

Dilutions and Ion Concentration

4.3

Dilutions and Ion Concentrations Assignment

1. An experiment requires 2.00 L of 0.200 M hydrochloric acid (HCl) solution. What volume of concentrated hydrochloric acid, containing 11.9 M hydrogen chloride, is needed?

$$M_1 V_1 = M_2 V_2$$

$$(11.9M)(V_1) = (0.2M)(2L)$$

$$V_1 = 0.033L \text{ L of HCl}$$

2. A chemist adds water to 120 mL of a 6.0 M solution of NaOH until the final volume is 2.0 L. What is the molarity of the resulting solution?

$$M_1 V_1 = M_2 V_2$$

$$(6.0M)(0.12L) = M_2 (2.0L)$$

$$M_2 = 0.036M \text{ [NaOH]}$$

3. What concentration results when 150 mL of a 0.36 M solution of magnesium sulfate, $MgSO_4$, are added to enough water to give a final solution volume of 750 mL?

$$M_1 V_1 = M_2 V_2$$

$$(0.36M)(0.15L) = M_2 (0.75L)$$

$$M_2 = 0.072M \text{ [MgSO}_4\text{]}$$

4. What concentration results when 150 mL of a 0.36 M solution of magnesium sulfate, $MgSO_4$, are added to 750 mL of water?

$$M_1 V_1 = M_2 V_2$$

$$(0.36M)(0.15L) = M_2 (0.9L)$$

$$M_2 = 0.060M \text{ [MgSO}_4\text{]}$$

5. Describe how you would prepare 250.0 mL of a 1.00 M NaOH solution.

$$wt = M \cdot mm \cdot V = (1.0M)(40g/mol)(0.25L)$$

$$wt = 10g \text{ NaOH}$$

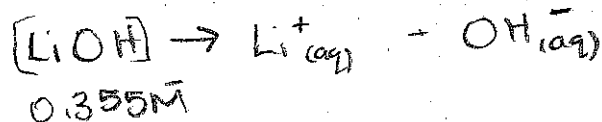
$$mm: \begin{array}{l} Na - 22.98 \times 1 \\ O - 16.00 \times 1 \\ H - 1.01 \times 1 \end{array}$$

$$40g/mol$$

- weigh out 10g NaOH using a balance.
- place into a volumetric flask (250mL)
- add about 100mL ^{dist} water - swirl to dissolve
- add the remaining 150mL distilled water to dissolve all

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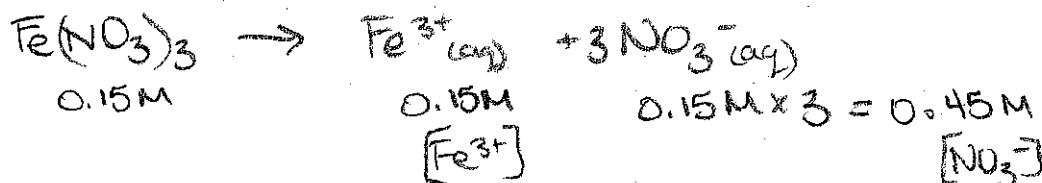
6. Lithium hydroxide has a solubility of 0.355 M. Find the concentration of the ions in the solution.



$$[Li^+] = 0.355M$$

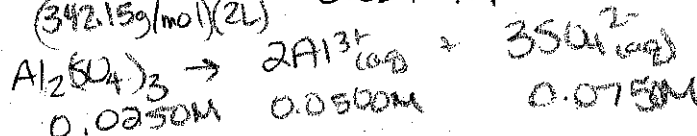
$$[OH^-] = 0.355M$$

7. Iron(III) nitrate has a solubility of 0.15 M. Find concentration of the ions in solution.



8. Calculate ion concentrations in a 2.00 L solution containing 17.1 g aluminum sulfate, $Al_2(SO_4)_3$.

$$M = \frac{wt}{mm \cdot V} = \frac{17.1g}{(342.15g/mol)(2L)} = 0.02499M$$



9. If 12.0 mL of a standard solution is diluted to 1.50 L twice during a serial dilution, what is the final concentration? The 2.00 L standard solution contains 6.86 g of HCl.

$$M = \frac{wt}{mm \cdot V} = \frac{6.86g}{(36.46g/mol)(2L)} = 0.0940756M$$

$$\begin{aligned} MM: H &= 1 \times 1.01 \\ Cl &= 1 \times 35.45 \\ \hline &36.46g/mol \end{aligned}$$

$$0.0940756M \times \frac{0.012L}{1.5L} \times \frac{0.012L}{1.5L} = \boxed{6.02 \times 10^{-6} M [HCl]}$$

10. After performing a serial dilution 3 times you find the concentration of the final $Mg(NO_3)_2$ solution is $1.30 \times 10^{-5} M$. If each serial dilution took 20.0 mL of a previous solution and diluted it to 1.25 L, what was the mass of $Mg(NO_3)_2$ in the standard solution?

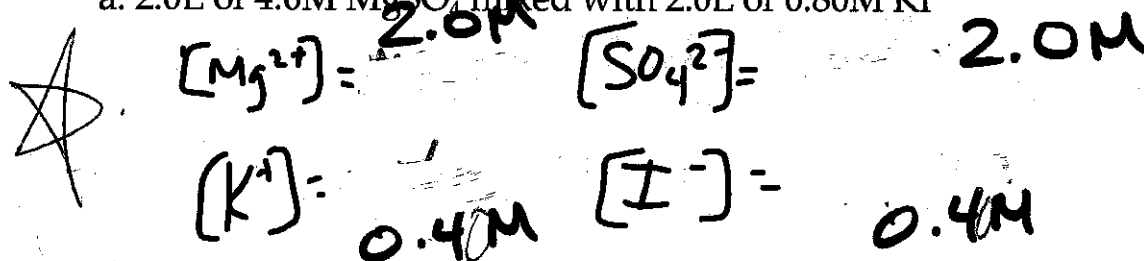
$$(final) \quad 1.30 \times 10^{-5} M = \frac{1.25L}{0.02L} \times \frac{1.25L}{0.02L} \times \frac{1.25L}{0.02L} \times x = 3.1738M$$

$$MM = 148.339g/mol \quad Mg(NO_3)_2$$

$$\begin{aligned} wt &= mm \cdot V \cdot M = (148.339g/mol) (1.25L) (3.1738M) \\ &= \boxed{590g} \quad Mg(NO_3)_2 \end{aligned}$$

11. Calculate the concentration of each ion in each of the following mixed solutions in which no reaction occurs

a. 2.0L of 4.0M MgSO_4 mixed with 2.0L of 0.80M KI



b. 3.0L of 0.48M NaOH mixed with 1.0L of 0.32M KOH

