Calculating Concentration from pH and pOH Answer Key

1. **(a)** $[H_3O^+(aq)] = 10^{-pH} = 10^{-2.34} = 4.6 \times 10^{-3}$ mol/L H_3O^+ (aq)

(b) $[H_3O^+(aq)] = 10^{-pH} = 10^{-15.6} = 3 \times 10^{-16}$ mol/L H_3O^+ (aq)

(c) $[H_3O^+(aq)] = 10^{-pH} = 10^{-4.4} = 4 \times 10^{-5}$ mol/L H_3O^+ (aq)

(d) $[H_3O^+(aq)] = 10^{-pH} = 10^{-1.892} = 0.0128$ mol/L H_3O^+ (aq)

(e) $[H_3O^+(aq)] = 10^{-pH} = 10^{-5.63} = 2.3 \times 10^{-6}$ mol/L H_3O^+ (aq)

2. **(a)** $[OH^-(aq)] = 10^{-pOH} = 10^{-1.45} = 0.035$ mol/L OH^- (aq)

(b) $[OH^-(aq)] = 10^{-pOH} = 10^{-10.672} = 2.13 \times 10^{-11}$ mol/L OH^- (aq)

(c) $[OH^-(aq)] = 10^{-pOH} = 10^{-7.3} = 5 \times 10^{-8}$ mol/L OH^- (aq)

(d) $[OH^-(aq)] = 10^{-pOH} = 10^{-2.982} = 1.04 \times 10^{-3}$ mol/L OH^- (aq)

(e) $[OH^-(aq)] = 10^{-pOH} = 10^{-4.932} = 1.17 \times 10^{-5}$ mol/L OH^- (aq)

(f) $[OH^-(aq)] = 10^{-pOH} = 10^{-10.2} = 6 \times 10^{-11}$ mol/L OH^- (aq)

3. $[H_3O^+(aq)] = 10^{-pH} = 2.0 \times 10^{-4}$ mol/L

$H_2O(\ell) + HCl(aq) \rightarrow H_3O^+(aq) + Cl^-(aq)$

$$[HCl(aq)] = 2.0 \times 10^{-4} \text{mol/L } H_3O^+ \times \frac{1 \text{ mol HCl}}{1 \text{ mol } H_3O^+}$$

$$= 2.0 \times 10^{-4} \text{ mol/L HCl}$$

4. $LiOH(aq) \rightarrow Li^+(aq) + OH^-(aq)$

$[OH^-(aq)] = 10^{-pOH} = 2.12 \times 10^{-5}$ mol/L OH^- (aq)

$$[\text{LiOH (aq)}] = 2.12 \times 10^{-5} \text{ mol/L} OH^- \times \frac{1 \text{ mol LiOH}}{1 \text{ mol } OH^-}$$

$$= 2.12 \times 10^{-5} \text{ mol/L}$$

5. $NaOH(aq) \rightarrow Na^+(aq) + OH^-(aq)$

$pOH = 14 - pH = 3.68$

$[OH^-(aq)] = 10^{-pOH} = 10^{-3.68} = 2.1 \times 10^{-4}$ mol/L

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(continued)

$$[\text{NaOH(aq)}] = 2.1 \times 10^{-4}\ \text{mol/L OH}^- \times \frac{1\ \text{mol NaOH}}{1\ \text{mol OH}^-}$$

$$= 2.1 \times 10^{-4}\ \text{mol/L NaOH (aq)}$$

6. $\text{Ba(OH)}_2\text{(aq)} \rightarrow \text{Ba}^{2+}\text{(aq)} + 2\text{OH}^-\text{(aq)}$

$\text{pOH} = 14.00 - \text{pH} = 2.164$

$[\text{OH}^-\text{(aq)}] = 10^{-\text{pOH}} = 10^{-2.164} = 6.85 \times 10^{-3}\ \text{mol/L OH}^-\text{ (aq)}$

$$[\text{Ba(OH)}_2\text{(aq)}] = 6.85 \times 10^{-3}\ \text{mol/L OH}^- \times \frac{1\ \text{mol Ba(OH)}_2}{2\ \text{mol OH}^-}$$

$$= 3.43 \times 10^{-3}\ \text{mol/L Ba(OH)}_2\text{ (aq)}$$

7. This solution is acidic. You can't make a basic solution acidic through dilution.

8. $\text{H}_2\text{O}(\ell) + \text{HCl(aq)} \rightarrow \text{H}_3\text{O}^+\text{(aq)} + \text{Cl}^-\text{(aq)}$

$[\text{H}_3\text{O}^+\text{(aq)}] = 10^{-3.298} = 5.04 \times 10^{-4}\ \text{mol/L}$

$$m_{\text{HCl(g)}} = 5.04 \times 10^{-4}\ \text{mol/L H}_3\text{O}^+ \times \frac{1\ \text{mol HCl}}{1\ \text{mol H}_3\text{O}^+} \times \frac{2.00\ \text{L}}{} \times \frac{36.46\ \text{g}}{\text{mol}}$$

$$= 0.0367\ \text{g HCl(g)}$$

9. $$m_{\text{RbOH(s)}} = 2.2 \times 10^{-5}\ \text{mol/L OH}^- \times \frac{1\ \text{mol RbOH}}{1\ \text{mol OH}^-} \times \frac{1.50\ \text{L}}{} \times \frac{102.48\ \text{g}}{\text{mol}}$$

$$= 0.0034\ \text{g RbOH(s)}$$

$\text{RbOH(aq)} \rightarrow \text{Rb}^+\text{(aq)} + \text{OH}^-\text{(aq)}$

$\text{pOH} = 14.00 - \text{pH} = 4.65$

$[\text{OH}^-\text{(aq)}] = 10^{-4.65} = 2.2 \times 10^{-5}\ \text{mol/L OH}^-\text{ (aq)}$

10. $\text{Sr(OH)}_2\text{(aq)} \rightarrow \text{Sr}^{2+}\text{(aq)} + 2\text{OH}^-\text{(aq)}$ $\quad \text{pOH} = 14.00 - \text{pH} = 5.66$

$[\text{OH}^-\text{(aq)}] = 10^{-5.66} = 2.2 \times 10^{-6}\ \text{mol/L OH}^-\text{(aq)}$

$$m_{\text{Sr(OH)}_2\text{(s)}} = 2.2 \times 10^{-6}\ \text{mol/L OH}^- \times \frac{1\ \text{mol Sr(OH)}_2}{2\ \text{mol OH}^-} \times \frac{3.0\ \text{L}}{} \times \frac{121.64\ \text{g}}{1\ \text{mol}}$$

$$= 4.0 \times 10^{-4}\ \text{g Sr(OH)}_2\text{(s)}$$