Hennefarth

Week 7 Discussion Worksheet Answers

1) Lets practice naming these compounds. Give the IUPAC name of the following complexes:

a) $[Cr(OH_2)_6]^{2+}$ Hexaaquachromium (II)

b) $K[FeCl_4]$ Potassium tetrachloroferrate (III)

c) $[Ag(NH_3)_2]^{+}$ Diammine silver (I)

d) $[Ni(CN)_4]^{2-}$ Tetracyanonickelate (II)

e) $Ru(py)_4Cl_2$ Tetrapyridinedichloro ruthenium (II)

For the following give the complex formula.

a) Tris (1,2-diaminoethane) cobalt (III) $[Co(en)_3]^{3+}$

b) Tris (2,2'-bipyridal) ruthenium (II) $[Ru(bipy)_3]^{3+}$

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

~~Mg, Ca, Sr, Ba~~

~~small~~ ~~large~~

Mg < Ca < Sr < Ba regarding radii

SO_4^{2-} is hard base. Hard acids tend to be smaller. Hence we assume Mg > Ca > Sr > Ba is hardness relations, so $MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4$ order of stability. Hence

$MgSO_4 < CaSO_4 < SrSO_4 < BaSO_4$

least soluble most soluble

3) Is OH^- or 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?

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

4) Using HSAB characteristics, answer the following questions.

a) Will Cu^{2+} react more strongly with OH^- or NH_3? With O^{2-} or S^{2-}?

Cu^{2+} closer to soft acid due to charge.

OH^- harder than 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 ⇒ with OH^- ; O^{2-}

c) Will Ag^+ react more strongly to NH_3 or PH_3?
PH_3 larger than NH_3 ⇒ 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.
a) $F^- + BF_3 \rightarrow BF_4^-$
F^- donates e^- ⇒ the base
BF_3 the acid
b) $O^{2-} + SO_3 \rightarrow SO_4^{2-}$
O^{2-} the base
SO_3 the acid
c) $B(OH)_3 + H_2O \rightarrow B(OH)_3(H_2O)$
H_2O the base
$B(OH)_3$ the acid
d) ~~[illegible]~~
$2NH_3 + Ag^+ \rightarrow [Ag(NH_3)_2]^+$

NH_3 the base, Ag^+ the acid.

6) Using hard-soft acid/base chemistry, determine whether the following reactions favor reactants, products, or neither.
a) $2TlF + K_2S \rightarrow Tl_2S + 2KF$
K^+ hard acid: prefers F^-, hard base. Tl^{2+} prefers S^{2-} since both soft.

So **products** favored.

b) $CH_3Hg I + HCl \rightarrow CH_3Hg Cl + HI$

Hg soft so prefers I^- also soft.

Reactants favored

c) $Fe_2O_3 + 3Ag_2S \rightarrow Fe_2S_3 + 3Ag_2O$

Ag^+ soft acid prefers S^{2-} (softer than O^{2-}).

Fe^{3+} hard : prefers O^{2-}

Reactants favored

d) $2HF + (CH_3Hg)_2S \rightarrow 2CH_3HgF + H_2S$

H^+ hard acid, prefers F, hard base.

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

So reactants favored.

7) a) Silver hexacyanoferrate (II)

$Ag_4[Fe(CN)_6]$

Iron is 2+ $\Rightarrow$ d^6

b) Triaquabromoplatinum (II) chloride

$[PtBr(H_2O)_3]Cl$

Pt is 2+ $\Rightarrow$ d^8

c) $[Ni(OH)_4(OH_2)]$ Tetraaqua dihydroxonickel (II)

Ni is 2+ $\Rightarrow$ d^8

d) $[(Co(en)_2Cl_2]NO_3$ dichloro bis(ethylenediamine) cobalt III nitrate

Co is 3+ $\Rightarrow$ d^6