CHEM 120 Review key (Molarity) for Chem. 141

1. Household bleach is an aqueous solution of sodium hypochlorite. What is the molarity of a bleach solution containing 17.8 g of sodium hypochlorite in a total volume of 455 mL?

$$\frac{17.8 g }{74.442 g/mol }=0.2391 moles NaClO $$

$$\frac{0.2391 moles }{0.455 L }=0.526 M$$

1. Muriatic acid, an industrial grade of concentrated HCl, is used to clean masonry and etch cement prior to painting. What volume of 11.7 M muriatic acid is required to make 15.0 L of a 3.4 M acid solution?

***M1V1 = M2V2; (11.7 M)(V) = (3.4 M)(15.0 L)***

***V = 4.4 L***

1. Citric acid, H3C6H5O7, in orange juice may be neutralized by sodium hydroxide according to the equation below. A 1.25 L sample of orange juice required 6.67 mL of a 0.025 *M* solution of NaOH to reach the equivalence point. What was the molarity of the citric acid in the orange juice sample?

**H3C6H5O7 (*aq*) + 3 NaOH (*aq*) → Na3C6H5O7 (*aq*) + 3 H2O (*l*)**

 *citric acid*

$$\left(0.025 M NaOH\right)× \left(0.00667 L\right)= 0.00016675 moles NaOH$$

$$\left(0.00016675 moles NaOH\right) × \frac{1 H\_{3}C\_{6}H\_{5}O\_{7} }{3 NaOH} = 0.0000555833 moles citric acid$$

$$\frac{0.0000555833 moles }{1.25 L}= 0.000044 M or 4.4 x 10^{–5} M$$

1. How many milliliters of 0.238 M KMnO4 are needed to react with 3.36 g of iron(II) sulfate, FeSO4? The reaction is as follows:

      10 FeSO4(aq) + 2 KMnO4(aq) + 8 H2SO4(aq) 🡪5 Fe2SO4(aq) + 2 MnSO4(aq) + K2SO4(aq) +8 H2O(l)

$$3.36 g FeSO\_{4}× \frac{1 mol FeSO\_{4} }{151.909 g FeSO\_{4} } = 0.02212 mol FeSO\_{4}$$

$$0.02212 mol FeSO\_{4} × \frac{2 mol KMnO\_{4}}{10 mol FeSO\_{4} }= 0.004424 mol KMnO\_{4} $$

$$0.004424 mol KMnO\_{4} × \frac{1 L}{0.238mol KMnO\_{4} } × \frac{1000 mL}{1 L}= 18.6 mL$$

1. A solution is prepared with 70.0 g nitric acid, HNO3, and 130.0 g water. It has a density of 1.21 g/mL

What is the molarity of the solution?

$$V\_{total}=V\_{solute}+V\_{solvent}=70.0 g+130.0 g=200.0 g×\frac{1 mL}{1.21 g}=165 mL$$

$$70.0 g HNO\_{3}×\frac{1 mol HNO\_{3} }{6302 g HNO\_{3}}=\frac{1.11 mol HNO\_{3}}{165 mL soln}×\frac{1000 mL}{1 L}=6.73 M HNO\_{3}$$

1. You mix 732.0 mL of 0.2187 M lithium sulfate with 350.0 mL of 0.5988 M titanium(III) nitrate. Determine the number of grams of titanium(III) sulfate solid produced, and the final concentration of all ions in the solution.

3 Li2SO4(aq) + 2 Ti(NO3)3(aq) 🡪 6 LiNO3(aq) + Ti2(SO4)3(s)

$$?mol Li\_{2}SO\_{4}=732.0 mL×\frac{0.2187 mol Li\_{2}SO\_{4} }{1000 mL}=0.1601 mol Li\_{2}SO\_{4}$$

$$?mol Ti\left(NO\_{3}\right)\_{3}=350.0 mL×\frac{0.5988 mol Ti\left(NO\_{3}\right)\_{3} }{1000 mL}=0.2096 mol Ti\left(NO\_{3}\right)\_{3}$$

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **X = 0.0534 mol** |  | **X=0.1048mol** |  |  |  |  |
|  | **3 Li2SO4** | **+** | **2 Ti(NO3)3** | **🡪** | **6 LiNO3** | **+** | **Ti2(SO4)3 (s)** |
| **I** | **0.1601 mol** |  | **0.2096 mol** |  | **0 mol** |  | **0 mol** |
| **** | **-3x** |  | **-2x** |  | **+6x** |  | **+ x** |
| **E** | **0.1601 – 3x** |  | **0.2096-2x** |  | **6x** |  | **1x** |
|  | **=0.1601-3(.0534)****=0 mol** |  | **=0.1497-2(.0534)****=0.1028 mol** |  | **=6(0.0534)****=0.3202 mol** |  | **=0.0534 mol** |

$$0.0534 mol Ti\_{2}\left(SO\_{4}\right)\_{3}×\frac{ 383.93 g Ti\_{2}\left(SO\_{4}\right)\_{3}}{1 mol Ti\_{2}\left(SO\_{4}\right)\_{3}}=$$

$$\left[Li^{+1}\right]=\frac{2\left(0.0 mol Li^{+1}\right)+0.3202 mol Li^{+1}}{1.0820 L solution}= \frac{0.3202 mol Li^{+1}}{0.9820 L}=$$

$$\left[SO\_{4}^{-2}\right]=\frac{0.0 mol SO\_{4}^{-2}}{1.0820 L solution}=$$

$$\left[Ti^{+3}\right]=\frac{0.1028mol Ti^{+3}}{1.0820 L solution}=$$

$$\left[NO\_{3}^{-1}\right]=\frac{3\left(0.1028 mol NO\_{3}^{-1}\right)+0.3202 mol NO\_{3}^{-1}}{1.0820 L solution}=$$

**Concentrations of all ions present after mixing.**

**Moles Ti2(SO4)3 produced 0.0534 Mass Ti2(SO4)3 produced 20.5 g**

**Moles Li+1 = 0.3202 mol [Li+1] = 0.2959 M**

**Moles SO4-2 = 0.0 mol [SO4-2] = 0.0 M**

**Moles Ti+3 = 0.1028 mol [Ti+2] = 0.0950 M**

**Moles NO3-1 = 0.6287 mol [NO3-1] = 0.5811 M**