KEY STUDY CARD H

H1

1) SOLUBILITY IS THE TERM USED TO DESCRIBE HOW MUCH AN IONIC SOLID CAN DISSOLVE IN WATER (1 L) TO PRODUCE IONS (every ionic compound is different (nature of reactants = bond energy) AND WE HAVE "SOLUBLE" (>0.1M) AND "LOW SOLUBILITY" (<0.1M) COMPOUNDS. THE [ion] CAN BE USED IN A K_{eq} (called K_{sp}) expression to CALCULATE THE CONSTANT ASSOCIATED WITH THE EQUILIBRIUM POSITION. THE K_{sp} TELLS YOU THE [MINIMUM] NEEDED TO FORM A PRECIPITATE (ppt.).

2) $PbBr_{2(s)} \rightleftharpoons Pb^{+2} + 2Br^-$ $\quad K_{sp} = [Pb^{+2}][Br^-]^2 = 6.6\times10^{-6}$

$X : X : 2X$ $\rightarrow (x)(2x)^2 = 6.6\times10^{-6}$

(OR let $X = [Pb^{+2}]$)

$4x^3 = 6.6\times10^{-6}$

$x = \sqrt[3]{\frac{6.6\times10^{-6}}{4}}$

$x = 0.012M$

$2X = [Br^-] = 0.024M$

$X = [PbBr_2]_{\text{solubility}} = 0.012\frac{mol}{L} \times \frac{367.0\,g}{mol} = \frac{4.4\,g}{L}$

3) $CaCO_{3(s)} \rightleftharpoons Ca^{+2} + CO_3^{-2}$ $\quad K_{sp} = [Ca^{+2}][CO_3^{-2}] = 5.0\times10^{-9}$

$X : X : X$ $\rightarrow (x)(x) = 5.0\times10^{-9}$

(OR let X = solubility of $CaCO_{3(s)}$)

$x = \sqrt{5.0\times10^{-9}}$

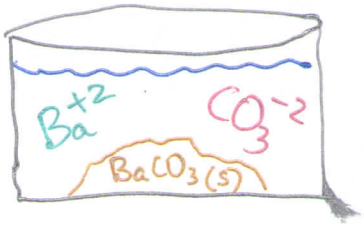
$x = 7.07\times10^{-5}M$

$\therefore x = [CaCO_3]_{\text{solubility}} = 7.07\times10^{-5}\frac{mol}{L} \times \frac{100.1\,g}{mol} \times 5.0L$

$= 0.035\,g\ CaCO_{3(s)}$ would dissolve in 5.0L

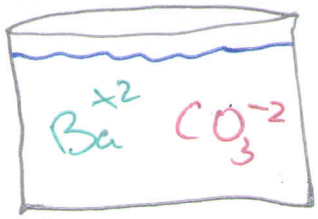
$\therefore$ LEFTOVER: $500.0\,g - 0.035\,g = 499.965\,g$ $\rightarrow$ 500.0 g LEFTOVER!

H2 1) a)



$Q > K_{sp}$

b)



$Q < K_{sp}$

2) F: $Fe(NO_3)_{2(aq)} + Sr(OH)_{2(aq)} \rightarrow Fe(OH)_{2(s)} + Sr(NO_3)_{2(aq)}$

* C.I.: $Fe^{+2} + 2NO_3^- + Sr^{+2} + 2OH^- \rightarrow Fe(OH)_{2(s)} + Sr^{+2} + 2NO_3^-$

$\Rightarrow Fe(OH)_{2(s)} \rightleftharpoons Fe^{+2} + 2OH^-$ $\quad K_{sp} = [Fe^{+2}][OH^-]^2 = 4.9\times10^{-17}$

$(Q = [Fe^{+2}][OH^-]^2)$

$Q = (1.33\times10^{-4})(6.67\times10^{-8})^2$

$= 5.9\times10^{-19}$

[DILUTION]:

$Fe(NO_3)_{2(aq)} \rightarrow Fe^{+2} + 2NO_3^-$ $\quad$ $Sr(OH)_{2(aq)} \rightarrow Sr^{+2} + 2OH^-$

1 : 1 $\quad$ 1 : 2

$[Fe^{+2}]_d = \frac{(2.0\times10^{-4}M)(100.0mL)}{150.0mL}$

$= 1.33\times10^{-4}M$

$[Sr(OH)_2]_d = \frac{(1.0\times10^{-7}M)(50.0mL)}{150.0mL}$

$= 3.33\times10^{-8}M$

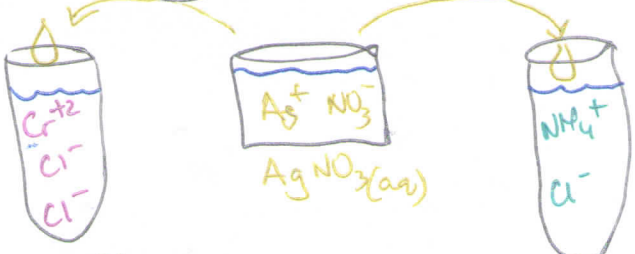
$[OH^-] = (2)(3.33\times10^{-8}M)$

$= 6.67\times10^{-8}M$

∴ since $Q < K_{sp}$ NO ppt forms.

* NOTE: Either the Complete Ionic OR each spontaneous

3) Test Tube (A) $\quad$ Test Tube (B)



0.20M $CrCl_{2(aq)}$ $\quad$ 0.50M $NH_4Cl_{(aq)}$

$CrCl_{2(aq)} \rightarrow Cr^{+2} + 2Cl^-$ $\quad$ $NH_4Cl_{(aq)} \rightarrow NH_4^+ + Cl^-$

1 : 2 $\quad$ 1 : 1

[0.20M] $\quad$ [0.40M] $\quad$ [0.50M] $\quad$ [0.50M]

∴ A ppt, $AgCl_{(s)}$, will form in TEST TUBE B first ∵ of the HIGHER $[Cl^-]$.

* Alternate Calculation:

$K_{sp} = [Ag^+][Cl^-] = 1.8\times10^{-1}$

(A) $(x)(0.40) = 1.8\times10^{-10}$

$x = [Ag^+] = 4.5\times10^{-10}M$

(B) $(x)(0.50) = 1.8\times10$

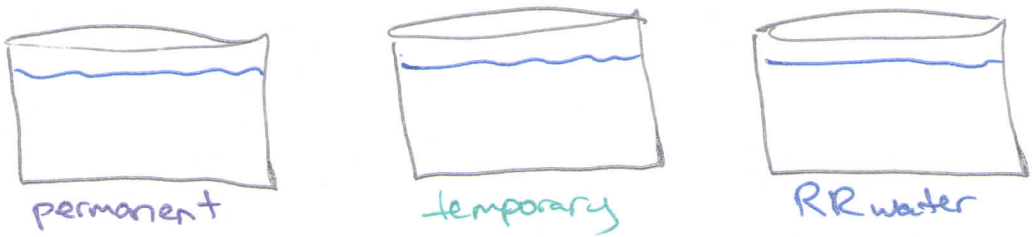
$x = [Ag^+]$

$= 3.6\times10^{-10}M$

H3 1) - Bitter taste
- leaves deposits (if heated / or water is evaporated)
↳ (ppt!)
- inhibits cleaning action of soaps

2)

* Initially, all 3 beakers "LOOK" the SAME!

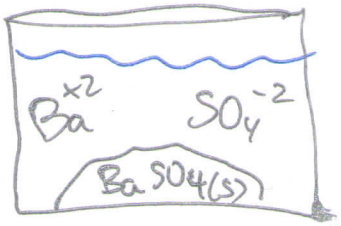


Procedure: (1st) Heat all 3 beakers → whichever forms a ppt will be TEMPORARY hard water.

(2nd) Add (ex. washing soda) $Na_2CO_{3(aq)}$, whichever of the remaining two beakers form a ppt is PERMANENT hard water.

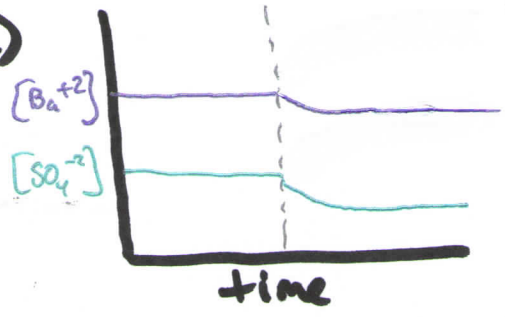
H4 1) $AX_{(s)} \rightleftharpoons A^+ + X^-$ (i) HEAT the solution
(ii) Form a ppt. with an ION using a SOLUBLE COMPOUND.

2)



(EXJ) + $BaSO_{4(s)} \rightleftharpoons Ba^{+2} + SO_4^{-2}$

a)



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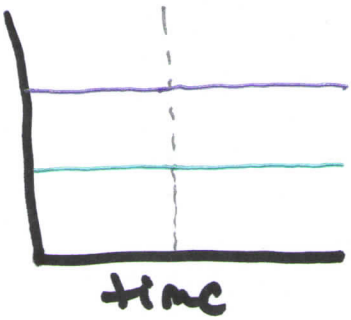

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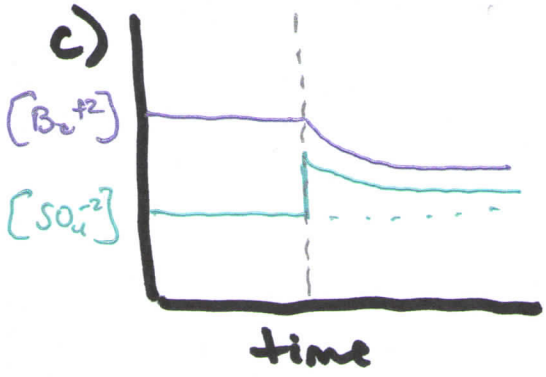

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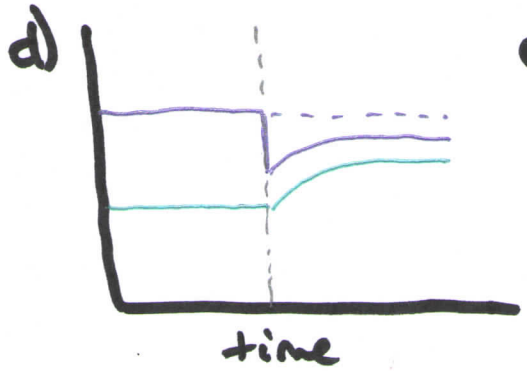

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