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? $M_1V_1 = M_2V_2$

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

$V_1 = 0.033L$ 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?

$M_1V_1 = M_2V_2$

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

$M_2 = 0.036M$ [NaOH]

3. What concentration results when 150 mL of a 0.36 M solution of magnesium sulfate, MgSO4, are added to enough water to give a final solution volume of 750 mL?

$M_1V_1 = M_2V_2$

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

$M_2 = 0.072M$ [$MgSO_4$]

4. What concentration results when 150 mL of a 0.36 M solution of magnesium sulfate, MgSO4, are added to 750 mL of water?

$M_1V_1 = M_2V_2$

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

$M_2 = 0.060M$ [$MgSO_4$]

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

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

$wt = 10g$ NaOH

mm: Na - 22.98 x 1
O - 16.00 x 1
H - 1.01 x 1
40 g/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

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

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

0.355M

$[Li^+] = 0.355M$

$[OH^-] = 0.355M$

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

$Fe(NO_3)_3 \rightarrow Fe^{3+}_{(aq)} + 3NO_3^-{}_{(aq)}$

0.15M 0.15M $0.15M \times 3 = 0.45M$

$[Fe^{3+}]$ $[NO_3^-]$

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

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

$Al_2(SO_4)_3 \rightarrow 2Al^{3+}_{(aq)} + 3SO_4^{2-}{}_{(aq)}$

0.02500M 0.0500M 0.0750M

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.

$M = \frac{wt}{mm \cdot V} = \frac{6.86g}{\left(36.46\frac{g}{mol}\right)(2L)} = 0.09407561M$

MM: H - 1×1.01
Cl - 1×35.45
36.46 g/mol

$0.09407561M \times \frac{0.012L}{1.5L} \times \frac{0.012L}{1.5L} = \boxed{6.02 \times 10^{-6} M\ [HCl]}$

10. After performing a serial dilution 3 times you find the concentration of the final $Mg(NO_3)_2$ solution is 1.30×10^{-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)

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

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

$wt = mm \cdot V \cdot M = \left(148.339\frac{g}{mol}\right)(1.25L)(3.1738M)$

$= 590 g\ Mg(NO_3)_2$

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

$[Mg^{2+}] =$ 2.0M $[SO_4^{2-}] =$ 2.0M

$[K^+] =$ 0.4M $[I^-] =$ 0.4M

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

$[Na^+] = 0.36M$

$[K^+] = 0.080M$

$[OH^-] = 0.44M.$