers  $PH_3$

d) Will  $Fe$ ,  $Fe^{2+}$ , or  $Fe^{3+}$  react more strongly to  $CO$ ?  
 $CO$  is soft, so we would expect

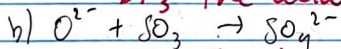
$Fe + CO$  to be the best.

5) In the following reactions identify the Lewis acid and the Lewis base.



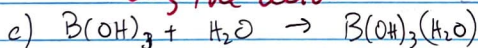
$F^-$  donates  $e^- \Rightarrow$  the base

$BF_3$  the acid



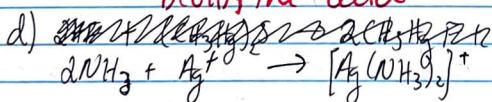
$O^{2-}$  the base

$SO_3$  the acid



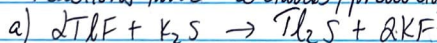
$H_2O$  the base

$B(OH)_3$  the acid



~~$NH_3$~~  the base,  $Ag^+$  the acid.

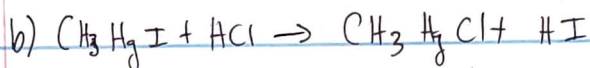
e) Using hard-soft acid/base chemistry, determine whether the following reactions favor reactants, products, or neither.



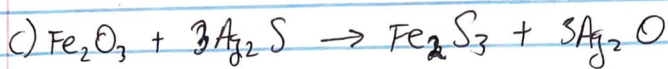
$K^+$  hard acid: prefers  $F^-$ , hard base.  $Tl^{2+}$  prefers  $S^{2-}$  since both soft.

so products favored.



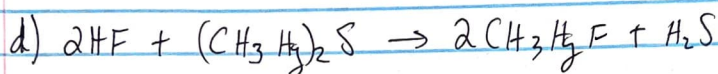


Hg soft so prefers  $\text{I}^-$  also soft.  
Reactants favored



$\text{As}^+$  soft acid prefers  $\text{S}^{2-}$  (softer than  $\text{O}^{2-}$ ).  
 $\text{Fe}^{3+}$  hard: prefers  $\text{O}^{2-}$

Reactants favored

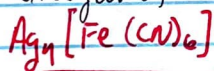


$\text{H}^+$  hard acid, prefers F, hard base.

Hg soft acid: prefers  $\text{S}^{2-}$ , soft.

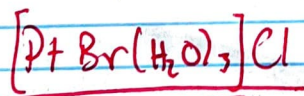
So reactants favored.

7) a) Silver hexacyanoferrate (II)



Iron is  $2+ \Rightarrow \boxed{d^6}$

b) Triaquachloroplatinum (II) chloride



Pt is  $2+ \Rightarrow \boxed{d^8}$

c)  $[\text{Ni}(\text{OH})_4(\text{OH}_2)]$  Tetraaquadihydroxonickel (II)

Ni is  $2+ \Rightarrow \boxed{d^8}$

d)  $[\text{Co}(\text{en})_2\text{Cl}_2]\text{NO}_3$  dichlorobis(ethylenediamine) cobalt (III) nitrate

Co is  $3+ \Rightarrow \boxed{d^6}$