Chem 223-Exam 1 answers

Compound	Ksp	molar sol(s)	gram sol	[cation]	[anion]
barium permanganate					0.00040

$Ba(MnO_4)_2$ gfw=375 **s**=[anion]/2=.0002 **gs**=(0.0002)*375/10=.0075 **ksp**=$4s^3=3.2*10^{-11}$

Compound	Ksp	gram sol	molar sol(s)	[cation]	[anion]
iron(II) carbonate			$5.6*10^{-6}$		

$FeCO_3$ gfw=115 **[anion]**=s=$5.6*10^{-6}$ **gs**=($5.6*10^{-6}$)*115/10 = $6.5*10^{-5}$ **Ksp**=$s^2=3.1*10^{-11}$

2.a) HCO_2H + NH_3 => HCO_2^- + NH_4^+

b) HN_3 + $(C_2H_5)_2NH$ => N_3^- + $(C_2H_5)_2NH_2^+$

c) HNO_3 + CN^- => NO_3^- + HCN

3.Common ion effect: $Fe(OH)_2$ **Ksp**=$4.9*10^{-17}=[Fe^{2+}][OH^-]^2$ [OH-]=.001

s=$[Fe^{2+}]=(4.9*10\text{-}^{17})/(0.001)^2=4.9*10^{-11}$

4. $[H_2PO_4^-]=[H+]=5.3*10^{-3}$ $[HPO_4^{2-}]=K_2=6.2*10^{-8}$ $[PO_4^{3-}]=K_2*K_3/[H^+]=5.6*10^{-18}$

5. Possible ppt BaF_2: **Ksp**=$1.8*10^{-7}$ on mixing $[Ba^{2+}]$=.001 $[F^-]$=.0015

Qion=$[Ba^{2+}][F^-]^2= 2.2*10^{-9}$ Q_{ion}<Ksp **no ppt**

6. $C_2H_5NH_3^+$ + F^- <=> $C_2H_5NH_2$ + HF

Ka=$1.6*10^{-11}$ Kb=$2.8*10^{-11}$ Kb=$6.4*10^{-4}$ Ka=$3.5*10^{-4}$

K_{rxn}=($1.6*10^{-11}$)*($2.8*10^{-11}$)/Kw=$4.5*10^{-7}$ equil favors reagents (weaker pair)-student is incorrect

7. Moles [OH-]=.100M*.0234L=.00234 gew=mass/moles = .384/.00234=164g/equiv

8.a) **strong acid**: $[H^+]=[NO_3^-]$=.025M **%ion**=100 HNO_3=0 [OH-]=$4*10^{-13}$ pH=1.60 pOH=12.40

b) **neutral** ClO_4^- is the conjugate base of the strong acid $HClO_4$

c) **weak acid** Ka=$1.4*10^{-3}$ approx$(.015*.0014)^{1/2}$=.0046-**invalid** quadratic yields 0.0039M

$[H^+]=[CH_2ClCO_2\text{-}]$=.0039M $[CH_2ClCO_2H]$=0.015-.0039=0.011M %ion=(0.039/.015)*100=26% [OH-]$2.6*10^{-12}$ pH=2.40 pOH=11.60

d) **weak base** (conjugate of HCO_2H) Kb=Kw/Ka= $5.5*10^{-11}$

weak approx:$[OH^-]=(.1*5.5*10^{-11})^{½}=2.3*10^{-6}$ (valid)=$[HCO_2H]$ [H+]=$4.3*10^{-9}$ pH=8.36 pOH=5.64

%ion=0 (really small) $[HCO_2^-]$=0.100M

9.lots of options-the following will describe using benzoic acid

a) benzoic acid(pKa=4.19) $C_6H_5CO_2H$ and $C_6H_5CO_2^-$

b) 4.20=4.19+log[base]/[acid] => [base]/[acid]=1.023 [acid]=1.00 [base]=1.023

c) no change-buffers are not affected by dilution

d)moles $C_6H_5CO_2H$ initial= 0.075*1.00=0.075 moles $C_6H_5CO_2^-$ initial=.075*1.023=0.0767

moles of acid added =0.020*.3=0.006

new moles $C_6H_5CO_2H$ =0.075+0.006=0.081 $C_6H_5CO_2^-$ =0.0767-.006=0.071

pH=4.19+ log(0.071/0.081)=4.14

10. First calculate the $[CO_3^{2-}]$ to start ppt of each:

Ag_2CO_3: $[Ag^+]^2[CO_3^{2-}]=8.4*10^{-12}$ If $[Ag^+]$=.005 $[CO_3^{2-}]=8.4*10^{-12}/(0.005)^2= 3.4*10^{-7}$

$CuCO_3$: $[Cu^{+2}][CO_3^{2-}]=2.5*10^{-10}$ If $[Cu^{2+}]$=.005 $[CO_3^{2-}]=2.5*10^{-12}/(0.005)= 5.0*10^{-8}$

The copper carbonate ppts first at a $[CO_3^{2-}]= 5*10^{-8}$

11. Anions which form insoluble salts with the cations given

Ba^{2+}: CO_3^{2-}, CrO_4^{2-},F^-,OH^-,SO_4^{2-}

Ca^{2+}: CO_3^{2-},F^-,OH^-,PO_4^{3-}

Mn^{2+}:CO_3^{2-},OH^-

One strategy(there are several): CrO_4^{2-}(for Ba^{2+}), then F^-(for Ca^{2+}), then OH^-(for Mn^{2+})

12. % ionization increases with dilution. Adding a strong acid to a solution of a weak acid decreases % ionization

13. Any salt for which the anion is a base will have increased solubility as the pH decreases since the

added H+ will react with the base. Examples are any carbonates or fluorides. If the anion is acid/base neutral, it will not react with the H+ and its solubility will not change. Examples are ay of the chlorides, bromides or iodides.