

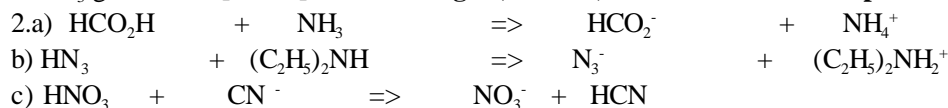
Chem 223-Exam 1 answers

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

$$\text{Ba}(\text{MnO}_4)_2 \quad \text{gfw}=375 \quad \text{s}=[\text{anion}]/2=.0002 \quad \text{gs}=(0.0002)*375/10=.0075 \quad \text{ksp}=4\text{s}^3=3.2*10^{-11}$$

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

$$\text{FeCO}_3 \quad \text{gfw}=115 \quad [\text{anion}]=\text{s}=5.6*10^{-6} \quad \text{gs}=(5.6*10^{-6})*115/10 = 6.5*10^{-5} \quad \text{Ksp}=\text{s}^2=3.1*10^{-11}$$



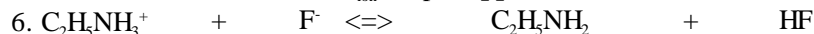
3. Common ion effect: $\text{Fe}(\text{OH})_2 \quad \text{Ksp}=4.9*10^{-17}=[\text{Fe}^{2+}][\text{OH}^-]^2 \quad [\text{OH}^-]=.001$

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

$$4. [\text{H}_2\text{PO}_4^-]=[\text{H}^+]=5.3*10^{-3} \quad [\text{HPO}_4^{2-}]=\text{K}_2=6.2*10^{-8} \quad [\text{PO}_4^{3-}]=\text{K}_2*\text{K}_3/[\text{H}^+]=5.6*10^{-18}$$

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

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



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

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

7. Moles $[\text{OH}^-]=.100\text{M}*.0234\text{L}=.00234$ gew=mass/moles = .384/.00234=164g/equiv

8.a) **strong acid**: $[\text{H}^+]=[\text{NO}_3^-]=.025\text{M} \quad \% \text{ion}=100 \quad \text{HNO}_3=0 \quad [\text{OH}^-]=4*10^{-13} \quad \text{pH}=1.60 \quad \text{pOH}=12.40$

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

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

$$[\text{H}^+]=[\text{CH}_2\text{ClCO}_2^-]=.0039\text{M} \quad [\text{CH}_2\text{ClCO}_2\text{H}]=0.015-.0039=0.011\text{M} \quad \% \text{ion}=(0.039/0.015)*100=26\% \quad [\text{OH}^-]=2.6*10^{-12} \quad \text{pH}=2.40 \quad \text{pOH}=11.60$$

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

$$\text{weak approx:} [\text{OH}^-]=(1*5.5*10^{-11})^{1/2}=2.3*10^{-6} \text{ (valid)}=[\text{HCO}_2\text{H}] \quad [\text{H}^+]=4.3*10^{-9} \quad \text{pH}=8.36 \quad \text{pOH}=5.64$$

$$\% \text{ion}=0 \text{ (really small)} \quad [\text{HCO}_2^-]=0.100\text{M}$$

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

a) benzoic acid ($\text{pKa}=4.19$) $\text{C}_6\text{H}_5\text{CO}_2\text{H}$ and $\text{C}_6\text{H}_5\text{CO}_2^-$

$$\text{b) } 4.20=4.19+\log[\text{base}]/[\text{acid}] \Rightarrow [\text{base}]/[\text{acid}]=1.023 \quad [\text{acid}]=1.00 \quad [\text{base}]=1.023$$

c) no change-buffers are not affected by dilution

$$\text{d) moles } \text{C}_6\text{H}_5\text{CO}_2\text{H} \text{ initial} = 0.075*1.00=0.075 \quad \text{moles } \text{C}_6\text{H}_5\text{CO}_2^- \text{ initial} = .075*1.023=0.0767$$

$$\text{moles of acid added} = 0.020*.3=0.006$$

$$\text{new moles } \text{C}_6\text{H}_5\text{CO}_2\text{H} = 0.075+0.006=0.081 \quad \text{C}_6\text{H}_5\text{CO}_2^- = 0.0767-.006=0.071$$

$$\text{pH}=4.19+\log(0.071/0.081)=4.14$$

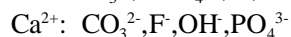
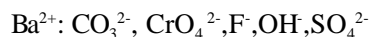
10. First calculate the $[\text{CO}_3^{2-}]$ to start ppt of each:

$$\text{Ag}_2\text{CO}_3: [\text{Ag}^+]^2[\text{CO}_3^{2-}] = 8.4*10^{-12} \quad \text{If } [\text{Ag}^+]=.005 \quad [\text{CO}_3^{2-}] = 8.4*10^{-12}/(0.005)^2 = 3.4*10^{-7}$$

$$\text{CuCO}_3: [\text{Cu}^{2+}][\text{CO}_3^{2-}] = 2.5*10^{-10} \quad \text{If } [\text{Cu}^{2+}]=.005 \quad [\text{CO}_3^{2-}] = 2.5*10^{-10}/(0.005) = 5.0*10^{-8}$$

The copper carbonate ppts first at a $[\text{CO}_3^{2-}] = 5*10^{-8}$

11. Anions which form insoluble salts with the cations given



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 any of the chlorides, bromides or iodides.