Chemistry 12 – Unit 3 *Solubility*

Name _____ Block: _____ Date: _____

Chemistry 12

KEY - MIXING STRONG ACIDS & BASES

58. $[H_3O^+] = 0.200\ M \times \frac{50.0\ mL}{100.0\ mL} = 0.100\ M$, $[OH^-] = 0.150\ M \times \frac{50.0\ mL}{100.0\ mL} = 0.0750\ M$
$[H_3O^+]_{XS} = 0.100 - 0.075 = 0.025\ M$, and **pH = 1.60**

59. $[H_3O^+] = 0.200\ M \times \frac{75.0\ mL}{300.0\ mL} = 0.0500\ M$, $[OH^-] = 0.150\ M \times \frac{225.0\ mL}{300.0\ mL} = 0.1125\ M$
$[OH^-]_{XS} = 0.1125 - 0.0500 = 0.0625\ M$, and **pOH = 1.204**

60. $[H_3O^+] = 0.0120\ M \times \frac{125.0\ mL}{150.0\ mL} = 0.0100\ M$, $[OH^-] = 0.0420\ M \times 2 \times \frac{25.0\ mL}{150.0\ mL} = 0.0140\ M$
$[OH^-]_{XS} = 0.0140 - 0.0100 = 0.0040\ M$, so that pOH = 2.40 and **pH = 11.60**

61. $[OH^-] = 0.0185\ M \times 2 \times \frac{50.0\ mL}{85.0\ mL} = 0.02176\ M$, $[H_3O^+] = \frac{0.130\ g}{0.0850\ L} \times \frac{1\ mol}{36.5\ g} = 0.04190\ M$
$[H_3O^+]_{XS} = 0.04190 - 0.02176 = 0.02014\ M$, so that pH = 1.696 and **pOH = 12.304**

62. $[H_3O^+] = \frac{6.00\ g}{0.2000\ L} \times \frac{1\ mol}{36.5\ g} = 0.8219\ M$, $[OH^-] = \frac{5.00\ g}{0.2000\ L} \times \frac{1\ mol}{56.1\ g} = 0.4456\ M$
$[H_3O^+]_{XS} = 0.8219 - 0.4456 = 0.3763$, and **pH = 0.424**

63. $[H_3O^+] = \frac{8.09\ g}{0.350\ L} \times \frac{1\ mol}{80.9\ g} = 0.2857\ M$, $[OH^-] = \frac{6.08\ g}{0.350\ L} \times \frac{1\ mol}{121.6\ g} \times 2 = 0.2857\ M$
Since $[H_3O^+] = [OH^-]$, the solution is neutral and **pOH = 7**

64. $[H_3O^+] = \frac{9.50\ g}{0.2000\ L} \times \frac{1\ mol}{127.9\ g} = 0.3714\ M$, $[OH^-] = \frac{0.450\ g}{0.2000\ L} \times \frac{1\ mol}{23.9\ g} = 0.09414\ M$
$[H_3O^+]_{XS} = 0.3714 - 0.09414 = 0.2772\ M$, and **pH = 0.557**

65. pH = 10.875 means pOH = 3.125, and $[OH^-]_{XS} = 7.499 \times 10^{-4}\ M$
$7.499 \times 10^{-4} = 0.00120 - [H_3O^+]_{ST}$, and $[H_3O^+]_{ST} = 4.501 \times 10^{-4}\ M$
$\text{mass HCl} = 4.501 \times 10^{-4} \frac{mol}{L} \times 2.000\ L \times \frac{36.5\ g}{1\ mol} =$ **0.033 g**

66. pH = 2.500 gives $[H_3O^+]_{XS} = 0.003162\ M$
$0.003162 = 0.0550 - [OH^-]_{ST}$, and $[OH^-]_{ST} = 0.05184\ M$
$\text{mass LiOH} = 0.05184 \frac{mol}{L} \times 0.7500\ L \times \frac{23.9\ g}{1\ mol} =$ **0.929 g**

67. pH = 2.750 gives $[H_3O^+] = 1.778 \times 10^{-3}\ M$
$1.778 \times 10^{-3} = 0.0150 - [OH^-]_{ST}$, and $[OH^-]_{ST} = 0.01322\ M$
$\text{mass } Ca(OH)_2 = 0.01322 \frac{mol\ OH^-}{L} \times \frac{1\ mol\ Ca(OH)_2}{2\ mol\ OH^-} \times 0.5000\ L \times \frac{74.1\ g}{1\ mol\ Ca(OH)_2} =$ **0.245 g**

68. (a) $Ca(OH)_2 \rightleftharpoons \underset{X}{Ca^{2+}} + \underset{2X}{2\ OH^-}$; $K_{sp} = [Ca^{2+}][OH^-]^2 = 3.88 \times 10^{-5}$
$= (X)(2X)^2 = 4X^3 = 3.88 \times 10^{-5}$
Solving: $X = 0.0213\ M$ and $[OH^-] = 2X = 0.0426\ M$, so pOH = 1.370 and **pH = 12.630**

(b) The equilibrium which exists in the solution is: $Ca(OH)_2(s) \rightleftharpoons Ca^{2+} + 2\ OH^-$. If HCl is added, the $[OH^-]$ will be decreased as a result of being neutralized by the added HCl. Therefore, the equilibrium shifts to the product side to make up for the decreased $[OH^-]$ and the solid $Ca(OH)_2$ will

dissolve.