Jorgensen

Calculating Concentration from pH and pOH

1. What is the concentration of hydronium ions (H_3O^+) in the following solutions given their pH values?

2 sig digs **(a)** pH = 2.34 10^{-pH} $10^{-2.34}$ 0.00456 mol/L or 4.6×10^{-3} mol/L

1 sig dig **(b)** pH = 15.6 3×10^{-16} mol/L

1 sig dig **(c)** pH = 4.4 4×10^{-5} mol/L

3 sig digs **(d)** pH = 1.892 0.0128 mol/L or 1.28×10^{-2} mol/L

2 sig digs **(e)** pH = 5.63 2.3×10^{-6} mol/L

2. What is the concentration of hydroxide ions (OH^-) in the following solutions given the following information?

(a) pOH = 1.45 10^{-pOH} 0.035 mol/L or 3.5×10^{-2} mol/L

(b) pOH = 10.672 2.13×10^{-11} mol/L

(c) pOH = 7.3 5×10^{-8} mol/L

pH + pOH = 14

(d) pH = 2.982 $14 - 2.982 = 11.018$ 9.59×10^{-12} mol/L

(e) pH = 4.932 $14 - 4.932 = 9.068$ 8.55×10^{-10} mol/L

(f) pH = 10 .2 $14 - 10.2 = 3.8$ 2×10^{-4} mol/L

3. What is the concentration of hydrochloric acid, HCl(aq), that gives a solution with a pH of 3.69?

$HCl(aq) \rightarrow H^+(aq) + Cl^-(aq)$

1:1 ratio

$10^{-3.69}$

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

4. What is the concentration of lithium hydroxide, LiOH(aq), that gives a solution with a pOH of 4.674?

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

1:1 ratio

10^{-pOH}

$10^{-4.674}$

2.12×10^{-5} mol/L

2.12×10^{-5} mol/L

5. What is the concentration of sodium hydroxide, NaOH(aq), that gives a solution with a pH of 10.32?

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

1:1 ratio

$[OH] = 10^{-pOH}$

$pH + pOH = 14$

$pOH = 3.68$

$10^{-3.68}$

$[NaOH] = 2.1 \times 10^{-4}$ mol/L

6. What is the concentration of barium hydroxide, $Ba(OH)_2(aq)$, that gives a solution with a pH of 11.836?

$Ba(OH)_{2(aq)} \rightarrow Ba^{2+}_{(aq)} + 2OH^-_{(aq)}$

1:2 ratio

$\frac{1\ Ba(OH)_2}{2\ OH^-} = \frac{x}{6.85\times10^{-3}}$

$x = 0.00343\ mol/L$

$pH = 11.836$

$pOH = 2.164$

$10^{-2.164}$

$6.85\times10^{-3}\ mol/L$

7. Is it possible to make an aqueous solution with strontium hydroxide, $Sr(OH)_2(aq)$, that gives a pOH of 10.54? If so calculate it. If not, explain why not.

8. What mass of hydrogen chloride gas, HCl(g), needs to be dissolved in 2.00 L of water to create a solution with a pH of 3.298?

Molar Mass = 36.46 g/mol

$[H_3O^+] = 10^{-3.298}$

$= 5.035\times10^{-4}\ mol/L$

1:1 ratio

$\frac{5.035\times10^{-4}\ mol}{1\ L} = \frac{1.007\times10^{-3}\ mol}{2.00\ L}$

$\frac{36.46\ g}{1\ mol} = \frac{0.0367\ g}{1.007\times10^{-3}\ mol}$

9. What mass of rubidium hydroxide, RbOH(s), needs to be dissolved in 1.50 L of water to create a solution with a pH of 9.35?

$pOH = 4.65$

$10^{-4.65}$

$[OH^-] = 2.24\times10^{-5}\ mol/L$

1:1 ratio $\therefore [RbOH] = 2.24\times10^{-5}\ mol/L$

$\frac{2.24\times10^{-5}\ mol}{1\ L} = \frac{3.35\times10^{-5}\ mol}{1.50\ L}$

$\frac{102.475\ g}{1\ mol} = \frac{0.034\ g}{3.35\times10^{-5}\ mol}$

10. What mass of strontium hydroxide, $Sr(OH)_2(s)$, needs to be dissolved in 3.0 L of water to create a solution with a pH of 8.34?

$pOH = 5.66$

$10^{-5.66}$

$[OH] = 2.19\times10^{-6}\ mol/L$

$Sr(OH)_2 \rightarrow Sr^{2+} + 2OH^-$

1:2 ratio

2.19×10^{-6}

$1.09\times10^{-6}\ mol/L$

$\frac{1.09\times10^{-6}\ mol}{1\ L} = \frac{3.28\times10^{-6}\ mol}{3.0\ L}$

Molar mass = 121.63 g/mol

$\frac{121.63\ g}{1\ mol} = \frac{4.0\times10^{-4}\ g}{3.28\times10^{-6}\ mol}$

$m_{Sr(OH)_2} = 4.0\times10^{-4}\ g$